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# CAS 2024 Annual Meeting

# Abstract Book

# CONTENTS

# AIRWAY MANAGEMENT

## Three-dimensional printed model to assist intubation in a patient with fibrous dysplasia: a case report

**Submission ID**

54

**AUTHORS**

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**INTRODUCTION**

Three-dimensional (3D) printing has many applications in perioperative environments, including surgical reconstruction, bronchial stenting, and training phantoms for ultrasound-guided neuraxial blocks, and recently in the management of difficult airways. Fibrous dysplasia is a benign skeletal condition and a genetic mutation that replaces normal bone with abnormal fibro-osseous tissue. It affects either one bone (monostotic) or multiple bones (polyostotic),[1] such as the long bones, ribs, craniofacial bones, and pelvis.[2] We present the application of a 3D-printed model to support the anesthesia and surgical planning processes of a patient with a predicted difficult airway secondary to severe temporomandibular joint fibrous dysplasia.

**CASE PRESENTATION**

A 58-yr-old lady with fibrous dysplasia presented with left hemifacial hypertrophy, requiring multiple previous osteotomies. Her symptoms recurred, and she presented with dysmorphia secondary to profound swelling of the left side of the face and severe restriction of mouth opening, which prevented her from eating solid food and subsequently resulted in significant weight loss. She was scheduled for a left condylotomy and fat graft insertion.

During the preanesthetic evaluation, we predicted difficulty in intubation and bag mask ventilation. Prior to surgery, we analyzed the 3D printed model of her skull and face, modelled off computed tomography (CT) scans taken for operative planning, and ascertained that except for her challenging 7-mm mouth opening, there was no obstruction internally and that her upper airway was otherwise patent.

Her nasal airway was confirmed to be patent posttopicalization and fibreoptic scope insertion. The upper airway was topicalized using nasal co-phenylcaine, 2% lignocaine for the

laryngophargnx, and a transtracheal local anesthetic injection. The first attempt at intubation was unsuccessful because copious secretions obstructed the view and the endotracheal tube (ETT) inadvertently slipped into the oesophagus during the adjustment of the tube postintubation. The second attempt at intubation was successful, and a #6.0 ivory nasal ETT was inserted. The patient's mouth opening improved postsurgery, and the patient was extubated uneventfully at the end of surgery and did not require reintubation. If a 3D-printed model was not available, we might have elected for the invasive approach of tracheostomy under local anesthesia because of the possibility of significant airway obstruction posteriorly.

**CONCLUSION**

Anesthesiologists continue to encounter significant challenges because of difficult airway, especially when faced with uncommon clinical situations such as fibrous dysplasia. There have been other case reports of the use of 3D technology, including the use of a 3D model to facilitate intubation,[3] to simulate tracheostomy, bronchoscopy and lung isolation.[4] As shown in our patient, the use of 3D technology to assist in the planning and execution of intubation in a patient with distorted anatomy is a helpful addition to a thorough airway examination when planning intubation and it avoided the need for invasive airway management techniques.

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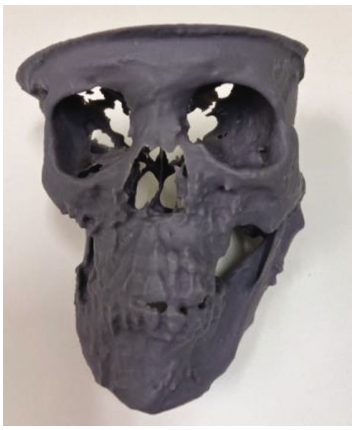
**Figure**



# Extubation forces generated by inflated *versus* deflated tracheal tube cuffs

**Submission ID**

100

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**INTRODUCTION**

Excessive forces during tracheal intubation or extubation can be associated with laryngeal trauma and lead to complications such as arytenoid dislocation, vocal cord damage, or laryngotracheal stenosis.[1] Conflicting strategies regarding management of the tracheal tube cuff at extubation have been proposed in the literature. In contrast to the conventional technique of complete cuff deflation before extubation, some advocate removal of the tracheal tube with the cuff fully inflated to reduce the risk of aspiration and atelectasis.[2,3] Another strategy is “snapping” or breakage of the pilot cuff tubing just before extubation, which allows for partial cuff deflation. Theoretically, a partially deflated cuff will carry secretions out of the glottis, while not causing excessive extraction forces. The purpose of this study was to compare the forces exerted on the glottis during extubation for three tracheal tube cuff conditions; cuff fully inflated, partially deflated, and fully deflated.

**METHODS**

This benchtop equipment study did not require research ethics review. A custom-built testing fixture was designed for this study. The test fixture included a low friction roller bed which was attached to an inline load cell (BTE 50N digital force gauge) and a plastic larynx model (Laerdal Airway Model, p/n 252500) which was rigidly attached to the roller bed. Testing was done using 7.5 mm ID Shiley Hi-Lo cuffed tracheal tubes (Covidien). The cuffs were lubricated with 0.5 mL of water-soluble lubricating gel before each test. For each test the tracheal tube was manually extracted at a rate consistent with clinical use. Twenty trials were performed for each of the three different cuff conditions; fully deflated, fully inflated (cuff pressure set to 30 cm $H_2O$ using a manometer), and pilot tubing snapped immediately before extubation (within one to two seconds). To assess for narrowing after pilot cuff tubing breakage, the outer diameter of the tubing was measured using digital calipers (Mastercraft, 58-6800-4) at the breakage point and 5 cm distal to the fracture point. Peak extraction force data was analyzed using analysis of variance with the Holm–Sidek correction. Pilot tube diameter data was analysed using a paired *t* test and linear regression.

## RESULTS

Extubation with the cuff fully inflated resulted in significantly higher peak extraction forces both the fully deflated (mean force 5.93N *vs* 3.49N; $P < 0.001$) or partially deflated conditions (mean force 3.92 N; $P < 0.001$; Figure). Partially deflated cuffs did cause marginally higher extraction forces than fully deflated, but this was not statistically significant ($P = 0.19$). In the group where the pilot tube was snapped, the diameter of the pilot cuff tubing was significantly reduced at the breakage point (diameter reduction range 4.4% to 15.4%; $P < 0.001$), and the reduction in diameter significantly correlated with increased extubation forces ($R^2 = 0.241$, slope, $P = 0.028$).

## DISCUSSION

Previous research has shown that stylet extraction forces exceeding 10N at the time of intubation were associated with increased risk of postoperative sore throat.[4] None of the extubation cuff strategies tested in this study were above this threshold. We also observed that breakage of the pilot tubing consistently caused narrowing of the tubing diameter, which is relevant as cases of complete pilot obstruction and extubation difficulties have been described with this technique.[5] A limitation of this study is the use of a plastic model with a fixed glottic aperture, which does not account for vocal cord adduction forces.

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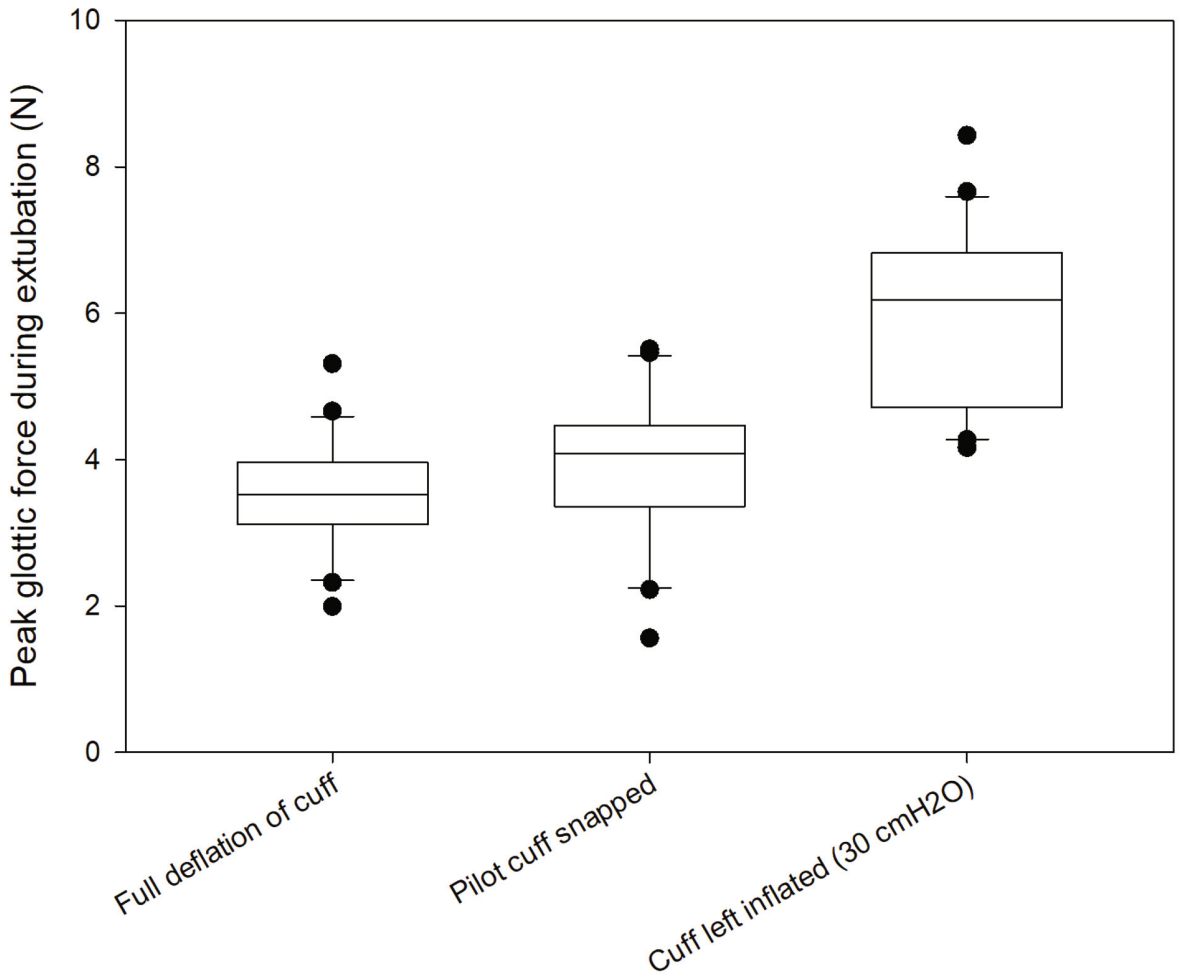
**Figure**


Peak glottic force during extubation (N)
10
8
6
4
2
0
Full deflation of cuff
Pilot cuff snapped
Cuff left inflated (30 cmH2O)

# Patterns of sugammadex usage for intraoperative muscle relaxant reversal at a Canadian academic teaching centre: a 70-month study

**Submission ID**

106

**AUTHORS**

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**INTRODUCTION**

Sugammadex is a selective binding agent used as an alternative to Neostigmine in the reversal of the nondepolarizing muscle relaxants (NDMR). The rapid onset of this drug makes its use appealing in many airway management scenarios including general anesthesia, emergency medicine, and critical care. Some studies have shown improved outcomes for surgical patients treated with Sugammadex in terms of reduced postoperative respiratory complications.[1] Others have failed to detect any differences in respiratory outcomes after a complete changeover from Neostigmine to Sugammadex.[2] Current national guidelines recommend the use of Sugammadex for reversal of deep neuromuscular motor blockade;[3,4] however, concerns have been raised regarding the cost of this drug and indication creep, particularly in terms of widespread usage because of unrestricted access. The purpose of this study was to characterize the patterns of NDMR reversal before and after the availability of Sugammadex in the operating rooms at our academic teaching institution.

**METHODS**

Institutional research ethics approval was granted for this retrospective database study. Our electronic anesthesia information management system (Innovian, Dräger Medical) was searched between January 2016 and October 2021 for all adult surgical cases done under general anesthesia with tracheal intubation. The first 17 months of our study period captured muscle relaxant and reversal agent usage before Sugammadex was made available in our operating rooms (June 2017). Demographic data including patient sex, age, body mass index, and surgery category were collected along with the airway management details, type and dose of muscle relaxant (Rocuronium, Succinylcholine, Cisatracurium), and type and dose of muscle relaxant reversal agent (Neostigmine or Sugammadex). The data was collated in pivot tables and expressed using mean (SD) or median [IQR], and the monthly proportions of drug usage after the Sugammadex release date were analyzed using linear regression (Sigma Stat 12).

**RESULTS**

A total of 73,099 adult surgeries were analyzed over the entire 70-month study period. The cohort was 47.9% female, with mean age of 58 (± 17) yr. In the 17-month period before Sugammadex release, a total 18,847 cases were performed with Rocuronium administration in 93.7% of the cases. The mean proportion of cases where Rocuronium was reversed with Neostigmine in the pre-Sugammadex release period was 68.4% (± 2.1). After its release, Sugammadex use (Figure) significantly increased (slope, +0.51% per month; $P < 0.001$; $R^2 = 0.952$) while the rate of Neostigmine usage significantly decreased (slope, −0.23% per month; $P < 0.001$; $R^2 = 0.742$). The total proportion of cases reversed by either Neostigmine or Sugammadex also was found to significantly increase after Sugammadex release (slope, +0.277% per month; $P < 0.001$; $R^2 = 0.827$). The most common Sugammadex dose range was 101–200 mg (62.9%), followed by < 100 mg (18.8%) with only 2.3% of cases using doses of more than 400 mg.

**DISCUSSION**

Our study shows a gradual increase in the use of Sugammadex since its release in our operating rooms, with a corresponding decrease in Neostigmine use. The total percentage of cases reversed also increased, which may be reflective of increased Rocuronium usage and dosages secondary to the arrival of a convenient new reversal agent. This study is limited in that we did not capture neuromuscular monitoring use[5] or postoperative respiratory complications[1,2] associated with each reversal drug. We recognize that during the latter months of our study, waves of high COVID-19 infection rates impacted airway management techniques and neuromuscular blockade usage.

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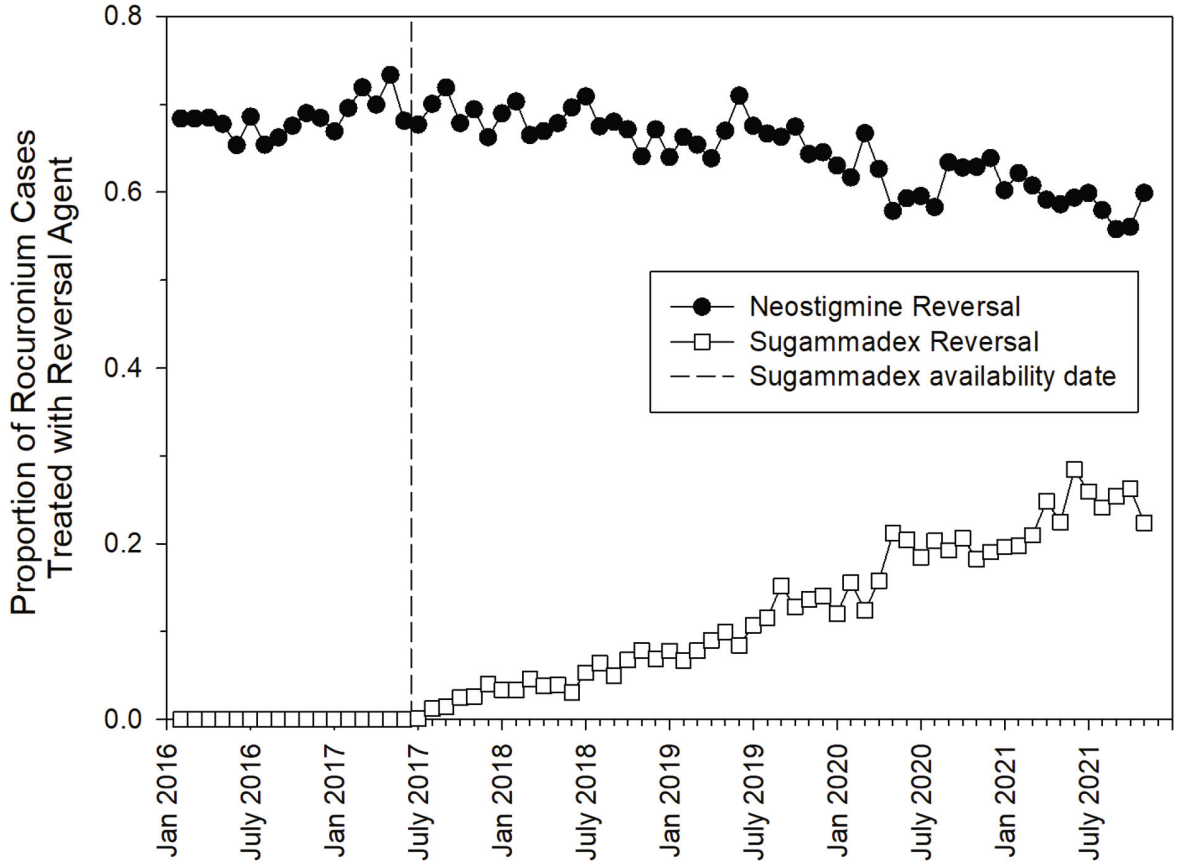
**Figure**


Proportion of Rocuronium Cases Treated with Reversal Agent
0.8
0.6
0.4
0.2
0.0
Neostigmine Reversal
Sugammadex Reversal
Sugammadex availability date
Jan 2016
July 2016
Jan 2017
July 2017
Jan 2018
July 2018
Jan 2019
July 2019
Jan 2020
July 2020
Jan 2021
July 2021

# Postoperative lingual nerve injury following airway management: a literature review

**Submission ID**

14

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**INTRODUCTION**

The lingual nerve is the terminal branch of the mandibular division of the fifth cranial nerve. Postoperative lingual nerve injury is a rare but serious complication following airway management and can lead to significant discomfort and disability. Lingual nerve neurapraxia commonly presents as tongue numbness and altered taste in the anterior two-thirds of the tongue. This literature review explores the etiology, clinical presentation, management strategies, and potential preventive measures for lingual nerve injuries associated with airway management during surgery.

**METHODS**

A search of PubMed, Medline, EMBASE Science Direct, Cochrane library, and Web of Science databases was done since inception to 8 June 2023, including any observational studies and clinical trials describing patients diagnosed with lingual nerve injury following airway instrumentation. Covidence software was used for screening. Duplicate records were removed, and two independent reviewers screened records for relevance. From eligible studies, we extracted patient related perioperative variables such as age, American Society of Anesthesiologists Physical Status score, Mallampati score, and comorbid diagnoses. We also extracted the type of airway management done such as use of endotracheal tube, laryngeal mask airway (LMA), cuffed oropharyngeal airway, or laryngoscopy. Additionally, we retrieved data regarding postoperative outcomes such as presentation, time to onset and resolution of symptoms, investigations, and treatments.

**RESULTS**

We identified 40 studies that assess lingual nerve injury following intubation, including 35 case reports. Patients predominantly reported symptoms of loss of sensation in the anterior two thirds of the tongue or taste disturbances either hours after surgery or at most 24 hr after the

operation. There was significant variability in the time until resolution of symptoms, ranging between two hours and 19 months postoperation. Multiple risk factors for lingual nerve injury were identified. Anesthesia factors include difficulty with intubation and use of LMA. Surgical factors are long duration of operation and surgery of the head and neck. Patient factor includes female sex. No clear evidence regarding whether body mass index, Mallampati score, and age are risk factors of neuropraxia.

**DISCUSSION**

Our review highlights that lingual nerve injury is a prevalent consequence of airway management. To ensure that patients are fully informed about the risks associated with airway management, it is crucial to include lingual nerve neuropraxia as a potential complication that may arise. Anesthesiologists play a vital role in communicating these risks and providing reassurance in case of complications. Additionally, anesthesiologists should diligently address and control modifiable risk factors to mitigate the risk of lingual nerve injury.

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# Spontaneous ventilation with laryngeal mask airway and bronchoscopy evaluation with bridge to extracorporeal membrane oxygenation during difficult tracheostomy for occluding tracheo-mediastinal thyroid neck mass: a case report

**Submission ID**

61

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**INTRODUCTION**

Invading neck masses with obstructing tracheal invasion and anterior mediastinal mass extension present potentially very difficult to impossible airway management and risk hemodynamic compromise. The Canadian Airway Focus Group recommendations suggest awake techniques in the predicted difficult tracheal intubation and difficult face-mask ventilation.[1] If this is not feasible, front of neck access is recommended. Nevertheless, in some cases, these options are not helpful. The use of supraglottic airways is also emphasized and may be used as a primary technique.[1] Veno-venous or veno-arterial extracorporeal membrane oxygenation (ECMO) has emerged as an advanced strategy to preserve oxygenation in these scenarios, and can be placed even in awake patients.[1–3] Here, we describe a case of difficult airway management decision-making through careful airway evaluation under anesthesia using a supraglottic airway (SGA) device followed by use of VV-ECMO to facilitate surgical airway access in a patient with locally advanced, metastatic, anaplastic thyroid cancer.

**CASE PRESENTATION**

A female in her 60s presents with acute stridor secondary to anaplastic thyroid cancer and a 7.5 cm × 6.0 cm anterior neck mass. Computed tomography scan revealed tracheal lumen invasion and displacement, mediastinal extension, abutting of pulmonary trunk, severe brachiocephalic vein compression, possible common carotid artery, and recurrent laryngeal nerve invasion. Her stridor improved with dexamethasone.

She was brought to the operating room (OR) and could only briefly lie flat but was hemodynamically stable. Front of neck access was not possible because of the large mass. Four

percent lidocaine was nebulized while lower-extremity intravenous, right-radial arterial access was obtained and a bispectral index monitor applied.

Multidisciplinary planning was performed involving anesthesia, vascular surgery, perfusion, ENT, and thoracics. To assess the airway, inhalational induction with sevoflurane was gradually titrated ensuring maintenance of spontaneous breathing and patency. A size-4 Unique™ laryngeal mask airway (LMA) was placed with aperture bars removed. Low pressure-support ventilation to optimize tidal volumes was well-tolerated. Flexible bronchoscopy via LMA allowed vocal cords be sprayed with 2% lidocaine. Invasion in the proximal trachea confirmed distal intubation is impossible.

As planned, cannulation for VV-ECMO via right femoral and right IJ was performed. Although pressure of the neck could interrupt the airway; cannulation was effective. Total intravenous anesthesia was maintained with remifentanil, propofol and rocuronium. Surgical exploration confirmed unresectable tracheal invasion at rings 2–7. Partial thyroidectomy debulking, esophagogastroduodenoscopy and difficult tracheostomy were performed. Ventilation resumed through tracheostomy allowing ECMO to be weaned and decannulated in the OR. The patient recovered in the postanesthesia care unit and transferred to ENT step-down for further care, eventually discharged home.

## CONCLUSION

Near-occlusive tracheal tumours with anterior neck and mediastinal involvement pose significant airway challenges. Multidisciplinary planning with careful approach of airway evaluation using spontaneous breathing and a supraglottic airway as a bridge to VV-ECMO where tracheal intubation or awake front of neck access is not possible can be an effective strategy.

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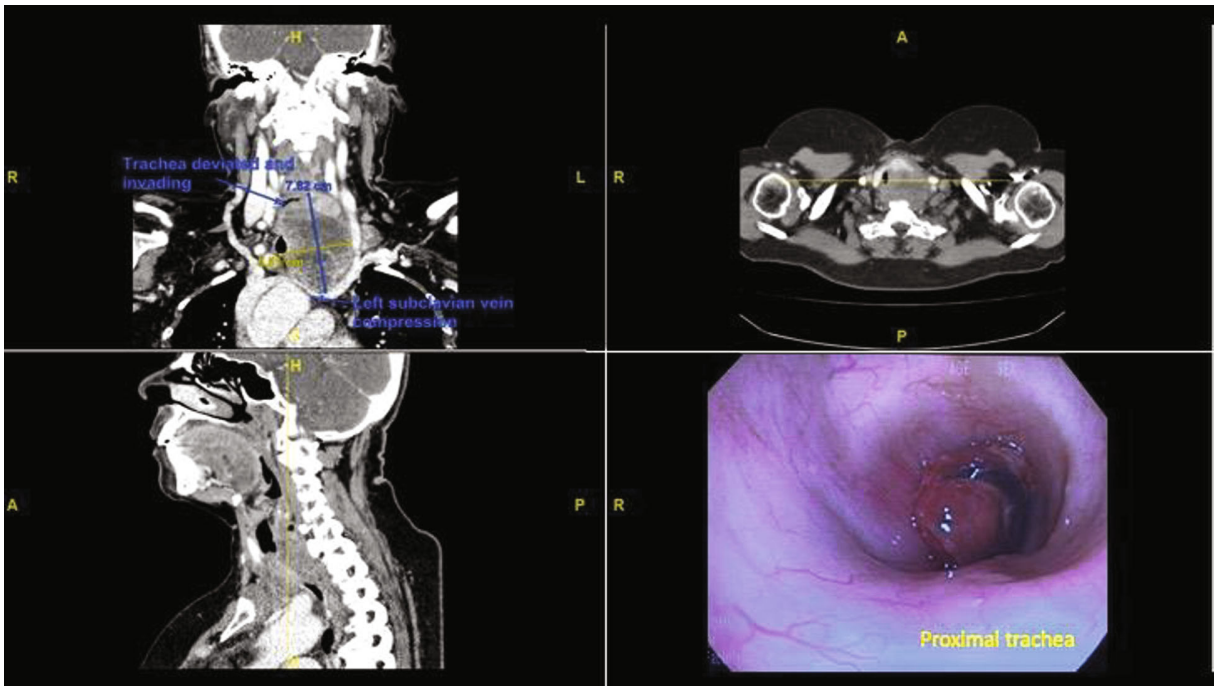
## Figure


H
R
L
Trachea deviated and invading
7.82 cm
Left subclavian vein compression
A
R
P
H
A
P
R
Proximal trachea

# Unwanted inflation from jet ventilation: a case report

**Submission ID**

45

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**INTRODUCTION**

Idiopathic subglottic stenosis presents a complex clinical challenge, necessitating intricate airway management during surgical interventions.[1] Jet ventilation, a technique designed to enhance surgical access while minimizing vocal cord pressure, is frequently employed in such cases.[2,3] Nevertheless, its advantages are accompanied by the potential for barotrauma-related complications, including subcutaneous emphysema, pneumomediastinum, and, rarely, tension pneumothorax.[4] This case report highlights a unique instance of tension pneumothorax arising from transtracheal jet ventilation during endoscopic airway surgery. Contributing factors include catheter misplacement, high driving pressures causing hyperinflation, or outflow tract obstruction leading to gas trapping, with the latter identified as the most likely cause in this case.[5] Effective communication and meticulous planning between anesthesia and otolaryngology teams are pivotal, particularly in critical incidences that demand swift recognition and intervention. While jet ventilation stands as an efficient method, this report highlights possibilities of barotrauma-related complications, emphasizing timely recognition and management for optimal patient outcomes required in intricate airway scenarios.

**CASE PRESENTATION**

A 69-yr-old woman with idiopathic subglottic stenosis who previously underwent multiple interventions, including dilatations and laryngotracheoplasties, returned to hospital with acute dyspnea and stridor. Initial treatments with steroids, bronchodilators, and antibiotics proved ineffective. A neck computed tomography scan revealed restenosis of the subglottis, prompting further intervention. In the operating room, difficulties arose during visualization on suspension microlaryngoscopy because of poor neck extension, small mouth opening, anterior larynx, and the presence of an endotracheal tube. Ventilation became critically compromised, leading to attempts of ventilation using a small ventilating bougie, resulting in worsening oxygen

saturation, airway bleeding, and subcutaneous emphysema. Despite re-intubation, respiratory distress persisted with the oxygen saturation hovering around 80% and $CO_2$ return at 45 mm Hg, and subsequently, a tension pneumothorax was diagnosed and addressed promptly with a chest tube insertion. Following intensive care unit transfer, the patient exhibited barotrauma-related complications, including subcutaneous emphysema, pneumomediastinum, and pneumoperitoneum. Her condition gradually improved, transitioning to a tracheostomy collar and subsequent decannulation. The patient experienced stability for 15 months until symptoms recurred, leading to an awake tracheostomy and an uneventful recovery. The patient has remained stable for 18 months postoperatively. This case highlights the challenges in managing complex airway issues upon using jet ventilation, highlighting the importance of prompt recognition and appropriate interventions to address complications.

## CONCLUSION

In conclusion, this case highlights the intricate balance required in employing jet ventilation for idiopathic subglottic stenosis. While the technique offers enhanced surgical access, the potential for rare but severe barotrauma-related complications demands consideration. The reported incident emphasizes the critical importance of being up to date with anesthesia guidelines, effective communication between specialties, and prompt recognition of evolving challenges. Successful resolution, marked by tracheostomy and chest tube insertion, attests to the significance of requiring prompt interventions in mitigating life-threatening complications. This case highlights the complexities inherent in managing complications such as pneumothorax, necessitating a multidisciplinary approach for optimal patient outcomes.

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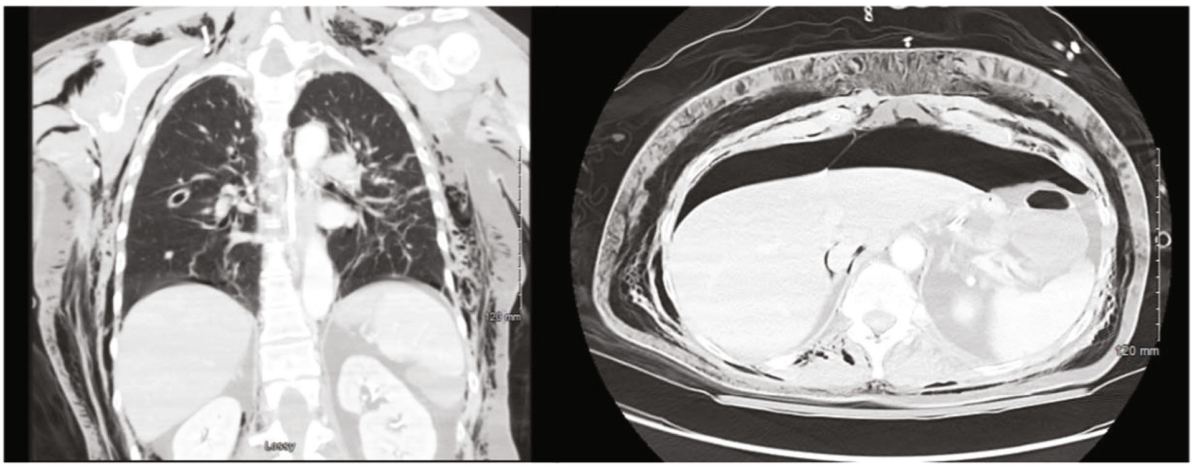
**Figure** Postoperative evidence of significant A) subcutaneous emphysema and B) pneumoperitoneum



# Use of oscillometry to compare airway resistance and reactance in the supine, lateral, and prone positions

**Submission ID**

114

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**INTRODUCTION**

Oscillometry is a noninvasive technique to measure respiratory system impedance measuring resistance (R) and reactance (X) by superimposing small pressure waveforms during passive tidal breathing.[1] It can be used to detect heterogeneous obstruction attributed to the small airways relative to more central airways from the difference in resistance measured at 5Hz and 19Hz (R5-19). Oscillometry is more sensitive than pulmonary function testing for detecting peripheral airway obstruction.[2] This technique is useful for assessment of asthma, chronic obstructive pulmonary disease, interstitial lung disease,[1,2] intubation and mechanical ventilation,[3] and more recently the effects of supine[4] and lateral body positioning.[5] Oscillometry may thus be useful to assess improved lung ventilatory mechanics from prone positioning commonly used for some surgical procedures and the management of severe COVID-19. The purpose of this study was to compare respiratory impedance in the supine, lateral and prone positions using oscillometry.

**METHODS**

Thirty-five healthy volunteers were recruited after institutional research ethics approval and provided signed consent before study participation. Study exclusion criteria included recent respiratory infection, smoking history, pregnancy, uncontrolled asthma, or a history of other lung diseases. Self-reported height, weight, sex, and birth year were collected prior to testing. Oscillometry (tremoflo, Thorasys) was performed on a hospital stretcher starting in the supine position (S), followed by the left lateral (LL) and then the prone position (P). Prone positioning was based on the “swimmers” position used to prone ventilated intensive care patients, with bolsters under the chest and pelvis leaving the abdomen hanging free. The nostrils were sealed using a nose clip, and the cheeks were supported to prevent upper airway shunting. Three trials with a total respiratory resistance (R5) coefficient of variation less than 10% were collected in each position.[1] Resistance and reactance data (cm $H_2O \cdot L^{-1} \cdot s^{-1}$) at 5, 19, and 5–19 Hz, along with the resonant frequency (Fres, Hz) and area under the reactance curve (AX, cm $H_2O \cdot L^{-1}$) were

analyzed using repeated measures analysis of variance, with the Holm–Sidak or Tukey test for multiple comparisons.

**RESULTS**

The preliminary study cohort included 19 males and 16 females, with a median age of (31 yr [IQR, 27–33] and mean body mass index of 26.2 $kg \cdot m^{-2}$ (SD ± 3.0) for males and 22.3 (SD ± 1.8) for females. Significant differences in R5, R19, and R5–19, X5, Ax and Fres were seen for the different conditions (Table).

**DISCUSSION**

Increased small airway resistance (R5–19) and lower lung compliance (more negative X5, increased Fres) have been previously reported in nonobese patients comparing supine to lateral positioning.[5] Our findings confirm this, but we also found lower resistance in lateral compared with prone position. Additionally, X5 was different only for lateral to prone, indicating less lung stiffness when lateral, agreeing with higher AX and Fres for supine and prone positions. Together these data show improved respiratory mechanics when lateral compared with supine and prone, from less airflow obstruction involving the small airways and increased compliance in the lateral position.

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**Table** Resistance and reactance results (*n* = 35 subjects) reported as mean (SD) or median [IQR], along with the positions that demonstrated significant differences with pairwise comparisons

| Variable (units) | Supine (S) | Lateral (LL) | Prone (P) | p < 0.05 |
|---|---|---|---|---|
| R5 (cmH2O/L/s) | 3.96 (1.19) | 3.36 (0.97) | 3.86 (1.17) | S vs LL, LL vs P |
| R19 (cmH2O/L/s) | 3.41 [2.73-4.13] | 2.93 [2.57-3.90] | 3.24 [2.69-3.96] | S vs LL, S vs P |
| R5-19 (cmH2O/L/s) | 0.34 [0.09-0.57] | 0.23 [(-0.04)-0.42] | 0.51 [0.23-0.71] | S vs LL, LL v P |
| X5 (cmH2O/L/s) | -1.25 [(-1.60)-(-0.96)] | -1.19 [(-1.46)-(-0.93)] | -1.28 [(-1.88)-(-1.02)] | LL vs P |
| AX (cmH2O/L) | 4.31 [2.47-6.63] | 3.19 [2.07-5.22] | 4.87 [3.33-6.87] | S vs LL, LL vs P |
| Fres (Hz) | 10.93 [9.77-12.44] | 10.44 [9.69-12.22] | 11.64 [10.52-13.88] | S vs LL, LL vs P |

# AMBULATORY ANESTHESIA

## Predicting quality of early postoperative recovery following interscalene block for outpatient arthroscopic shoulder surgery: secondary analysis of a randomized controlled trial

**Submission ID**

48

**AUTHORS**

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**INTRODUCTION**

Single injection interscalene block (ISB) is commonly used during ambulatory arthroscopic shoulder surgery for effective postoperative analgesia and reliable surgical anesthesia.[1] Yet, side effects of ISB, such as temporary unilateral phrenic nerve paralysis and rebound pain, could negatively impact recovery.[1,2]

Postoperative recovery is best assessed using validated, multidimensional patient reported outcome measures[3] like the Quality of Recovery-15 questionnaire (QoR-15).[4] The QoR-15 is increasingly used in anesthesia research, but previous work has usually reported unadjusted scores for intervention and comparator groups.[3] A better understanding of how common patient, surgical, and anesthetic characteristics affect quality of recovery is needed to guide future research.

Our objective in this study was to identify independent predictors of postoperative day one QoR-15 among commonly collected patient, surgical and anesthetic characteristics. We hypothesized that dexamethasone would be associated with an increased QoR-15 score, based on the original trial results.

**METHODS**

Our research ethics board approved this secondary analysis of randomized trial data collected between September 2017 and April 2018 in adult patients undergoing arthroscopic shoulder

surgery. The original single-centre, double-blinded trial compared analgesic block duration after ISB with 30 cc of 0.5% bupivacaine and one of three intravenous adjunct regimens: 50 μg of dexmedetomidine, 4 mg of dexamethasone or both adjuncts.

All candidate predictor variables were defined before analysis. A pain-free first postoperative night was defined as an analgesic block duration exceeding 0800 hr on postoperative day one, based on concerns about nocturnal rebound pain[2] and QoR-15 featuring two sleep-related questions.

The primary outcome of this study, QoR-15, was a secondary outcome in the original study. It was assessed by telephone interview on postoperative day one. A multivariable model was constructed using Group Least Absolute Shrinkage and Selection Operator (LASSO) analysis.[5] It is more likely to find the true relevant predictors and make better out-of-sample predictions than traditional forward and backward variable selection because it simultaneously selects variables and estimates parameters in one step. A disadvantage of group LASSO is that no *P* values or confidence intervals are provided, as the complex sampling distributions are conditional on the selection process.

**RESULTS**

In the original trial, dexamethasone significantly increased analgesic block duration *vs* dexmedetomidine. In this secondary analysis, 194 of 197 randomized patients were included and 112 experienced a pain-free first postoperative night. The mean QoR-15 score was 118.0 (standard deviation, 19.3) and the median was 121 [range, 41–150]. The minimum possible score is 0 and the maximum 150, with higher scores indicating better quality of recovery.

In univariate analysis, randomization to dexamethasone led to a 9.8 point (95% confidence interval, 3.3 to 16.3; *P* = 0.003) increase in QoR-15 *vs* dexmedetomidine. The minimum clinically important difference for the QoR-15 is 8 points.[4] In multivariable analysis, the adjusted coefficient for experiencing a pain-free first postoperative night had the greatest effect on QoR-15 (7.9-point improvement). Adjusted coefficients for randomization to dexamethasone (0.4 points), block duration (0.01 points per hour) and other predictors were much smaller (Figure).

**DISCUSSION**

Intravenous dexamethasone 4 mg led to a clinically important improvement in postoperative day one QoR-15 compared to 50 mg of intravenous dexmedetomidine. In multivariable analysis, this effect appears to be mediated by an increased likelihood of analgesic block duration extending beyond the first postoperative night in patients who received dexamethasone. Differences in analgesic block duration or other mechanisms specific to the adjuvants were much less important. QoR-15 contains multiple questions related to sleep, physical comfort, and emotional state.[4] Interactions between these domains and quality of recovery may be responsible for the threshold effect of a pain-free first night.

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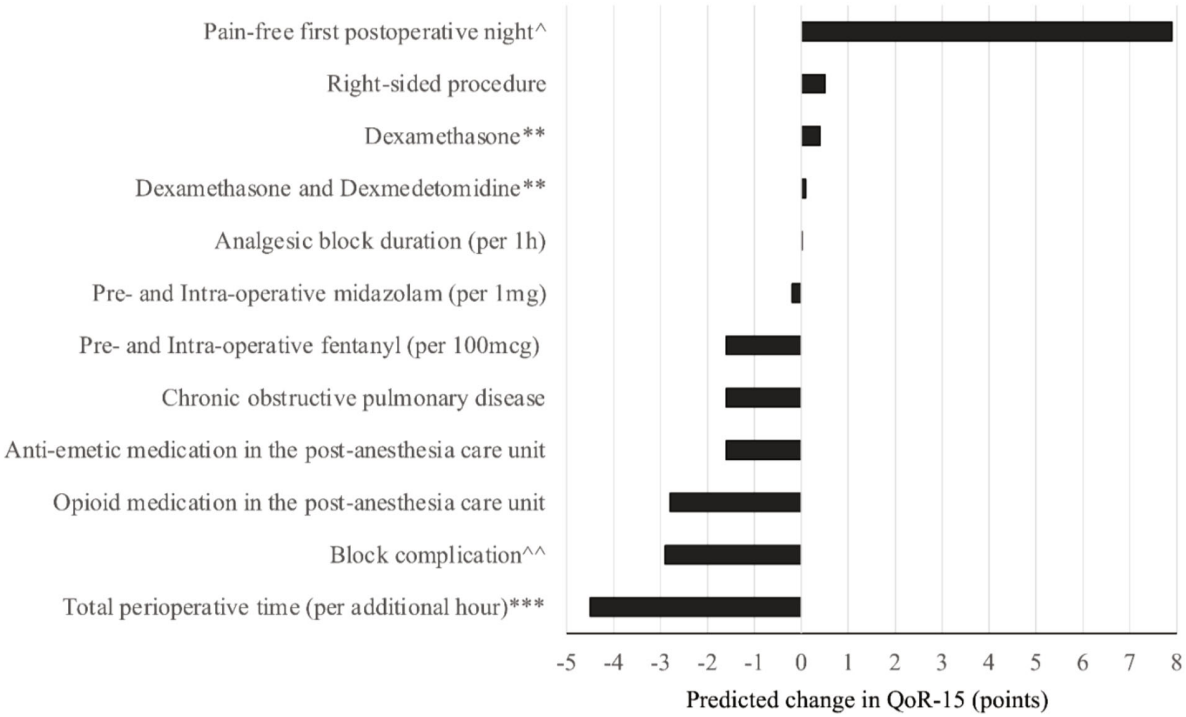
**Figure** Multivariable model coefficients from Group Least Absolute Shrinkage and Selection Operator (LASSO) analysis of postoperative day on QoR-15 scores*




*Positive and negative coefficients imply improved and worsened recovery, respectively. The Group LASSO method does not provide confidence intervals or *p* values but offers better predictive properties than forward or backward regression, especially with large numbers of candidate predictor variables.

^A pain-free postoperative night was defined as an analgesic block duration that exceeded 0800h on postoperative day one.

**The randomization groups in the original trial were 50mcg intravenous dexmedetomidine (reference group), 4mg intravenous dexamethasone, or both adjuvants.

^^Block complications consisted of transient paresthesias (n = 4), bradycardia (n = 2), intermittent atrial bigeminy, Horner's syndrome and repeated moving and coughing during the block (n = 1 each).

***Total perioperative time included time from interscalene block insertion to postoperative discharge from the facility.

# BASIC SCIENCE

## Intravenous soybean oil emulsion (intralipid) reverses propofol induced hypotension but not cortical burst suppression in rats

**Submission ID**

42

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**INTRODUCTION**

Propofol is a lipid-soluble intravenous agent widely used for the induction and maintenance of general anesthesia. A major limitation of propofol is its hypotensive effect,[1] which is treated through fluid resuscitation and vasopressor medications. Nevertheless, in cases of severe or refractory hypotension, further treatment options are needed. In recent decades, intravenous lipid emulsions (ILE) such as Intralipid (20% soybean oil) have been shown to improve hemodynamics in lipid soluble medication overdoses (i.e., local anesthetics, calcium channel blockers, beta blockers).[2] Initially, ILE were hypothesized to sequester lipophilic drugs from the aqueous phase of circulation,[3] albeit subsequent studies suggest ILE directly augment systemic vasoconstriction, cardiac contractility, and cellular signalling and metabolism.[2,4,5] As a result, the extent to which Intralipid co-administration with propofol may impact depth of anesthesia through acting as a 'lipid sink' remains unclear. We hypothesized that Intralipid reverses propofol mediated vasodilation, thereby increasing blood pressure, without altering depth of anesthesia.

**METHODS**

All experiments described were approved by our Institutional Animal Care Committee. Male 4-month-old Sprague Dawley rats were induced and maintained under isoflurane general anesthesia (2.5–3.0% at 1 $L \cdot min^{-1}$) and bilateral femoral intravenous and left femoral arterial catheters were inserted. Tracheostomy was performed, and rats were ventilated with a tidal volume of 2.5 $mL \cdot kg^{-1}$ at 20 breaths per minute. Rats were repositioned prone, and

electroencephalogram (EEG) electrodes were inserted through burr holes bilaterally into the frontal cortex (2 mm anterior and 2 mm lateral to Bregma), parietal cortex (2 mm posterior and 4 mm lateral to Bregma), and cerebellum. Following completion of surgery, rats were transitioned from isoflurane (2.1–2.3% at 1 $L \cdot min^{-1}$) to propofol infusion (0.8–1.0 $mg \cdot kg^{-1} \cdot min^{-1}$), with each anesthetic titrated to cessation of motor response to toe pinch with forceps. Hemodynamic and EEG (sampling rate 400 Hz, band-pass filtered 1–150 Hz) recording baselines were established for at least ten minutes for each anesthetic. Following baseline measurements with propofol infusion, rats were randomized into two separate groups receiving four sequential boluses of either bovine serum albumin (BSA) (20% v/v at 1 $mL \cdot kg^{-1}$; $n = 7$) or Intralipid (20% v/v soybean oil at 1 $mL \cdot kg^{-1}$; $n = 6$) delivered one minute apart. Data are presented mean ± standard error of the mean and analyzed by two-way analysis of variance with GraphPad Prism 10, where $P < 0.05$ was significant.

## RESULTS

Rats under isoflurane general anesthesia had mean arterial pressure (MAP) of 106.2 ± 3.5 mm Hg and 103.3 ± 3.3 mm Hg in the BSA and Intralipid groups with corresponding heart rates of 350.8 ± 9.9 bpm and 350.5 ± 13.5 bpm, respectively. Propofol infusion thereafter yielded baseline MAP of 74.9 ± 2.6 mm Hg and 67.1 ± 5.7 mm Hg for BSA and intralipid bolus groups, respectively, with corresponding baseline heart rates of 321.6 ± 11.0 bpm and 315.2 ± 9.7 bpm. Cumulative sequential boluses of either BSA or Intralipid (four 1 $mL \cdot kg^{-1}$ boluses each one minute apart; total dose 4 $mL \cdot kg^{-1}$) increased MAP by 12.2 ± 1.8 mm Hg and 12.3 ± 1.9 mm Hg ($P = 0.98$), respectively, with corresponding heart rate increases of 0.5 ± 2.7 bpm and 0.9 ± 1.7 bpm ($P = 0.26$). Change in mean EEG power readings following sequential boluses of BSA and Intralipid were +305.8 ± 86.8 $\mu V^2$ and −319.4 ± 112.4 $\mu V^2$ ($P = 0.0001$), respectively.

## DISCUSSION

We have shown that intralipid reverses hypotension without reduction in depth of anesthesia. Similar improvements in MAP with BSA and Intralipid may suggest increased colloid osmotic pressure is a mechanism of action, albeit this comparison is potentially confounded by propofol binding and sequestration by BSA as indicated by increased mean EEG power. Therefore, these data may corroborate intralipid induced vasoconstriction *in vivo*, which was previously reported in *ex vivo* studies from our group.[5] Intralipid may be a promising therapeutic agent for refractory propofol induced hypotension, which does not decrease depth of anesthesia by acting as a 'lipid sink.'

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# CARDIOVASCULAR AND THORACIC

## An unusual complication of a pulmonary artery catheter

**Submission ID**

60

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**INTRODUCTION**

We had a patient in the operation room about to under-go a double lung transplant for Idiopathic pulmonary fibrosis (IPF). The pulmonary artery catheter (PAC) was attempted to be floated through a left sided internal jugular vein Cordis sheath but was unsuccessful after multiple attempts. The PAC subsequently formed a knot and while attempting to withdraw it, it snared the newly inserted left subclavian vein triple lumen central line causing an abrupt stoppage of all the infusions running through it. Knot formation is a recognized complication associated with PAC insertion,[1] but snaring of the subclavian central line hasn't been reported before. We believe our experience with this case can be of use to others.

**CASE PRESENTATION**

A 58-yr-old man with history of IPF was posted for an emergency double lung transplant. In view of fairly normal pulmonary artery pressures, the patient was induced and intubated with a double-lumen endobronchial tube (DLT), maintained on propofol total intravenous anesthesia and subsequently planned to float a PAC through a left-sided internal jugular vein (IJV) Cordis sheath and also place a left sided subclavian triple lumen central line. The central line and Cordis sheath were inserted uneventfully but the PAC could not be floated following multiple attempts. The surgeons opened the chest with a clam-shell incision. Another attempt to float the catheter once the chest was opened was unsuccessful. The catheter was then attempted to be withdrawn, but during that process it was noted that all the drug infusions running through the subclavian central line stopped abruptly. On dissecting the mediastinal structures, the surgeons noticed a large hematoma in the mediastinum. A new femoral central line was inserted by the surgeons and on vascular exploration it was noted that the subclavian catheter had perforated the vein at the atrial-caval junction. The catheter was cut and the vein repaired. The double lung transplant was completed successfully with extracorporeal membrane oxygenation support and at the end of the case, fluoroscopy was used to identify the PAC

knotted in the left IJV. The left side neck was explored by Vascular surgery and the PAC was noted to have snared the subclavian central line catheter. Both the PAC and central line were removed and the neck closed.

## CONCLUSION

Indications for using PAC in cardiac and noncardiac surgical patients include severe left ventricular dysfunction, severe pulmonary hypertension, septic shock, cardiogenic shock, pulmonary edema, and severe toxaemia of pregnancy. Complications associated with PAC[2] are divided into the following categories: venous access, dysrythmias, complications associated with catheter residence inside the body including venous thrombosis, thrombophlebitis, pulmonary embolism, cardiac mural thrombi, valvular injury, infection, and pulmonary artery rupture. Sepsis is a complication of PAC residence. The PAC snaring the subclavian catheter is something we did not find in literature and wanted to add it to the list of vascular complications.

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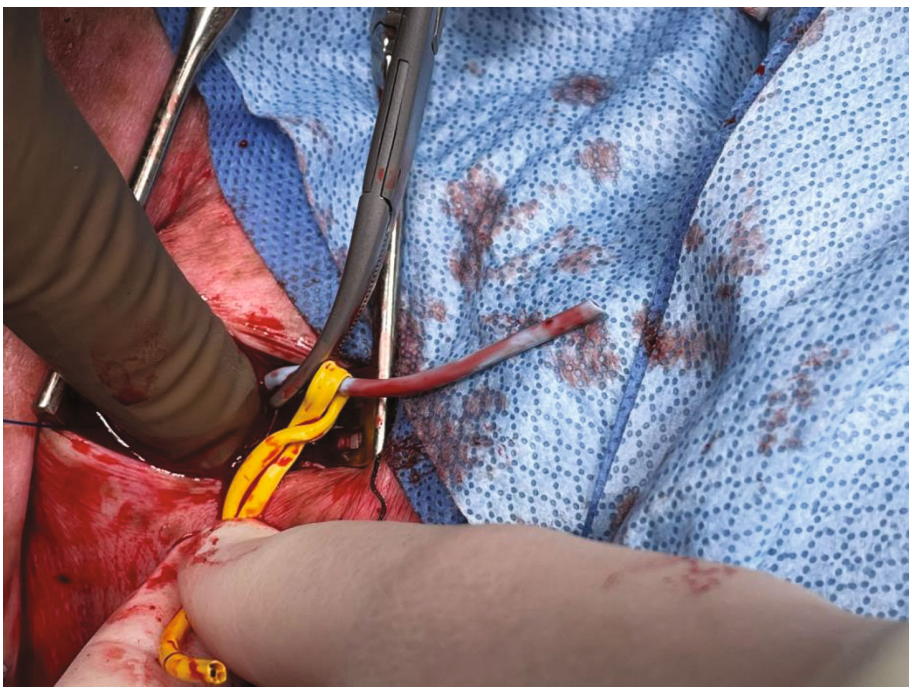
**Figure**



# Analgesic efficacy of single shot erector spinae block in video-assisted thoracoscopic surgery: a propensity score matched retrospective cohort study

**Submission ID**

8

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**INTRODUCTION**

Video-assisted thoracic surgery (VATS) is a minimally invasive surgical technique with rising popularity over the last two decades, though effective analgesia for management of VATS-associated pain remains as a challenge.[1] While thoracic epidural analgesia has traditionally been utilized, it is invasive and technically demanding.[2] Recently, interfascial plane blocks such as erector spinae plane block (ESPB) has emerged as a promising analgesic method for VATS for its ease and safety of placement.[3] Furthermore, it has been postulated to be more effective than routine systemic analgesia alone, potentially by targeting both dorsal and ventral rami of thoracic spinal nerves. Despite its potential, studies that evaluated the analgesic efficacy of ESPB in VATS yielded inconclusive results.[4,5] Therefore, our aim was to determine whether ESPB in patients undergoing VATS is associated with reduced opioid consumption in the first 12 postoperative hr through a retrospective propensity score-matched cohort study.

**METHODS**

This study was approved by the Western University Health Science Research Ethics Board. We conducted a single-centre retrospective study including patients who had undergone VATS procedures at a single tertiary academic centre in Canada from 2018 to 2020. Our primary outcome was the total opioid consumption in IV hydromorphone equivalents in the first 12 postoperative hr. Our secondary outcomes included the area under curve (AUC) of the numeric rating scale for pain in the first 12 postoperative hr, incidence of hypoxia during the first 12 postoperative hr, duration of postanesthetic recovery unit (PACU) stay, and the total length of hospital stay. We used binomial logistic regression to model whether patients received ESPB as a function of age, sex, body mass index, American Society of Anesthesiologists Physical Status, and surgery type to generate a propensity score for each patient for matching. Continuous

postmatch variables were analyzed using Mann–Whitney *U* tests and categorical variables using Fisher's exact tests. Outcomes were presented as difference in means and odds ratios with 95% confidence intervals (CI), and $P < 0.05$ was considered statistically significant.

**RESULTS**

From 1 December 2018 to 1 January 2020, 286 patients undergoing VATS at Victoria hospital in London, ON, Canada were screened. One hundred and seventy patients met the inclusion criteria and 55 patients each in the ESBP and no-block groups were matched. Compared to the no-block group, ESPB was associated with a 1.2 mg (95% CI, −2.2 to −0.2 mg; $P = 0.02$) reduction of opioid use in 12-hr opioid use in intravenous hydromorphone equivalents. Nevertheless, no associated differences were found in 12-hr pain score AUC, PACU length of stay, hospital length of stay, or incidence of hypoxia between the two groups.

**DISCUSSION**

In our study, for patients undergoing VATS, ESPB was associated with a modest reduction in the total opioid consumption in the first 12 postoperative hr, although we did not observe a difference in 12-hr pain score AUC, PACU length of stay, hospital length of stay, or incidence of hypoxia. As such, ESPB may offer benefits through the reduction of opioid consumption, as repeated use of opioids place patients at risk of side effects including respiratory depression, sedation, and nausea. While its analgesic efficacy may be limited, ESPB could be considered a component of multimodal analgesia in VATS.

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# Autologous cell salvage: an *in vivo* comparison of autotransfusion devices in cardiac surgery

**Submission ID**

72

**AUTHORS**

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*These authors contributed equally to the work

**INTRODUCTION**

Autologous cell salvage is recommended for surgical procedures where high-volume blood loss (> 500 mL) is expected to reduce the need for allogeneic red blood cell (RBC) transfusions.[1] In cardiac surgery, it is recommended that autologous cell salvage be used for all cases, at least in 'collect only' mode to allow for processing and reinfusion if significant blood loss occurs.[1] Comparative analysis of a previous generation of autotransfusion devices demonstrated significant differences in device removal of heparin (UFH), potassium, plasma free hemoglobin (PfHb), white blood cells (WBCs), and platelets in cardiac surgery.[2] As part of a quality improvement initiative in our institution, the aim of this study was to compare the wash quality of autologous RBCs processed during cardiac surgery by four modern, commercially available autotransfusion devices: Medtronic AutoLog iQ, LivaNova Xtra, Haemonetics Cell Saver Elite+, and Fresenius Kabi CATSmart.

**METHODS**

This prospective observational study, conducted with Institutional Quality Improvement Review Committee approval and research ethics board waiver, focused on 130 adult patients undergoing cardiac surgery with autologous cell salvage between 9 May 2023 and 29 September 2023. Autotransfusion devices were trialed consecutively, completing data collection for each device before introducing the next. Patients were grouped according to the autotransfusion device employed, determined by the device under evaluation at that point in time. Manufacturer-recommended settings and heparinized saline (30 $U \cdot mL^{-1}$) as an anticoagulant were uniformly applied, with perfusionists choosing processing set sizes of

125 mL or 225 mL when applicable. Unwashed and washed samples were collected pre- and postprocessing, respectively, analyzing Hematocrit (Hct), WBC, platelet (PLT), heparin (UFH), potassium (K+), and plasma free hemoglobin (PfHb) levels. Device-reported Hct measurements were recorded for comparison to laboratory measurements. Washout quality was assessed by contaminant removal ratios and reinfusion concentrations of UFH and K+.

Standard descriptive statistics (mean with SD, median with percentiles/IQR, and proportions) were employed. Normal distribution was evaluated using graphical assessments and the Shapiro–Wilk test. Statistical analysis, utilizing one-way analysis of variance or Kruskal–Wallis ranks as appropriate, considered significance threshold of $< 0.05$. Data analysis was conducted using R Statistical Software V 4.2.3 (3).

**RESULTS**

One hundred and fifteen were included in the analysis, AutoLog iQ 30 (26%), Xtra 30 (26%), Cell Saver Elite+ 29 (25%), and CATSmart 26 (23%). Mean age of the population was 61 ± 15.7 yr, 22% were female (*n* = 26), with mean BMI of 28.21 ± 5.3 $kg \cdot m^{-2}$. The distribution of the procedures was: 24% two major procedures (*n* = 28), 21% isolated coronary artery bypass graft surgery (CABG) (*n* = 24), 16% off-pump (*n* = 18), 12% ≥ 3 major procedures (*n* = 14), 9% Re-dos (*n* = 10), 7% single non-CABG (*n* = 8), 4% MICS (*n* = 5), 4% thoracic aorta (*n* = 5), and 3% others (*n* = 3). Hct of the packed red cell concentrate and RBC recovery rates differed significantly between devices. All devices removed > 99% UHF, > 95% K+, > 94% PLT, and > 8 5% PfHb, yet exhibited varying WBC elimination rates (Figure). The lowest median reinfusion concentration of UFH was 0.09 (0.03) $U \cdot mL^{-1}$ PRC by the Elite+ 125 mL and the highest was 0.62 (0.15) $U \cdot mL^{-1}$ PRC, by the Xtra 125 mL processing sets.

**DISCUSSION**

This study highlighted the variations in PRC concentrate hematocrit among autotransfusion devices. The observed differences in RBC mass recovery rates between bowl sizes for Xtra and Elite+ devices could have implications for the efficiency and performance of these systems when a high rate of blood loss is anticipated. Ineffective WBC removal by autotransfusion devices warrants consideration for additional postprocessing filtration methods. Limitations include nonrandomization and potential measurement variability, impacting baseline characteristics and study scope. Further investigations are warranted to address the clinical relevance of these variations in autologous blood transfusion.

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**Figure** Results by device

**A. Complete Blood Count by Device**

| | Bowl Size | n | Pre-Hct % | Post-Hct % | Pre-Plt (x10^9/L) | Post-Plt (x10^9/L) | Pre-WBC (x10^9/L) | Post-WBC (x10^9/L) |
|---|---|---|---|---|---|---|---|---|
| AutoLog iQ | 135 ml | 30 | 14 (7) | 63 (3) | 50.5 (34.5) | 8.5 (10.5) | 3.05 (1.65) | 10.35 (5.3) |
| Xtra | 125 ml | 15 | 11 (4.5) | 63 (2.5) | 36 (26) | 7 (12.5) | 2.2 (1.65) | 6.60 (5.75) |
| Xtra | 225 ml | 15 | 16 (4.5) | 62 (2.5) | 60 (30) | 17 (27) | 4.4 (2.10) | 12 (3.75) |
| Elite+ | 125 ml | 15 | 13 (10.5) | 62 (5) | 55 (31) | 15 (40.5) | 3.4 (2.85) | 13.6 (13.9) |
| Elite+ | 225 ml | 14 | 19 (1.75) | 56 (4.5) | 66 (24.25) | 12.5 (14) | 4.4 (3.27) | 12.35 (8.33) |
| CATSmart | N/A | 26 | 15.5 (5.75) | 71 (8) | 49.5 (39.5) | 6 (11.25) | 3.5 (3.15) | 10.05 (8.7) |

** Values presented as Median (IQR)*

**B. Plasma Concentrations by Device**

| | Bowl Size | n | Pre-UFH (U/ml) | Post-UFH (U/ml) | Pre-K+ (mmol/L) | Post-K+ (mmol/L) | Pre-PfHb (mg/L) | Post-PfHb (mg/L) |
|---|---|---|---|---|---|---|---|---|
| AutoLog iQ | 135 ml | 30 | 17 (5.82) | 0.57 (0.32) | 4.7 (1.93) | 2.1 (0.95) | 1905 (2269) | 2373 (1464) |
| Xtra | 125 ml | 15 | 16.2 (2.3) | 1.70 (0.42) | 4.2 (2.05) | 1.7 (0.70) | 1530 (1615) | 2884 (1207) |
| Xtra | 225 ml | 15 | 15 (2.9) | 0.92 (0.42) | 5.4 (2.6) | 1.9 (1.05) | 2668 (1080) | 2800 (1218) |
| Elite+ | 125 ml | 15 | 17.6 (3.30) | 0.24 (0.08) | 4.8 (1.75) | 2.4 (0.95) | 2060 (865) | 3395 (2113) |
| Elite+ | 225 ml | 14 | 15.4 (4.10) | 0.55 (0.25) | 5.5 (1.30) | 1.9 (0.75) | 3180 (2433) | 2500 (903) |
| CATSmart | N/A | 26 | 15.2 (2.35) | 1.06 (1.06) | 4.75 (1.83) | 2.7 (1.02) | 2391 (2573) | 2991 (3172) |

**Values presented as Median (IQR)*

**C. RBC Recovery and Washout quality by Device**

| | AutoLog iQ 135 ml | Xtra 125 ml | Xtra 225 ml | Elite+ 125 ml | Elite+ 225 ml | CATSmart N/A | *p-value* |
|---|---|---|---|---|---|---|---|
| $RBC_{Rec}$ | 86 [74;91] | 95 [91;99] | 87 [83;90] | 87 [78;94] | 94 [92;97] | 65 [56;74] | <0.001 |
| $RBC_{RecR}$ | 19 [17;20] | 12 [11;13] | 19 [17;21] | 8 [8;10] | 24 [22;25] | 14 [12;16] | 0.021 |
| $WBC_{RR}$ | 42 [34;58] | 50 [44;62] | 35 [29;48] | 27 [21;35] | 26 [19;33] | 59 [42;68] | < 0.001 |
| $PLT_{RR}$ | 97 [94;98] | 97 [95;98] | 95 [86;96] | 95 [86;97] | 94 [89;96] | 98 [97;99] | < 0.001 |
| $PfHb_{RR}$ | 92 [87;95] | 89 [83;91] | 89 [85;91] | 85 [72;88] | 88 [87;91] | 93 [88;94] | < 0.001 |
| $K+_{RR}$ | 96 [95;98] | 97 [95;98] | 96 [94;97] | 94 [94;98] | 95 [93;95] | 97 [96;98] | 0.004 |
| $UFH_{RR}$ | 100 [100;100] | 99 [99;99] | 99 [99;99] | 100 [100;100] | 99 [99;100] | 100 [99;100] | < 0.001 |

*RBC = Red Blood Cell; Rec = Recovery; RecR = Recovery Rate; Hct = Hematocrit; RR = Removal Rate*

** Values are presented as Median[25%;75%]*

# Incidence of spinal hematoma in cardiac surgery after spinal anesthetic: a systematic review

**Submission ID**

13

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**INTRODUCTION**

Spinal anesthesia in cardiac surgery is a technique with many potential benefits including improved postoperative analgesia, hemodynamic stability from denervation of the surgical site, positive myocardial oxygen balance due to hypodynamic circulation and decrease of the stress response.[1–3] One reason for hesitancy of further investigating this technique is the risk of spinal hematoma. Incidence of spinal hematoma in cardiac surgery after spinal anesthesia was projected as 1:3600 by Ho *et al*. in the year 2000.[4] This study was a retrospective review with limited data. This information is utilized by the American Society of Regional Anesthesia (ASRA) to formulate the guidelines which are utilized by anesthetists to have risk benefit discussions with patients regarding spinal anesthesia.[5] The objective of this study was to collect an up-to-date data set to project the incidence of spinal hematoma in patients undergoing cardiac surgery who receive spinals as part of their anesthetic plan, and full dose heparinization afterwards.

**METHODS**

A retrospective systematic literature review looking at all cases of spinal anesthesia in cardiac surgery. We formulated a search strategy with our librarian and searched MEDLINE, Embase and Cochrane Central Register of Controlled Trials (CENTRAL) through the Ovid platform to identify studies, case reports or case series looking at patients who have received spinal anesthesia during cardiac surgery and any spinal hematoma case reports. This review is conducted according to guidelines enumerated in the Methodological Expectations of Cochrane Intervention Reviews (MECIR) and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA). With the help of international collaborators, two reviewers were utilized, and a third reviewer was used for dispute resolution. We assessed the number of cardiac surgeries conducted with spinal anesthesia and how many spinal hematomas have been documented, compared to how many cardiac surgeries were conducted with spinal anesthesia without spinal hematoma. This information was used to extrapolate the risk of spinal hematoma in cardiac surgery using both the Hanley and Lippman–Hand probability method to estimate the maximum risk, which was previously used by Ho *et al*., and weighted proportion. We reviewed American Society of Anesthesiologists (ASA) closed claims the claims in the Canadian Medical Protective Association.

**RESULTS**

We reviewed 416 full text articles, of which 286 were excluded. The remaining 130 studies were included. We found 23,782 spinal anesthetics conducted in cardiac surgery patients with zero spinal hematomas identified. This is 13,782 more cases than the previous incidence prediction. Maximum risk was determined to be 1 in 7,927 using the Hanley *et al*. approximation. This cuts the risk estimate nearly in half of what was previously predicted. We also reviewed the ASA closed claims which looked at 97 cases of spinal hematoma after spinal anesthesia. None of these cases were from cardiac surgery. There were zero cases of spinal hematoma after spinal anesthesia in cardiac surgery from the Canadian Medical Protective Association.

**DISCUSSION**

We found more than double the number of spinal's have been conducted in cardiac surgery since the initial risk evaluation conducted by Ho *et al*., with no reported incidence of spinal hematoma. This provides practitioners and patients with more confidence to include spinal anesthesia in their cardiac anesthetic plans and further study this technique. This risk is similar to other groups of patients, particularly vascular patients where spinal is used routinely. To address limitations with our study design, we approached closed claims bodies to further delineate the safety profile of spinal anesthesia in cardiac surgery.

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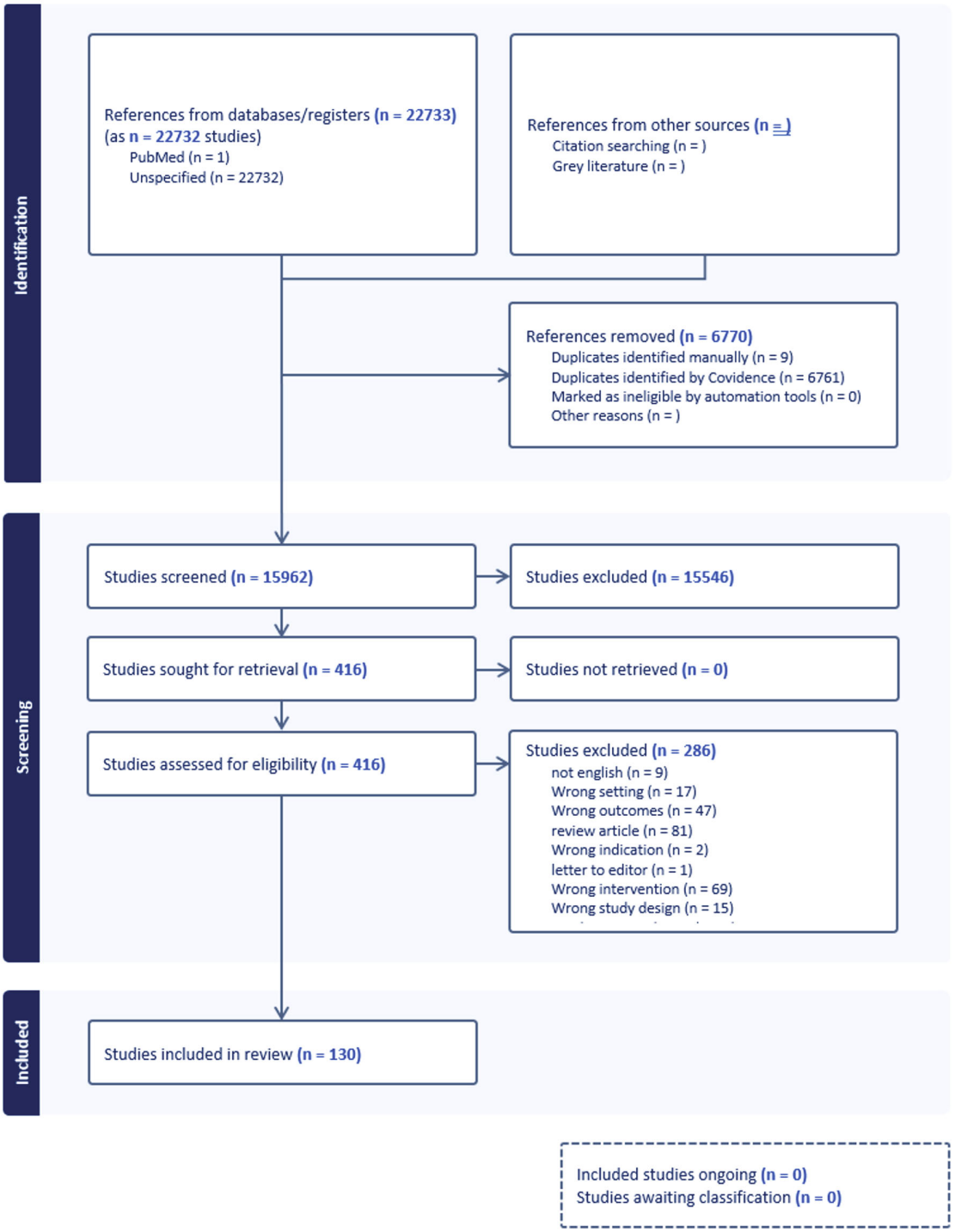
**Figure** Incidence of spinal hematoma in cardiac surgery after spinal anesthesia



# CHRONIC PAIN

## Perioperative dexamethasone and chronic postmastectomy pain: a retrospective cohort study

**Submission ID**

10

**AUTHORS**

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**INTRODUCTION**

Chronic postsurgical pain (CPSP) following breast cancer surgery is an unresolved issue, with varying manifestations such as site-specific or referred pain. The mechanisms of CPSP remain elusive. Intriguingly, recent evidence indicates that anti-inflammatory drugs may, paradoxically, exacerbate chronic pain.[1] We evaluate the incidence and severity of CPSP in breast cancer patients who perioperatively received intravenous dexamethasone for the prophylaxis of postoperative nausea and vomiting versus those who did not. While dexamethasone may alleviate acute pain, we hypothesize that it heightens CPSP's risk and severity.

**METHODS**

After obtaining research ethics board approval, we surveyed by telephone female patients who underwent complex breast surgery by two senior surgeons at a university-affiliated Canadian hospital between February 2018 to June 2023. Patients underwent diverse mastectomy procedures including modified radical, total, nipple-sparing, skin-sparing, and simple mastectomies, often combined with sentinel lymph node biopsies or axillary dissections, performed unilaterally or bilaterally. Additionally, the procedures encompassed breast reconstruction surgeries, frequently following the mastectomy. Subjects were evaluated at least three months postoperatively. Patients were queried regarding the presence of pain and, if applicable, its location (surgical site or other) and severity on a 10-point scale. Data was obtained on age, time since surgery, and dexamethasone dose.

**RESULTS**

We interviewed 269 patients. Final analysis excluded nine patients for undergoing surgeries elsewhere postinitial breast surgery, and 34 for pre-existing chronic pain diagnoses. One hundred and ninety-seven patients received dexamethasone and 72 did not. The dexamethasone group had an average age of 57.9 (SD, 14.2) yr, compared to 61.9 (SD, 15.1) yr for the nondexamethasone group. One hundred and six (52.8%) patients in the dexamethasone group had pain compared to 33 (45.8%) in the nondexamethasone group. This difference was not statistically significant. Binominal logistic regression identified no differences between the groups for total pain ($P = 0.35$), pain at the surgical site or elsewhere ($P = 0.17$; $P = 0.67$), and worst pain severity at the surgical site or elsewhere ($P = 0.15$; $P = 0.75$). Age reached statistical significance as a predictor of pain at the surgical site ($P = 0.014$). For each additional year of age, the likelihood of experiencing pain increases by 2.19%.

**DISCUSSION**

Taking into the account the limitations of this small retrospective analysis, the results of the present survey do not show a statistically significant impact of the perioperative use of dexamethasone on the incidence or severity of chronic pain after complex breast cancer surgery. A larger-scale, high-quality randomized controlled trial will be required to comprehensively assess the effects of perioperative dexamethasone on CPSP.

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# Prospective preference assessment for the psilocybin for enhanced analgesia in chronic neuropathic pain trial

## Submission ID

53

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## INTRODUCTION

Preliminary evidence suggests the potential for psilocybin, the active component of "magic mushrooms," to alleviate chronic pain.[1–3] Nevertheless, the therapeutic efficacy of psilocybin in chronic neuropathic pain remains understudied. To address this gap in evidence, we propose to conduct the Psilocybin for Enhanced Analgesia in Chronic Neuropathic PAIN (PEACE-PAIN) pilot, randomized, active-placebo controlled trial. Negative perceptions of psilocybin and challenges of participant enrollment may represent barriers to conducting the PEACE-PAIN trial.[4,5] Thus, prior to trial initiation, we conducted a prospective preference assessment (PPA) to examine patient attitudes towards the trial. In this prospective preference assessment (PPA), the objectives were to: 1) determine patients' willingness to participate in the PEACE-PAIN trial; 2) identify areas for improvement in the trial protocol to enhance patient enrollment and acceptability; and 3) explore differences in characteristics between patients who would and would not be willing to participate in the PEACE-PAIN trial.

## METHODS

Patients, aged 18 yr and older with chronic neuropathic pain (at least three months in duration), were enrolled in the PPA. The PPA consisted of four sections: 1) a brief, researcher-produced vignette describing the proposed trial; 2) an assessment of the individuals'

understanding of the trial; 3) open ended questions assessing attitudes towards the trial (i.e., factors that motivate and discourage participation); and 4) patient completed questionnaires. Content analysis was used to inductively and deductively identify factors that would motivate or discourage participation in the proposed trial. Demographics, clinical characteristics, and perceptions of psilocybin were collected to explore differences in characteristics between patients who were willing and unwilling to participate.

**RESULTS**

A total of 26 patients (mean age, 56.6 [SD, 16.7] yr; 61.5% female] were included in the study. Survey results showed that most participants (76.9%) were willing to participate in the PEACE-PAIN trial. “Willing” participants reported higher prior psychedelic use (75%) as compared to the “maybe willing” (0%) and “not willing” participants (0%). Interviews indicated that the top two factors that motivated participation included the need for new treatment options (31.7%) and benefits to personal pain management (31.7%). The top two discouraging factors included practical difficulties of research participation (16.7%) and adverse events associated with psilocybin (16.7%).

**DISCUSSION**

The study design of the PEACE-PAIN trial is supported by patient survey responses but may benefit from potential modifications, namely incorporating thorough discussions of the current evidence for efficacy, safety, tolerability, and approaches to address adverse effects of psilocybin. Additionally, the study findings, particularly the interest in participation by individuals with prior psychedelic use, may have implications beyond the PEACE-PAIN trial, as it can be used to inform other psilocybin trials.

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# Ultrasound X fluoroscopic guidance for needle placement during spinal injections for pain management: a systemic review and meta-analysis

**Submission ID**

64

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**INTRODUCTION**

Neck and low back pain are among the most prevalent health conditions, associated with disability-adjusted life years (DALY's). Steroids and analgesics spinal injections are considered the main approaches to ease this chronic pain. Fluoroscopy is a widely used method for fast and effective needle spinal placement. Ultrasound (US) has been proposed as a less expensive and less radioactive alternative for this procedure. Nevertheless, it remains uncertain whether ultrasound-guided spinal injections provide sufficient pain reduction, disability improvement, or a preferable side effect profile compared to fluoroscopy guidance. Thus, we conducted a systematic review and meta-analysis to compare both strategies when applied to the nonpediatric population.

**METHODS**

PubMed, EMBASE, and Cochrane databases were queried for randomized controlled trials (RCTs) and observational studies comparing spinal steroids or anesthetic injections under US *vs* fluoroscopy guidance. Two different authors selected the articles based on previously established inclusion and exclusion criteria, and any disagreement was solved by a third author. The data was independently collected by two parties, and any differences were confirmed with proofreading of the selected papers. The outcomes assessed included pain scores after one and three months of the procedure, using the visual analog scale (VAS). The level of disability was analyzed via the Oswestry Disability Index (ODI) after one and three months. Overall side effects and procedure duration were also analyzed. Statistical analyses were performed using the R Studio software (version 2023.06.0+421) using the random effects model.

**RESULTS**

Nineteen studies were included, comprising 12 RCTs and 2,057 patients, of whom 48.76% were in the US group. There were no statistically significant differences among pain scores at one and three months (mean difference [MD], −0.03; 95% confidence interval [CI], −0.18, 0.13; *P* = 0.10; *n* = 1,543, and MD, 0.02; 95% CI, −0.08, 0.12; *P* = 0.95; *n* = 1,847, respectively). ODI at one and three months (MD, 0.40; 95% CI, −0.41, 1.21; *P* = 0.23; *n* = 1,086, and MD, 0.21; 95% CI, −0.30, 0.72]; *P* = 0.68; *n* = 1,206, respectively), overall side effects (odds ratio, 0.94; 95% CI, 0.68, 1.32; *P* = 0.91; *n* = 1,433), and procedure duration (MD, -1.65; 95% CI, −3.66, 0.36; *P* = 0.01; *n* = 792) also showed no statistically significant differences between groups.

**DISCUSSION**

Our findings suggest no differences between the use of US or fluoroscopy for spinal injections in the nonpediatric population in terms of efficacy and safety. Radiation is a known mutagenic source, possibly leading to cancer and other diseases. Moreover, the cost and health care burden should be considered when choosing a treatment option to deliver care. US is both more competitively priced and nonradioactive in comparison to fluoroscopy. Therefore, US guidance seems a feasible, less harmful, and adequate choice for needle placement during spinal injections.

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# CRITICAL CARE MEDICINE

## Trends in tracheostomy use among critically-ill adult patients receiving anticipated prolonged invasive mechanical ventilation: a retrospective cohort study in a Canadian provincial regional catchment area from 2013 to 2019

**Submission ID**

122

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**INTRODUCTION**

Tracheostomy is commonly performed in critically-ill patients receiving anticipated prolonged invasive mechanical ventilation (IMV). Suggested benefits of IMV via a tracheostomy include decreased sedation requirements, improved pulmonary toilet, and accelerated ventilator weaning. Nevertheless, tracheostomy use among mechanically-ventilated patients may also be associated with poorer outcomes, including increased intensive care unit (ICU), in-hospital, and 28-day mortality, and impaired functionality among long-term ICU survivors. Clinicians must appropriately identify suitable candidates who may benefit from this procedure while considering risk factor profiles, prognosis, and patient goals of care. The overall objective of this study is to examine trends in tracheostomy use, timing, and outcomes for anticipated prolonged IMV, and to determine baseline patient and ICU admission characteristics associated with tracheostomy receipt compared with ongoing translaryngeal intubation (TLI). The results of this descriptive epidemiological analysis may help inform clinicians, patients, and their families to assist in their decision-making process regarding management strategies in this critically-ill population.

**METHODS**

This retrospective cohort study examines critically-ill adults (≥ 18 yr) requiring admission to a level-3 ICU in the regional catchment area of a Canadian provincial health authority between

1 January 2013 and 31 December 2019 (inclusive) with respiratory failure (RF) requiring IMV for at least three consecutive days. Clinical and health administrative data, obtained from a prospectively-maintained centralized regional critical care database, include sociodemographic characteristics, APACHE II severity of illness scores, lengths of stay (LOS), ICU organ support and related procedures, and ICU mortality. The primary outcome is ICU mortality, with ventilator-free days (VFDs), IMV duration, ventilator-associated pneumonia (VAP), and ICU LOS as secondary outcomes. Age- and sex-standardized use rates per 1,000 ventilated adult residents were determined as: 1) cumulative incidence rates of *de novo* tracheostomy insertion among adult hospitalized patients receiving IMV to estimate overall population burden; and 2) average (age-adjusted) annual percent change (AAPC) in the incidence rate of tracheostomy. Generalized linear models were used to examine trends in patient and hospital characteristics associated with tracheostomy receipt, timing, and use over the study period.

**RESULTS**

Between 1 January 2013 to 31 December 2019, there were 7,455 eligible IMV episodes among 7,192 adults admitted to a level-3 ICU in the Canadian province under study, of whom 439 underwent tracheostomy whereas 6,753 received ongoing TLI during their first qualifying (index) IMV episode. The AAPC in the tracheostomy incidence rate was −3.2% (95% confidence interval [CI], −12.0 to 7.3) overall, and −4.5 (−11.6 to 4.2) and 0.2 (−22.8 to 29.8) among males and females, respectively. The modeled age-adjusted rate per 1,000 ventilated patients decreased from 78.5 in 2013 to 64.4 in 2019, although this decrease was not statistically significant. Regarding trends among APACHE II principal admission diagnosis category groups, the AAPC was −1.9 (−26.5 to 49.0), −3.9 (−10.2 to 2.4), 11.2 (−3.9 to 26.5), and −14.8 (−31.7 to 6.7) for cardiovascular, neurologic, respiratory, and other conditions, respectively (see Table 1 for additional results).

**DISCUSSION**

This study provides potentially informative population-level data on trends in tracheostomy use, associated characteristics, and patient outcomes from a large province-wide, Canadian perspective with robust data sources. These results will be useful in apprising health care providers of variables potentially associated with post-tracheostomy outcomes in prolonged IMV settings to facilitate the development and adoption of more patient-centered management strategies. Canada's aging population will increasingly challenge our health care systems, and informing patients and their families of anticipated outcomes following tracheostomy in a diverse critically-ill patient population may aid with appropriate decision-making and resource use.

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**Table 1** Tracheostomy use, patient characteristics, and outcomes among adults receiving invasive mechanical ventilation in a Canadian provincial regional catchment area, 2013–2019, overall and by year

| Characteristic | | 2013 (N=1071) | 2014 (N=1003) | 2015 (N=1012) | 2016 (N=951) | 2017 (N=1034) | 2018 (N=1032) | 2019 (N=1089) | Total (N=7192) | P-Value |
|---|---|---|---|---|---|---|---|---|---|---|
| Tracheostomy receipt, N (%) | | 61 (5.7%) | 46 (4.6%) | 54 (5.3%) | 80 (8.4%) | 61 (5.9%) | 71 (6.9%) | 66 (6.1%) | 439 (6.1%) | 0.017 |
| Tracheostomy timing (days), median (IQR) | | 15 (11, 19) | 20 (14, 26) | 15.5 (11, 22) | 16 (10, 22) | 15 (12, 20) | 16 (11, 23) | 18.5 (14, 23) | 16 (11, 22) | 0.038 |
| Age group (years), N (%) | Age 18-59 | 436 (40.7%) | 457 (45.6%) | 430 (42.5%) | 426 (44.8%) | 452 (43.7%) | 418 (40.5%) | 462 (42.4%) | 3081 (42.8%) | 0.019 |
| | Age 60-79 | 496 (46.3%) | 453 (45.2%) | 471 (46.5%) | 451 (47.4%) | 484 (46.8%) | 510 (49.4%) | 525 (48.2%) | 3390 (47.1%) | |
| | Age 80+ | 139 (13.0%) | 93 (9.3%) | 111 (11.0%) | 74 (7.8%) | 98 (9.5%) | 104 (10.1%) | 102 (9.4%) | 721 (10.0%) | |
| Age (years), median (IQR) | | 64 (51, 73) | 61 (50, 72) | 63 (51, 73) | 62 (48, 71) | 63 (49, 72) | 63 (52, 72) | 62 (50, 71) | 63 (50, 72) | 0.02 |
| Female sex, N (%) | | 429 (40.1%) | 415 (41.4%) | 412 (40.7%) | 393 (41.3%) | 435 (42.1%) | 412 (39.9%) | 443 (40.7%) | 2939 (40.9%) | 0.959 |
| Hospital type, N (%) | Community | 316 (29.5%) | 278 (27.7%) | 291 (28.8%) | 291 (30.6%) | 284 (27.5%) | 250 (24.2%) | 200 (18.4%) | 1910 (26.6%) | <.001 |
| | Tertiary | 755 (70.5%) | 725 (72.3%) | 721 (71.2%) | 660 (69.4%) | 750 (72.5%) | 782 (75.8%) | 889 (81.6%) | 5282 (73.4%) | |
| ICU type, N (%) | Coronary care | 117 (10.9%) | 95 (9.5%) | 76 (7.5%) | 90 (9.5%) | 115 (11.1%) | 137 (13.3%) | 153 (14.0%) | 783 (10.9%) | <.001 |
| | Medical | 241 (22.5%) | 249 (24.8%) | 237 (23.4%) | 208 (21.9%) | 228 (22.1%) | 240 (23.3%) | 281 (25.8%) | 1684 (23.4%) | |
| | Medical-surgical | 510 (47.6%) | 467 (46.6%) | 490 (48.4%) | 456 (47.9%) | 462 (44.7%) | 452 (43.8%) | 437 (40.1%) | 3274 (45.5%) | |
| | Surgical | 203 (19.0%) | 192 (19.1%) | 209 (20.7%) | 197 (20.7%) | 229 (22.1%) | 203 (19.7%) | 218 (20.0%) | 1451 (20.2%) | |
| Admission source, N (%) | ER/UC | 529 (49.4%) | 511 (50.9%) | 495 (48.9%) | 509 (53.5%) | 505 (48.8%) | 542 (52.5%) | 524 (48.1%) | 3615 (50.3%) | <.001 |
| | ICU | 20 (1.9%) | 33 (3.3%) | 29 (2.9%) | 23 (2.4%) | 34 (3.3%) | 15 (1.5%) | 15 (1.4%) | 169 (2.3%) | |
| | OR/RR | 212 (19.8%) | 181 (18.0%) | 183 (18.1%) | 174 (18.3%) | 216 (20.9%) | 208 (20.2%) | 244 (22.4%) | 1418 (19.7%) | |
| | Ward | 301 (28.1%) | 270 (26.9%) | 289 (28.6%) | 241 (25.3%) | 278 (26.9%) | 266 (25.8%) | 304 (27.9%) | 1949 (27.1%) | |
| | Other | 9 (0.8%) | 8 (0.8%) | 16 (1.6%) | 4 (0.4%) | 1 (0.1%) | 1 (0.1%) | 2 (0.2%) | 41 (0.6%) | |
| APACHE II total score, median (IQR) | | 21 (17, 27) | 21 (17, 27) | 23 (17, 28) | 21 (17, 27) | 22 (18, 28) | 23 (18, 29) | 23 (18, 29) | 22 (17, 28) | — |
| Admission type (for APACHE II), N (%) | Medical | 836 (78.1%) | 804 (80.2%) | 791 (78.2%) | 725 (76.2%) | 757 (73.2%) | 793 (76.8%) | 840 (77.1%) | 5546 (77.1%) | <.001 |
| | Elective surgery | 124 (11.6%) | 87 (8.7%) | 80 (7.9%) | 70 (7.4%) | 62 (6.0%) | 91 (8.8%) | 89 (8.2%) | 603 (8.4%) | |
| | Emergency surgery | 111 (10.4%) | 112 (11.2%) | 141 (13.9%) | 156 (16.4%) | 215 (20.8%) | 148 (14.3%) | 160 (14.7%) | 1043 (14.5%) | |
| Admission type (for APACHE II) = Surgical, N (%) | | 235 (21.9%) | 199 (19.8%) | 221 (21.8%) | 226 (23.8%) | 277 (26.8%) | 239 (23.2%) | 249 (22.9%) | 1646 (22.9%) | 0.015 |
| Admission type (for APACHE II) = Surgical Emergency, N (%) | | 111 (10.4%) | 112 (11.2%) | 141 (13.9%) | 156 (16.4%) | 215 (20.8%) | 148 (14.3%) | 160 (14.7%) | 1043 (14.5%) | <.001 |
| Principal admission diagnosis category group, N (%) | Cardiovascular | 545 (50.9%) | 493 (49.2%) | 544 (53.8%) | 526 (55.3%) | 619 (59.9%) | 621 (60.2%) | 623 (57.2%) | 3971 (55.2%) | <.001 |
| | Neurologic | 101 (9.4%) | 131 (13.1%) | 126 (12.5%) | 106 (11.1%) | 142 (13.7%) | 121 (11.7%) | 135 (12.4%) | 862 (12.0%) | |
| | Respiratory | 295 (27.5%) | 276 (27.5%) | 224 (22.1%) | 217 (22.8%) | 164 (15.9%) | 191 (18.5%) | 241 (22.1%) | 1608 (22.4%) | |
| | Other | 130 (12.1%) | 103 (10.3%) | 118 (11.7%) | 102 (10.7%) | 109 (10.5%) | 99 (9.6%) | 90 (8.3%) | 751 (10.4%) | |
| APACHE II predicted risk of (in-hospital) mortality (%), median (IQR) | | 41 (19, 61) | 41 (20, 60) | 44 (21, 66) | 41 (20, 63) | 46 (24, 66) | 48 (27, 70) | 51 (28, 73) | 45 (23, 66) | <.001 |
| Charlson Comorbidity Index score, median (IQR) | | 2 (1, 4) | 2 (1, 4) | 2 (1, 4) | 2 (1, 4) | 2 (1, 4) | 2 (1, 4) | 2 (1, 4) | 2 (1, 4) | — |
| ICU LOS (days), median (IQR) | | 8 (5, 13) | 8 (5, 13) | 8 (5, 13) | 8 (5, 14) | 7 (4, 13) | 8 (4, 14) | 7 (4, 13) | 8 (4, 13) | 0.045 |
| IMV duration (days), median (IQR) | | 6 (4, 10) | 6 (4, 10) | 6 (4, 10) | 6 (4, 11) | 6 (4, 10) | 6 (4, 11) | 6 (4, 11) | 6 (4, 10) | 0.002 |
| ICU mortality (overall), N (%) | | 224 (20.9%) | 207 (20.6%) | 220 (21.7%) | 135 (14.2%) | 241 (23.3%) | 257 (24.9%) | 271 (24.9%) | 1555 (21.6%) | <.001 |
| ICU mortality (28-day), N (%) | | 253 (23.6%) | 216 (21.5%) | 230 (22.7%) | 140 (14.7%) | 245 (23.7%) | 268 (26.0%) | 294 (27.0%) | 1646 (22.9%) | <.001 |
| Ventilator-free days (VFD) to day 28, median (IQR) | | 20 (0, 23) | 20 (2, 23) | 20 (0, 23) | 19 (9, 23) | 19 (0, 23) | 18 (0, 23) | 18 (0, 23) | 19 (0, 23) | — |
| Ventilator-associated pneumonia (VAP), N (%) | | 45 (4.2%) | 43 (4.3%) | 38 (3.8%) | 45 (4.7%) | 52 (5.0%) | 55 (5.3%) | 68 (6.2%) | 346 (4.8%) | 0.145 |

APACHE II, Acute Physiology and Chronic Health Evaluation II; ER, emergency room; ICU, intensive care unit; IMV, invasive mechanical ventilation; LOS, length of stay; OR, operating room; RR, recovery room; TLI, translaryngeal intubation; UC, urgent care; VAP, ventilator-acquired pneumonia; VFD, ventilator-free days.

# ECONOMICS

## Initiation of a prehabilitation program at a tertiary care centre: an economic analysis

**Submission ID**

85

**AUTHORS**

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**INTRODUCTION**

The average age and comorbidity burden of our surgical population is increasing. Older, more comorbid, patients are at increased risk of postoperative complications. These complications are significant causes of morbidity and mortality.[1] Postoperative complications also increase length of stay and need for additional treatment, thereby increasing the cost of perioperative care.

Prehabilitation is a multimodal intervention to optimize patients prior to surgery. Prehabilitation aims to reduce the incidence and severity of postoperative complications, particularly in high-risk surgical populations. Prehabilitation is therefore expected to result in postoperative cost savings.

Our aim was to assess the cost impact of our prehabilitation programme on two high volume, high risk surgical populations at a large tertiary academic hospital: patients undergoing major gynae-oncological procedures and patients undergoing radical cystectomy. Prehabilitation domains that were focused on during this period were anemia, smoking cessation, glycemic control, sleep apnea and cardiac risk stratification.

**METHODS**

Six months of data were extracted from existing NSQIP data for the control group (December 2017–May 2018) and from existing REDcap data for the prehabilitation group (December 2019–May 2020). Major gynae-oncology was defined as open hysterectomy with or without BSO, lymph node dissection or omentectomy. Radical cystectomy was defined as open cystectomy.

Baseline demographics recorded included age, body mass index, American Society of Anesthesiologists Physical Status class, smoking status, diabetes mellitus (yes/no) and anemia (yes/no).

National Surgical Quality Improvement Program (NSQIP) outcome data were extracted. Where readmission or reoperation occurred, review was undertaken to establish the reason for readmission and the nature of re-operation.

The NSQIP complications were tallied and converted into percent incidence. The cost per patient was calculated based on percent incidence and cost per complication. Costs were taken from the Canadian Institute for Health Information calculator.

For reoperations and readmissions an average of the costs associated with each re-operation or readmission respectively was calculated. This was then converted to a per patient cost, as described above.

The cost per patient for each of the outcomes were summed and the total costs per patient between control and prehabilitation groups compared.

Costs for implementation of the programme were taken from an assessment performed as part of a provincial collaborative.

**RESULTS**

*Gynae-oncology*

There were 112 patients in the control group (C) *vs* 42 patients in the prehabilitation group (P). Median age was 61 yr (C) *vs* 62.5 yr (P). Other baseline characteristics were equivalent.
The cost saving generated by prehabilitation was $814/ patient, driven by a reduced readmission rate.

*Radical cystectomy*

There were 42 patients in the control group and 21 patients in the prehabilitation group. Median age was 71 yr (C) *vs* 67 yr (P). Other than age, baseline characteristics were equivalent.
The cost saving generated by prehabilitation was $5,097/ patient, driven by reductions in surgical site infections and reoperations.

A provincial collaborative with 11 other hospitals assessed the costs of prehabilitation at $54–$1,789 per patient. We estimate our costs to be at the lower end of this range; our centre had high patient numbers, no new services were created, and no additional staffing costs were incurred.

**DISCUSSION**

Our centre demonstrated net cost savings from prehabilitation for radical cystectomy and major gynae-oncology procedures, after accounting for implementation costs.

Strengths of this study are that we are a high-volume centre (90% of provincial caseload for both procedures), and baseline demographics were similar in control and prehabilitation groups. Because of the single-centre nature of the study data, it is more likely that the savings seen are attributable to the prehabilitation intervention.

Small sample size in the prehabilitation groups reflected the difficulty of screening the patients and initiating prehabilitation a minimum of three weeks prior to their date for surgery.

**REFERENCES**

No references.

# Where's my laryngeal mask airway?

**Submission ID**

96

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**INTRODUCTION**

Laryngeal mask airways (LMAs) are medical airway devices used in the provision of anesthesia but also as rescue devices in emergencies. Our hospital uses reusable LMAs to reduce excess waste and minimize environmental impact. Recurrent shortages of LMAs, despite being reusable, led to surgical delays as staff searched for LMAs and almost $10,000 in annual costs to the surgical program to replace missing LMAs. Our project sought to understand the causes for the missing LMAs and develop a process to reduce shrinkage which would help reduce costs for the hospital and surgical program.

**METHODS**

A process map was made with the key stakeholders. This included staff from: Department of Anesthesia (DOA) (users), nursing (collecting used LMAs), housekeeping (transporting used equipment for reprocessing), Medical Device Reoricessing Department (MDRD) (reprocessing devices and restocking supply) and hospital administration (ordering). Potential causes were identified that included: an inconvenient storage location for LMAs that promoted hoarding and inconsistent practices by DOA members for used LMA's. These practices included wrapping used LMAs in sterile towels (MDRD's workflow was to place towels in the linen cart and nonlinen material was thrown out) and placing used LMAs in plastic bags (the cleaning staff believed the bags were garbage). Ultimately, the root cause was determined to be the product design of the LMAs themselves. Despite being a reusable product, the plastic LMAs looked disposable. New anesthesia staff and trainees would often dispose of LMAs after use. Meetings were then held with each stakeholder department to disseminate findings and problem solve solutions.

## RESULTS

Our plan-do-study-act cycle began with stakeholder meetings in January 2021. The new process, developed from these meetings, was introduced to the various stakeholders again in meetings (early March 2021) and launched in late March 2021. Monthly meetings were had with the leads of each stakeholder group to obtain feedback and assess the effectiveness of the process. Monthly stock counts of LMA's were initiated in the OR. After eight months zero LMAs had gone missing. Compared with the annual re-orders of LMAs we saw a significant reduction in the number of LMAs that needed to be repurchased.

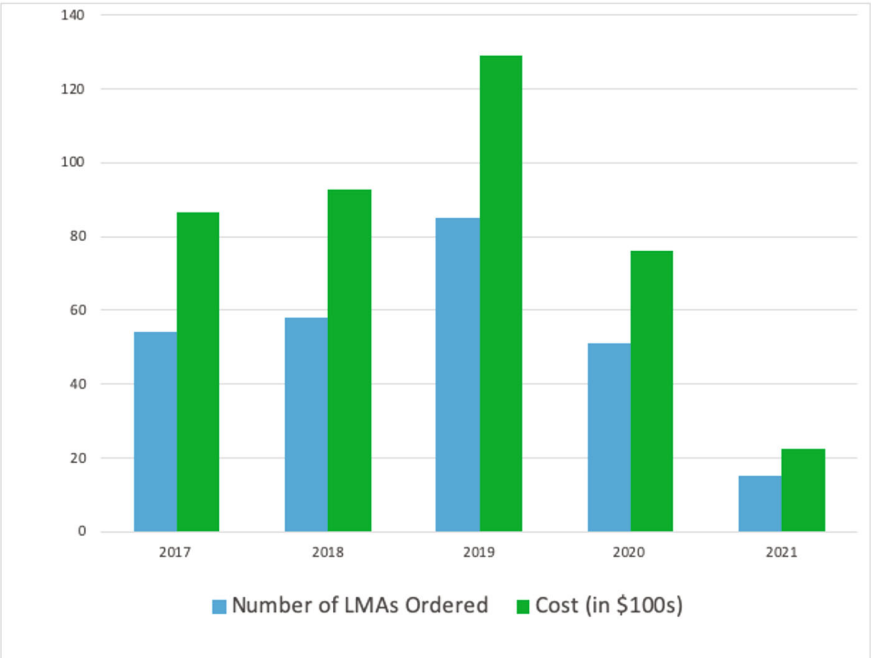
## DISCUSSION

Previous efforts to improve this issue had focused on educating stakeholders that LMAs were not disposable. These efforts failed to appreciate the viewpoints and workflows of the various stakeholders. At a cost of $250 for each LMA this new process will result in significant cost savings for the hospital, around $10,000 annually. Some factors to quality improvement may seem out of your control (a product design that made a reusable product appear disposable) yet these factors can be mitigated through a collaborative process and creative thinking around process flow (placing LMAs in obviously nondisposable trays).

## REFERENCES

No references.

**Table** Annual LMA re-orders and cost from 2016–2021



# EDUCATION AND SIMULATION IN ANESTHESIA

## "Speaking up" for patient safety in an emergency: the effect of cultural diversity

**Submission ID**

6

**AUTHORS**

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**INTRODUCTION**

Communication problems can have a profound negative effect on crisis management. Effective communication during acute situations when different levels of authority exist within the team may be challenging. Authority gradients are most accentuated between attending physicians and residents and can pose a threat to patient safety.

The aim of the current study was therefore to examine the effect of national culture on speaking up and challenging authority behavior by comparing residents from Canada and Israel. These are two very different cultures where the communication dynamic tends to be much more reserved in North America *vs* direct and even aggressive in Israel. Our main objective was to examine the potential impact of factors that affect speaking up behavior in both cultures, which may help improve resident training and promote changes in organizational and professional culture to encourage "speaking up."

**METHODS**

Anesthesia residents from both countries participated in a simulated crisis that presented them with situational opportunities to challenge a staff regarding clearly wrong clinical decisions in a life-threatening scenario. During the simulation, a routine induction turns into a 'can't intubate can't ventilate' scenario. During the scenario the learner has five distinct challenge opportunities to speak up and change the staff anesthesiologist's management. The learner is expected to offer to change patient management. These are all well within the resident's

fundamental expected knowledge base, thereby ensuring the scenario does not test the resident's knowledge but rather their communication skills and their ability to challenge wrong decisions by a superior.

Deliberate deception was used to preserve the "natural" hierarchy gradient. The primary outcome was the best-responses challenge attempt on the previously validated modified Advocacy-Inquiry scale (mAIS) between groups. The secondary outcomes were: 1) the number of challenge attempts 2) Ottawa Global Rating Scale scores (GRS).

Scenarios were videotaped and scored on the mAIS by two independent raters.

**RESULTS**

Forty-four residents completed the study (22 in each group). For the primary outcome, the median [IQR range] for maximum mAIS was 3.0 [2.5–3.1 (0.0–5.5)] for the Israel group and 3.0 [3.0–4.0 (0.0-5.0)] for the Canada group (95% confidence interval, −0.76 to 0.31; *P* = 0.34). There was no statistically significant difference between the groups in the max mAIS, the cumulative number of challenges made nor the total GRS score.

**DISCUSSION**

In the current study we did not find a difference between groups for the primary outcome measure of mAIS, or the secondary outcomes of the GRS score and number of challenge attempts. Our data does not support the hypothesis that the different cultural backgrounds of Israeli and Canadian anesthesiology residents affect speaking up in a crisis situation.

It may hint at the profound effect of the deeply engrained hierarchy in medicine and the need to address it professionally to foster a culture in which trainees feel safe to speak up for patient safety.

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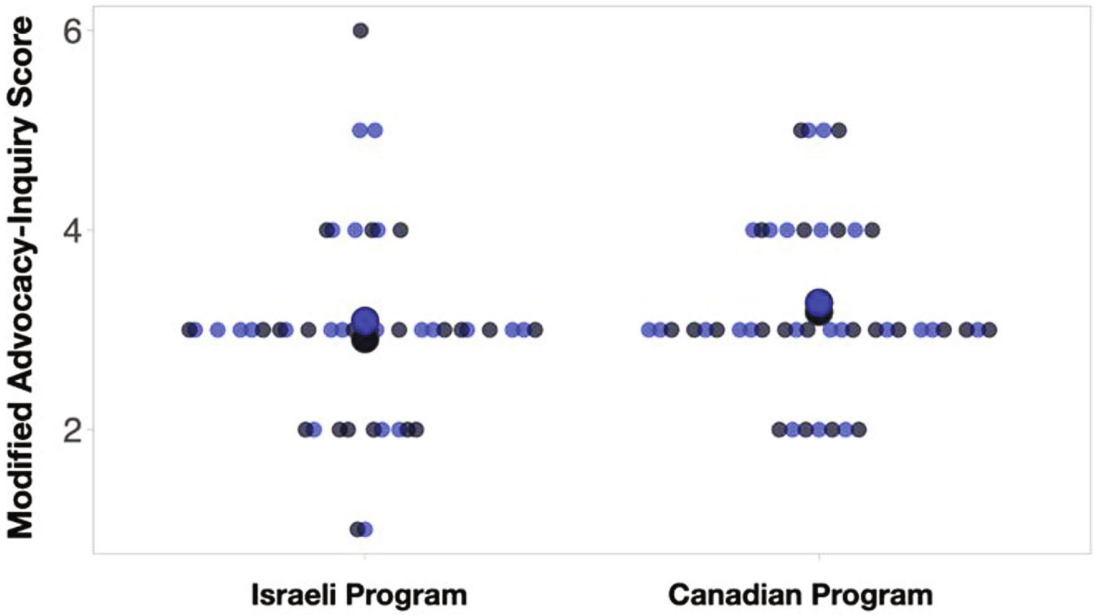
**Figure** Best modified advocacy-inquiry score for all participants over the five different opportunities to challenge in the scenario for the two groups




The smaller dots represent individual data points, with light and darker dots representing the two raters. The larger circles represent the median scores as rated by the two raters (again in light and darker blue).

# Developing a simulation-based anesthesia and crisis management education program for pediatric diagnostic imaging nurses assisting anesthesiologists

**Submission ID**

95

**AUTHORS**

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**INTRODUCTION**

The 2023 Guidelines to the Practice of Anesthesia[1] state that health care facilities 'must ensure that ancillary personnel are available' and that they 'should have the competencies to meet the specific needs of subspecialty areas of anesthesia.' It is therefore our responsibility as anesthesiologists to lead this multidisciplinary training. At our tertiary level pediatric facility, ancillary staff assisting anesthesia come from a wide range of services, including many remote from the operating room. Diagnostic imaging is one such department. The usual technique in this department uses titrated intravenous anesthesia while maintaining spontaneous ventilation and requires little airway manipulation. Nevertheless, the diagnostic imaging nursing team revealed they had developed significant anxiety assisting in alternative techniques including several fundamental areas relating to airway manipulation and perianesthesia crisis management.

**METHODS**

A needs assessment was conducted using a computerized survey of the diagnostic imaging nurses, which they all completed. This identified the specific areas of concern which included basic airway management, assistance of intubation and management of laryngospasm. It also addressed the preferred education delivery methods and potential impediments to attendance. One-hour sessions were planned, each with four or five participants, and were provided *in situ* to facilitate maximal attendance. A pilot session covering basic and advanced airway management using simulated obstruction and hypoventilation introduced simulation-based learning and provided a common basic skillset to the participants. A lesson plan, using Gagne's events of instruction,[2] simulation activity running sheet and handout was then created for the session. Debriefing of the simulation component was conducted using the Promoting Excellence and Reflective Learning in Simulation (PEARLS) framework.[3] The participants were asked to

complete written evaluations immediately prior and after the session. This used Likert scales for ease of response and free text comments to evaluate the session and inform further session development of the program. Paired pre- and postsession Likert scale data was evaluated for significance using *t* tests.

**RESULTS**

A total of 11 learners attended one-hour sessions, which took place *in situ* in the diagnostic imaging department after completion of patient care activities. Nine (81%) completed the pre- and postsession evaluations. Overall, there was an increase in the Likert scale rating for all the self-evaluated knowledge and skill domains. The mean difference in confidence in assisting intubation was 0.89 ($P = 0.026$) and for accessing anesthesia equipment and drugs this was 0.67 ($P = 0.025$). For confidence in recognizing features of a difficult airway the mean difference was 1.22 ($P = 0.00002$). Following the session, 100% of the learners completing evaluations agreed or strongly agreed that the learning environment was safe and positive, and that they were engaged and satisfied with the session. The written comments detailed desired topics for future sessions.

**DISCUSSION**

We have shown it is feasible to run *in situ* simulation sessions where learners were unanimously satisfied with the sessions and showed improved self-evaluated knowledge and skills. As hypothesized, running *in situ* sessions facilitated attendance but also revealed latent environmental risks that needed addressing, for example, the way the anesthesia carts are organized. The program also fosters multidisciplinary working and camaraderie amongst the staff involved. Further sessions are underway where we will also evaluate effectiveness with objective knowledge questionnaires in addition to self-evaluation of confidence. Furthermore, other nonoperating room ancillary teams have expressed interest in similar training.

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# Effectiveness of extended reality-based simulation training in ultrasound-guided regional anesthesia: a systematic review

## Submission ID

102

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## INTRODUCTION

Ultrasound-guided regional anesthesia (UGRA) has replaced landmark-based approaches to performing nerve blocks; however, UGRA is a complex skill requiring knowledge of sonoanatomy, dexterity, and safe needling techniques.[1] Simulation-based procedural training may be an ideal tool to supplement gaps in clinical exposure because it allows for deliberate psychomotor practice in a controlled environment while avoiding any patient risk. A recent systematic review found that simulation-based UGRA training is effective in improving knowledge, skills, and patient outcomes.[2] Nevertheless, multiple different modalities were used including gel phantoms, animal models, and cadavers; each presenting with unique advantages and disadvantages. Extended reality presents a novel modality for learning these skills, with the potential for improved accessibility, versatility, portability, and cost-effectiveness.[3] We conducted a systematic review to evaluate the effectiveness of extended reality technology in UGRA training. This will inform and optimize future UGRA educational training programs and research endeavours.

## METHODS

The systematic review was performed following A Measurement Tool to Assess Systematic Reviews 2 (AMSTAR 2) and reported in adherence to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines.[4,5] The protocol was prospectively registered. Studies identified in MEDLINE, EMBASE, Cochrane Library, and Scopus were included if they assessed extended reality in UGRA training, including alternate reality (AR), virtual reality (VR), and mixed reality (MR). AR overlays a digital interface on existing surroundings, VR presents a computer-rendered three-dimensional environment or model, and MR is a continuum between digital and physical elements. We included studies in

both clinical and nonclinical settings evaluating all health care providers on four learning outcomes, according to a modified Kirkpatrick/Phillips model: Level 2, knowledge and skills; Level 3, transfer of learnt behaviors; Level 4, patient outcomes; and, Level 5, cost-benefit. A literature search was conduced by an experienced librarian. The screening template was pilot-tested prior to extraction. After extracting all the articles, two authors independently screened all the titles and abstracts, completed a full-text review, and extracted relevant data. A third author resolved discrepancies during screening/review. Two authors also independently assessed each of the final studies for quality and risk of bias.

**RESULTS**

We screened 694 citations and 57 full texts and included six studies in our review. Three studies used immersive augmented reality (AR), one study used nonimmersive VR, and one study used immersive VR. One study showed that interactive virtual simulation improved knowledge acquisition (Kirkpatrick 2). All six studies had an outcome regarding skill acquisition (Kirkpatrick 2); four of these found that extended reality simulation can shorten procedure time, and improve certain aspects of UGRA performance (e.g., needle visibility), though two showed no significant differences in skill acquisition. Two studies examined behaviors (Kirkpatrick 3); one showed potentially improved ergonomics with a head-mounted display, however the other was terminated prematurely because of technical issues. None of the studies included outcomes related to Kirkpatrick level 4 or 5. Three of the studies had a significant risk of bias, because of poor randomization, group crossover, low recruitment, and confounding variables.

**DISCUSSION**

Extended reality training can improve knowledge, skills and behaviors associated with performing UGRA. AR displays improved ergonomics, and shortened procedure times; however, three studies used head-mounted US displays, not “true” AR. Immersive VR trainers provided comparable or improved knowledge and skill acquisition and trainee satisfaction; however, no completed studies directly compared VR with traditional simulation. Though extended reality training shows promise, there is currently little high-quality evidence in this rapidly expanding field. Consensus on definitions of “extended reality” should be reached, and further studies are necessary to evaluate the effectiveness of extended reality-based UGRA simulation.

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# Global health education in Canadian anesthesia residency programs: a survey of opportunities and attitudes

**Submission ID**

117

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## INTRODUCTION

Understanding global health (GH) priorities is imperative to a physician's ability to address health disparities and provide equitable care for all populations. In the field of anesthesia, GH competencies are invaluable as 28% of the global disease burden comes from surgical conditions, and consequently, anesthesia and postoperative care.[1] The changing demographics of Canada, secondary to the influx of immigrant and refugee populations, has further necessitated the need for structured GH education during residency.[2] Currently, there is a paucity of literature on the extent of GH education in Canadian residency programs. The purpose of our survey was to: 1) assess the extent of GH opportunities in Canadian anesthesia residency programs, 2) assess the attitudes of anesthesia program directors (PDs) and residents toward GH training, and 3) identify barriers to participation in GH training within Canadian anesthesia residency programs.

## METHODS

An online cross-sectional survey was conducted following the Phillips *et al*.[3] design. The survey was reviewed by an expert panel and subsequently, a 16-question pilot survey was conducted. The pilot survey indicated a Cronbach's alpha reliability of 0.610. The deviation below the accepted minimum threshold of 0.7 was justified by the limited sample size of 13 participants. After the pilot survey, study data was collected via two distinct surveys sent to Canadian anesthesia (PDs) and residents. The surveys used a combination of open-ended, closed-ended, and 5-point Likert scale questions. The PD survey consisted of 32 questions and was distributed via email, between September to October 2023. The resident survey consisted of 25 questions and was distributed via the Canadian Anesthesiologists' Society mailing platform, between October to November 2023. Both groups were sent two reminder emails, each at two-week intervals. Survey response rate (RR) was calculated and adjusted using the American

Association for Public Opinion Research response rate definitions.[3] The nonresponse bias (NRB) was calculated using the proxy nonrespondent model.[3] Survey responses were analyzed using descriptive statistics analysis. Inferential statistics analysis (Fisher's exact test) was used to compare the responses of PDs and residents.

**RESULTS**

We received 76 completed surveys—65 from residents and 11 from PDs. Our overall RR was 12%, PD RR was 70%, and resident RR was 10%. The calculated NRB was found unlikely to have practical significance. The internal consistency, for all parts of the survey, was considered acceptable as measured by Cronbach's alpha (0.66 to 0.93). Eighty-two percent of PDs agreed that it is important for anesthesia residents to understand the global shortage in anesthesia and that Indigenous health-focused experiences should be strongly encouraged. Eleven percent of PDs identified their programs as having a GH curriculum or budget. Sixty-six percent of residents agreed that training in resource-constrained communities should be strongly encouraged. Eighty-one percent of residents were interested in GH initiatives and only 41% felt they could easily arrange such experiences. The only statistically significant difference between PDs' and residents' answers was perceptions of financial barriers to engaging in GH experiences ($P = 0.04$).

**DISCUSSION**

The survey revealed a consensus among anesthesia PDs and residents around the importance of GH, including Indigenous health, within anesthesia training. The statistically significant difference between PDs and residents regarding perceptions of financial barriers may stem from a lack of insight into residents' financial challenges and a lack of unawareness regarding available funding opportunities amongst residents. Residents' strong interest in GH and the identified lack of curriculum support the need to incorporate formal GH curriculum in residency. Limitations of this study include a low resident RR, which can be attributed to time constraints faced by residents and the survey's length.

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# When the hero feels like a fraud: a survey of imposter syndrome among anesthesiologists

**Submission ID**

39

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**INTRODUCTION**

Imposter syndrome (IS) is a concept that describes persistent internal feelings of intellectual fraudulence among high-achieving individuals, often despite objective evidence to the contrary.[1] Recently, IS has become a subject of growing interest within the medical profession, likely because of its potential impacts on physician burnout, reduced work performance, and compromised quality of health care for the public.[2,3] Anesthesia is a unique specialty where the daily clinical environment can rapidly change from quiet and predictable routines to high-intensity life-threatening situations, and an anesthesiologist's ability to handle a crisis can be the difference between a patient's life or death. While there have been very few studies that focus specifically on IS within anesthesia, the risk of burnout is known to be high.[4] This survey aims to explore the overall prevalence of IS among anesthesiologists within a single Canadian province and to compare that prevalence at different career stages.

**METHODS**

Following approval from the local research ethics board, a link to complete an anonymous survey was sent by email to the province's anesthesiologists at staff, fellow, and resident levels, as well as to third- and fourth-year medical students who were considering pursuing training in anesthesia. Medical students, residents, and fellows were contacted by administrative staff through university mailing lists. Staff anesthesiologists were contacted through the provincial anesthesiologists' society membership mailing list. Individual consent to participate was implied by the voluntary completion of the survey.

The survey included questions of demographic and professional background such as gender and years in clinical practice, and the Clance Imposter Phenomenon Scale (CIPS), a validated tool for assessing IS.[5] The CIPS score (20–100) was calculated as instructed with higher scores indicating more frequent or intense imposter feelings. A CIPS score greater than

40 indicates at least moderate IS. Participants were also asked to self-evaluate the severity of their IS and consider its potential impacts on their career.

Data was analyzed using R (R Foundation for Statistical Computing, Vienna, Austria). Linear regression analysis was performed to assess associations of demographic or professional factors with severity of IS as quantified by the CIPS score.

**RESULTS**

At the time of submission, 125 responses were obtained, with 98 completed in full and included for analysis. Forty-four (45%) respondents were female; eight were medical students, nine residents, eight fellows, and 73 staff. The median [IQR] CIPS score was 59 [47–69]. Eighty-four (86%) participants had CIPS scores greater than 40, indicating at least moderate IS.

Linear regression analysis of preliminary data revealed no statistically significant association between increased CIPS score and age ($P = 0.82$), female gender ($P = 0.16$), current clinical role ($P = 0.78$) or years since graduating from medical school ($P = 0.16$).

Sixty-three (64%) respondents subjectively felt that they experienced IS, with 33 indicating that it affected them mildly, 26 moderately, and four severely. The most common reported professional impacts of IS were feeling inadequate about their patient care abilities (39/62, 63%), wondering if they were competent in their clinical role (36/62, 58%), and avoiding difficult or high-risk procedures (30/62, 48%).

**DISCUSSION**

Early responses suggest a high prevalence and severity of IS among anesthesiologists in our province. No significant associations were seen between CIPS scores and the demographic or professional factors evaluated, but data collection is ongoing. The high prevalence is consistent with other studies of IS among physicians, which may reflect the perfectionistic and high-expectation culture of medicine.[2,3] Response bias is possible, with individuals who experience IS being more inclined to complete a voluntary survey.

Future research is planned in the form of semistructured interviews with willing participants to explore the professional impacts of IS in greater depth.

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# ENVIRONMENTAL SUSTAINABILITY

## Environmentally sustainable measures for regional anesthesiologists and beyond: a quality improvement initiative

**Submission ID**

73

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**INTRODUCTION**

Imaging modalities used by the health care industry have a significant environmental impact and cost associated with their use.[1] A report by Natural Resources Canada details that ultrasound machines are one of the top five most energy-consuming medical devices in hospitals and that up to 80% of the energy used by imaging devices is consumed when not scanning.[2] At our provincial health service, scope 2 emissions (purchased electricity) contribute to just under half of total greenhouse gas emissions. Ultrasound machines play an integral role for anesthesiologists, and any measures to help combat the climate crisis are urgently required.[3] This quality improvement study aims to identify energy-saving strategies to decrease the impact of ultrasound usage at our institution. We hypothesized that turning the ultrasound machine off overnight and when not in use would significantly decrease the energy consumption.

**METHODS**

Ethics was waived by our institutional research ethics board. Energy consumption data was collected by a portable data logger (ONSET HOBO®, Montreal, QC, Canada) connected to a single ultrasound machine (Sonosite LX®, Bothwell, WA, USA) in the hospital's regional nerve block room, where ultrasound-guided nerve blocks are performed perioperatively. As per usual practice in our department, the typical use of the ultrasound machine without energy-saving interventions was logged over three weeks (control). For the following four weeks, we implemented the energy-saving intervention by turning off the ultrasound machine when not in

use, which included overnight (intervention). Scanning time and number of scans were charted for each period. The primary outcome was energy consumption in kilowatt-hours (kWh) in both the control and the intervention group. The secondary outcomes were ultrasound machine usage and the energy cost. Mean and standard deviation were used for normally distributed data. The Chi square test was used to compare the difference between the two groups, with the *P* value of 0.05 being statistically significant.

**RESULTS**

After implementing the simple intervention of turning the machine off between scans and while not in use, we observed an 80% relative energy saving between the control and intervention group. The ultrasound machine was in use a total of 600 min during the control period and 1,186 min during the intervention period. To account for any effect of the difference in usage, we computed the energy usage per minute of scanning, by dividing the daily energy usage (Wh) by the daily usage time (minutes) and estimated an energy saving of 87% per minute of active scanning. The absolute energy saving per day is equal to 1.55 kWh. Given that an average of 110 g $CO_2$ is emitted per kWh of electricity consumed in Canada, the wastage was equivalent to 62.07 kg $CO_2$ emissions per year.[4] This yearly energy saving is equivalent to $108.34 for a single ultrasound machine.[5]

**DISCUSSION**

Actively switching off an ultrasound machine when not in use is a simple, convenient, and effective opportunity to significantly reduce energy consumption, minimize carbon footprint, and save costs. This intervention is a valuable strategy to reduce scope 2 emissions, which play a large part in the carbon footprint in health care. Taking into account the growing number of ultrasound machines in an average hospital, this represents a promising area for a simple intervention for planet health.

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**Table** Energy consumption and savings of control and intervention

| | Control | Intervention |
|---|---|---|
| Total Energy Consumption (Wh): mean (SD) | 34,062: (0.6) | 9167.0: (0.6) |
| Total Hours Recorded (hours) | 413.3 | 571.7 |
| Total Active Scanning Time (minutes) | 600 | 1186 |
| Average Active Power (Watts): mean (SD) | 80.56: (33.09) | 18.02: (33.01) |
| Energy Consumption Per Day (Wh) | 1930.83 | 384.87 |
| Energy Savings Per Day (Wh) | | 1545.96 |
| Energy Savings Per Day (%) | | 80 |
| Energy Saving Per Minute of Scanning (%) | | 87 |
| CO2 Emission Reduction Per Year (Kg) | | 161.27 |
| Cost Savings Per Year (CAD$) | | 108.34 |

# Public perception of health care, anesthesia, and climate change

**Submission ID**

46

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**INTRODUCTION**

'Code Red for Humanity' was declared by the World Health Organization in 2021,[1] and climate change-related cardiovascular and respiratory conditions are predicted to increase worldwide.[2] Moreover, USA and Canada's health care industries, with particularly resource-intensive operating rooms, are significant contributors to national greenhouse gas emissions.[3] In the perioperative arena, anesthetic gas use and energy consumption are the largest sources of emissions.[4] Hence, it is vital to promote environmentally sustainable anesthesia choices through informed decision-making, with crucial consideration of patients' attitudes and knowledge of such issues.

With this background, the aim of this observational study was to investigate the perception and attitudes of patients and family members surrounding the intersectionality of climate change and health care and their willingness for action. Additionally, we investigated whether perceptions and attitudes translated into choosing anesthesia options with different environmental footprints. We hypothesized that < 30% of our study population were aware of health care's contributions to climate change.

**METHODS**

Following institutional review board ethics approval and obtaining written informed consent from patients and/or their family members who met inclusion and exclusion criteria, participants were interviewed using a standard set of questions. The completion of questionnaires was conducted on the surgical wards and day-surgery ward. A research assistant explained the purpose of the study before administering the questionnaire to participants, and remained available throughout its completion to provide any necessary clarification. Participants could choose to individually complete the paper survey or have the research assistant conduct the survey verbally. The survey consisted of nine questions that queried participants on their demographic information, perceptions of climate change, perceptions of health impacts of climate change, knowledge of health care and its impact on climate change,

and willingness to learn more about climate change and their health/health care system. For normally distributed continuous data, mean and standard deviation were used. Ordinal and interval data including survey responses were analyzed using Chi square tests to determine if significant associations existed between perceptions of health care's carbon footprint and age group, sex, education, income, choice of anesthesia or request for further information. All analysis was performed on SPSS (SPSS version 26, IBM Corp., Armonk, NY, USA) and *P* value < 0.05 was considered significant.

**RESULTS**

A total of 320 participants completed the survey. Results showed 32% of participants acknowledged health care 'greatly contributes to climate change,' and a large majority (82.5%) thought 'health care contributes to climate change in some form.' Nevertheless, perceptions did not necessarily translate to choices, as many still opted for general anesthetic (45%). As shown in the Figure, participants were more likely to choose a greener option if they perceived that health care 'somewhat or greatly contributed to climate change' (*P* = 0.002). Many participants believed urgent action should be taken (46%), which again, did not translate to choosing the greenest anesthetic option—a regional technique with relaxing background music (21%). A strong association existed between perception of health care's environmental impact and level of education (*P* = 0.015); no association was found with income, age, or sex.

**DISCUSSION**

Over 80% of our study population was aware that health care impacts the environment and climate change, but many continued to choose the more carbon-intensive anesthetic. A traditional view of perception and action assumes the causal flow between the two is linear, and they are merely instrumentally related. A two-level interdependence view argues that perception and action co-depend on dynamically circular sub-personal relations.[5] Our study highlights that public education regarding health care and climate change is required, however, education alone is not enough. Thus, perhaps health care needs to focus on cultural change towards climate resilience for a healthier and more sustainable planet.

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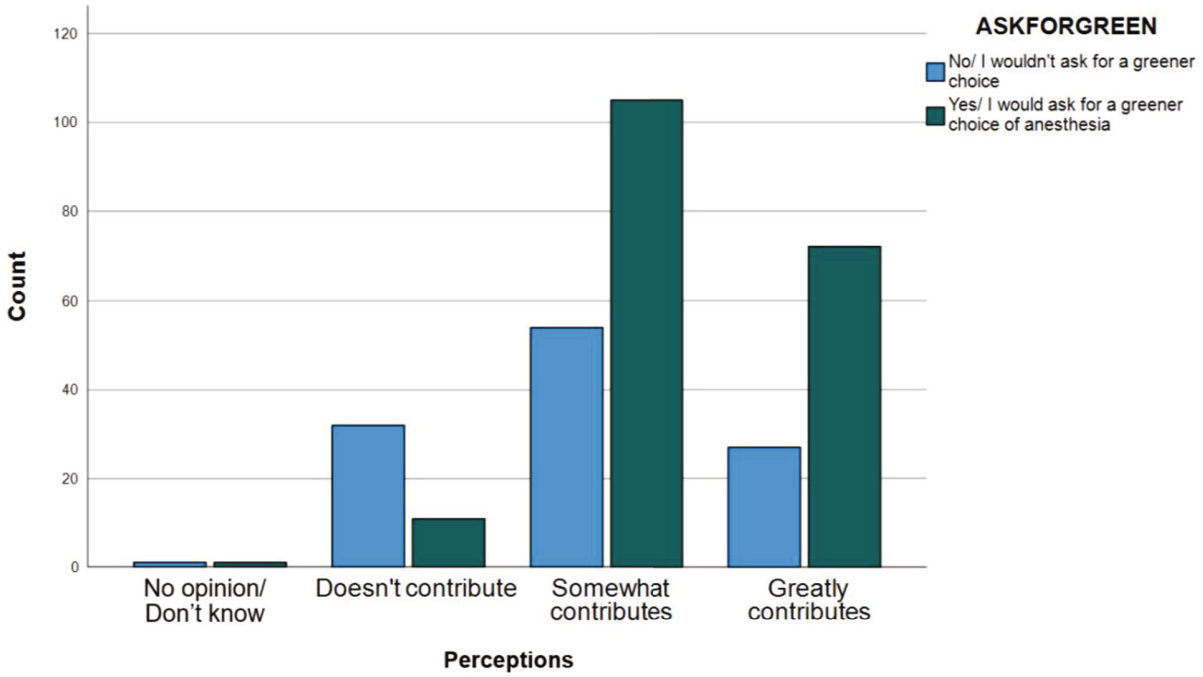
**Figure** Bar chart showing the number of participants that would or would not ask for a greener choice of anesthesia with different perceptions of health care contributing to climate change



# Waste generated by different types of anesthesia: a randomized controlled trial

## Submission ID

43

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## INTRODUCTION

As climate change poses a threat to human health,[1] it is imperative to look at major carbon contributors such as health care, an industry contributing nearly 5% of global greenhouse gas emissions.[2] Within the operating room, anesthesia is the largest carbon contributor, and may have potential to reduce carbon contributions by modifying and optimizing anesthesia techniques.[3] Prior research comparing different anesthesia techniques, namely regional anesthesia (RA), general anesthesia (GA), and a combination of both RA and GA failed to show a difference in carbon contributions between the techniques, however it was suggested that reducing oxygen flow with regional anesthesia is a possible factor to reduce emissions.[4] Our study aims to assess recycle and nonrecyclable contributions from RA, GA, and a combination of RA and GA among patients undergoing wrist surgeries, while titrating oxygen flow per patient requirements.

## METHODS

Ethics approval has been approved by the institutional review board committee, and written, informed consent was obtained from patients. In this prospective, randomized control trial, patients > 18 yr of age undergoing open reduction and internal fixation wrist surgery were randomized to one of three groups: 1) GA, 2) RA, or 3) combined GA + RA.

Patients in the GA group were induced with propofol and airway devices used were either reusable LMA or endotracheal tube with reusable laryngoscope under the discretion of the anesthesiologist. Sevoflurane was used as maintenance, alongside medical air/oxygen.

Patients in the RA group received a brachial plexus block and had the option of receiving light sedation with midazolam. When required, anesthetists were instructed to titrate $O_2$ to maintain $O_2$ saturation > 95%.

Patients in the GA + RA group received both of the previously described techniques.

Groups were compared using one-way analysis of variance. In all groups, the primary outcomes were recycle, nonrecycle waste production (in grams). Secondary outcomes were oxygen use (in liters) between the three anesthetic techniques. Data on gaseous and volatile consumption was collected on the anesthesia machines, and recyclable and nonrecyclable waste was collected and weighed on a digital scale with a precision of 0.01 g.

**RESULTS**

There were eight patients in the GA group, nine in the RA group, and ten in the GA + RA group for a total of 27 patients. For nonrecyclable waste, the RA only group generated the least amount (Table). For recyclable waste, the GA + RA group generated the highest amount, and by each group was GA > RA > RA + GA (Table). Nevertheless, the difference was not statistically different. For oxygen used, the most was in the GA group, and by each group was GA > GA + RA > RA and upon examining the data, two cases in the RA only group left the oxygen delivery on default mode of 10 $L \cdot min^{-1}$ on the anesthetic machine, rather than switching the oxygen flow to 'pause,' while monitoring capnography. When these two data were excluded, the average oxygen volume was lowest in the RA group which was statistically significant (Table).

**DISCUSSION**

Among anesthetic techniques, RA on average had the lowest nonrecyclable waste contributions. More strikingly, the oxygen use (which has a significant carbon footprint)[4] markedly reduced in the RA-only group when excluding two outliers, which had oxygen flow rates of 10 $L \cdot min^{-1}$ of oxygen as capnographic monitoring was used without pausing the oxygen flow. This suggests an impactful strategy to reduce environmental impact within RA, defaulting lower gas flow on the anesthetic machine, or having a mode on the anesthetic machine reminding anesthetists to turn off the anesthetic machine fresh gas flow when only using its capnography monitoring function.

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**Table**

| Mean Values | GA | RA | GA+RA | P-Value |
|---|---|---|---|---|
| | N=8 | N=9 | N=10 | |
| Oxygen Use (L) | 232.38 | 52.43 | 167.6 | 0.00025 |
| Recyclable Waste (g) | 42.25 | 64.3 | 73.1 | 0.99015 |
| Non-Recyclable Waste (g) | 249.25 | 203.4 | 227.2 | 0.99015 |

# EQUIPMENT MONITORING

## Neuromuscular blockade antagonism and monitoring: a prospective single centre observational study

**Submission ID**

113

**AUTHORS**

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**INTRODUCTION**

Studies have shown that when neuromuscular blockers (NMBs) are employed in clinical practice, the incidence of residual neuromuscular blockade can be as high as 64%.[1–3] This may increase the risk of respiratory complications at extubation and in the immediate postoperative period.[1,3] Furthermore, clinically significant residual neuromuscular blockade cannot be consistently identified with subjective neuromuscular monitoring (NM) tests such as qualitative NM (classic train-of-four monitoring) or clinical signs.[1–3] The 2023 American Society of Anesthesiologists (ASA) guidelines recommend using quantitative NM when using NMBs.[1] Train-of-four ratios (T-ratios), a quantitative NM technique, objectively assess the degree of the residual neuromuscular blockade and are considered standard of care. T-ratios of ≥ 0.9 are the current standard for safe extubation irrespective of reversal agent use. This prospective single-centre observational study aimed to compare current neuromonitoring practice, at our institution, to ASA guidelines.

**METHODS**

After ethics review board QA/QI waiver, data was prospectively collected on elective laparoscopic surgical procedures at our institution. Anesthetists were asked to answer a brief questionnaire including choice of NMB agent used, whether NM was employed (i.e., quantitative or qualitative) and perceived barriers to the use of NM during surgery. At our centre, accelerometers are readily available as a quantitative NM tool (GE HealthCare, NMT MechanoSensor, USA). Answers provided by anesthetists were subsequently cross-referenced

to the electronic anesthetic chart to determine whether T-ratios were recorded, and if, Sugammadex or Neostigmine/Glycopyrrolate were administered as reversal agents.

**RESULTS**

A total of 92 elective laparoscopic surgical procedures were included in this study. In 73 of 92 cases, rocuronium bromide was used. Of these 73 procedures using an NMB, 20/73 (27%) used no form of NM, only 43/73 (59%) used quantitative NM, and 10/73 (14%) used qualitative NM. Of those employing quantitative NM (43 cases), only 19/43 (44%) recorded T-ratios on the electronic anesthetic chart. Furthermore, reversal agents were used in 49/73 (67%) surgical procedures (12 Sugammadex and 37 Neostigmine/Glycopyrrolate), while no reversal was administered in 24/73 (33%) cases. Among those procedures using NMBs but no form of NM (20 cases), a reversal agent was given before extubation in only 13/20 (65%) cases while no reversal was given in 7/20 (35%) cases. Lastly, barriers to using quantitative NM included set-up time, equipment malfunction and inaccurate readings because of accelerometer positioning.

**DISCUSSION**

Clinical practice at our institution does not entirely comply with ASA guidelines. Despite administering NMBs, quantitative NM was only used in 59% of cases and T-ratios were documented by an even smaller proportion of consultants (44%). This may be explained by barriers such as set-up time, equipment malfunction and inaccurate readings because of accelerometer positioning. The use of alternate technology such as Electromyography could promote the use of T-ratios among clinicians, as it provides reliable quantitative assessment of neuromuscular blockade despite thumb restriction.[4] Addressing these barriers will facilitate widespread adoption of quantitative NM in daily clinical practice.

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# GENDER STUDIES

## Equity and diversity in Canadian anesthesiology residency programs

**Submission ID**

68

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**INTRODUCTION**

Increased diversity in the health care workforce has been shown to lead to higher quality patient care, reduce health disparities, and enhance team performance.[1] The overarching trend in medicine is underrepresentation of women and minority groups in most specialties, including anesthesiology.[2] To address this, diversity is needed within residency training programs to create a workforce that can approach widening inequities in health care.[3] Currently, there is no data regarding the demographic features of anesthesiology residents in Canada. It is important to obtain this information, as well as resident perceptions of equity and diversity within their training programs. This can then be in turn used to guide future equity and diversity initiatives within anesthesiology residency programs across Canada.

**METHODS**

To gather data from anesthesiology residents across Canada, we designed a brief online survey to be completed anonymously (Figure). Ethics approval was obtained from the local ethics board. The survey was distributed to program coordinators at the 17 Canadian anesthesiology residency programs, for distribution to all resident physicians in their respective training program. Only resident physicians were included in the survey. The survey consisted of 17 multiple choice questions. All questions were made optional. Question topics were made broadly to address four main categories. Firstly, response data related to postgraduate training year and residency program were collected. Next, questions related to gender and ethnic identity were posed. Additionally, trainees were asked about their perceptions of diversity within their residency cohorts, of staff at their institutions, and broadly within anesthesiology as a specialty. Finally, knowledge of existing initiatives in residency programs to foster equity and inclusion was addressed. Descriptive analysis of the resulting data was then completed to

identify trends and patterns. To be included in analysis, a minimum of one answered question was required.

**RESULTS**

In total, 123 responses from 15 of 17 Canadian anesthesiology residency programs were received and analyzed. Of the respondents, 49% identified as male, 48% as female, and 1% as nonbinary. No respondents identified as transgender. The majority of respondents identified as heterosexual (84%), 7% identified as lesbian or gay, and 8% as bisexual. With regards to ethnicity, 68% of respondents identified as White/European, 13% as East Asian, 8% as South Asian, 4% as Black, and 1% as Indigenous. Most trainees felt that their programs contained trainees and staff of diverse backgrounds (81% and 73%, respectively) and that equity and inclusion are important in residency training (87%). Nevertheless, 52% were unaware of existing initiatives in their programs about equity and diversity. Additionally, 43% of residents reported receiving no training in antiracism, sexual harassment, gender inclusivity, unconscious bias, or microaggressions.

**DISCUSSION**

This study reveals a similar proportion of male and female trainees within Canadian anesthesiology residency programs. Compared to Canadian demographic data,[4] there is similar representation of most ethnicities, however, Indigenous individuals were underrepresented. LGBTQ representation was also similar to Canadian demographic data. Most residents believe equity and inclusivity are important in training, however, the majority were not aware of any existing initiatives within their programs. Important areas of future growth include further implementation of equity and diversity initiatives to not only ensure trainees reflect the diverse communities they serve, but to educate and train them to care for minority groups.

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## Figure

1. Please select your current level of training:
   - PGY1
   - PGY2
   - PGY3
   - PGY4
   - PGY5

2. Please select your Anesthesia training program:
   - University of Alberta
   - University of Calgary
   - University of British Columbia
   - University of Saskatchewan
   - University of Manitoba
   - University of Toronto
   - McGill University
   - Western University
   - McMaster University
   - Sherbrooke University
   - Queens University
   - University of Ottawa
   - Dalhousie University
   - Memorial University
   - NOSM University
   - Université de Montréal
   - Université Laval

3. What is your biological sex?
   - Male
   - Female
   - Prefer not to say

4. What is your current gender identity?
   - Male
   - Female
   - Trans male
   - Trans female
   - Non-binary / Non-conforming
   - Other
   - Prefer not to say

5. What is your sexual orientation?
   - Lesbian or gay
   - Bisexual
   - Straight/Heterosexual
   - Non- binary / third gender
   - Prefer not to say
   - Other

6. What race/ethnicity do you identify as? Please select all that apply.
   - East Asian
   - South Asian
   - South East Asian
   - West Asian
   - Middle Eastern
   - Latin X or Hispanic
   - Black or African
   - Indigenous
   - White or European
   - Other

7. Do you believe that your residency program contains trainees from diverse backgrounds?
   - Yes
   - No
   - Not sure

8. If you answered "yes" to Question 7, please select which diverse backgrounds (select as many as apply). If you did not answer "yes" to question 7, please skip this question.
   - Gender
   - Age
   - Race/Ethnicity
   - LGBTQ

9. Do you believe that the anesthesia program at your institution contains staff physicians from diverse backgrounds?
   - Yes
   - No
   - Not sure

10. If you answered "yes" to Question 9, please select which diverse backgrounds (select as many as apply). If you did not answer yes to question 9, please skip this question.
    - Gender
    - Age
    - Race/ Ethnicity
    - LGBTQ

11. How do you think your residency program compares to other residency programs at your institution, in regards diversity and inclusion?
    - More diverse than other residency programs at my institution
    - Less diverse than other residency programs at my institution
    - Not sure

12. Are you aware of any existing initiatives within your residency program to increase diversity and inclusion?
    - Yes
    - No
    - Not sure

13. Do you believe that it is important for an anesthesia residency program to demonstrate diversity and inclusivity?
    - Yes
    - No
    - Not sure

14. Do you believe Anesthesia is attracting under-represented minorities into its training programs?
    - Yes
    - No
    - Not sure

15. Did your race/ethnicity, sexuality, or gender influence your decision to pursue training in anesthesiology?
    - Yes
    - No

16. If you answered "yes" to Question 15, what factor(s) influenced your decision? Please select all that apply. If you did not answer "yes" to question 15, please skip this question.
    - Race/ethnicity
    - Sexuality
    - Gender

17. Does your resident cohort receive training at your institution in any of the following areas?
    - Anti-racism
    - Sexual harassment
    - Gender inclusivity
    - Unconscious bias
    - Microaggressions
    - Have not received training on any of these items

# NEUROANESTHESIA

## Comparative study on incidence of airway related complications while using polyvinyl chloride tubes with a strategic cuff release maneuver *versus* armoured flexometallic tubes endotracheal tubes in neurosurgical patients undergoing surgery in lateral position

**Submission ID**

69

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**INTRODUCTION**

Prolonged surgical duration and extreme neck positions increase the complexity, raising the risk of airway compromise[1] in neurosurgical patients. Endotracheal tube (ETT) choice is pivotal, with conventional polyvinyl chloride (PVC) tubes prone to kinking[2] and flexometallic tubes (FMT) introducing their own challenges.[3] Tube biting, especially during motor evoked potential monitoring, and the need for postoperative tube exchanges from flexometallic to PVC tubes in patients requiring postoperative mechanical ventilation, brings its own set of complications. Recognizing these issues, a strategic cuff release maneuver was proposed for PVC tubes to mitigate kinking. The hypothesis posited that this maneuver would prevent kinking and twisting, with a noninferiority clinical trial conducted to validate this approach. We compared incidence of intraoperative kinking and related complications. Other measurables were airway, respiratory and hemodynamic complications in post-operative period and length of stay in the intensive care unit (ICU) and hospital.

**METHODS**

A single-centre prospective randomized controlled trial, approved by institute ethics committee, and registered in CTRI, recruited American Society of Anesthesiologists Physical Status I/II patients (aged 18–65) undergoing elective neurosurgeries in lateral position. Patients were randomized into Group PVC (PVC tubes) or Group FMT (armoured FMT), both using STERIMED® high-volume, low-pressure cuffs for intubation. Group PVC incorporated a strategic cuff release prior to the final neck positioning (neck flexion, lateral tilt, and lateral rotation)

following the 3-pin application on the patient's head. The ET cuff was temporarily deflated to facilitate free movement of the distal end of the ET. Head was secured in the Mayfield skull clamp upon achieving the optimum head position for surgery. The ET cuff was reinflated to targeted pressure of 25–30 cm water.

During the intraoperative period, patients were monitored for any signs of ET kinking, which included an abrupt rise in peak airway pressure, expiratory tidal volume changes, desaturation, or the appearance of a characteristic end-tidal carbon dioxide ($EtCO_2$) graph. A backup action plan was kept ready for kinking events.

Postoperative care and extubation were based on patient condition and protocol, documenting hemodynamic and respiratory complications during tube exchange and postoperative airway issues and other complications during ICU stay.

**RESULTS**

A total of 70 patients recruited with 35 patients in each group. Both groups had comparable baseline characteristics. No tube kinking signs were observed during surgery in any of the groups. Postoperative ventilation need matched at 71% for both groups. Flexometallic tubes patients underwent exchange with PVC tube after completion of surgery inside OT. This was associated with desaturation in three patients, airway injury in one patient. Tube exchange was also associated with hypertension (72%), hypotension (4%), and tachycardia in 80% of cases in FMT group requiring postoperative ventilation. Patients in FMT group had higher postextubation sore throat (66% *vs* 34%; *P* = 0.009) and hoarseness (57% *vs* 29%; *P* = 0.016) than the PVC group. Intensive care unit stay, and hospital stay was comparable in both the groups.

**DISCUSSION**

Polyvinyl chloride tubes with a strategic cuff release manoeuvre displayed remarkable safety, lacking any kinking issues during challenging neck positions for neurosurgical patients. We conclude that PVC tube with this maneuver are not inferior but match and even excel beyond flexometallic tubes, potentially reducing postoperative airway complications in neurosurgical patients undergoing surgery in lateral position.

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# Disruption of somatosensory network connectivity in patients with supratentorial gliomas during mild sedation with midazolam

**Submission ID**

77

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**INTRODUCTION**

Midazolam can induce transient motor deficits in patients with supratentorial gliomas. This effect can be reversed by the specific antagonist flumazenil.[1] Brain imaging studies indicate that midazolam induced light sedation preserves or increases lower-level functional networks connectivity, such as the somatosensory network.[2,3] Nevertheless, these findings were in healthy brains. Patients with gliomas may have brain network reorganization to adapt and compensate for the pathological state.[4] Therefore, it is unclear how the brain networks of patients with gliomas reacts during mild sedation considering the effects of both the tumor and drug. The object of this study was to examine the changes in sensorimotor within-networks and internetwork functional connectivity before and after midazolam mild sedation in patients with motor cortex gliomas.

**METHODS**

Thirty-six subjects, 20 glioma patients, 16 healthy volunteers, were enrolled. All met the inclusion criteria and signed informed consent. The study was approved by IRB at Beijing Tiantan Hospital (No. KY2018-050-02) and ClinicalTrials.gov (NCT81701038).

Upon entry into the MRI operating room, peripheral intravenous access was established, along with routine monitoring (ECG, BP, $SpO_2$ end-tidal $CO_2$) and oxygen supplementation. Initial structural and resting state functional magnetic resonance imaging (rs-fMRI) scans were performed. Then, participants were given intravenous midazolam starting at 0.03 $mg \cdot kg^{-1}$ and titrated to mild sedation, OAA/S = 4. A rs-fMRI scan was repeated during sedation.

MRI data acquisition was performed on a Siemens 3.0-Tesla Verio scanner. Independent Component Analysis[5] was used to identify functional connectivity within the sensorimotor

network. Regions of interest were extracted for internetwork functional connectivity comparison.

Continuous variables were analyzed by independent sample *t* tests. Categorical variables were subjected to Chi square tests. The General Linear Model was applied for image comparison, with reported functional connectivity results based on an uncorrected voxel-wise height threshold of $P < 0.001$, complemented by a false discovery rate-corrected cluster-wise threshold of $P < 0.05$.

**RESULTS**

Two glioma patients were excluded due to over-sized tumors and excessive head movement. Therefore 18 glioma patients and 16 healthy volunteers were used for data analysis.

Compared to the healthy controls, the sensorimotor network (SMN) connectivity was reduced in glioma group before sedation. After mild sedation, the SMN intra-network connectivity was intact in healthy controls, by contrast, it was disrupted in the glioma group as there was increased connectivity in precentral and postcentral gyrus regions within SMN (Voxel, P[unexpected] < 0.005; Cluster, P[FDR] < 0.05).

For the internetwork connectivity, the SMN-right supramarginal gyrus connection in the glioma group was increased during awake state but was replaced by SMN-precuneous and SMN-anterior cingulate increases during mild sedation (Voxel, P[unexpected] < 0.001; Cluster size > 20). These changes were not seen in healthy control.

**DISCUSSION**

Glioma patients' brain network alterations are complex and extensive, involving reduced long-distance connections and changes in cross-hemispheric connections. Brain reorganization may allow compensation for some of these impairments. The glioma patients exhibited disruptions within intra- and inter- network connectivities. Surgery and sedative drugs may disrupt network compensation, leading to the re-emergence of (pre-existing) neurofunctional impairments. During the “double attack” from midazolam and the glioma, the pattern of intra- and inter-network connectivity were generally disrupted, which indicated that some of the network compensation became maladaptive. This may contribute to the reversible clinically unmasked focal neurological deficit phenomenon with sedation.

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# Effect of hypotension on adverse outcome(s) in patients with moderate to severe traumatic brain injury: systematic review and meta-analysis

**Submission ID**

108

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**INTRODUCTION**

Traumatic brain injury (TBI) is a leading cause of death and disability worldwide. The estimated incidence of TBI is approximately 69 million per year with a disability rate of 111 per 100,000 individuals.[1,2] Using a systolic blood pressure (SBP) of ≤ 90 mm Hg threshold, studies have shown that hypotension as a secondary injury in TBI patients is associated with poorer outcomes.[3] To reflect this, management guidelines from the Brain Trauma Foundation advises maintaining a SBP of ≤ 100 mm Hg for TBI patients 50 to 69 yr of age or ≤ 110 mm Hg for other age groups.[4] Currently, there lacks a comprehensive review examining the effect of hypotension on TBI patient outcomes. Thus, this systematic review aims to present pooled results of available literature and provide insight into the impact of hypotension on adverse outcomes in the moderate to severe TBI setting.

**METHODS**

This study protocol has been registered in the PROSPERO registry. A literature search of studies examining the outcomes of moderate to severe TBI patients with hypotension was conducted using MEDLINE, Embase, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, CINAHL, and Web of Science, and Scopus. Eligibility criteria included: moderate to severe TBI patients based on Glasgow Coma Scale or abbreviated injury scale scale, reported adverse outcomes, and age ≥ 10. Exclusion criteria include studies examining only mild TBI, case series, case reports, and reviews. Independent reviewers will conduct initial title and abstract screening followed by full-text review for eligibility using Covidence software.

Data extraction of study characteristics, patient characteristics, outcomes, and quality of study will be conducted using an independent form. The primary outcome of interest was adverse outcomes (death and/or vegetative state) following hypotension in TBI patients within six months. Secondary outcomes included incidence of hypotension, and adverse outcomes in association with patient characteristics such as age, TBI severity, etc. Forest plots, odds ratios, and incidence with 95% confidence intervals were generated. Subgroup analyses, meta-regression, and sensitivity analysis were performed to assess publication bias and heterogeneity.

**RESULTS**

The search strategy identified 16,720 records with 54 studies meeting eligibility criteria consisting of 363,820 patients. Pooled analysis demonstrated an increased risk of mortality in hypotensive TBI patients (odds ratio [OR], 2.17; 95% confidence interval [CI], 1.93 to 2.43). When only assessing studies with a hypotension threshold of SBP ≤ 90 mm Hg (35 studies), the risk of mortality was higher (OR, 2.49; 95% CI, 2.07 to 3.00). Further subgroup analysis was performed to assess risk of mortality in relation to TBI severity, hypoxia adjustment, location of blood pressure measurement, TBI classification, and various hypotension blood pressure thresholds. For secondary outcome, pooled analysis showed an overall incidence of hypotension of 17.95% (95% CI, 16.52 to 19.37). Incidence was further subcategorized and assessed based on various hypotension blood pressure thresholds, where the incidence of hypotension was 15.24% (95% CI, 14.04 to 16.43) in studies utilizing SBP ≤ 90 mm Hg as threshold.

**DISCUSSION**

This systematic review presents data of nearly 370,000 patients which empirically demonstrate the increased risk of mortality in TBI patients that develop hypotension. Our results show that the risk of adverse outcomes is true regardless of the TBI scale used (AIS *vs* GCS), and at what location the hypotension was determined (ED *vs* EMS). Furthermore, our results demonstrate the high incidence of hypotension in moderate to severe TBI patients. This systematic review can be served to further support current guidelines and recommendations to maintain blood pressure control above 90 mm Hg when providing care to patients with TBI.

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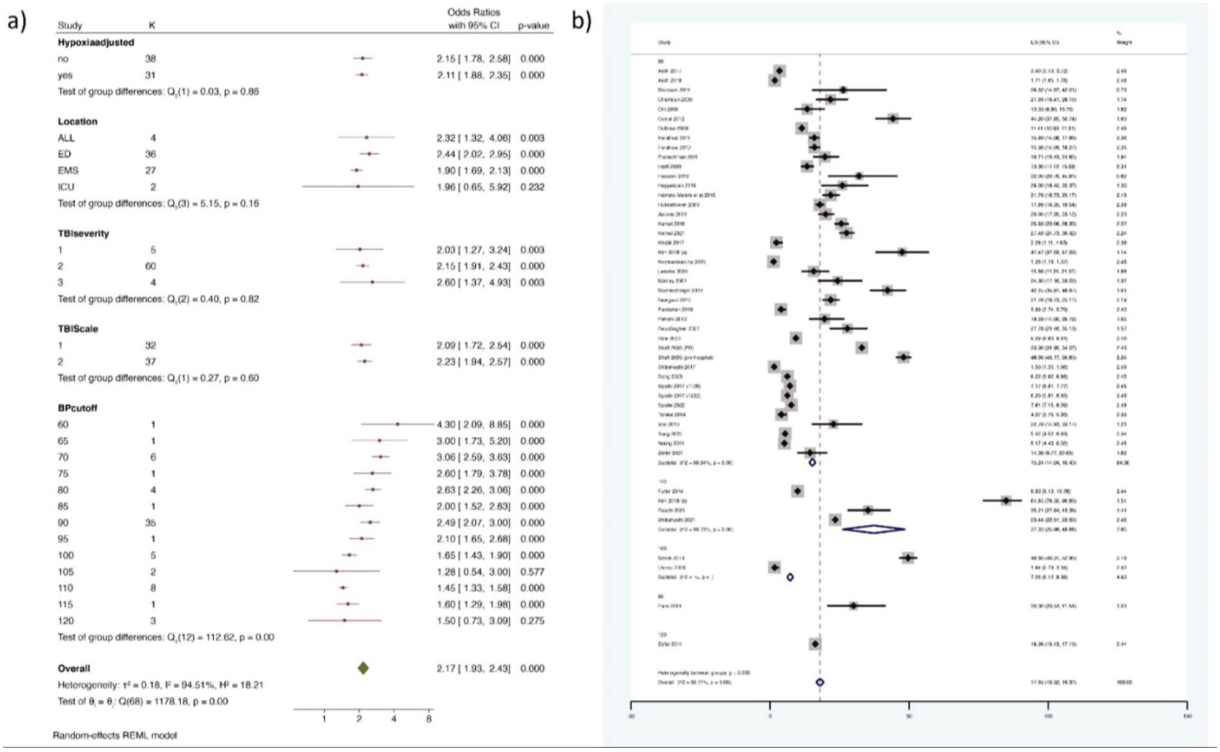
**Figure**



# Management of idiopathic intracranial hypertension in a young patient with severe class 3 obesity

**Submission ID**

23

**AUTHORS**

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## INTRODUCTION

Idiopathic intracranial hypertension (IIH) is a condition of increased intracranial pressure (ICP) without structural cause seen on conventional imaging.[1,2] Patients with IIH can present with headache, papilledema, visual disturbance, and sixth cranial nerve palsy.[1,2] IIH has been strongly associated with obesity (World Health Organization [WHO] classification body mass index [BMI] > 30),[1] which is correlated with increased morbidity and mortality.[3,4] Initial treatment in IIH includes weight loss and medical management with carbonic anhydrase inhibitors such as acetazolamide, which work by decreasing cerebrospinal fluid (CSF) production. Cerebrospinal fluid shunting procedures are another option for treatment.[2] Venous sinus stenting is usually reserved for patients with refractory IIH and papilledema despite maximal medical treatment.[2]

We report a young male patient with severe class 3 obesity (BMI, 107) with severe bilateral transverse sinus stenosis for stenting under general anesthesia. Patient was seen in preoperative clinic for better planning and arrangement of extra personnel and equipment.

## CASE PRESENTATION

A 23-yr-old male patient (weight, 286 kg; height, 163 cm; BMI, 107) presented with history of refractory IIH for five years. Airway examination showed a good mouth opening (Mallampati score 3), good thyromental distance (> 6 cm), normal upper lip bite test (class 1), and normal neck movement. After written informed consent was obtained, the patient positioned himself on the interventional radiology table to minimize risk to patient and staff.[4] A troop pillow with extra blankets to augment ramped position[5] were used, with extra arm boards to support the pannus (Figure A). Standard monitors, a pre-induction radial arterial line, and an 18G *iv* cannula were placed using ultrasound guidance.

Patient's airway was topicalized using lidocaine nebulization and 4% lidocaine spray. Loading dose of 1 $\mu g \cdot kg^{-1}$ dexmedetomidine was infused over ten minutes. Patient was intubated using awake fibreoptic bronchoscopic technique with videolaryngoscope assistance.

After endotracheal tube was secured, general anesthesia was induced using propofol 200 mg and rocuronium 100 mg, and maintained using Desflurane (Et 3–6%) and Dexmedetomidine 0.3–0.6 $\mu g \cdot kg^{-1} \cdot hr^{-1}$, avoiding opioids altogether. Intraoperative hemodynamics were stable. Venous sinus pressures were high (Figure B). Unfortunately, only left transverse sinus could be stented.

At the end, Sugammadex 500 mg *iv* was given and Desflurane was discontinued. Patient was extubated fully awake, and he remained stable and pain-free postoperatively. Nevertheless, we needed 15 personnel to transfer the patient onto the special expandable bed (weight rating, 454 kg) (Figure C). At three months, he reported much improvement in headache and vision.

## CONCLUSION

Super-morbid obesity poses multifaceted challenges for the anesthesiologist. Our patient's body habitus and high BMI (107) precluded simple procedures like computed tomography scanning, and also dictated management as a difficult airway. Coordinated planning through preoperative clinic visit was crucial to successful management, with two anesthesiologists, and extra personnel and equipment transfers involved in out-of-operating-room procedures, and anticipation of potential complications. Weight rating of beds must be checked before perioperative use. Ultrasound guidance proved extremely helpful for vascular access. Dexmedetomidine appears to be a safe choice as an anesthetic adjuvant in such patients, providing anxiolysis for awake intubation, and reducing opioid and anesthetic consumption perioperatively.

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## Figure

| Venous sinus pressures | Baseline | Post-stent |
|---|---|---|
| Right lateral transverse sinus | 57 | 55 |
| Right mid-transverse sinus | 53 | 56 |
| Right medial transverse sinus | 56 | 56 |
| Torcula | 53 | 57 |
| Left lateral transverse sinus | 52 | 57 |
| Left mid-transverse sinus | 52 | 58 |
| Left medial transverse sinus | 52 | 58 |
| Left superior sigmoid sinus | 51 | 56 |
| Left inferior sigmoid sinus | 35 | 38 |
| Left internal jugular vein | 33 | 38 |

(B)


(C)

(A)

# OBSTETRIC ANESTHESIA

## Anesthesia practice during elective Cesarean delivery under spinal anesthesia: a prospective observational study

**Submission ID**

62

**AUTHORS**

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**INTRODUCTION**

The incidence of intraoperative pain in women undergoing elective Cesarean delivery (CD) under neuraxial anesthesia is reported as high as 22.7%.[1] This is associated with poor patient outcomes and adverse psychological sequelae.[2] The 2022 Obstetric Anaesthetists' Association (OAA) guidelines provide recommendations for best clinical practice, specifically targeting prevention and management of intraoperative pain during CD.[2] The purpose of this observational study was to assess our current clinical practice during elective CD under spinal anesthesia with respect to OAA guidelines.

**METHODS**

After research ethics board review ethics approval was waived. This prospective observational study evaluated anesthesia consultants during elective CDs under spinal anesthesia in healthy pregnant patients. Consultants were encouraged to follow their usual clinical practice. Data was collected by a single assessor. Primary areas evaluated included requirement for additional intravenous (IV) analgesia, spinal sensory block assessment modality and technique, target sensory block level, and identification of T5 dermatome on a standardized diagram. Group performance is presented as frequencies and percentages.

**RESULTS**

A total of 14 consultants were evaluated. No patients required additional IV analgesia. Spinal block assessment was performed using a combination of modalities including light touch, pinprick and ice 1/14 (7%), light touch and ice 5/14 (36%), pinprick and ice 7/14 (50%), and ice

only 1/14 (7%). Among consultants employing light touch, 3/6 (50%) used a cotton ball, 2/6 (33%) used gauze, 1/6 (17%) used a Neurotip. When inquired about target sensory level before surgery initiation, 2/6 (33%) aimed for T5 to light touch, 3/6 aimed for T6 to light touch and 1/6 aimed for T4 to ice without using light touch as target modality. T5 dermatome was correctly identified by 4/14 (29%) consultants (Figure). None of the consultants using light touch and targeting T5 level was able to correctly mark T5 dermatome on a standardized diagram.

## DISCUSSION

Considerable differences were found between our clinical practice and OAA guidelines. Furthermore, we observed significant practice variability among consultants. OAA guidelines recommend light touch as primary modality with at least T5 sensory block to minimize the risk of intraoperative pain.[2] Less than half of consultants used light touch with another modality. Only two consultants targeted T5 prior to incision, both of them misidentified T5 by one dermatome. Overall, less than a third of consultants marked T5 dermatome correctly. The results of this study identified areas and opportunities to standardize our anesthesia practice in alignment with OAA guidelines.

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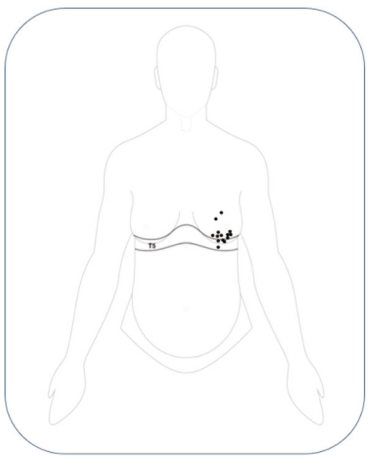
**Figure** Standardized upper female torso diagram




(•) represents individual consultant T5 dermatome identification (*n* = 14). Actual sensory T5 dermatome outlined. Based on the original Cleveland Clinic 2022 Dermatome Diagram.

# Point-of-care ultrasound in anesthesia and critical care for obstetric patients: a scoping review

**Submission ID**

105

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**INTRODUCTION**

Often marked by rapid shifts and increased diagnostic uncertainty, pregnancy, labour, and delivery present unique clinical challenges. The growing use of diagnostic point-of-care ultrasound (POCUS) as an extension of physical examination in this setting has been boosted by increasingly accessible training and equipment. Nevertheless, the evidence for its exact role, pregnancy-specific validation, standardization of techniques, normal values and patient benefits have yet to be defined for many of the POCUS modalities in this population.

The purpose of this review is to present the inclusive scope and the nature of the literature to date on diagnostic POCUS in obstetric anesthesia and critical care. The intent is to identify research strengths and gaps, facilitate the work of researchers, clinicians, and educators to expedite further projects, define the scope of POCUS skills for obstetric anesthesiologists, compose curricula and perform periodic updates. The scoping review methodology is suited for this purpose.

**METHODS**

We applied the five-stage process from the Joanna Briggs Institute methodology for scoping reviews updated by Arksey and O'Malley.[1,2] Given the evolving scope of POCUS, we anchored its definition within the indication-acquisition-interpretation-medical decision (I-AIM) framework as "ultrasound use at the bedside for immediate diagnostic purposes."[3] The search strategy stemmed from the research questions: to identify the publications, methodologies, clinical aspects, research gaps and suggestions for further research.

The strategy was broadly inclusive and peer-reviewed by a health science librarian. We included English-language publications on anesthesia and critical care for obstetric populations from 24 weeks gestation to postpartum, excluding the studies of procedural ultrasound, education, and simulation. The search was conducted in PubMed, EMBASE and WebOfScience,

covering the period from January 2000 to 2024. The retrieved articles were uploaded into Covidence (Veritas Health Innovation, Australia), deduplicated and independently screened by two reviewers. Relevant articles were re-screened for eligibility based on the full text and the data extracted for analysis from the finally included articles. The third reviewer was available to reach a consensus. Descriptive analysis was conducted to summarize the findings adhering to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis extension for scoping reviews (PRISMA-ScR).[4]

**RESULTS**

Of the 7,777 identified articles, with 851 duplicates and 6,200 excluded during initial screening, 864 were selected for full-text review. Data were extracted from 351 articles that met the criteria (Figure). Globally, literature on POCUS has increased over time, with 31% of studies identified as "POCUS."

Original research comprised 126 observational studies, 15 randomized trials, and three systematic reviews. The most represented applications of POCUS were gastric, cardiac, prediction of postspinal hypotension, lung ultrasound and validation studies (cardiac output, ventricular function). Hemodynamic instability was the most common indication, with multiple modalities used (cardiac, lung, and vascular ultrasound) for risk stratification, fluid management and prediction/detection of complications of preeclampsia. Small exploratory studies (median sample size, 44.5; IQR, 25–64) were prevalent, with 44.3% featuring parallel comparison group(s). Case reports represented 42% of all articles, highlighting POCUS's role in reducing diagnostic uncertainty, expediting management, and guiding the treatment.

**DISCUSSION**

This review presents the first attempt to summarize the entire scope of literature on the use of POCUS in obstetric anesthesia and critical care. Point-of-care ultrasound has the potential to improve timing and accuracy of bedside decisions in this challenging setting. Embraced globally, POCUS may address the rising maternal morbidity in high- and low- resource settings. Advancing from exploratory research towards larger multicentre studies is necessary to support the clinical utility of POCUS evident in case reports. In its published form, this scoping review may support further strides towards its broader clinical implementations.

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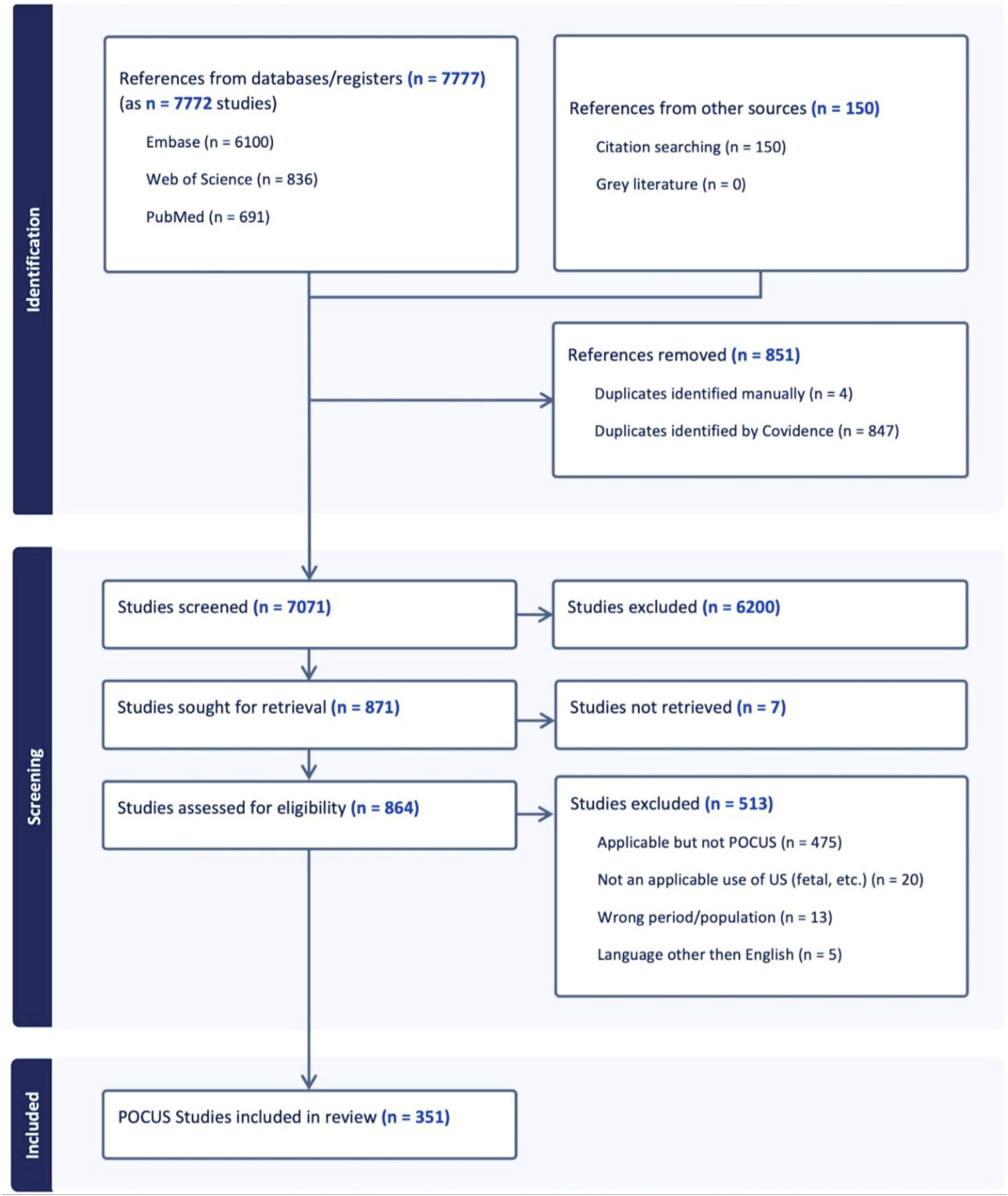
**Figure** PRISMA flow diagram



# The incidence of spinal anesthesia failures during elective Cesarean deliveries: a comparison of two different suppliers

**Submission ID**

88

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**INTRODUCTION**

Spinal anesthesia is commonly used in Cesarean deliveries. This procedure uses bupivacaine to achieve a subarachnoid block (SAB). A failed SAB can be defined as surgical pain/discomfort requiring further intravenous/inhalational agents, or conversion to general anesthesia.[1] The conversion to general anesthetic may negatively impact the neonate, as many induction medications readily cross the placenta.[2] The associated swelling, friable tissues, and decreased esophageal sphincter tone also increase the risk of intubation in pregnancy.[2]

The literature identifies multiple patient, provider, and/or product factors associated with SAB failures. A previous chart review found the failure rate at our maternity hospital was 2.5% in 2020, following a change in bupivacaine supplier in 2018. This is comparable to previous literature citing a 0.5–6.4%[2,3] failure rate. We therefore sought to determine the rate of Cesarean delivery SAB failures at our maternity hospital in 2017, in comparison to 2020, along with factors associated with SAB failures.

**METHODS**

Anesthetic and obstetric records were obtained for all Cesarean deliveries performed at our maternity hospital from June 2017 to June 2018 ($N$ = 1,519). A complete chart review was performed for all SAB cases ($n$ = 922), with non-SAB anesthesia cases (e.g., general anesthesia) excluded from the analysis ($n$ = 527). Subarachnoid block cases were then categorized as either a successful or failed block. Subarachnoid block failures were then categorized based on management (e.g., SAB re-attempted, intraoperative supplementation, or conversion to general anesthesia).

Patient factors (body mass index, number of fetuses, gestational age, diagnosis of gestational hypertension and gestational diabetes mellitus) and spinal anesthesia factors (bupivacaine baricity and volume, fentanyl and epi-morphine doses, insertion level, number of attempts, complications, time from SAB to recovery room) were recorded. Mann–Whitney $U$,

Chi square, and Fisher's Exact tests were used to evaluate differences in metrics between successful and failed blocks in 2017–18, as well as between the failure groups in 2017–18 and 2020. Alpha was adjusted to account for multiple comparisons (a = 0.025).

**RESULTS**

The SAB failure rate at our maternity hospital from June 2017–June 2018 was 4.3%, in comparison to the observed SAB failure rate in 2020 of 2.5% ($P = 0.018$). The risk of SAB failure with a 95% confidence interval was 1.73 (1.1 to 2.9) times greater in 2017–18 *vs* 2020. No significant differences were observed with respect to patient factors between successes and failures in 2017-18 or 2020. Nevertheless, failures required significantly more insertion attempts than successful blocks in 2017–18 (2.0 [1.0–2.0], 1.0 [1.0–1.0]; $P < 0.001$) and 2020 (2.0 [1.0–2.0], 1.0 [1.0–1.0]; $P < 0.001$). Additionally, we found that failures in 2017–18 were significantly longer cases overall, as compared with successful blocks (105.0 min [90.0–125.0], 90.0 [73.0–110.0]; $P < 0.001$). There was no statistical difference in factors between the 2017–18 and 2020 failure groups. In 2020, failures were observed to occur in batches. This grouping effect was not observed in 2017–18 with bupivacaine from a different supplier.

**DISCUSSION**

The SAB failure rate in 2017–18 was almost double the rate observed in 2020. This was inconsistent with our hypothesis that the failure rate would be lower in 2017–18, prior to the transition to generic bupivacaine. In 2017–18, failures were more likely with longer cases, a possible indicator of increased surgical complexity. We did not find an association between failure rates and patient factors or anesthetic complications. The observed grouping of failures in 2020 may be related to the integrity of certain bupivacaine lot numbers. These findings will inform an ongoing prospective study on SAB failures at our maternity hospital.

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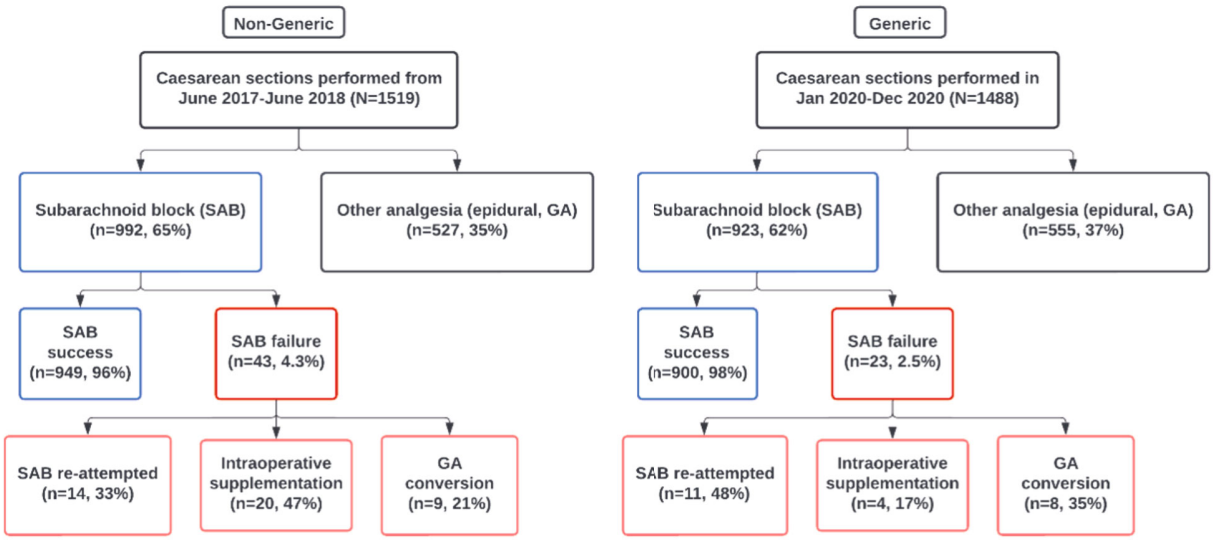
**Figure** Flow charts describing the distributions of subarachnoid block (SAB) success and failures in 2017–18 and 2020 at our maternity hospital



# The role of extracorporeal membrane oxygenation in acute intrapartum or postpartum events during Cesarean delivery: a scoping review

**Submission ID**

55

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## INTRODUCTION

Cardiovascular diseases, hypertensive disorders of pregnancy, postpartum hemorrhage (PPH), and obstetric embolism, including amniotic fluid embolism (AFE) and pulmonary embolism (PE), are among the most common diagnoses associated with maternal death in Canada.[1] These conditions may cause hemodynamic collapse with cardiopulmonary failure and subsequent multi-organ failure. In critical situations, extracorporeal membrane oxygenation (ECMO) can temporarily facilitate gas exchange and/or circulatory support. There is presently no consensus regarding the peripartum use of ECMO in the obstetric population, given the rarity of these clinical diagnoses and lack of randomized controlled trials. We aimed to review the literature and determine whether there is a role for ECMO in the management of acute intrapartum or early postpartum events causing hemodynamic instability during Cesarean delivery in obstetric patients.

## METHODS

Search criteria were established using a modified PICO model. Our study population included patients undergoing or who immediately underwent a Cesarean delivery. Intervention was the use of ECMO for acute intraoperative or postoperative events causing hemodynamic instability within 24 hr of delivery. Case reports of ongoing ECMO support prior to Cesarean delivery were excluded. Outcomes included maternal mortality, days on ventilator, intensive care unit length of stay, hospital length of stay, and maternal complications. Fetal or neonatal mortality was not considered a relevant outcome given delivery occurred prior to ECMO initiation. We searched PubMed, Embase, Medline, and Cochrane Central databases until 14 April 2023 to identify articles for review. Two authors independently assessed titles, abstracts, and full-text articles. We included case reports and case series published in full and in English. Research ethics approval was not required for this review of published papers.

**RESULTS**

We identified 18 publications concerning ECMO use in obstetrics following an acute intraoperative or postoperative event (Table). Twenty unique cases were described among the case reports and case series. The average maternal age was 34.6 yr. Of the 17 patients whose gestational ages were reported, 12 were term and four were preterm. The most common clinical diagnosis was AFE (*n* = 13), followed by PE (*n* = 3), PPH (*n* = 3), and stress-induced cardiomyopathy (*n* = 1). Nineteen patients were initiated on venoarterial ECMO and one on veno-arteriovenous ECMO, with a mean ECMO duration of 4.2 days. There was one maternal death (5%) secondary to hemodynamic collapse because of oxygenator blockage by amniotic fluid debris shortly after connection to ECMO. Twelve patients remained on the ventilator for an average of 15.3 days (median = 6.5 days). Ten of 15 patients had uneventful recoveries, with four patients reporting neurologic weakness at discharge and one patient with neurocognitive dysfunction.

**DISCUSSION**

Our results suggest that ECMO use in the obstetric population for hemodynamic collapse during or immediately following Cesarean delivery is associated with good maternal survival to discharge, with a maternal mortality of 5%. AFE was the most common indication. Most patients had no neurocognitive deficits at discharge. The occurrence of disseminated intravascular coagulation in most patients rendered the adjustment of anticoagulation for ECMO a challenge. Limitations include the observational nature of the data, limited sample size, and publication bias favouring publication of successful cases. Further prospective studies are needed. In conclusion, ECMO can be considered in acute peripartum cardiopulmonary failure.

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**Table** Characteristics of patients treated with extracorporeal membrane oxygenation

| Study | Study Design | Age (y) | Gestational Age (wks) | Clinical Diagnosis | Timing of Presentation | Type of ECMO | Duration on ECMO (d)[a] | Maternal Death | Days on Ventilator (d) | Hospital LOS (d) | Maternal Complications at Discharge |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Adachi et al. 2021 | Case report | 40 | 37 | AFE | Postpartum | VA | 4 | No | 6 | 17 | None |
| Balciuniene et al. 2021 | Case report | 28 | 40 | PE | Postpartum | VAV | 10 | No | N/A | N/A | None |
| Biderman et al. 2017 | Case series | 41 | N/A | AFE | Intrapartum | VA | 4 | No | 25 | N/A | N/A |
| | | 41 | N/A | AFE | Intrapartum | VA | 6 | No | 92 | N/A | N/A |
| | | 31 | N/A | AFE | Intrapartum | VA | 0 | Yes | 0 | N/A | N/A |
| Depondt et al. 2019 | Case report | 36 | 39 | AFE | Postpartum | VA | 5 | No | 5 | N/A | None |
| Fang et al. 2016 | Case report | 35 | 36 | AFE | Postpartum | VA | 2 | No | 8 | N/A | Mild right hand motor weakness |
| Fernandes et al. 2015[b] | Case report | 30 | 37 | PE | Postpartum | VA, then VV | 3.5 | No | N/A | 46 | None |
| Leeper et al. 2013[b] | Case report | | | | | | | | | | |
| Golzarian et al. 2023 | Case report | 31 | 35 | AFE | Postpartum | VA | 5 | No | N/A | N/A | None |
| Hsieh et al. 2000 | Case report | 34 | N/A | AFE | Intrapartum | VA | 1.5 | No | N/A | 24 | None |
| Huang et al. 2017 | Case series | 39 | 34 | AFE +/- PPH | Intrapartum | VA | 2 | No | N/A | 14 | None |
| | | 34 | 39 | PPH | Postpartum | VA, then VV | 2 | No | N/A | 12 | None |
| Ijuin et al. 2021 | Case report | 39 | 38 | AFE | Postpartum | VA | 3 | No | 6 | 14 | After 3 months of rehabilitation following discharge, cerebral performance category score of 2; able to perform independent activities of daily life |
| Jo et al. 2011 | Case report | 37 | 37 | Stress-induced CM | Postpartum | VA | 8 | No | 10 | 22 | None |
| Kim et al. 2020 | Case report | 39 | 38 | AFE | Intrapartum | VA | 5 | No | 7 | >41 | Neuropathic pain and symptoms of foot drop in the right leg; able to take small steps while relying on a quad cane |
| McDonald et al. 2017 | Case report | 22 | 36 | PE | Postpartum | VA | 5 | No | N/A | N/A | A persistent right foot drop and a right flexion contracture of upper limb post fasciotomy |
| Reyftmann et al. 2006 | Case report | 36 | 37 | PPH | Postpartum | VA | 6.5 | No | N/A | N/A | None |
| Tafesse et al. 2022 | Case report | 34 | 39 | PPH | Postpartum | VA | 5 | No | 6 | 26 | Still required hemodialysis at discharge, but no longer required 4 months postpartum |
| Viau-Lapointe et al. 2019 | Case report | 30 | 38 | AFE | Postpartum | VA | 2 | No | 13 | 18 | Still with difficulty walking at 9 months followup |
| Wu et al. 2022 | Case report | 35 | 34 | AFE | Postpartum | VA | 4 | No | 6 | 90 | None |

[a]Rounded to nearest half day
[b]Fernandes *et al*. and Leeper *at al*. describe the same clinical case

AFE = amniotic fluid embolism; CM = cardiomyopathy; ECMO = extracorporeal membrane oxygenation; LOS = length of stay; PE = pulmonary embolism; PPH = postpartum hemorrhage; VA = venoarterial; VAV = veno-arteriovenous; VV = venovenous

# The use of social media to augment postpartum research recruitment: an exploratory study

**Submission ID**

125

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**INTRODUCTION**

Recruitment of postpartum research participants is challenging.[1] As digital platforms and technologies become more prevalent, social media may be an efficient, cost-effective strategy to augment traditional advertising and in-person approach to patient recruitment. Eight in ten Canadian adults use social media platforms.[2] One study in pregnant patients found the incorporation of social media with traditional recruitment strategies led to a 12-fold higher rate of recruitment (from 0.62 recruits/month to 7.5 recruits/month).[3] The purpose of this study was to explore the engagement characteristics of a social media strategy when combined with conventional approaches, in the setting of an ongoing prospective provincial longitudinal cohort study for patients undergoing Cesarean delivery.

**METHODS**

After institutional research ethics board approval, postpartum patients who had a scheduled Cesarean delivery in the preceding week were recruited into a longitudinal study, with completion of eligibility questionnaire, consent, and questionnaires using a digital health platform. Patient recruitment consisted of conventional approaches (i.e., in-person, posters) and social media platforms (Instagram, Facebook, and Messenger). For social media, starting

September 2023 we posted educational postpartum content twice weekly, reached out to other perinatal accounts in the province, and included targeted keywords in posts. Starting November 2023, we ran seven social media advertising campaigns using graphics containing study information with an embedded link to the study sign-up website. Each advertising campaign was scheduled with a new graphic design and ran for seven days, using platform targets including age (19 to 45 yr) and geography. As part of the longitudinal study, participants were asked on the digital platform how they learned about the research study. Our primary outcome was the proportion of participants who learned about the study through social media compared with other sources. Secondary outcomes included engagement metrics from advertising campaigns and educational costs, as well as the total costs incurred from social media. Results were analyzed using descriptive statistics.

**RESULTS**

Between August 2023 and January 2024, 39 participants consented to the research study. Of these participants, 61.5% (24/39) indicated they learned about the study through social media, 12.8% (5/39) through physical posters, 10.2% (4/39) through health care providers, and 7.7% (3/39) through other sources such as community organizations, family or friends, and patient information packages. The remaining 7.7% (3/39) participants did not respond to the question. On average, each of the seven-week-long campaigns led to a reach of 14,123 Facebook accounts and 189 link clicks to the study website with sign-up information. Women aged 35–44 accounted for 50% of link clicks across all ad campaigns. The bi-weekly patient educational material reached 2,146 Instagram accounts. The total cost of the advertisement campaigns was $770.82.

**DISCUSSION**

Social media contributed to more than half of the patient recruitment, reaching a wide provincial population that would not have been possible with traditional in-person recruitment. Nevertheless, social media recruitment requires dedicated planning and effort, and the recruited population may not be representative of the demographic spectrum of the postpartum population. Further studies are needed to determine optimal social media strategies for postpartum research recruitment, including the role of educational materials, privacy and security, the use of other social media platforms, and ensuring representation across diverse demographics.

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# PAIN MANAGEMENT

## Enhancing pain education for people living with dementia and family caregivers: analysis of existing resources and future directions

**Submission ID**

94

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**INTRODUCTION**

The prevalence of dementia has increased dramatically over the past decades. Likewise, there is a growing need for quality education to help people living with dementia (PLwD) and family caregivers (FCG's).[1] Pain is one of the most common symptoms that people with dementia experience and has several negative impacts including unnecessary suffering, verbal, or physical aggression towards FCG's, interference with independence, cognitive function, and social interaction.[2,3] Unfortunately, the pain is often poorly recognized and commonly undertreated because as dementia progresses, communication and the ability to self-manage is impaired.[4] Family caregivers are ideally positioned to support pain recognition and care planning because of their familiarity with and proximity to the PLwD.[5] The aims of this research were to 1) describe the development of a pain management learning curriculum based on identified and prioritized learning needs, 2) map this curriculum against existing sources of publicly available online information, and 3) to screen for quality and readability of the information.

**METHODS**

Our previous research identified learning needs and priorities of PLwD and FCG's for pain education from 27 semistructured interviews with 29 adult FCG's and seven PLwD through the development of a learning curriculum. The learning curriculum consists of five topics (recognizing pain, understanding pain, supporting caregiver roles, treating pain with medications, and treating pain with nondrug treatments). The study aim was to map the learning curriculum against existing information on publicly available sources. A four-phase

approach (phase 1: identification of learning needs and development of the learning curriculum, phase 2: learning priorities survey, phase 3: mapping learning curriculum against existing pain information, phase 4: quality and readability assessment) was used to develop the learning curriculum and evaluate existing publicly available resources. The following inclusion criteria were used to select online resources for review: online websites or PDF's, publication date or "last updated date" within the last ten years, English, and targeted to the public, people living with dementia, or family caregivers. Duplicates were removed as well as materials targeted for health care providers, academics, or materials in draft form. A total of 34 sources were mapped against the learning curriculum and analyzed using the DISCERN tool and Flesch–Kincaid readability test.

**RESULTS**

Of the 34 sources analzyed using the DISCERN tool, one (3%) scored excellent, two (6%) scored good, 12 (35%) scored fair, and 20 (59%) scored poor. The values of the DISCERN tool ranged from 0 to 73. The readability grade level and readability ease had a mean of 10.04 and mean of 53.44, respectively. The readability grade level and readability ease ranged from 5.6 to 13.4 and 39.6 to 68.4, respectively.

**DISCUSSION**

Our research shows the majority of pain information available to FCG's is not reliable, does not have good quality of information for treatment choices, and has an unsatisfactory overall rating. Moreover, most of these sources that provide information on recognizing, understanding, and treating pain are ineffective for FCG's as users experience a hard time reading and understanding them. Future research is needed to develop training materials with FCG's and PLwD input to improve recognition and management of pain and bridge the gap between existing resources and information deemed important for FCG's and PLwD.

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# Incidence and predictors of moderate to severe postorthopedic surgical pain and patients' satisfaction with treatment in a teaching hospital

**Submission ID**

56

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**INTRODUCTION**

Orthopedic surgeries are synonymous with high pain scores, especially within the first 24 hr. Studies have shown that despite advances in pain research and pharmaceuticals, a large number of patients continue to experience significant postoperative pain worldwide.[1,2] Our objective was to evaluate the effectiveness of postorthopedic surgical pain management in our center by examining the incidence of moderate to severe pain, influence of the type of anesthesia employed and the predictors of moderate to severe pain as well as patients' satisfaction with treatment.

**METHODS**

Following Institutional Ethical Committee approval, we conducted a prospective observational cohort study on all patients 18 yr and above who had orthopedic surgeries from 1 February to 31 May 2023. The anesthetic techniques employed were spinal bupivacaine-morphine (SB-M), general anesthesia (GA), peripheral nerve block (PNB) and spinal bupivacaine-fentanyl (SB-F). This study was an attempt at procedure-specific pain intervention in our institution. The numerical rating scale (NRS) was used to measure the severity of postoperative pain at three time points after surgery: in the postanesthesia care unit (PACU), four hours and 24 hr. Each patient was instructed preoperatively in the 11-point NRS viz. 0 = no pain, 1–3 = mild pain, 4–6 moderate pain, and 7–10 = severe pain. We defined NRS ≥ 4/10 as moderate to severe pain. Satisfaction was measured using a 5-point Likert scale. Logistic regression was employed to identify predictors of moderate to severe pain.

**RESULTS**

We studied 289 patients. The incidence of moderate to severe pain in the PACU, four hours and 24 hr time intervals were 17%, 36%, and 35% respectively. The NRS pain scores for PNB and SB-M patients were significantly lower than GA patients in the PACU and four hours ($P = 0.001$). The mean time to first request for analgesics in the PNB patients was 602.6 ± 335 min *vs* 279.7 ± 293 for GA patients ($P = 0.001$). The mean total pethidine consumption in 24 hr was significantly higher in GA patients than PNB patients ($P = 0.041$). Multivariate binary logistic regression showed that GA was an independent predictor of moderate to severe pain while spinal bupivacaine-morphine was significantly protective in the PACU (odds ratio [OR], 0.10; 95% confidence interval [CI], 0.03 to 0.36; $P = 0.000$), and four hours (OR, 0.34; 95% CI, 0.14 to 0.84; $P = 0.020$). Most participants (75%) expressed satisfaction with the quality of pain management.

**DISCUSSION**

We found a lower incidence of moderate to severe pain than previous studies.[1–3] The independent predictor of moderate to severe pain was GA, SB-M offered significant protection. A high proportion of participants were satisfied with their pain management. Further research should explore the impact of using regional anesthetic techniques as adjuncts to GA.

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# Use of the electronic health record epic to impact the quality and safety of postoperative pregabalin use at a Canadian tertiary academic hospital: an interrupted time series

**Submission ID**

93

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**INTRODUCTION**

Optimizing postoperative analgesia is a primary objective of patients and clinicians. Pregabalin is commonly used off-label as a nonopioid analgesic in postoperative multimodal analgesic pathways.[1] Pregabalin's analgesic efficacy in the postoperative period when balanced against its potential for harm has come into question given reports of pregabalin-related adverse effects.[2] Furthermore, adverse respiratory and sedative events are amplified when pregabalin is prescribed concurrently with opioids.[3] Recent evidence suggests that pregabalin's routine use should be reduced considering its analgesic inefficacy in the postoperative period, balanced against its potential for harm.[4] Changes in prescribing can be effected by using practice change advisories in the Electronic Health Record (EHR).[5]

The objective of this study was to investigate the effects of a series of sequential EHR optimization strategies on pregabalin prescribing habits by the Acute Pain Service (APS) at a large academic health sciences centre.

**METHODS**

This project received ethics exemption as a quality improvement project using routinely collected, de-identified data. We conducted a quasi-experimental interrupted times series (ITS) analysis of retrospective data. We identified all postoperative admissions to our APS from January 2021 to December 2022. Our primary outcome was the proportion of APS admissions prescribed pregabalin; our balancing measure was the highest pain score on postoperative day 1.

Two practice change strategies were implemented in our EHR. First, in January 2022 we introduced a Best Practice Advisory (BPA) that triggered to warn of pregabalin's increased risks for sedation or respiratory depression if pregabalin was selected on the APS orders. Second, in June 2022, pregabalin was removed as a standard checkbox in the APS orders.

We defined weekly periods across our time series, and used segmented linear regression, accounting for first-degree autocorrelation to estimate the time trend, step change, slope change, and total counterfactual difference (estimating the total impact of slope and step changes over the measurement period) associated with EHR change strategies. Estimation of parameters of interest at the second change point accounted for the effects of the first change strategy. For each parameter, we estimated the point estimate and 95% confidence interval (CI).

**RESULTS**

We included 10,667 patients (5,563 pre-intervention, 2,750 postchange 1 [BPA] and 2,354 postchange 2 [orders]). Pre-intervention, 1,288 APS admissions had a pregabalin order (23%) compared with 460 (17%) after the BPA and 406 (17%) postorder removal.

From the ITS analysis, step, slope, and total counterfactual differences were not significantly different after either change strategy.

After the BPA, the step change was −2.8% (95% CI, −7.5% to 2.0%; *P* = 0.250), slope change was 0.3%/week (95% CI, −0.002% to 0.5%; *P* = 0.051), and total counterfactual difference was −2.5% (95% CI, −7.1% to 2.1%; *P* = 0.286).

After the order removal, step change was 1.2% (95% CI, −4.4% to 6.8%; *P* = 0.666), slope change was −0.3%/week (95% CI, −0.07% to 0.1%; *P* = 0.197), and total counterfactual difference was 0.9% (95% CI, −4.6% to 6.5%; *P* = 0.735).

The only statistically significant effect estimated was the overall trend prior to implementation (−0.2%/week; 95% CI, −0.3% to −0.1%; *P* = 0.001). No changes in pain scores were identified.

**DISCUSSION**

Following quality improvement initiative to decrease pregabalin use on our APS service using EHR-based change strategies, we did not identify a significant association of EHR change strategies with pregabalin prescribing immediately after implementation, as a continuing trend, or as a total effect. Nevertheless, over the study period pregabalin prescribing decreased by 6%. The lack of association with our change strategies is likely attributable, at least in part, to a strong pre-existing trend of decreased pregabalin prescribing, which may be explained by the emergence of data on pregabalin's lack of clinical efficacy and safety that were featured in local educational initiatives.

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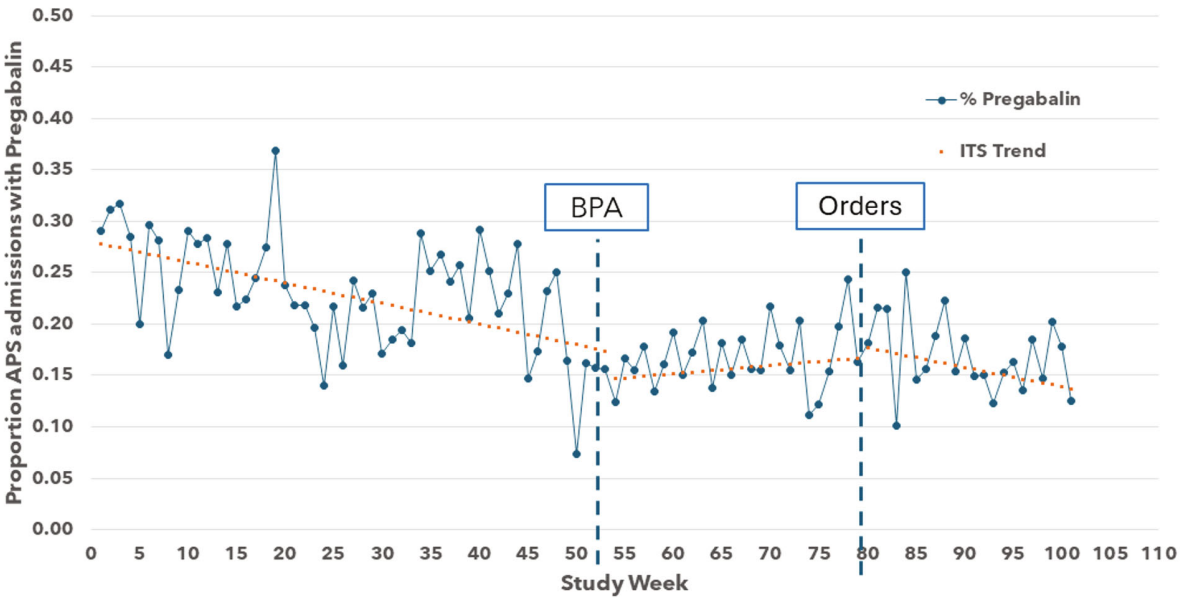
**Figure** Weekly pregabalin usage for APS admissions




This figure presents the actual weekly proportion of new APS admissions prescribed pregabalin (blue line with dots), the model estimated trend across, and change inbetween, each study segment (red dotted line, from the interrupted time series [ITS]), along with timing of the first (best practice advisory [BPA]) and second (removal of order checkbox) change strategies

# PATIENT SAFETY

## Assessing the risk of microbiological contamination with staphylococcus epidermidis in anesthetic emergency drugs

**Submission ID**

82

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**INTRODUCTION**

Microbiological contamination in anesthetic medications is a potential source for patient exposure to pathogens, with conflicting evidence pertaining to the anesthetic environment, and little data to determine bacterial viability regarding colony-forming units (CFU) over time.[1–4] Predawn emergency medications stored for periods of time may be potential sources for patient exposure.[1,3,4] Our study sought to determine the viability of a potential bacterial contaminant, *Staphylococcus epidermidis,* in normal saline, phenylephrine prepared in normal saline, and norepinephrine prepared in 5% dextrose solution. *S. epidermidis* was selected as it represents a common skin microbe which may inadvertently contaminate our medications during preparation, and its role in opportunistic nosocomial infections is becoming more appreciated.[5]

**METHODS**

Two lab strains of *S. epidermidis* were cultured in a microbiology laboratory, where they were grown to saturation in liquid medium then normalized to specific optical densities as determined by absorbance spectroscopy at a wavelength of 595 nm. Bacteria from each optical density were serially diluted in normal saline and plated on solid media to determine the number of CFU per mL of culture. Based on these data, a known quantity of *S. epidermidis* (approximately $4.0 \times 10^4$ CFU/mL initial concentration) was inoculated into three samples for each solution: 250 mL of phenylephrine 60 $\mu g \cdot mL^{-1}$ 0.9% NaCl, 250 mL of norepinephrine 16 $\mu g \cdot mL^{-1}$ in 5% dextrose, and lab-prepared sterile 0.9% NaCl solution as a control. These agents were chosen as a representative sample of commonly-employed vasopressors and diluents. All the above were prepared aseptically in a biosafety cabinet. Medications and controls were

stored at room temperature. Using strict aseptic technique, aliquots were collected at 24-hr intervals from each solution from days 0 to 7. Serial dilutions were performed, plated on trypticase soy agar, and incubated at 37 °C overnight. CFU counts were obtained from each plate and plotted over the 7-day study period. Concurrent control samples prior to inoculation were collected to rule out pre-existing contamination of the medications.

**RESULTS**

Normal saline control samples exhibited the longest viability. All medications and controls had similar CFU counts on day zero, indicating successful inoculation, but only normal saline controls exhibited viability beyond day zero. Counts rapidly diminished below the limit of detection by day 3 for normal saline, without any rebound detected within the remaining 7-day study period.

**DISCUSSION**

These data support that this isolate of *S. epidermidis* is viable for over 24 hr in 0.9% NaCl solution, but not in solutions with phenylephrine or norepinephrine. None of the agents studied exhibited contact antimicrobial activity, suggesting that *S. epidermidis* may remain viable for some short period of time in the above agents, leading to patient exposure after recent contamination. Saline "flush" bags used to prepare medications may represent an under-appreciated source of bacterial contamination and potential patient exposure given the timeframe of viability in this solution. The above provides a foundation for further research regarding in vitro antimicrobial effects of our medications against more virulent pathogens such as Staphylococcus aureus.

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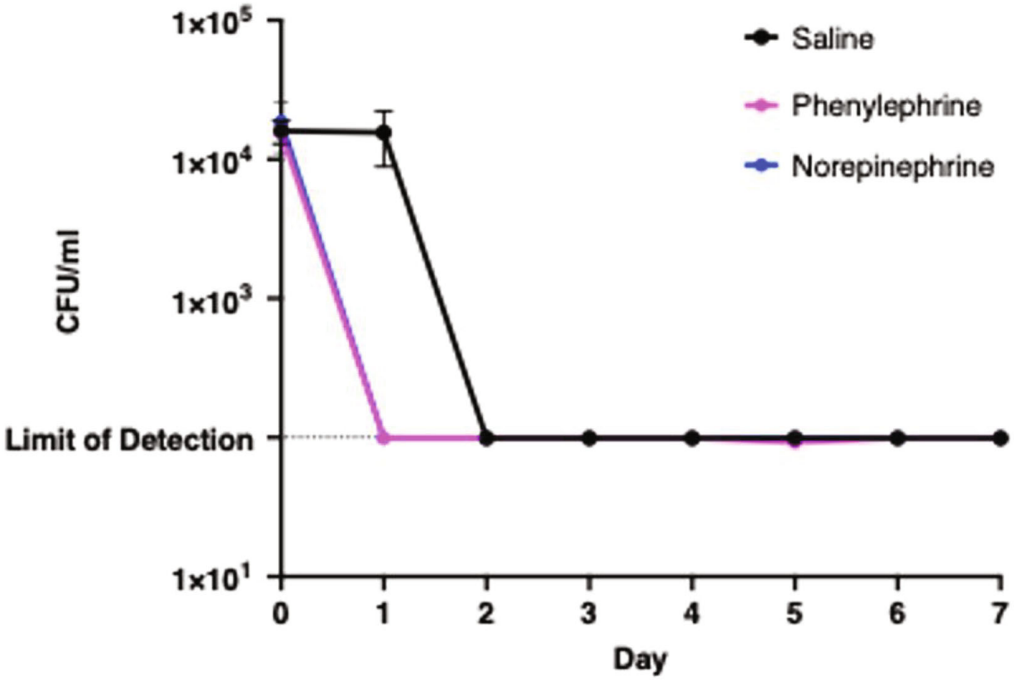
**Figure**


1×10^5
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7
Day
Saline
Phenylephrine
Norepinephrine

# Comparison of catheter malposition between left and right ultrasound-guided infraclavicular subclavian venous catheterizations: a randomized controlled trial

**Submission ID**

24

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**INTRODUCTION**

Central venous catheterization is commonly used in the intensive care unit (ICU) and operating theatre, with the subclavian vein often chosen because of its lower infection risk and enhanced patient comfort. Nevertheless, this procedure carries potential complications, including subclavian artery puncture, pneumothorax, and catheter malposition. Catheter malposition is particularly problematic in certain clinical scenarios, such as cranial surgery, as it can increase the risk of venous wall erosion, catheter dysfunction, and inaccurate central venous pressure measurement. Despite the advantages of ultrasound-guided subclavian venous catheterization (SVC) over landmark-guided methods, catheter malposition remains a concern. This study hypothesized that the malposition rate after ultrasound-guided infraclavicular catheterization would be lower with left access than with right access because of the asymmetry of the brachiocephalic veins. The research compared catheterization-related complications, including malposition, and the overall performance of left and right ultrasound-guided infraclavicular catheterizations.

**METHODS**

Patients were randomly assigned to either left ($n$ = 224) or right ($n$ = 225) SVC group. After anesthesia induction, a board-certified anaesthesiologist with extensive experience performed left or right ultrasound-guided infraclavicular SVC based on group assignment. The patient, in a supine position, underwent skin disinfection, and the anesthesiologist, wearing sterile attire, used a central venous catheterization set and a portable ultrasound machine. The ultrasound probe was positioned in the infraclavicular fossa, and after obtaining optimal views, SVC was attempted. Successful puncture was confirmed by blood aspiration, and a guidewire, dilator, and catheter were inserted. Time points were recorded, and if desaturation occurred or exceeded three minutes, the attempt was considered failed. After successful SVC,

ultrasonography checked for catheter malposition, and postsurgery, chest radiography was performed. If needed, subsequent attempts or landmark-guided SVC were conducted. Catheterization-related complications (incidence of catheter malposition rate [primary outcome measure], artery puncture, hematoma formation, pneumothorax, chylothorax, and desaturation) and catheterization performance (overall and first-pass success rates, number of attempts, incidence of posterior venous wall puncture, times, and number of insertions for needle, guidewire, dilator, and catheter) were investigated.

**RESULTS**

Catheter malposition rate was fewer (10 [4.5%] *vs* 31 [13.8%]; $P = 0.001$), especially into the ipsilateral internal jugular vein (9 [4.0%] *vs* 24 [10.7%]; $P = 0.007$), in the left SVC group than in the right SVC group. In the left SVC group, catheterization success rates on the first-pass (88 [39.3%] *vs* 65 [28.9%]; $P = 0.020$) and first attempt (198 [88.4%] *vs* 181 [80.4%]; $P = 0.020$) were higher whereas times for vein visualization (30 [18–50] sec *vs* 20 [13–38] sec; $P < 0.001$) and total catheterization (134 [113–182] sec *vs* 132 [103–170] sec; $P = 0.034$) were longer. There were no significant differences in other catheterization performance and catheterization-related complications between the two groups.

**DISCUSSION**

In this study, the catheter malposition rate was approximately 5% and 14% after left and right ultrasound-guided infraclavicular SVC, respectively. Left access demonstrated higher success rates on the first pass, although it required more time for vein visualization. Additionally, it is recommended to minimize catheter malposition, especially into the ipsilateral internal jugular vein, after ultrasound-guided infraclavicular SVC. Therefore, left access is recommended to reduce catheter malposition after ultrasound-guided infraclavicular SVC.

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# PEDIATRIC ANESTHESIA

## Anesthesia management for pediatric intestinal transplant– single-centre ten-year review

**Submission ID**

58

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**INTRODUCTION**

Pediatric intestinal transplantation (ITx), performed either in isolation or in combination with the liver or multivisceral transplantation, is an uncommonly performed surgery that is complex and challenging. It is the main treatment modality for progressive intestinal failure- associated liver disease, progressive loss of central vein access and repeated admissions requiring critical care management.[1] Previously reported challenges for the anesthesiologist include establishing vascular access, managing hemodynamics, and fluid and electrolytes management.[2] Existing literature mainly report perioperative anesthesia management of ITx in the adult population[2–4] with scattered cases reports of the pediatric ITx anesthesia management experience.[5] In this case series, we aim to evaluate a tertiary pediatric hospital's perioperative management of patients undergoing ITx between 2012 to 2023 and identify best practices to optimize perioperative anesthetic care.

**METHODS**

We received approval from the hospital's Research Ethics Board, who granted a waiver for written consent. Cases were identified from the intestine transplant patient list which tracks all children who have received ITx (isolated, combined liver-intestine or multivisceral) between January 2012 to August 2023. Data was obtained from a combination of the intestine transplant patient list and electronic medical records. Demographic information such as recipient and donor age, weight, height, sex was collected. Patients' electronic medical records were

interrogated for 1) preoperative data comprising comorbid or etiologic information, indication for transplant, pretransplant laboratory and pathological investigations, 2) intraoperative information including operative timings, choice of anesthetic and pain management modalities, volume of fluids and blood products administered, maximal doses of vasopressors and inotropic agents, number of central and peripheral vascular access, duration of postreperfusion syndrome (30% reduction in mean arterial pressure for at least one minute within ten minutes of unclamping), perioperative cardiac and respiratory complications, hypothermia, and 3) postoperative length of intensive care unit (ICU) stay, days to extubation, 30-day return to the operating room (OR), and one-year graft and patient survival. Data reporting consisted of median [interquartile range (IQR)] for continuous variables, and number (percentage) for categorical variables.

**RESULTS**

Eleven patients, median age 9.2 yr [range, 0.7–13.3] underwent ITx between 2012–2023. Eighty-one-point eight percent were male. Predominant diagnosis was Gastroschisis (45.5%) while progressive liver disease (54.5%) was main indication for transplant. Forty-five-point five percent had isolated ITx, 36.4% multivisceral transplant, 18.2% liver and intestine transplant. All patients had at least one central venous catheter placed by interventional radiologist. Median volume of red cells transfused was 24.4 $mL \cdot kg^{-1}$ [IQR, 21.4–74.3], FFP 40.3 $mL \cdot kg^{-1}$ [IQR, 21.4–7.8]. Median volume of crystalloids was 65.2 $mL \cdot kg^{-1}$ [IQR, 48.8–98.6], colloids 36.2 $mL \cdot kg^{-1}$ [IQR, 12–49]. For analgesia, all patients had opioid infusion. Thirty-six-point four percent patients received bilateral transversus abdominis plane block. Twenty-seven percent of patients were extubated in OR with median ICU stay of 3 days [range, 1–17]. One patient had post reperfusion syndrome at five minutes, while most (72.7%) patients were hypothermic ($T < 35$ °C). To date, one-year patient and graft survival is 100%.

**DISCUSSION**

Isolated and combined ITx in pediatric patients involves a high-risk population and poses significant challenges to the anesthesiologist. The anesthetic management should focus on: 1) preoperative planning for establishment of central and peripheral intravenous access with consideration for involvement of interventional radiology; 2) consider regional techniques for optimal analgesia; 3) anticipation of potential PRS by titrating inotropes prior to unclamping to raise mean arterial pressure 20% above baseline; 4) careful fluid management with crystalloids as the main fluid of choice; and 5) maintenance of intraoperative normothermia.

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# Enhancing caregiver recall in pediatric anesthesia consent: a randomized trial comparing standard verbal methods to visual aid-assisted consent

**Submission ID**

52

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**INTRODUCTION**

In pediatric anesthesia, caregiver comprehension is crucial for informed consent, given the unique challenges of assuming responsibility in the absence of patient consent. Consent relies on disclosure, comprehension, and voluntary choice; yet research in pediatric consent highlights a gap in caregiver comprehension and retention.[1] Ineffective consent can limit informed health care decisions and reduce trust in providers, impacting patient satisfaction and anesthesia outcomes.[2] Prior studies have demonstrated visual aids (VA) to be effective in various hospital settings, such as for procedural sedation in the pediatric emergency department, yet their impact in pediatric anesthesia remains understudied.[3,4] Caregivers were most uncertain about common side effects, major complications, postoperative planning/pain management, and reasons for fasting guidelines.[5] This study aims to develop and evaluate a visual aid for pediatric anesthesia consent, with the anticipation of enhancing caregiver understanding and recall of risks associated with general anesthesia.

**METHODS**

This randomized controlled trial involves caregivers of pediatric patients undergoing noncomplex elective surgeries under general anesthesia. Patients were randomly assigned to one of two groups: those undergoing the anesthesia consent process through standard verbal methods and those receiving verbal consent facilitated by a visual aid. The VA design describes general anesthesia with a pictorial representation of 15 common events and risks of anesthesia tailored to the pediatric population. Patients randomized to the standard consent method spoke with anesthesia providers based on their own personal practices, however, with an emphasis on common events/risks highlighted in the visual aid. After the consent process, a standardized questionnaire was administered to gather patient and caregiver characteristics and to evaluate caregiver recall and satisfaction, employing a 5-point Likert scale. Exclusion criteria: major or emergency surgery, American Society of Anesthesiologists Physical Status IV

or V, non-English speaking, pediatric patients consenting themselves, and caregiver refusal. Complex procedures were excluded because of differing risk profiles associated with anesthesia, and because of the possibility of excess preoperative anxiety confounding recall rates. Statistical analysis includes descriptive statistics, *t* tests, and linear regression.

**RESULTS**

In the preliminary data, 96 patients participated (52 assigned VA, 44 assigned standard). Parents consented with VA demonstrated significantly higher recall of risks and events than those consented using standard methods (mean, 4.3 *vs* 1.8; difference, 2.5; 95% confidence interval, 1.7 to 3.4). Seven-point-seven percent did not recall any risks/events in the VA group *vs* 25% in the standard group ($P < 0.05$). Both groups overwhelmingly found the information easy to understand and nonthreatening, reporting an excellent overall experience and agreeing the time allocated to consent to be appropriate. Despite exploring variables such as patient age, history of anesthesia exposure, caregiver education, gender, and caregiver's own exposure to anesthesia, linear regression models did not reveal any significant correlations with recall rates and these variables. A multivariate model incorporating these predictors yielded an adjusted $R^2$ of 0.241.

**DISCUSSION**

Integrating visual aids proves promising, as this study reveals significant disparities in recall rates between the VA and standard anesthesia consent groups. Despite good comprehension of the anesthesia process, a substantial proportion of caregivers in the standard consent group failed to recall crucial information, highlighting the limitations of verbal communication alone. Future efforts should focus on optimal delivery methods, with consideration to timing, and medium, online, or physical aids, to enhance caregiver comprehension and allow time to plan questions for the day of surgery. Adapting the VA for self-consenting pediatric patients holds the potential for broader application.

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# Is an abdominal compression test useful to predict fluid responsiveness in children undergoing general anesthesia?

**Submission ID**

87

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**INTRODUCTION**

Intraoperative hypovolemia is a leading cause of cardiac arrest during pediatric surgery.[1] Successful resuscitation is more likely when the underlying etiology is addressed making rapid and accurate etiological diagnosis critical.

Patients with improved cardiac output after intravascular volume resuscitation are termed fluid responsive, with fluid responsiveness generally defined by an increase in cardiac output by more than 15% in response to a bolus of intravascular fluid.[2] The abdominal compression test (ACT) is used in some pediatric intensive care units to determine if a patient is fluid responsive.[3] The test is based upon the reversible increase in cardiac preload with external pressure applied over the liver.[4] Despite its common use, the ACT has limited study in children, with no identifiable previous studies in children during the intraoperative period.[3] This study aimed to determine whether the abdominal compression test can accurately identify fluid responsive pediatric patients undergoing general anesthesia.

**METHODS**

A prospective, self-controlled, observational, diagnostic study was conducted following local Research Ethics Board approval. Consenting eligible participants included: ages between three months to 17 yr, American Society of Anesthesiology Physical Status I–III, undergoing elective procedures under general anesthesia scheduled for at least 30 min. Participants were excluded if they had hepatosplenomegaly, portal hypertension or an abdominal wall abscess.

The ACT included manually applying sustained 20–25 mm Hg pressure (calibrated using a sphygmomanometer) over the patient's right upper quadrant for approximately ten seconds. Two ACTs were performed on each patient during general anesthesia: first prior to the surgical procedure and before intravascular fluid administration (Time 1), second after procedure completion, intravascular fluid loading, and prior to anesthesia emergence (Time 2). Ultrasound

cardiac output assessment (Zonare ZS3 Ultrasound System, C9-3 probe; San Jose, CA, USA) was assessed by velocity time integrals (VTI) measured at the left ventricular outflow tract before and after each ACT. All ultrasound images and measurements were reviewed by a pediatric cardiologist to ensure adequate quality.

The primary outcome was % VTI change before and after each ACT, stratified by study assessment (Time 1 and 2); secondary outcomes included the assessment of ACT diagnostic accuracy to diagnose fluid responsiveness.

**RESULTS**

Thirty-eight patients were enrolled in this study including 23 males and 15 females, median age 52 months [IQR, 28.0–80.3], median weight 17.2 kg [IQR, 12.4–22.9], median preprocedural fast 235 min [IQR, 169–571], median intravenous fluids administered between first and second ACT 14.5 $mL \cdot kg^{-1}$ [8.7–20.3], median time between first and second ACT 44.4 min [IQR, 31.7–70.4).

At Time 1 (before intravascular fluid administration) the median VTI increase with ACT was 19.1% [IQR, 8.2–23.8]; at Time 2 (after fluid administration) the median VTI increase with ACT was 5.7% [IQR, 3.3–9.7] (Figure). The diagnostic accuracy of the ACT to assess fluid responsiveness as evaluated by the area under the receiver operating characteristic curve is 0.91 (0.81 to 1.00).

**DISCUSSION**

In a controlled operative room environment of otherwise healthy children, the ACT increased cardiac output to a greater extent in relatively hypovolemic children (Time 1) compared with the children who are generally volume replete (Time 2). The area under the receiver operating characteristic curve assessment of ACT to diagnose fluid responsiveness is 0.91 (0.81 to 1.00); a measurement described as excellent diagnosis accuracy.[5] Our findings suggest the abdominal compression test is a simple, useful clinical bedside tool to identify fluid responsive patients, although further study is warranted.

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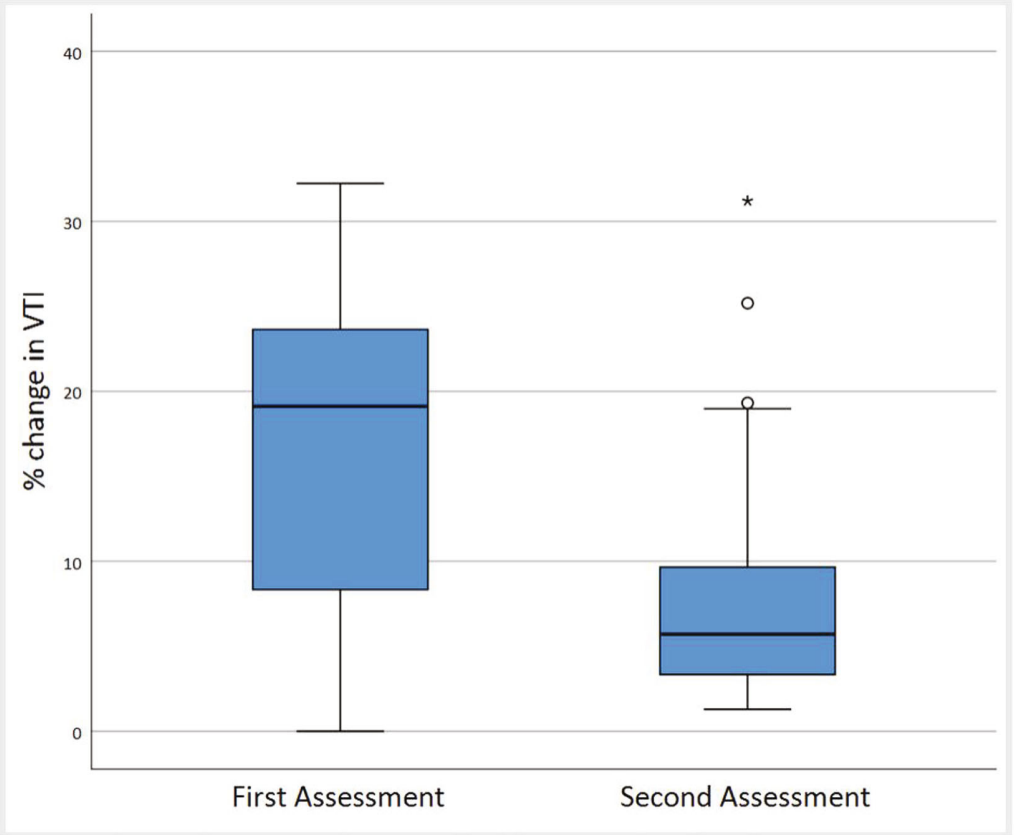
**Figure** Box and whisker plot of percent change in velocity time integral (cardiac output assessment) from pre- to postabdominal compression tests at first (time 1) and second (time 2) study assessments




*The boxplots contain the median (dark line in middle of boxes), interquartile range (upper and lower edges of the box), and upper and lower limits (1.5* interquartile range). This is also mentioned in a comment in the abstract.

# PERIOPERATIVE

## Adherence to, and barriers and facilitators of, prehabilitation for adult surgical patients: a systematic review

**Submission ID**

57

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**INTRODUCTION**

Prehabilitation is a uni- or multimodal intervention that aims to increase patients' reserves before surgery to improve postoperative recovery. Low certainty evidence suggests that prehabilitation interventions may improve outcomes,[1] but a key barrier to prehabilitation effectiveness is poor intervention adherence. In fact, several recent low risk of bias trials show large benefits from prehabilitation in adherent participants, but no impact across all participants because of low adherence.[2–4] While some reviews have identified predictors of, and barriers and facilitators to, exercise adherence, data specific to prehabilitation and multicomponent (e.g., exercise, nutrition, psychocognitive) interventions are lacking. Therefore, we undertook a systematic review: 1) to estimate prehabilitation adherence overall and by intervention component, 2) to describe how adherence is measured, 3) to identify predictors of adherence, and 4) to identify barriers and facilitators to adherence as reported in randomized trials of prehabilitation in adult surgical patients.

**METHODS**

Ethical review was not required for this prespecified substudy of a larger review focused on comparative efficacy of prehabilitation components. Our protocol was directly informed using integrated knowledge translation methods that engaged diverse partners. Best practices were used for duplicate title/abstract and full text review, applied using a peer-reviewed search strategy in seven biomedical databases without language restrictions (inception to February 2023). Studies of adult, surgical patients participants randomized to a prehabilitation program

for ≥ 7 days before elective surgery and that reported a measure of adherence were included. Data were extracted in duplicate from included studies, and authors were contacted to recover missing data. Adherence was extracted as reported (continuous measure of proportion of prehabilitation completed, or as a binary indicator of meeting a certain threshold of participation).

Descriptive statistics of included studies, measures of adherence, and median [interquartile range (IQR)] for adherence were calculated across all studies and for each prehabilitation component. Barriers and facilitators to adherence were identified with supporting text, and were inductively coded into themes by two authors. Themes were deductively organized per the Theoretical Domains Framework (TDF). An ongoing meta-regression analysis will estimate the association of pre-specified patient, procedural and program features with adherence.

**RESULTS**

We screened 5,498 titles and included 106 studies (*n* = 4,640), 43% underwent general, 23% orthopedic, and 19% thoracic surgery. Median adherence as a proportion of prehabilitation completed was 92% [IQR, 82–97] and 83% [IQR, 64–92] using threshold definitions. Nutritional adherence was 89% [IQR, 79–94] and exercise was 76% [IQR, 58–90]. Definitions used to measure adherence were heterogeneous.

We identified four barrier themes: 1) Health conditions (acute and chronic medical issues, gastrointestinal intolerance); 2) Personal factors (anxiety, time constraints, competing commitments); 3) Social influences (lack of social support, social roles); and 4) Logistical issues (lack of access to transport, supervision, supplements and information technology).

Six facilitator themes included: 1) Supervision (by physiotherapist/dietician); 2) Home-based training; 3) Personalization (individualized program, variety); 4) Access to resources (program materials, equipment, supplements and information technology); 5) Supporting program engagement (coaching, motivation); and 6) Presence of social support (training with relatives/support person) (TDF domains, Table).

**DISCUSSION**

Prehabilitation adherence is variable across trials, as are metrics used to quantify adherence. To improve reporting and interpretation of prehabilitation evidence, the field should establish common metrics and approaches to adherence measurement. To increase prehabilitation efficacy through improved adherence, TDF-informed barriers and facilitators identified in our review could be linked to evidence-based strategies using the related Behaviour Change Matrix (e.g., use of incentives and self-monitoring to overcome Beliefs about capabilities.[5] Promisingly, many factors identified as barriers had their counter condition identified as a facilitator (e.g., lack of supervision as barrier, presence of supervision as facilitator).

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## Table

| Theme | Example (s) | TDF Domain (s) |
|---|---|---|
| **Barriers** | | |
| Health conditions | Acute and chronic medical issues, gastrointestinal intolerance | Beliefs about capabilities |
| Personal factors | Anxiety, time constraints, competing commitments | Emotion, Goals, Behavioural regulation |
| Social influences | Lack of social support, social roles | Social influences, Social role and identity |
| Logistical issues | Lack of access to transport, training supervision, supplements and information technology | Environmental context and resources, Reinforcement |
| **Facilitators** | | |
| Supervision by specialists | Partially/fully supervision by physiotherapist/dietitian following individual progression | Behavioural regulations, Environmental context and resources |
| Home-based training | | Environmental context and resources |
| Personalization | Tailored training/nutrition to patient and home environment, variety in nutrition | Behavioural regulation |
| Adequate access to supplements/equipment | Training booklet, videos, pedometer, step-trainer, heart rate monitor, jug, shaker bottle, mobile software application | Environmental context and resources |
| Supporting and reinforcing program engagement | Coaching, motivation techniques | Beliefs about capabilities, Beliefs about consequences, Optimism, Goals, Reinforcement |
| Presence of social support | Training with relatives/support person | Social influences, Reinforcement |

# Assessing the Fragility Index of randomized controlled trials supporting perioperative care guidelines: preliminary results of a methodological survey

**Submission ID**

76

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**INTRODUCTION**

The Fragility Index (FI) and the Reverse Fragility Index (rFI) indicate the number of events needed to change and revert the study's statistical significance.[1] Robustness analysis evaluates how minor changes impact outcomes in Randomized Controlled Trials (RCTs), offering valuable insights into the stability and susceptibility to manipulation or misinterpretation of statistically insignificant results.[3]

Limitations in conducting RCTs in perioperative medicine, including nonstatistically significant results and susceptibility to spin bias, have spurred comprehensive research methods for better study comparisons.[3] Using fragility assessment as a complementary measure to determine study stability has been proposed as a potential solution.[4]

This study surveyed Clinical Practice Guidelines (CPGs) from the North American and European Societies of Anesthesiology published in the last ten years to determine their FI/rFI and explore trial characteristics associated with fragility.

**METHODS**

Randomized controlled trials supporting CPGs from the American and European Societies of Anesthesia were systematically surveyed. The updated protocol is registered with the OSF registries (Registration DOI: 10.17605/OSF.IO/8KBPE). Our report follows Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines for methodological investigations.[5]

Perioperative CPGs created between January 2012 and December 2022 by the European and North American Societies of Anesthesia were identified. All documents clearly designated as “guidelines” were included, while pain management and critical care evidence-based guidelines, practice advisories, consensus statements, and less recent guideline iterations were excluded.

To find all human clinical trials mentioned in each guideline, we surveyed chosen CPGs. Fragility analysis used only two-parallel-arm or two-by-two factorial trials with a 1:1 allocation ratio, assessing a binary outcome.

The Fragility Index will be computed using a random sample of 200 RCTs meeting eligibility criteria, stratified by recommended categories (general, regional, obstetric, pediatric, neuro-anesthesia, and cardiovascular).

Data from the included guidelines were collected separately by six team members. Reviewers compared results, settling conflicts by consensus. If the guidelines targeted a multidisciplinary audience, the total recommendations were counted, but for FI analysis, only those for anesthesiologists were considered.

**RESULTS**

Of the 2,934 references found, 64 guidelines were used in the analysis. The Figure displays the PRISMA Flowchart.

ERAS guidelines accounted for 39% (*n* = 25), Task Force and Working Group guidelines for 36% (*n* = 23), and CPGs for 33% (*n* = 21). Forty-eight percent (*n* = 31) used the GRADE System for classifying evidence quality, 39% (*n* = 25) used a society-based method, 9% (*n* = 6) used the ACC/AHA Classification System, and 3% (*n* = 2) did not report the classification system used.

Seventy-four percent (*n* = 1.841) of the 2,476 recommendations relate to general anesthesia care. The studies' quality was: 34% low (*n* = 835), 22% intermediate (*n* = 550), 19% high (*n* = 482), and 25% unknown (*n* = 609).

The 1,918 RCTs obtained from the survey are being evaluated for eligibility; of these, approximately 30% have satisfied the inclusion criteria for FI/rFI assessment.

**DISCUSSION**

Methodological differences exist in evaluating evidence levels across guidelines; 48% use the GRADE system, and 39% employ adaptations of various grading systems. These adaptations combine ACC/AHA, GRADE, and the Oxford Centre for Evidence-Based Medicine, incorporating separate categories for expert opinion-based recommendations. Our results align with Laserna *et al*.[5] Notably, 609 of 2,476 recommendations omit quality reporting.

While guideline quality was not assessed, the widespread under-reporting aligns with concerns raised in prior studies. Preliminary findings stress the need for standardized CPG methodologies to enhance research reliability. FI/rFI assessments will shed light on anesthetic trial strength and potential fragility factors.

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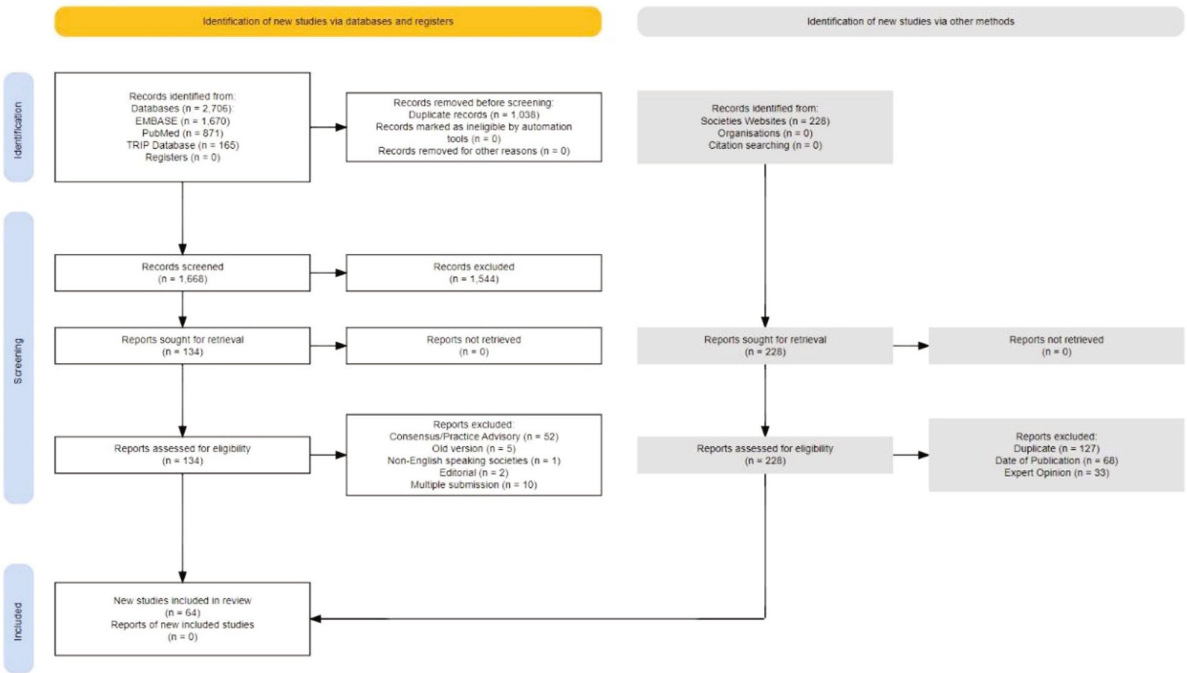
## Figure



# Atypical takotsubo cardiomyopathy post microlaryngoscopy dilatation of subglottic stenosis: a case report

**Submission ID**

92

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## INTRODUCTION

One of the complications of general anesthesia post operatively is hemodynamic instability, the deferential diagnosis can be listed from the most common as hypovolemia into the least common as acute nonischemic cardiomyopathy (Takotsubo syndrome). Takotsubo syndrome is a reversible acute heart failure because of nonischemic cardiomyopathy and characteristic regional motion abnormality, was first described in the Japanese population by Sato *et al*. in the 1990s.[1] The similarity of signs and symptoms for different reasons of this critical presentation requires a thorough examination and quick decision to guide the management of patient. Point of care Ultrasound, POCUS, considered as a crucial tool to diagnose such a rare critical condition in post anesthesia care unit and it can lead to a definitive diagnosis and optimum outcome for our patient.[2]

## CASE PRESENTATION

A 52-yr-old female with idiopathic subglottic stenosis presented for microlaryngoscopy with balloon dilation of her subglottic stenosis. Her past medical history is significant for Sjogren's syndrome, hypothyroid and bronchial webbing (interstitial lung disease). After uneventful surgery and general anesthesia, she was transferred to postanesthesia care unit (PACU). after 30 min she developed an acute onset of atrial fibrillation with rapid ventricular response and borderline hypotension with mean arterial pressure around 65 mmHg. Patient was fully conscious, no chest pain, no signs or symptoms of heart failure, good capillary refill and her skin was warm to touch An immediate lung and Heart POCUS has been performed by her anesthesiologist and it showed no acute pathology in her lungs and her ECHO was positive for severely reduced left ventricular ejection fraction (EF was estimated visually to be 25–30%) and there was akinesis of all basal and mid ventricular segments and preserved apical contractility. Right ventricular function was preserved and there was no significant valvular pathology. As the patient had a normal ECHO before and the new imaging shows an acute cardiomyopathy with heart failure so a diagnosis of atypical Takotsubo syndrome was on top of the differential

diagnosis, and patient transferred immediately to intensive care unit to further monitoring, management of the acute heart failure as well as to confirm the diagnosis since it is a diagnosis of exclusion. The patient was discharged from hospital and followed up in cardiology clinic where another Echo was performed after one month and showed normal findings.

**CONCLUSION**

This case report emphasizes the role of point of care ultrasound for diagnosis unstable critically ill patients in perioperative period and how it can guide management without delay. TTE was performed by the anesthesiologist in the Post Anesthesia Care unit and the findings obtained immediately and the diagnosis of Reverse Takotsubo syndrome was the most likely to explain the patient presentation after excluding other causes. POCUS helped in continuity of care and a favorable outcome for this patient.

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# Changes in health-related quality of life in young-old and old-old patients undergoing elective orthopedic surgery: a systematic review

**Submission ID**

17

**AUTHORS**

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**INTRODUCTION**

Joint replacement surgery is a commonly performed operation, and demand is expected to increase with the aging population.[1] The primary objective of these procedures is to improve the quality of life for older patients. Nevertheless, there is a notable gap in research exploring differences in postoperative health-related quality of life (HRQoL) changes among patients aged 65 yr and older. Given the broad age range within the older population, there is a significant need to identify clinically relevant differences in HRQoL outcomes between young-old and old-old adults undergoing elective orthopedic surgery. This systematic review aims to investigate variations in HRQoL improvement, as assessed by patient-reported outcome measures, following total hip arthroplasty (THA), total knee arthroplasty (TKA), and partial knee arthroplasty (PKA) between young-old and old-old adults.

**METHODS**

A comprehensive search of six electronic databases was conducted from their inception dates to 15 May 2023. Inclusion criteria were patients aged ≥ 65 yr undergoing TKA, THA, or PKA who were assessed preoperatively and postoperatively using validated HRQoL assessment tools, including the EuroQol five-dimension (EQ-5D), Short Form 36 (SF-36), and Short Form 12 (SF-12). Qualitative analyses were performed for the included studies, summarizing study characteristics, patient demographics, pre- and postoperative HRQoL scores at common timelines (3-, 12-, and 24-months), and secondary outcomes. Descriptive summaries were provided for the primary outcome, which was the change in HRQoL postoperatively compared with the baseline score between young-old and old-old groups. Additional outcomes included

postoperative complications, length of stay (LOS), and mortality. While consensus on the optimal sub-classification of older adults into different age groups is lacking, several studies designated individuals aged 65–74 yr as young-old and those aged 75 and above as old-old.[2–4] Accordingly, we defined "young-old" as individuals aged 65–74 yr and "old-old" as those aged ≥ 75 yr. In cases where these age groups were not used, we classified the younger group (< 80) as "young-old" and the older age group (≥ 80) as "old-old."

**RESULTS**

The search yielded 12,229 articles; twelve studies (*n* = 103,613) were included. Studies using EQ-5D found no significant differences between young-old and old-old patients after hip and knee arthroplasty. Analyses of SF-36 and SF-12 scales showed no significant age-related differences in postoperative improvements in physical and mental health. Our review of four studies that included multivariable analyses revealed inconsistent associations between age and EQ-5D. Some studies reported enhanced EQ-5D improvements in older patients, while others suggested older age correlated with decreased postoperative EQ-5D change. Nonetheless, we found that even the old-old patients had measurable improvements in their HRQoL scores. Analysis of various factors influencing EQ-5D indicated preoperative EQ-5D had a negative correlation, while being female and not having comorbidities exhibited positive associations with EQ-5D improvement. Comparisons between young-old and old-old age groups in postoperative complications, hospital LOS, and mortality revealed no associated age-related changes in HRQoL.

**DISCUSSION**

Young-old and old-old patients exhibited comparable improvements in HRQoL following hip and knee arthroplasty. Older patients did not have higher rates of postoperative complications, longer hospital LOS, and increased mortality. Our comprehensive comparison of postoperative HRQoL changes within the wide age spectrum of the older population emphasizes that age is not a barrier to effective surgery. Challenging biased assumptions about older patients' tolerance and benefits from surgery is crucial, given the growing population aged 65 yr and older.[5] While chronological age is a consideration in joint arthroplasty, priority should be placed on assessing patients' comorbidities and functional status.

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**Table** Multivariate analysis of factors associated with postoperative EQ-5D change

| First author, year | Postoperative timepoint (months) | Association between age and EQ-5D change | Other coefficients for EQ-5D change |
|---|---|---|---|
| Aalund, 2017 | 3<br>12 | 0.0026 (P<0.001)<br>0.0020 (P=0.001) | Preoperative EQ-5D score:<br>-0.841 (P<0.001)<br>-0.804 (P<0.001) |
| Gordon, 2014 | 12 | Negative, non-linear association | Preoperative EQ-5D score:<br>-3.9 |
| Miao, 2018 | 6 | n.s. | Women: 7.613 (P<0.05)<br>No comorbidities: 3.259 (P<0.05)<br>Employment status, living status, physical barriers at home: n.s. |
| Williams, 2013 | 6<br>24 | Negative, linear association:<br>P=0.013<br>P=0.033 | NR |

EQ-5D = EuroQol-5 dimension; NR = not reported = n.s. = not significant

# Defining the minimal clinically important difference of days alive and at home within 30 days after inpatient noncardiac surgery

**Submission ID**

37

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**INTRODUCTION**

Days alive and at home within 30 days after surgery (DAH30) is a newly validated perioperative outcome that has garnered significant interest in recent years, in light of improved understanding of the gaps in patient-centred indices of surgical recovery. Unlike traditional measures of mortality, morbidity, and length of stay, DAH30 offers the advantage of encapsulating additional patient-centred aspects of the perioperative experience, including functional status, the quality of recovery and postdischarge disposition, while remaining equally accessible. To facilitate its use in research and quality improvement, there is a need to define the Minimal Clinically Important Difference (MCID) of DAH30, which specifies the minimum number of additional days at home after surgery that may be perceived as meaningful and relevant to patients beyond statistical significance alone. Our objective was to define and externally validate the MCID of DAH30 for patients undergoing elective noncardiac inpatient surgery at a population level.

**METHODS**

After Research Ethics Board approval, we conducted a cross-sectional analysis of linked health administrative data in Ontario (ON) and Nova Scotia (NS). This study included all patients aged ≥ 45 yr undergoing inpatient elective noncardiac surgery in the province of Ontario as well as two tertiary hospitals in Halifax from 2013 to 2017. Organ donors and patients with unlinkable records were excluded. DAH30 was calculated by subtracting 30 days by the number of days spent admitted in a hospital (including re-admissions) within 30 days after surgery. Patients who died intraoperatively or during the index hospitalization would be assigned a DAH30 value of 0. The MCID was evaluated using both distribution-based and anchor-based methods, as per recent expert-consensus methodology. For distribution-based methods, we calculated 0.3 standard deviation (SD), 5%, and 10% range of DAH30. For anchor-based methods, we

calculated the median difference in DAH30 amongst 1) patients who had 30-day in-hospital postoperative morbidity (composite of major complications including cardiac, respiratory, renal and neurological complications) compared to those who did not, and 2) patients who required a postoperative intensive care unit (ICU) admission, compared to those who did not.

**RESULTS**

We identified a cohort of 559,626 patients undergoing elective inpatient noncardiac surgery (15,477 patients in NS, 544,149 patients in ON) with a mean (SD) age of 67.6 (10) yr. 52.7% of patients were female and the median duration of surgery was 121 min [IQR, 95–182]. The median DAH30 was 25 days (22 to 27). The 5% and 10% of DAH30 range was 1.5 and 3.0 days, respectively, and the 0.3 SD was 1.9 days. Triangulation of these methods show a distribution-based MCID for DAH30 of 2.1 days. Composite postoperative morbidity occurred in 12.3% of patients and 6.5% of patients required postoperative ICU admissions. Anchor-based methods of MCID produced an MCID of 7 and 6 days, anchored to composite morbidity and ICU admission, respectively. The MCID of DAH30 did not differ based on sex or comorbidity indices, but urological and obstetrical/gynecological surgery showed a lower MCID in subgroup analysis.

**DISCUSSION**

We defined the minimal clinically important difference of DAH30 in the largest surgical cohort to date spanning two provinces in Canada and across all inpatient noncardiac surgical specialties. Distribution and anchor-based methods per recommended MCID methodology were used and the MCID values across clinical subgroups were compared. This will guide the clinical interpretation of DAH30 as a newly validated patient-centred perioperative outcome and inform future research and clinical trial design.

**REFERENCES**

No references.

# Effectiveness of dexmedetomidine during surgery under general anesthesia on patient-centred outcomes: a systematic review and Bayesian meta-analysis

**Submission ID**

59

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**INTRODUCTION**

Dexmedetomidine (an alpha-2 agonist) has been increasingly used off-labelled as an opioid minimization strategy for surgical patients during and after general anaesthesia.[1] This strategy can reduce short-term opioid use as well as opioid-related adverse events, however, its impact on patient-centred outcomes (i.e., outcomes that are meaningful to patients) and clinically important adverse events remains uncertain.[2] Patient-centred outcomes are recommended in the evaluation of opioid minimization strategies, but they are critically underreported in randomized clinical trials (RCTs).[3,4] Our main objective is to evaluate the impact of dexmedetomidine initiated during surgery compared to placebo, opioid, or usual standard of care on patient-centred outcomes among adult surgical patients following general anaesthesia and determine the certainty of evidence.

## METHODS

We conducted a systematic review and Bayesian meta-analysis following the Cochrane's Handbook recommendations. We searched MEDLINE, Embase, CENTRAL, Web of Science, and CINAHL, and included RCTs evaluating the intraoperative use of dexmedetomidine that reported at least one patient-centred outcome. Our primary outcome was the postoperative quality of recovery (QoR). Our secondary outcomes included patients' well-being, function, health-related quality of life, life impact, multidimensional acute pain, chronic pain, persistent opioid use, opioid-related adverse events, hospital length of stay, and clinically important adverse events (i.e., requiring an intervention). Citations were identified, screened, and extracted in duplicates. We conducted meta-analyses using random effects Bayesian model with weak informative prior. We estimated the probability of achieving any benefit as well as the probability of achieving a clinically significant benefit (minimally important difference = 6 units for QoR-15). Tools with similar constructs were pooled as standardized mean difference and converted to their respective original scales to facilitate clinical interpretation.[5] We assessed statistical heterogeneity with the tau-squared and explored sources of heterogeneity with meta-regressions. We assessed the risk of bias of RCTs using the Cochrane's Risk of Bias 2.0 tool and the certainty of evidence using the Grading of Recommendations, Assessment, Development, and Evaluations (GRADE) methodology.

## RESULTS

We identified 49,069 citations from our search strategy, of which 44 RCTs involving 5,904 participants were included in our meta-analyses. The median duration of infusion was 2.3 hr [IQR, 1.7–3.9] and the median dose of the bolus and intraoperative infusion respectively were 0.5 $\mu g \cdot kg^{-1}$ [IQR, 0.5–1.0] and 0.5 $\mu g \cdot kg^{-1} \cdot h^{-1}$ [IQR, 0.4–0.5]. Intraoperative dexmedetomidine administration was associated with an improvement in postoperative Quality of Recovery (mean difference [MD] in QoR-15 = 8.88; 95% credible interval [CrI]; 3.46 to 14.22, *n* = 21 RCTs, moderate certainty of evidence). We found a 99% probability of any benefit and 86% probability of clinically meaningful benefit. We estimated a 99% probability of any benefit on chronic pain incidence (low certainty of evidence), and 94% (clinically significant hypotension) and 96% (clinically significant bradycardia) probabilities of harm (both very low certainty of evidence).

## DISCUSSION

In our systematic review and meta-analysis, we found a high probability that dexmedetomidine initiated during surgery under general anaesthesia may lead to a clinically appreciable improvement in the quality of recovery and chronic pain after surgery. We also found an increased risk of hypotension and bradycardia requiring intervention that was supported by very low certainty of evidence. This shows the need for further high-quality RCTs to determine the safety and effectiveness of intraoperative dexmedetomidine among adult surgical patients.

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# Feasibility of an online, self-administered cognitive screening tool in older patients undergoing ambulatory surgery

## Submission ID

79

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## INTRODUCTION

An increasing number of older adults are undergoing surgery on an ambulatory basis. Up to 37% of older adults undergoing elective noncardiac surgery may have undiagnosed cognitive impairment.[1] Cognitive impairment is associated with increased rates of perioperative delirium and other adverse outcomes,[2] however, there are few studies on perioperative neurocognitive disorders (PND) in older adults undergoing ambulatory surgery. Preoperative cognitive screening of older adults has been recommended but is challenging to perform in busy preoperative clinics.[3] Self-administered computerized assessments may have potential benefits compared to traditional cognitive assessments including remote assessments, not needing an administrator, automated scoring, decreased assessor bias, and higher standardization. The objective of this study was to assess the feasibility of using the Brain Health Assessment (BHA)—a self-administered, web-based cognitive screening tool previously validated in the general population against the MoCA to screen older adults for cognitive impairment before ambulatory surgery.[4,5]

## METHODS

Research ethics board approval was obtained. Inclusion criteria: adults (> 65 yr of age) undergoing ambulatory surgery, proficient in English. Exclusion criteria: intracranial surgery or previous diagnosis of major neurocognitive disorders. Written informed consent was obtained from all participants. The primary feasibility outcome was implementation (recruitment and retention rate). Other feasibility outcomes included acceptability (satisfaction with the BHA), demand (to what extent the BHA is likely to be used by patients, and practicality (to what extent the BHA can be carried out with intended participants). We hypothesized that: 1) recruitment rate would meet 30%, with 90% retention, 2) > 70% of participants would find the BHA satisfying, 3) the BHA would be preferred by > 50% of participants, and that 4) >70% of

participants would be comfortable and capable of completing the BHA. Participants who could not complete the BHA because of lack of computer competency, or who were unwilling to participate long-term, were asked to complete baseline assessments and the Animal Fluency Test (AFT) prior to surgery. Participants with computer competency were asked to complete the BHA preoperatively and 1 week, 1 month, and 3 months following surgery as well as a BHA usability survey at one week following their surgery.

**RESULTS**

A total of 458 participants were assessed for eligibility. Reasons for exclusion are shown in the Figure. A total of 78 participants were recruited with a median age [IQR] of 70.0 [66.8–74.3], 41/78 (41%) female participants, 64/78 (84.2%) participants with higher than high-school education. Sixty-one participants agreed to do the BHA, and 56 completed the baseline BHA assessment.

Implementation - recruitment rate was 23%, with retention rate of 55/61 (90%) at one week, 51/61 (83%) at one month, and 40/61 (65.5%) at three months.

Acceptability was high with 55/56 (99.2%) of participants finding the BHA website easy to navigate and language easy to understand. Demand was high with 55/56 (99.2%) participants preferring digital to provider-administered assessments. Practicality was high with 70/75 (93.3%) of participants comfortable with using computers, 64/78 (82%) participants using computers on a daily basis, and 47/56 (83.9%) found the BHA to be not technologically challenging.

**DISCUSSION**

Our feasibility outcome, recruitment rate was lower than anticipated. The retention rates were high at one week and one month but decreased three months after surgery. This may be partially attributed to the study being conducted during the COVID-19 pandemic as many participants cited being over-burdened with telephone/virtual assessments. Of the other feasibility outcomes, acceptability, demand, and practicality were high. The high rate of baseline completion of the BHA and its favourable useability by participants in this study suggests that the BHA may be a feasible cognitive screening tool in more technologically savvy older adults undergoing ambulatory surgery.

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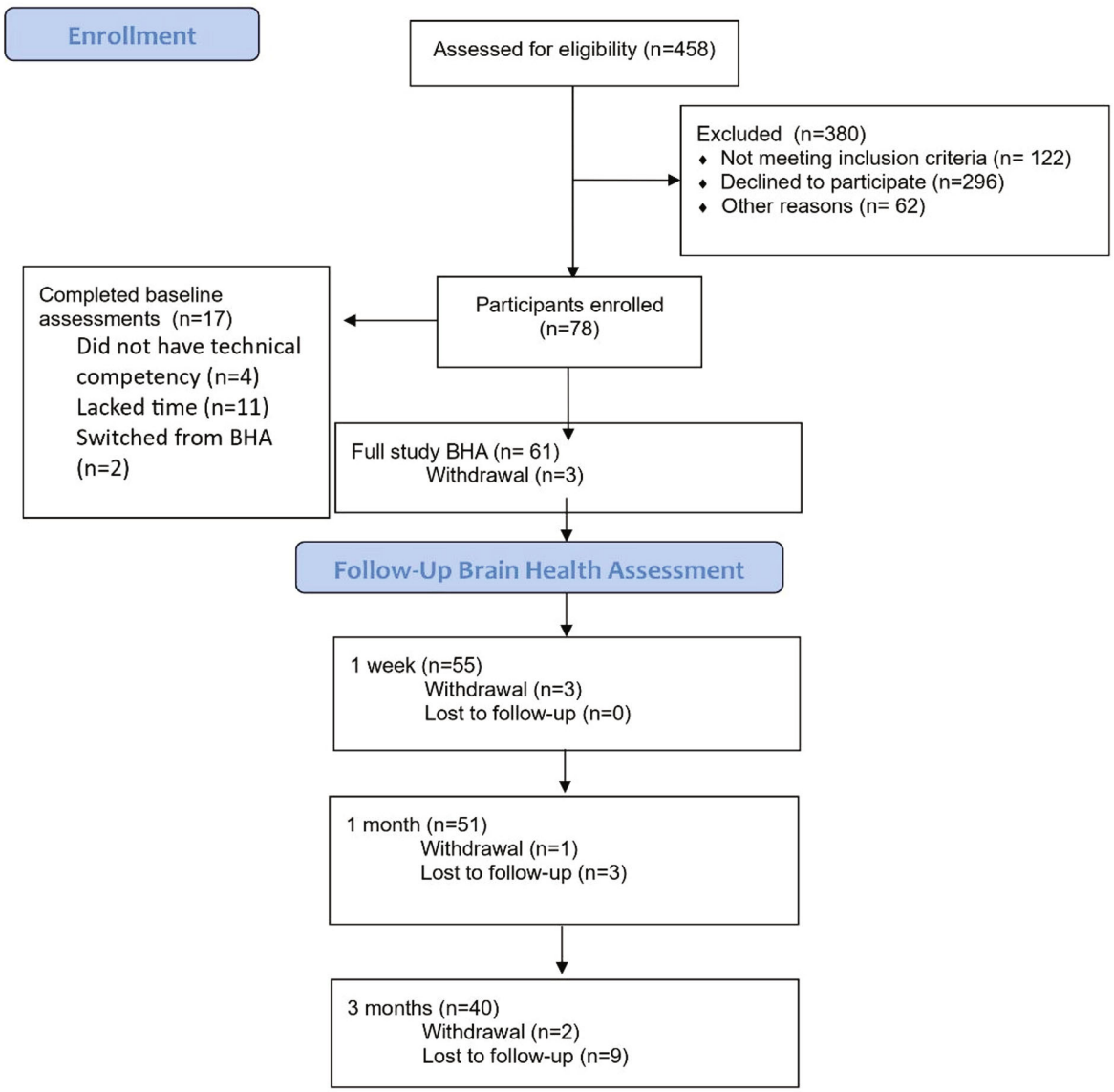
**Figure**



# Intraoperative hypotension during liver transplantation and acute kidney injury: a retrospective cohort study

## Submission ID

120

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## INTRODUCTION

Acute Kidney Injury (AKI) after orthotopic liver transplantation occurs frequently and is associated with prolonged intensive care unit (ICU) and hospital stay, increased risk of developing chronic renal disease, and decreased graft survival. Recent study showed that a mean arterial pressure (MAP) of < 55 mm Hg for a duration over 20 min is associated with postoperative AKI.[1] This intraoperative hypotension is a potential modifiable risk factor for the clinician.

With the current study we aimed to determine in which of the different phases of liver transplantation hypotension has the strongest association with AKI: the an-hepatic or the postreperfusion phase. This would provide guidance to the clinician if one would aim to minimize the occurrence of hypotension.

## METHODS

This was a retrospective single-centre cohort study in adult patients undergoing liver transplantation between January 2016 and June 2022. The local research ethics board approved the study with a waiver for informed consent. Exclusion criteria included combined kidney-liver transplant or multivisceral transplant, absence of digital hemodynamic data, death or retransplantation within 48 hr. Primary outcome was AKI defined as the Kidney Disease Improving Global Outcomes (KDIGO) criteria:[2] an absolute increase in serum creatinine of 26.5 umol·$L^{-1}$ or a relative 1.5 increase from baseline value. The exposure was hypotension, defined as the duration (in minutes) below MAPs of 75, 70, 65, 60, 55, 50, 45, and 40 mm Hg, during the total duration of transplantation, during the an-hepatic phase and neohepatic phase. Multivariable logistic regression analysis was used to explore the association between

intraoperative hypotension, quantified by time duration (in min) under various MAP thresholds, and the primary outcome of early postoperative AKI according to the KDIGO criteria.

**RESULTS**

The etiology of liver disease of 1,259 patients included, was HCC (39%), alcoholic cirrhosis (21%), nonalcoholic steatohepatitis (20%) and Hepatitis C (20%). Median age was 58 yr, median MELD-NA score was 19 (SD, 12–29) and 34% of the donor type was living-related. Classic caval interposition was used in 74% and full caval clamp in 80% of cases. Cold ischemic time was 346 min (SD, 151–473) and warm ischemia 48 min (SD, 37–59). Median estimated blood loss was 2.5L (SD, 1.5–4.1). Transfused units of red blood cells were 3 (SD, 1–6).

AKI occurred in 577 patients (46%). Univariable analysis showed an association between AKI and MAP < 55 mm Hg for > 20 min (OR, 2.3; 95% confidence interval [CI], 1.3 to 4.1). During the an-hepatic phase the association became apparent at a MAP < 60 mm Hg for > 20 min (OR, 1.5; 95% CI, 1.0 to 2.3) and became stronger at MAP < 55 mm Hg for > 20 min (OR, 2.4; 95% CI, 1.2 to 5.2). Confounder for the association was an etiology of acute hepatic failure.

**DISCUSSION**

Intraoperative hypotension (MAP < 55 mm Hg) is independently associated with AKI following liver transplantation. In the current study we found that this association is mainly because of hypotension during the an-hepatic phase and not during the neo-hepatic phase. Additional hemodynamic support should be considered in the an-hepatic phase to optimize postoperative kidney function.

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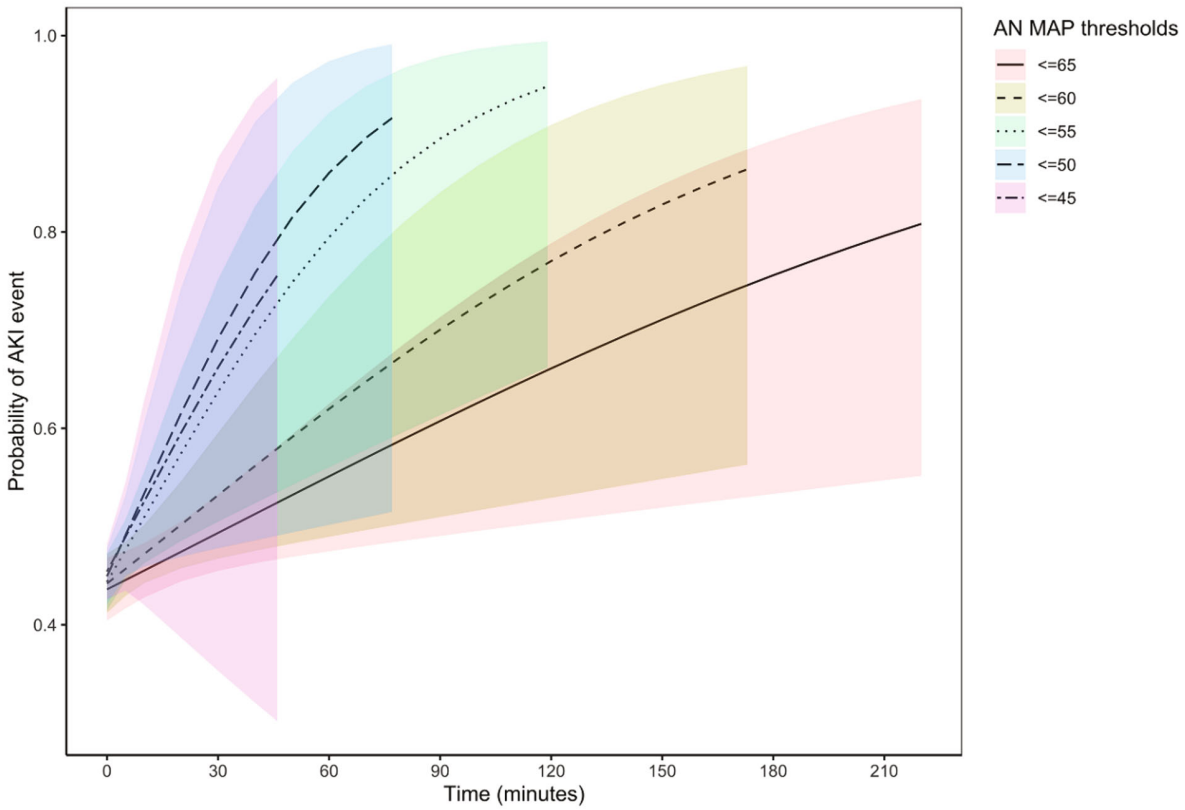
## Figure


AN MAP thresholds
<=65
<=60
<=55
<=50
<=45
Probability of AKI event
1.0
0.8
0.6
0.4
0
30
60
90
120
150
180
210
Time (minutes)

# Optimizing patient-centred and environmentally sustainable preoperative anesthesiology care through virtual consultation: a population-based comparative effectiveness study

**Submission ID**

38

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## INTRODUCTION

More than 300 million surgeries are performed annually.[1] Most are elective and involve a preoperative anesthesiology consultation. Observational data consistently suggest consistent benefits in reducing morbidity, mortality, length of stay (LOS) and costs.[2,3]

While anesthesiology consultations appear to provide benefit, the process of preoperative consultation has detrimental impacts for patients and the environment. Travel for preoperative visits contributes to the estimated 5 million kg of carbon dioxide equivalents (KgCO2-eq) generated yearly in providing surgery.[4] Patients also identify logistical challenges in accessing in-person appointments.

Virtual delivery of anesthesiology consultations represents a strategy that could reduce the carbon intensity of routine perioperative processes, and improve access for patients. Introduction of virtual consults during the pandemic represents a natural experiment that can be harnessed to estimate the comparative effectiveness of virtual *vs* in-person consultations in terms clinical outcomes, carbon emissions, and travel time.

## METHODS

Research ethics board review was waived under provincial privacy legislation. This was a historical population-based cohort study using linked administrative data.

We identified all American Society of Anesthesiologists (ASA) Physical Status III–IV adults having preoperative anesthesiology consultation prior to elective, intermediate- to high-risk, noncardiac surgery in one Canadian province (1 October 2020 to 1 March 2022). The exposure was virtual *vs* in-person anesthesiology consultation, identified using validated physician billing codes. The primary clinical outcome was 90-day mortality or major morbidity (Clavien-Dindo grade 3–5); secondary outcomes were 90-day: mortality, LOS, days alive and at home (DAH),

and health system costs. Environmental and patient-convenience outcomes were KgCO2-eq and estimated travel distance, calculated using validated methods.

Clinical outcomes were analyzed under a noninferiority framework, with a relative margin of 1.10 (noninferiority concluded if the upper 2-sided 95% confidence interval [CI] was < 1.10). Confounder adjustment used propensity score (PS) overlap weights, with the PS based on age, sex, year of surgery, hospital type, income quintile, surgery type, all Elixhauser comorbidities, ASA score, cancer status, frailty index score, and receipt of a concurrent preoperative medical consultation. Regression outcome models then adjusted for the PS overlap weight and for individual hospital using generalized estimating equations.

**RESULTS**

Among 24,135 nonorthopedic elective surgeries identified, 8,628 patients had an in-person anesthesiology consultation while 8,399 had a virtual consultation in 60-days before surgery. Prior to weighting, virtual consult patients were more likely to go to a teaching centre, have peripheral artery surgery or endovascular aneurysm repair; in-person consults were more common for ASA Physical Status IV and thoracic surgery patients. PS-weighted cohorts had no differences in baseline variables.

Prior to PS-weighted adjustment, virtual consultation was associated with greater morbidity and mortality (OR, 1.08; 95% CI, 1.01 to 1.16); after adjustment, the noninferiority of virtual consults with morbidity and mortality was inconclusive (OR, 0.99; 95% CI, 0.89 to 1.101). Noninferiority of secondary clinical outcomes was found for LOS, total costs, DAH, and major morbidity; noninferiority was inconclusive for mortality (see Figure).

Each virtual visit was estimated to save 42 (SD 83) km of driving distance, and to reduce 8,618 (SD, 17,199) KgCO2-eq emissions.

**DISCUSSION**

In a population-based study, we found inconclusive evidence for the noninferiority of virtual anesthesiology consultations compared to in person for the primary outcome of major morbidity and mortality; noninferiority was shown for associations with LOS, costs, DAH, and major morbidity. As randomized trials and meta-analyses[5] suggest that virtual consults are noninferior to regarding cancellations and processes of care, our data may support ongoing use of virtual anesthesiology consultations. As virtual consults support health system sustainability and convenience, these data could help patients make an informed decision regarding the modality of preoperative consultation that best fits their needs and preferences.

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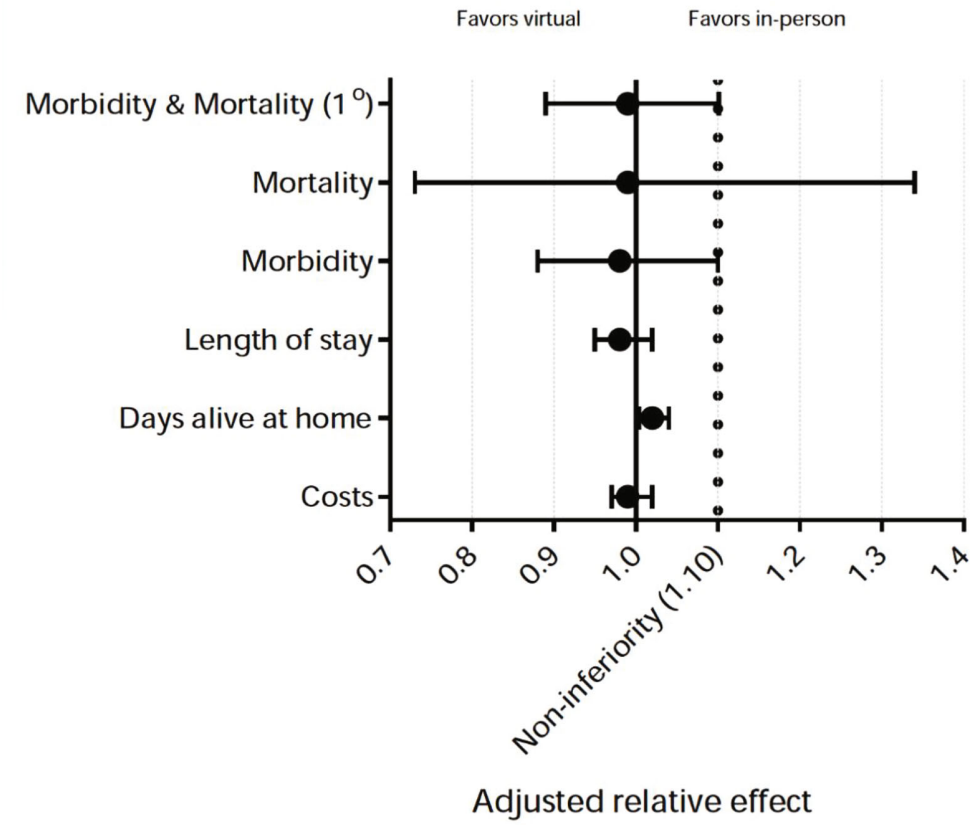
**Figure**



# Perioperative outcomes among patients from northern and southern Ontario undergoing major elective surgery: a population-based cohort study

**Submission ID**

44

**AUTHORS**

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**INTRODUCTION**

While patient-specific and procedural risk factors are established predictors of surgical outcomes, social determinants of health have emerged as important perioperative risk modifiers for Canadian patients. Recent studies have found evidence that indigenous identity is associated with increased postoperative mortality and morbidity.[1] In Northern Ontario, well-defined geographic and socioeconomic constraints contribute to multiple health care disparities including life expectancy that is two years shorter than Southern counterparts.[2] Northern residents often travel longer distances to access tertiary care which may contribute to barriers in obtaining timely surgical care as well as receiving adequate postoperative follow up.[3] To date, there have been no studies comparing postoperative outcomes between Northern and Southern Ontario residents. The objective of this study was to measure and compare key postoperative outcomes in Northern and Southern Ontario patients undergoing elective major noncardiac surgery.

**METHODS**

All data used for this project are routinely collected and anonymized, exempting institutional review under section 45 of Ontario's Personal Health Information Protection Act. This was a population-based retrospective cohort study conducted in Ontario, Canada using a linked administrative health care dataset. All Ontario residents aged 18 or older on the day of elective, major noncardiac surgery from 1 April 2009 to 31 March 2021 were identified. Sex-neutral surgeries established to be of intermediate to high physiologic stress were included.[4] Additionally, only the first eligible surgery for each participant during the study period was included. Northern Ontario residency status was determined based on each patient's postal code, identifying those living in the Northeast and Northwest Local Health Integration

Networks, with all other patients designated Southern Ontario residents. The primary outcome was 30-day mortality after surgery. Secondary outcomes were days alive at home, hospital length of stay, total health care system costs, discharge disposition and readmissions. Adjusted and unadjusted associations of Northern Ontario residency status with the aforementioned outcomes were estimated using regression models. Adjusted models included the follow prespecified covariates: sex, age, neighborhood income quintile, rurality, year of surgery, surgical procedure, comorbidities, and number of prior hospitalizations and emergency department visits.

**RESULTS**

We identified 562,115 elective surgical cases that met the inclusion criteria which included 41,191 patients from Northern Ontario. The Northern residents were more likely to belong to the lowest income quintile, travelled longer distances to their hospital, and were less often rostered with a family physician. Mortality within 30 days of surgery did not differ geographically, with 89 (0.2%) deaths in the Northern cohort compared to 1,114 (0.2%) Southern Ontario patients (adjusted odds ratio [OR], 1.04; 95% confidence interval [CI], 0.85 to 1.27). Total health care costs were lower for Northern residents at 30 days (adjusted ratio of mean [RoM], 0.92; 95% CI, 0.89 to 0.86) and 365 days (adjusted RoM, 0.93; 95% CI, 0.90 to 0.96), while length of stay was longer (adjusted RoM, 1.06; 95% CI, 1.01 to 1.11) for Northern residents. The number of days alive at home, nonhome discharges, and readmission rates were similar between the two groups.

**DISCUSSION**

Although Northern Ontario residents face multiple health care challenges, they were not found to experience more postoperative mortality after major elective surgery. Although there were small differences in health care costs and hospital length of stay, there were overall no clinically meaningful differences in perioperative outcomes between Northern and Southern Ontario patients. The observed trend toward differences in nonhome discharge dispositions and health care costs may suggest variations in access to health care resources across the province. Further research is required to better understand these trends and their implications for health care delivery and patient outcomes in different regions.

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# Preoperative concerns of patients aged 50 years and older undergoing noncardiac surgery: a systematic review and meta-analysis

## Submission ID

118

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## INTRODUCTION

In the preoperative setting, patients often experience feelings of intense worry surrounding their upcoming surgery.[1] Older adults (≥ 50 yr) undergoing noncardiac surgery possess unique concerns, influenced by age-related needs, perceptions, and health-status.[2,3] When left unaddressed, these concerns can manifest as preoperative anxiety and act as independent risk factors for postoperative morbidity and mortality.[1,3] They can also negatively impact functional trajectory and recovery.[4] Despite the rapidly aging population, the unique preoperative concerns in patients of this demographic have not been systematically examined.[5] This systematic review and meta-analysis aims to comprehensively summarize the preoperative concerns of patients aged 50 yr and older undergoing noncardiac surgery. By elucidating the nature of these concerns, tailored preoperative interventions can be designed to decrease the incidence of preoperative anxiety and improve postoperative outcomes.[5]

## METHODS

A literature search was conducted across five databases from 2000 to March 26, 2023. The inclusion criteria were: 1) patients aged ≥ 50 yr undergoing noncardiac surgery with overnight stay; 2) presence of concerns identified in the preoperative period; 3) preoperative concerns collected with valid instruments; 4) at least one preoperative concern outcome reported (mean or incidence); 5) randomized controlled trials, prospective cohort studies, and cross-sectional studies; and 6) English language. Seventeen articles (1,777 participants) were included after abstract and full-text screening. Data on study characteristics, participant characteristics, identified concerns, and their relative rankings (based on the reported outcomes of each study) were extracted. Identified concerns were thematically classified into

domains and subdomains. Studies employing instruments that assessed two concerns or less were analyzed using comparative analysis. For studies assessing three or more concerns, the top concern domains and subdomains were identified using a proportional frequency analysis. This was accomplished by calculating the frequency at which each domain and subdomain ranked within the top five concerns across studies, relative to its total frequency of assessment across all studies. Meta-analysis was performed when two or more studies assessed concerns using the same questionnaire.

**RESULTS**

Studies were divided into mixed noncardiac (*n* = 549), orthopedic (*n* = 645), vascular (*n* = 444) and oncologic surgery (*n* = 139). Concerns were categorized into seven domains: 1) anesthesia, 2) complications, 3) impact to daily life, 4) medical experience, 5) pain, 6) recovery and rehabilitation, and 7) surgery. Twelve studies (*n* = 1,485) employed scales evaluating three or more concerns (Table). Of these, pain was the most important concern among mixed noncardiac and orthopedic surgical populations but was ranked comparatively lower in vascular and oncological surgery patients. Vascular surgery patients were most concerned about surgery and complications, while patients undergoing cancer surgeries prioritized complications and the medical experience. Seven studies (*n* = 879) employed scales that solely compared surgery and anesthesia-related concerns. Of these, surgery ranked higher in all studies. The pooled mean difference between surgery-related anxiety and anesthesia-related anxiety was 1.54 in orthopedic and oncologic surgery populations (95% confidence interval, 1.12 to 1.95, $I^2 = 0\%$; $P < 0.001$).

**DISCUSSION**

The preoperative concerns of older noncardiac surgical patients vary greatly depending on the nature of the surgical procedure. The fear of pain is especially prevalent in older orthopedic surgery patients, which may be attributed to the painful nature of joint replacements. In comparison, vascular surgeries which are typically higher-risk and more complex generate worries about the surgery itself and postoperative complications. Oncological surgeries invoke fears about complications and medical experience because of its association with potential malignancy. These observed results emphasize the importance of tailoring preoperative counseling to address specific fears of each surgical population.

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**Table** Top domains and subdomains for different types of surgery

| Surgery type | Studies (n) | Sample[a] | Top 3 Domains | Top 5 Subdomains (Associated Domain) |
|---|---|---|---|---|
| **Mixed Surgery[b]** | 3 | 425 | 1 Pain | 1 General Cx fear |
| | | | 2 Cx | 2 Postop pain |
| | | | 3 Surgery | 3 Personal life disruption (Impact on Daily Life) |
| | | | | 4 Recovery (Recovery/Rehabilitation) |
| | | | | 5 General surgery fear |
| **Orthopedic Surgery** | 7 | 645 | 1 Pain | 1 General surgery fear |
| | | | 2 Anesthesia | 2 General pain fear |
| | | | 3 Surgery | 3 Anesthesia risks |
| | | | | 4 Postop pain |
| | | | | 5 Intraop pain |
| **Vascular Surgery** | 1 | 385 | 1 Surgery | 1 General Cx fear |
| | | | 2 Cx | 2 General surgery fear |
| | | | 3 Anesthesia | 3 Anesthesia risks |
| | | | | 4 Anesthesia side-effects |
| | | | | 5 Postop pain |
| **Oncological Surgery** | 1 | 30 | 1 Cx | 1 Fear of the unknown (Medical Experience) |
| | | | 2 Anesthesia | 2 General Cx fear |
| | | | 3 Medical experience | 3 Surgery specific Cx |
| | | | | 4 Surgical outcome |
| | | | | 5 Anesthesia risks |

[a]The sample size was summed across all studies evaluating each surgery type
[b]Mixed surgeries include: abdominal, breast, cardiac, colorectal, general, gynecologic, neurosurgery or neurosurgery spine surgery; ophthalmologic, oral, orthopedic, otolaryngology, plastic, urologic, and vascular surgeries

# Preoperative depression and health-related quality of life following cardiac surgery: a systematic narrative review

**Submission ID**

89

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**INTRODUCTION**

Depression is highly prevalent among adults undergoing cardiac surgery with estimates ranging from 19–37%.[1] Preoperative depression is known to confer an increased risk for adverse clinical outcomes following cardiac surgery including infection, cardiac complications, rehospitalization, and mortality.[2] Depression may also be a predictor of various patient-reported outcomes such as health-related quality of life (HRQoL), which is an important indicator of patient satisfaction and surgical success.[3] Nevertheless, the association between preoperative depression and HRQoL after cardiac surgery in adults has not yet been thoroughly reviewed.

**METHODS**

This systematic review searched Medline, Embase, CENTRAL, and PsychINFO for studies examining adults undergoing cardiac surgery that reported the association between preoperative depression and postoperative HRQoL outcomes. Articles were screened by two independent reviewers, and data from eligible studies were extracted using a standardized collection form. We collected data on study and participant characteristics, depression measure, HRQoL measure, and statistical estimates related to the association between preoperative depression and HRQoL outcomes at any time after cardiac surgery. A narrative synthesis was only performed on the most commonly reported HRQoL measure, the Short Form 36 (SF-36) and its derivative scales, given significant heterogeneity in study design across included studies.

**RESULTS**

Four thousand, five hundred and fifty-four patients from 11 studies reported outcomes from SF-36 or derivative scales. Seven studies reported adjusted estimates between preoperative depression and SF-36 summary scores up to one year: physical component score (PCS) and/or mental component score (MCS). Preoperative depression was associated with lower MCS and less MCS improvement in five studies. One study reported increased odds of MCS improvement. Depression was associated with a lower postoperative PCS and less PCS improvement in one study and two studies, respectively. Four studies reported no impact of depression on PCS. Additionally, three studies reported adjusted estimates with SF-36's subscale scores up to six months. Depression was negatively associated with 'energy/fatigue' and 'general health' scores in these studies. Depression was also negatively associated with 'social functioning' and 'role limitations because of emotional health,' but not 'emotional well-being' at six months.

**DISCUSSION**

This review highlights the detrimental and independent impact of preoperative depression on HRQoL up to one year following cardiac surgery, especially the mental or psychologic domain. Depression also had a negative impact on self-perceived energy, health, and general functioning (e.g., social, occupational, and daily activities) at six months. Nevertheless, heterogeneity of the included studies precluded meta-analyses. Further work is needed to quantify the impact of preoperative depression on patient-reported outcomes including HRQoL after cardiac surgery. A better understanding of these relationships will inform tailored patient counseling and the development of perioperative mental health screening and management protocols in this population.

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# Role of cerebral oximetry in reducing postoperative end organ dysfunction after major noncardiac surgery

**Submission ID**

28

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**INTRODUCTION**

With the increase in life expectancy observed in the last decades, the elderly population with multiple comorbidities requiring general anesthesia for major noncardiac surgery has increased dramatically. Major postoperative complications in this subgroup of patients have been reported in the range of 20%.[1] Regional cerebral oxygen saturation ($rSO_2$) provides a noninvasive alternative to systemic oxygen balance that correlates well with the gold standard of mixed venous oxygen saturation.[2] Interventions designed to minimize perioperative reduction in $rSO_2$ may improve overall outcomes, particularly if $rSO_2$ is considered a reflection of adequacy of global perfusion using brain as the index organ.[3] We hypothesized that implementation of a cerebral oximetry-based management strategy would reduce end organ dysfunction and its associated postoperative morbidity after major noncardiac surgery.

**METHODS**

After research ethics board approval, and informed patient consent, we conducted a prospective double-blind randomized controlled clinical trial in elderly patients undergoing major noncardiac surgery. Bilateral cerebral oximetry sensors (Masimo, Root® $O_3^{TM}$ Regional Oximetry) were placed on the fronto-temporal area before induction of anesthesia to measure $rSO_2$ intraoperatively. Patients were randomized to either an interventional group; where a predetermined standardized algorithm was used in an attempt to restore $rSO_2$ only if $rSO_2$ reduced 10% below the baseline value for at least 15 sec, or a control group, where patients were managed based on routine clinical practice. The cerebral oximetry monitor was blinded in the control arm but the data was recorded continuously. The algorithm to restore $rSO_2$ included adjustments to increase cerebral perfusion pressure, $FiO_2$, end-tidal $CO_2$, depth of anesthesia, hematocrit, and cardiac index. This sequence was not reinforced to any specific order. Major postoperative adverse outcomes, quality of recovery scores (QoR-15), disability free survival (WHODAS-2), and length of hospital stay were recorded. Continuous data were analysed with *t* test or Mann–Whitney *U* test. Categorical data was analyzed with Chi square or Fisher's Exact

tests. Statistical analysis was conducted using MINITAB® statistical software. *P* value < 0.05 was considered significant.

**RESULTS**

A total of 101 patients were randomized to either the interventional (*n* = 52), or control groups (*n* = 49), respectively. There was no difference between the two groups with respect to demographic data and surgical characteristics (Table A). Cerebral desaturation occurred in 30 (58%) and 31 (63%) patients in the interventional and control groups, respectively. Cumulative cerebral desaturation time was longer in the control group; 23 ± 48 min *vs* 9 ± 15 min, *P* = 0.01. There were a total of 142 algorithm-based interventions with a median of 2 [range, 1–12] in the interventional group. Postoperative morbidity and functional outcomes were similar between the two groups (Table B). The current study was powered to recruit 394 patients (NCT03861026), however, because of the COVID-19 pandemic and the lack of ongoing funding, the study was halted at 101 patients.

**DISCUSSION**

A drop in $rSO_2$ for more than 10% from the baseline values occurred in more than a half of patients undergoing major noncardiac surgery. The restoration of $rSO_2$ was achieved in 45 patients (86.5%) in the interventional group. Even though the duration of cumulative desaturation was significantly longer in the control group, the major postoperative morbidity and functional recovery was similar between the two groups. Future studies need to be adequately powered to determine the appropriate utility of intraoperative cerebral oximetry in patients undergoing major noncardiac surgery.

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**Table** A) Baseline characteristics and B) postoperative outcomes

| | Variable | Intervention Group (n = 52) | Control Group (n = 49) |
|---|---|---|---|
| Part A | Age, years | 70 ± 5 | 69 ± 6 |
| | Male gender | 25 (48) | 27 (55) |
| | Frailty scale | 2.5 [1, 5] | 3 [1, 7] |
| | Duke Activity Status Index | 24 [5, 51] | 21 [7, 58] |
| | Duration of surgery, min | 362 ± 148 | 328 ± 117 |
| | Perioperative blood product transfusion | 5 (10) | 4 (8) |
| | Intraoperative fluid balance, ml | 2229 ± 1352 | 1913 ± 895 |
| | Perioperative vasoactive drugs | 13 (25) | 12 (24) |
| Part B | Postoperative composite morbidity | 8 (15%) | 7 (14%) |
| | Length of hospital stay, days | 3 [1, 16] | 3 [1, 14] |
| | Quality of Recovery-15 (baseline) | 127 [99, 150] | 124 [48, 148] |
| | Quality of Recovery-15 (postoperative day 1) | 105 [54, 145] | 108 [64, 127] |
| | Quality of Recovery-15 (hospital discharge) | 110 [44, 145] | 111 [64, 135] |
| | Disability free survival at 6 months (WHODAS-2) | 4 [1, 23] | 4 [1, 34] |

Data expressed as mean ± SD, number of patients (%), and median [range]

Composite morbidity included postoperative delirium, stroke, transient ischemic attacks, myocardial infarction, pulmonary embolism, renal failure, pneumonia, atrial fibrillation, massive transfusion, prolonged mechanical ventilation, major wound disruption, sepsis, reintubation, and an unplanned return to the operating room

# Solutions to reduce burnout syndrome among perioperative health care providers in low resources settings: a qualitative study

**Submission ID**

41

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**INTRODUCTION**

Research from high-income contexts indicates that perioperative care providers may be at high risk for burnout, with significant downstream effects on patient safety.[1,2] Many interventions to reduce or prevent burnout among health care providers have been developed but very few focus on low-resource settings.[3,4] Adequate solutions to address burnout may be particularly important in low-income countries such as Rwanda where there are already very few health care workers and lack of motivation may also result in those workers either leaving health care or the country. This study aimed to explore solutions to address burnout among Rwandan perioperative care providers.

**METHODS**

Semistructured interviews were conducted with perioperative care providers (obstetricians, surgeons, anesthetists, midwives, nurses) in hospitals across all five provinces in Rwanda. Interviews were thematically analyzed with a qualitative case-study approach.

**RESULTS**

The findings from this study suggest specific individual level solutions such as facilitating healthy behavior and coping mechanisms, and mainly system level solutions such as building resilience; ensuring availability of equipment, supplies, and drugs; reducing staffing shortages and motivating existing staff in effort to decrease attrition; increasing awareness and advocacy

about burnout both within the health care community and general population; and better remuneration.

**DISCUSSION**

Only few burnout prevention interventions have been tested in low- and middle-income countries especially in Sub-Saharan Africa (SSA). Some examples include the Workplace Wellness Program (WWP) in Botswana and burnout awareness, emotional empowerment, and stress management programs in the middle east countries.[3,4] Context-specific interventions at both individual level (i.e., facilitating coping mechanisms) and system level (i.e., better working conditions such as adequate equipment, staff, remuneration, awareness programs, etc.) have the potential to decrease burnout among perioperative health care providers in low resources settings. More studies are needed to test the implementation of burnout reduction interventions in low- and middle-income countries.

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# The impact of glucagon-like peptide-1 receptor agonist use on gastric emptying half-time: a systematic review and meta-analysis

**Submission ID**

81

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## INTRODUCTION

Since 2022, glucagon-like peptide-1 receptor (GLP-1R) agonists have been used as frontline therapy for type 2 diabetes mellitus (T2DM).[1] Recently, their application has extended to chronic weight management, leveraging a mechanism believed to involve delayed gastric emptying and the promotion of early satiety.[2] Nevertheless, this may have implications for the risk of pulmonary aspiration of gastric contents in the perioperative period.

Current surgical recommendations advocate for the cessation of long-acting GLP-1R agonists at least a week prior to the surgery.[3] Nevertheless, concerns about an increased risk of regurgitation and pulmonary aspiration have surfaced through several case reports.[4,5] Despite efforts by organizations such as The American Society of Anesthesiologists to provide guidelines,[3] the available evidence remains limited, predominantly relying on anecdotal reports. This systematic review and meta-analysis aimed to assess and quantify the impact of GLP-1R agonists on gastric emptying in the adult population.

## METHODS

Electronic databases were searched for relevant articles from inception to 13 July 2023, for randomized controlled trials and prospective cohort studies that evaluate the impact of taking any approved GLP-1R agonist on gastric emptying half time (T½). Acceptable GLP-1R agonists included both short-agenting agents such as exenatide, dulaglutide, and lixisenatide, as well as long-acting agents such as liraglutide and semaglutide. There were no restrictions placed on the indication for GLP-1R use. Only studies that included a placebo group or baseline values for comparison were included. Studies that included patients with gastroparesis, or that did not specify the exclusion of diabetic patients with gastroparesis were excluded. Screening and extraction of identified articles was carried out independently by two reviewers. Standardized mean difference was calculated to compare pre-post T½, and meta-analysis was performed. Three-level meta-analysis was used for studies that provided two sets of results for different

dosages or durations. Cumulative meta-analysis was conducted to check the effect of each study on heterogeneity followed by the recalculation of heterogeneity. We further completed the Egger's asymmetry test. The results were presented in the form of forest plots.

**RESULTS**

Thirty-four gastric emptying studies were identified. Of these, nine studies comprising 445 patients provided data on T½ and were included for quantitative synthesis. Liraglutide was the most studied (*n* = 5), followed by lixisenatide (*n* = 3). Semaglutide and exenatide were each used in one study. Gastric emptying was assessed with the $^{13}$C-Octanoic breath test (*n* = 5), scintigraphy (*n* = 3), and paracetamol absorption (*n* = 1). The indication for use was most commonly for treatment of T2DM (*n* = 5), followed by obesity (*n* = 3) and type 1 diabetes (*n* = 1). Three studies had a study duration of less than seven days, while the remaining studies ranged from 21 to 168 days. All studies reported a significant delay in gastric emptying in patients treated with GLP-1R-agonists compared to baseline or placebo. Meta-analysis showed that the use of a GLP-1R-agonist was associated with over a two-fold increase in T½ (SMD = 2.38; 95% CI, 1.05 to 3.71; $I^2$, 97.7%; P ≤ 0.001).

**DISCUSSION**

This study shows that the use of a GLP-1R agonist may result in significant delays to gastric emptying half time when used either for obesity or T2DM. This prolongation is preserved even with long-term use up to 168 days. We found a high level of heterogeneity in the literature that quantify the impact of GLP-1R agonist use on gastric emptying because of variable outcomes being reported. Further work is needed to assess the impact of these findings on preoperative fasting guidelines and clinical practice.

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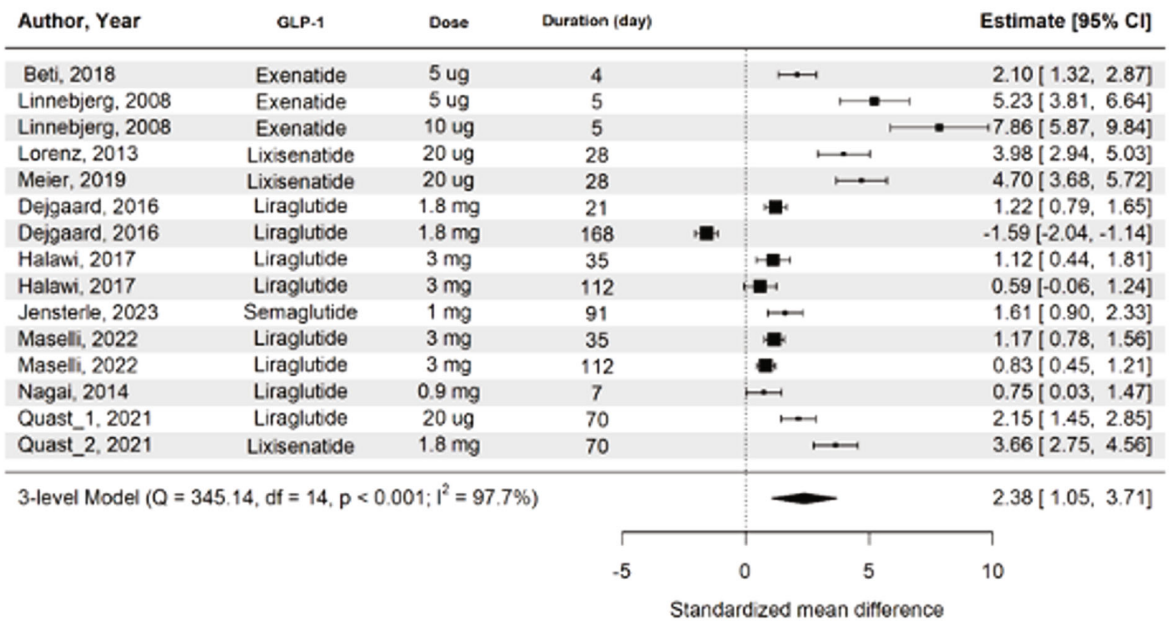
**Figure** Forest plot of GLP-1R agonist use and gastric emptying half-time



# The impact of near-infrared spectroscopy-based intraoperative management on neurocognitive outcomes in adults undergoing cardiac surgery: a systematic review and meta-analysis

**Submission ID**

25

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**INTRODUCTION**

Adverse neurocognitive outcomes are common after adult cardiac surgery, with postoperative cognitive decline (POCD) ranging from 30–80% at discharge. Based on the premise that adverse neurologic outcomes are caused by focal or global cerebral hypoxia, near-infrared spectroscopy (NIRS) guided anesthetic delivery may be used to prevent adverse postoperative neurologic outcomes. We undertook a systematic review and meta-analysis of RCTs to describe the effect of NIRS-guided intraoperative management on postoperative neurocognitive outcomes and mortality in adults undergoing cardiac surgery on cardiopulmonary bypass.

**METHODS**

We searched CENTRAL, CINAHL, EMBASE, MEDLINE, PsycInfo, and Web of Science from inception until 31 October 2023 for randomized controlled trials (RCTs) evaluating the effect of NIRS-guided intraoperative management *vs* standard care (no NIRS or blinded NIRS monitoring) in adults undergoing cardiac surgery on cardiopulmonary bypass. Pairs of reviewers screened titles and abstracts and full texts, and independently extracted data which were combined using a random-effects model. We evaluated the outcomes of POCD, delirium, stroke, and mortality. We assessed the risk of bias of included trials using a modified version of the Cochrane Risk of Bias tool, and evaluated the overall quality of evidence for each outcome using the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) approach.

**RESULTS**

We included 16 RCTs (*n* = 2,560); 6/16 were judged to be at high risk of bias, primarily because of inadequate reporting. NIRS-guided intraoperative management decreased the incidence of short-term adverse neurocognitive outcomes, including POCD (*n* = 796; risk ratio [RR], 0.65; 95% confidence interval [CI], 0.42 to 0.99; I2 = 64.9%; very low-quality evidence) and delirium (*n* = 1,197; RR, 0.74; 95% CI, 0.57 to 0.98; I2 = 7.9%; low quality evidence). NIRS guided management did not however lead to a higher mean MMSE score in the early postoperative period (*n* = 301; mean difference [MD], 1.72; 95% CI, −0.02 to 3.46; I2 = 89.6%; very low-quality evidence) or from 6–12 weeks postoperatively (*n* = 222; MD, 0.14; 95% CI, −1.54 to 1.83; I2 = 83.9%; very low-quality evidence). NIRS guided management also did not reduce the risk of stroke (*n* = 1,657; RR, 0.89; 95% CI, 0.42 to 1.91; I2 = 6.0%; low quality evidence) or mortality (*n* = 1,438; RR, 0.84; 95% CI, 0.47 to 1.52; I2 = 0.0%; low-quality evidence).

**DISCUSSION**

We identified low to very-low quality evidence that NIRS guided intraoperative management reduces the risk of short-term postoperative cognitive decline and delirium, but does not decrease the risk of stroke or mortality. More rigorous evidence is required to clarify the role of NIRS-guided intraoperative management for preventing adverse neurocognitive outcomes in adults undergoing cardiac surgery on cardiopulmonary bypass.

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No references.

# The impact of perioperative complications on employment and earnings after elective hip or knee replacement surgery: a population-based cohort study

**Submission ID**

29

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**INTRODUCTION**

After successful joint replacement surgery, patients are better able to participate in the workforce.[1] Nevertheless, complications such as adverse cardiac events, organ failure, re-operation, or unexpected re-admission to hospital can steer patients away from a typical recovery and potentially impact their ability to return to work and earn an income.[2] In this study we aimed to quantify the negative impact of perioperative complications on employment status and earnings after elective hip or knee replacement surgery.

**METHODS**

We conducted a population-based cohort study using data from the Canadian Hospitalization and Taxation Database from 2004–2019.[3] Our Research Ethics Board waived the need for ethics approval as these data are publicly available. We included adults aged 30–63 yr having an index elective hip or knee arthroplasty who had filed tax returns every year from the year before surgery through to two years after surgery. Our primary exposure was a perioperative complication, defined as a composite of adverse medical events or rehospitalization within 30 days. Our coprimary outcomes were employment in the second year after surgery and the difference in earnings from the year before surgery to the second year after surgery. Patients with complications were matched 1:1 to those without complications using propensity scores, with exact matching on the month and fiscal year of surgery, type of surgery, and presurgery employment status. The propensity score model also included baseline characteristics related to demographics, comorbidity, and family finances. We used a probit regression model to assess the marginal effect of perioperative complications on employment after surgery and a

difference-in-difference ordinary least squares regression model to assess the marginal effect on change in earnings from before to after surgery.

**RESULTS**

We captured 207,885 working-aged adults undergoing an index elective hip or knee replacement surgery (age 56.2 ± 6.0 yr; 56.0% female; 40.4% hip; 59.6% knee). Perioperative complications were experienced by 12,655 (6.1%) of the sample. After matching, 22,568 patients (11,284 pairs) were included in primary analyses. In the second fiscal year after surgery, 58.7% of patients with complications were working compared to 60.9% of patients without complications (−2.2 percentage points [pp]; 95% CI, −3.5 pp to −1.0 pp). Patients with complications had an average $1,672 greater decline in annual earnings from before surgery (95% CI, −$2,895 to −449), compared to patients without complications.

**DISCUSSION**

Perioperative complications resulted in a lower likelihood of employment and lower earnings for working-aged adults having elective hip or knee replacement surgery. In addition to their detrimental impact on patients and their families, perioperative complications may also have broader economic implications related to increased health care use, reduced workforce productivity, and lost taxation revenue. Our findings may inform future decisions about health care resource allocation and evaluations of perioperative care.

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# Virtual multidisciplinary preoperative assessments: a multisite formative evaluation and evidence-based guide for implementing change

**Submission ID**

9

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**INTRODUCTION**

Virtual care is not new to medical systems, yet the adoption of this innovation has been slow in certain clinical encounters. Multidisciplinary preoperative assessments are well-suited to virtual care.[1] Implementation science can be described as striving to understand what, why, and how interventions work in “real world” settings.[2] Implementation science frameworks are used to guide implementation design, evaluation, and sustainability plans.[2] The use of these frameworks can improve adoption and integration of evidence-based interventions within health care systems.[2] We applied established implementation science methodology to the development of a virtual preoperative assessment pathway. The purpose of this study was to increase patients’ access to high-quality virtual care and identify strategies to aid in the deployment of virtual preoperative clinics.

**METHODS**

This study was approved by our institution’s Research Ethics Board. We conducted a two-phase formative evaluation to develop a virtual multidisciplinary preoperative assessment pathway. In phase 1, using the Promoting Action on Research Implementation in Health Services (PARIHS) implementation framework[3] we conducted key stakeholder semi-structured interviews to identify and understand factors influencing the development and adoption of virtual multidisciplinary preoperative assessments. Purposive and snowball sampling were used to interview stakeholders including patients and their caregivers, physicians, registered nurses, allied health care professionals, schedulers, and information technologists. Each audio recorded interview was conducted by a research coordinator via video or phone call and subsequently transcribed. Transcripts were coded using deductive thematic analysis to examine the ways that

stakeholders described their experiences within the three major elements of the PARIHS framework (Evidence, Context, Facilitation) and further organized within the elements by themes and subthemes. Coding was supported by qualitative data analysis software (Nvivo 12, QSR International). In phase 2, evidence-based strategies from the Expert Recommendations for Implementing Change (ERIC)[4] project were matched to all identified subthemes from the formative evaluation and rank ordered based on stakeholder scoring of both importance and feasibility using Go-Zone analysis.[5]

**RESULTS**

Forty participants were interviewed, including 12 patients or family members, 18 health care providers, and 10 administrative decision makers. Eight themes and 49 subthemes were identified to focus the implementation of virtual preoperative assessment. Three themes aligned predominantly with Evidence: 1) patient benefits of virtual care, 2) patient concerns about virtual preoperative assessment, and 3) relative advantage of virtual preoperative assessment. Four themes aligned predominantly with Context: 4) virtual care resources, 5) external supports, 6) health care provider culture, training, and needs, and 7) workflow and process. One theme aligned with Facilitation: 8) facilitators of virtual preoperative assessment. Subthemes were matched to expert recommendations and twelve strategies were judged to be most important and feasible by a panel of stakeholders in preoperative assessment (Table).

**DISCUSSION**

Using established methodology, we identified twelve feasible strategies for implementing virtual multidisciplinary preoperative assessments. These strategies are likely transferrable to other institutions considering implementation of virtual preoperative care with adaptation to the local context. We have developed a local virtual care process for multidisciplinary preoperative assessments based on these findings and evaluation of both implementation and clinical outputs of the pathway are ongoing. Our data suggest a virtual multidisciplinary preoperative assessment pathway is feasible, may improve clinical efficiency, and could reduce the burden of travel and related costs for patients, especially for those in rural and remote areas.

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**Table** Strategies for implementing virtual multidisciplinary preoperative assessments

| Strategy | Description[4] |
|---|---|
| **Build a coalition** | Recruit and cultivate relationships with partners in the implementation effort. |
| **Conduct local consensus discussions** | Include local providers and other stakeholders in discussions that address whether the chosen problem is important and whether the clinical innovation to address it is appropriate. |
| **Develop a formal implementation blueprint** | Develop a formal implementation blueprint that includes all goals and strategies. The blueprint should include: 1) aim/purpose of the implementation; 2) scope of the change (e.g., what organizational units are affected); 3) timeframe and milestones; and 4) appropriate performance/progress measures. Use and update this plan to guide the implementation effort over time. |
| **Develop educational materials** | Develop and format manuals, toolkits, and other supporting materials in ways that make it easier for stakeholders to learn about the innovation and for clinicians to learn how to deliver the clinical innovation. |
| **Distribute educational materials** | Distribute educational materials (including guidelines, manuals, and toolkits) in person, by mail, and/or electronically. |
| **Identify and prepare champions** | Identify and prepare individuals who dedicate themselves to supporting, marketing, and driving through an implementation, overcoming indifference or resistance that the intervention may provoke in an organization. |
| **Identify early adopters** | Identify early adopters at the local site to learn from their experiences with the practice innovation. |
| **Involve patients and family members** | Engage or include patients/consumers and families in the implementation effort. |
| **Prepare patients/consumers to be active participants** | Prepare patients/consumers to be active in their care, to ask questions, and specifically to inquire about care guidelines, the evidence behind clinical decisions, or about available evidence-supported treatments. |
| **Purposefully re-examine the implementation** | Monitor progress and adjust clinical practices and implementation strategies to continuously improve the quality of care. |
| **Revise professional roles** | Shift and revise roles among professionals who provide care, and redesign job characteristics. |
| **Stage implementation scale up** | Phase implementation efforts by starting with small pilots or demonstration projects and gradually moving to a system wide rollout. |

# REGIONAL & ACUTE PAIN

## Critical limb ischemia presenting as motor block in a patient with a continuous thoracic epidural: a case report

**Submission ID**

49

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**INTRODUCTION**

Epidural analgesia (EA) is a common modality that provides superior postoperative analgesia compared with parenteral opioids for select procedures, while reducing many perioperative complications.[1] While EA ideally provides sensory, but not motor, blockade, inadvertent motor blockade occurs in 5–36% of patients. Though more common with lumbar epidurals, 2% of motor blocks occur with thoracic epidurals.[1] Motor block may be a sign of a serious complication such as an epidural hematoma, abscess, or spinal cord injury.[1] We discuss the case of a patient who underwent an incisional hernia repair under general anesthesia and EA, and developed unilateral motor weakness secondary to acute iliac artery thrombosis. This (usually extremely painful) presentation may have been partially masked by EA. This report highlights the need to maintain a broad differential diagnosis when assessing motor weakness in patients with EA, including neuraxial and nonneuraxial etiologies. Research ethics board approval and consent were obtained for publication.

**CASE PRESENTATION**

A 67-yr-old, American Society of Anesthesiologists Physical Status IV, male presented for an elective open incisional hernia repair. Preoperatively, an epidural was placed at T9–T10 without complication. Continuous EA infusion (bupivacaine 0.1% + hydromorphone 10 $\mu g \cdot mL^{-1}$) was initiated at 5 $mL \cdot hr^{-1}$ and maintained throughout the unremarkable general anesthesia course.

One hour postoperatively, he presented with decreased level of consciousness (LOC) and respiratory acidosis (pH = 7.16; $PCO_2$ = 76 mm Hg), which was managed with BiPAP

ventilation. Shortly after, his LOC improved and he complained of pain in the right lower abdomen. To assess epidural function, a 7 mL 2% lidocaine bolus was titrated, resulting in bilateral T6–L1 sensory block. The patient was pain-free, however developed motor block of the right lower extremity (modified Bromage 3).[2] The EA infusion was paused and the patient transferred to ICU for continued BiPAP ventilation.

Four hours postoperatively, the patient's weakness had gradually improved (modified Bromage 5)[2] and the epidural infusion was restarted.

Overnight, the patient remained difficult to assess because of fluctuating LOC, attributed to hypercapnia versus delirium. He occasionally complained of right lower quadrant pain and had fluctuating (modified Bromage 2–4)[2] right lower extremity weakness.

Because of concerns over potential intraabdominal hemorrhage (hemoglobin drop 128 to 91 $g \cdot dL^{-1}$), an urgent CT scan was ordered. Concurrently, the epidural was removed because of the uncertain clinical picture (i.e., fluctuating unilateral leg weakness despite diluted LA solution in a 'difficult-to-assess' patient with fluctuating LOC), and images of the vertebral canal were ordered on CT. CT revealed extensive right common iliac artery thrombosis and the patient underwent amputation.

## CONCLUSION

We present the case of a patient with a thoracic epidural who developed postoperative unilateral lower limb weakness secondary to acute iliac artery thrombosis. This diagnosis may have, in part, been masked by a functioning epidural catheter.

Motor block may be a sign of devastating EA complications, including hematoma and abscesses. Importantly, motor weakness can also be caused by nonneuraxial events, including stroke, acute limb ischemia, myositis, and Guillain–Barre syndrome.[3]

This case highlights the need to carefully assess patients with epidural catheters presenting with motor block and to maintain a broad differential of neuraxial and nonneuraxial etiologies of motor weakness.

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# Efficacy of surgically-inserted rectus sheath catheters, epidural, and patient-controlled analgesia for major urologic surgeries

**Submission ID**

78

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**INTRODUCTION**

Protocols for Enhanced Recovery After Surgery recommend epidural analgesia in open surgical procedures. Epidurals however, have associated risks, and variable success rates depending on the anesthesiologists' skill set, diligent follow-up care, and adequate nursing training. Contrastingly, rectus sheath (RS) catheters are gaining popularity as a perioperative pain adjunct with comparable efficacy and considerably less risks than epidurals.[1] The use of RS catheters is effective and safe in patients undergoing major open urologic procedures,[2] but the utility of surgically-initiated RS (SI-RS) catheters is currently unknown.[3] At our institution SI-RS catheter placement using visualization and tactile sensation prior to incision closure has been offered for patients undergoing open urologic surgeries since 2013, and is a stable component of multimodal analgesia (MMA) regimen for these surgeries.

In this retrospective cohort study, we examined the analgesic benefits of SI-RS catheters compared with a patient-controlled-analgesic (PCA)-based or epidural-based MMA following open cystectomies and cystoprostatectomies.

**METHODS**

Study approval was obtained by our institutional review board and patient consent was waived. Patients undergoing cystectomy/cystoprostatectomy at our institution from January 2010 to December 2016 were eligible (three years of data before and after SI-RS catheter insertion became routine). Inclusion criteria were > 17 yr old, elective open cystectomy/cystoprostatectomy, and ASA Physical Status I–III. Eligible patients were grouped into PCA-only, SI-RS with PCA, and thoracic epidural analgesia (TEA) only.

Our primary outcome was pain score at 24 hr with movement. Secondary outcomes included intraoperative and postanesthesia care unit opioid consumption, pain scores on movement at 12, 24, 48, and 72 postoperative hr, length of PACU and hospital stay, ICU admission, and incidence of nausea/vomiting. Given the variability in the use of opioid analgesia (oral/IV-PCA/epidural opioids), we included the use of IV-PCA as a covariate instead of analyzing total opioid usage with each modality.

Pain scores were analyzed after dichotomizing them to acceptable (VAS ≤ 5/10) *vs* not acceptable (VAS > 5/10). Nonpain outcomes were similarly dichotomized. Multivariable logistic regression was performed. Analgesic modality was the grouping variable while age, sex, body mass index, ASA classification, smoking status, chronic pain, opioid dependence, psychiatric illness, history of COPD, DM, and recreational drug use were covariates.

**RESULTS**

Total number of 133 eligible charts were included. Fifty-nine patients were in the no block group, 50 patients in the SI-RS group, and 24 patients in the TEA group.

The probability of having a VAS (0–10) score of < 5/10 at 24 hr postop was significantly higher with the use of either SI-RS or TEA compared no block, and there was no significant difference between SI-RS and TEA groups. A similar result was noted for pain scores on movement at other time points. The groups showed no difference in ICU admissions, time to mobilization, time to oral diet, or length of hospital stay. TEA resulted in a significantly longer length of PACU stay. There was no difference in the incidence of nausea/vomiting between the groups, but it was weakly associated with the use of IV-PCA. No leakage was noted in any of the 50 RS catheters with only one dislodgement.

**DISCUSSION**

Pain scores on movement were lower with the use of SI-RS or TEA and were comparable. TEA resulted in a longer PACU stay and was not associated with significant analgesic benefits. There was no leakage in the catheter-over-needle assemblies used where the needle is housed within the catheter allowing a ‘snug-fit’ to the skin preventing leakage and dislodgement.

Study limitations are intrinsic to its small sample size and retrospective design with inconsistencies of data and recordkeeping.

Prospective RCTs are necessary to determine whether SI-RS catheters are an effective analgesic compared with other modalities for this patient population.

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# Local anesthetic systemic toxicity in ultrasound-guided single-shot nerve blocks: a systematic review

**Submission ID**

115

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**INTRODUCTION**

Ultrasound guidance has markedly increased patient safety and minimized complications, contributing significantly to the prominence of regional anesthesia. The assessment of this tool, with its direct visualization and precise nerve targeting, seeks to diminish local anesthetic (LA) dosage, presumably leading to enhanced outcomes. Despite these benefits, the widespread use of LAs in regional anesthesia faces a challenge because of their systemic toxicity (LAST). The majority of the available data regarding this potentially fatal complication is composed of case reports and series. Our systematic review aims to expand upon previous studies and analyze the available literature regarding the occurrence of LAST during ultrasound-guided single-shot blocks.

**METHODS**

To conduct a comprehensive systematic review, we aimed to assess the occurrence of LAST in single-shot ultrasound-guided peripheral nerve and fascial plane blocks, without age restrictions. Our eligibility criteria focused on case reports or series, excluding studies using LA infusions through catheters. The primary objectives were to gather data on patients' demographics, the administered dose of local anesthetic, the severity of LAST cases, onset time and severity of symptoms, and the use of lipid emulsion as a treatment modality.

**RESULTS**

A comprehensive literature search in MEDLINE, Cochrane, and EMBASE yielded 1,561 studies related to LAST. Among these, we included 28 adult patients and one neonate, drawn from 26 case reports meeting our eligibility criteria. The clinical spectrum of LAST ranged from mild

symptoms like perioral numbness and sensory disturbances to severe manifestations, including seizures and cardiac arrest. Most reports described the occurrence of LAST despite the use of recommended dosages of LA. Among the reported cases, only four involved overdoses of LA, two of which resulted in cardiac arrest. Brachial plexus blocks accounted for 13 cases, while fascial plane blocks were associated with ten cases and inferior limb blocks with five. Ropivacaine was implicated in 51.7% of toxicity cases, while Bupivacaine was mentioned in 41%. Approximately 20% of the cases did not use lipid emulsion, with one of them resulting in cardiac arrest. All reported patients experienced a full recovery.

**DISCUSSION**

Despite adhering to the recommended clinical dosage of LA remains an essential safety measure during the execution of ultrasound-guided single-shot blocks, our study shows that the majority of the LASTs occurred within a dose range considered safe. Nevertheless, the cases in which the recommended maximum dose was reached or surpassed exhibited more severe LAST symptoms. Therefore, acknowledging the limitations inherent in studies relying on descriptive sources such as case reports, our findings highlight the necessity for further investigation, particularly in a better understanding of the relationship between the administered dose of LA and its potential associated toxicity.

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# Rebound pain in opioid-tolerant patients following peripheral nerve blockade for ambulatory surgery: a retrospective cohort study

**Submission ID**

111

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## INTRODUCTION

Rebound pain, defined as significant pain following recession of peripheral nerve blockade, presents a potential limitation to single shot regional anesthesia for ambulatory surgery.[1] In particular, the risk of rebound pain for opioid tolerant patients remains to be fully characterized and this may represent a high risk population for home analgesia management. Therefore, it is essential to characterize the risk of rebound pain in opioid-tolerant patients receiving peripheral nerve blocks for ambulatory surgery in deciding on the most appropriate anesthetic technique and timing of hospital discharge. The primary objective of this study was to compare the incidence of rebound pain for opioid-tolerant and nontolerant patients who received single shot peripheral nerve blocks for ambulatory surgery. Secondary objectives were to report patient satisfaction and rates of return to hospital following discharge.

## METHODS

Following the institutional research ethics board and waiver of consent approvals, a single-centre retrospective cohort study was conducted at Queen Elizabeth II Health Sciences Center in Halifax, NS, Canada. Ambulatory surgery patients who received a peripheral nerve block between March 2017 and December 2022 were included in the study. Opioid tolerance was defined as the use of more than 60 $mg \cdot kg^{-1}$ oral morphine per day,[2] or the use of methadone, buprenorphine or fentanyl patches.

We examined the incidence of rebound pain, defined as the transition from well-controlled pain (numerical rating scale [NRS] < 3) to severe pain (NRS > 7) as well as rebound pain scores, defined as the difference between maximum PACU pain and home pain scores. Patient satisfaction scores and incidence of returning to hospital after discharge were recorded. Data was obtained from hospital medical record databases (Innovian, Dragerwerk AG & Co., Lubeck, Germany) and questionnaire-based sources. Statistical analysis was performed in Graphpad Prism (Version 10) and IBM SPSS Statistics (Version 28). Categorical and numerical data were analyzed with Fisher's exact tests and Mann–Whitney tests, respectively.

## RESULTS

Three thousand, six hundred patients met the inclusion criteria. Of these, 47 patients were identified as opioid-tolerant and 3,553 patients as nontolerant. Opioid tolerant patients were more commonly given perioperative dexamethasone, a known modifier of rebound pain[1] (46.9% *vs* 32.9%; *P* = 0.02). The highest mean (SD) PACU NRS pain scores were higher in the opioid-tolerant (5.5 [3.5]), compared with nonopioid tolerant patients (3.2 [3.3]) (*P* = 0.0003). In contrast, the highest mean (SD) pain scores at home were not significantly different between opioid tolerant (5.5 [3.8]) and nontolerant patients (5.3 [3.3]) (*P* = 0.57). Thus, the mean RPS was reduced in opioid tolerant patients (1.7 [4.2] *vs* 3.9 [4.1]). We did not find a significant difference in the satisfaction scores between the groups, with a mean (SD) Likert score of 3.9 (0.9) for opioid-tolerant and 4.0 (0.8) for nontolerant (*P* = 0.80). Nevertheless, the opioid-tolerant patients were more likely to return to the hospital after discharge (12% opioid tolerant *vs* 3% nontolerant; *P* = 0.02).

## DISCUSSION

In this retrospective study, we did not find an increased risk of rebound pain in opioid-tolerant patients who received single shot peripheral nerve blocks for ambulatory surgery. Rebound pain scores were in fact reduced in the opioid tolerant population, owing to a similar maximum home pain score following an elevated PACU pain score. Opioid-tolerant patients reported similar satisfaction rates with peripheral nerve blockade as nontolerant patients. Nevertheless, there was a higher rate of return to hospital in the opioid-tolerant population. Confounders include an increased use of dexamethasone in the opioid tolerant population which may have contributed to less rebound pain.

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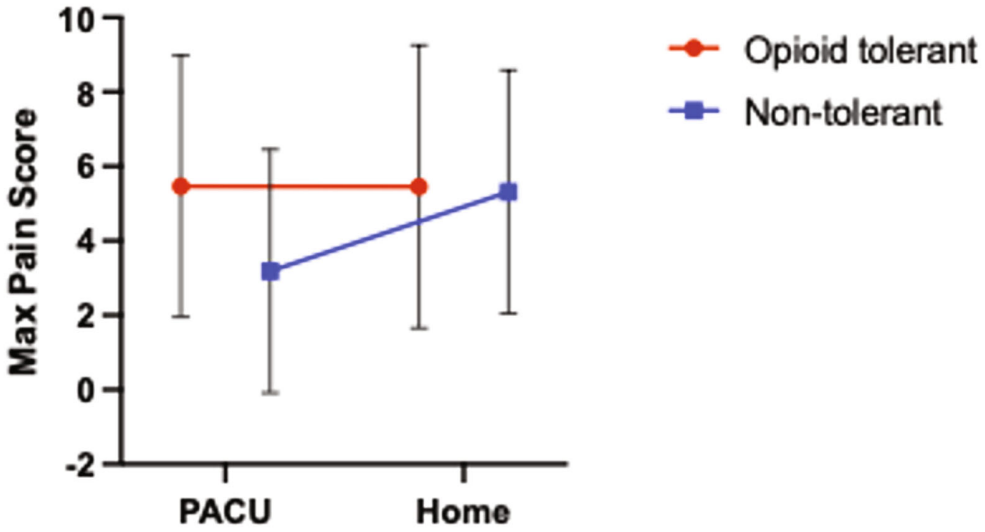
**Figure** Max postanesthesia care unit and home pain



# Safety of a catheter-over-needle system for epidural placement in a porcine *in vivo* model

**Submission ID**

70

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## INTRODUCTION

Continuous epidural analgesia remains an effective modality in the perioperative period and the gold standard for labour analgesia.[1] Epidural catheters are traditionally placed using a catheter-through-needle (CTN) technique. Recent studies have shown that catheter-over-needle (CON) systems have decreased complication rates (accidental catheter dislodgement and medication leakage at the catheter insertion site) and improved analgesia outcomes in peripheral nerve blocks compared with CTN techniques.[2,3] Further study has shown the feasibility of placing epidural catheters using a novel CON system in fresh human cadavers.[4] This proof of concept investigation aims to study the efficacy of epidural catheter placement and potential damage of the spinal cord and surrounding structures caused by using a novel CON system in a live animal model.

## METHODS

After local Animal Ethics Board approval, a CON epidural system (E-Cath Acc. Tsui; Tuohy 83mm, Pajunk, Geisingen, Germany) was used to evaluate the efficacy and safety of placing epidural catheters in live anesthetized pigs. Pigs were chosen as they share vertebral and spinal cord anatomy similar to humans and other nonhuman primates.[5] The animals were anesthetized, endotracheally intubated, and positioned laterally. Three CON epidural catheter placements were attempted per animal using loss-of-resistance technique alone (Animal 1) before adding fluoroscopic guidance (Animals 2-6), given the procedural and safety concerns experienced in Animal 1. The animals were then euthanized via a pharmacologic overdose and necropsy was performed to assess final catheter location (epidural placement success) in addition to both gross anatomical and histopathological evidence of damage to the spinal cord and surrounding structures.

## RESULTS

Six pigs (10–12 weeks old, about 30 kg) were used. A Gross necropsy examination showed 17 of 18 catheters were successfully placed in the epidural space. In Animal 1 (epidural placed without fluoroscopic guidance) significant difficulty was experienced identifying the loss-of-resistance in addition to involuntary muscle contraction during placement. Number of attempts per epidural catheter placement in Animal 1 was 3, 10, and 1 respectively, with 2 of 3 catheters ultimately placed in the epidural space. Additionally, significant gross and histopathological injury was found including epidural and subdural hemorrhage, as well as hemorrhagic cavitation in the spinal cord with associated neuronal degeneration and necrosis. In all subsequent animals (procedure completed with fluoroscopic assistance) epidural placement was clinically unremarkable. There was a maximum of 2 attempts, all were sucessfully placed within the epidural space, and there was no evidence of gross or histopathologic spinal cord damage (Figure).

## DISCUSSION

This study showed this novel CON system for placing epidural catheters can be successful in a live animal model. The experience with Animal 1 (procedural failure, multiple attempts, and spinal cord damage) is likely related to a dermal plug in the nonstylet epidural needle in the CON kit. Although we did not use a stylet for subsequent procedures, the use of fluoroscopy minimized attempts and distance of tissue the needle passed through, reducing the risk of plugging and subsequent damage. Our results showed a CON based epidural placement technique is possible; but further investigation is required, including using a stylet epidural needle.

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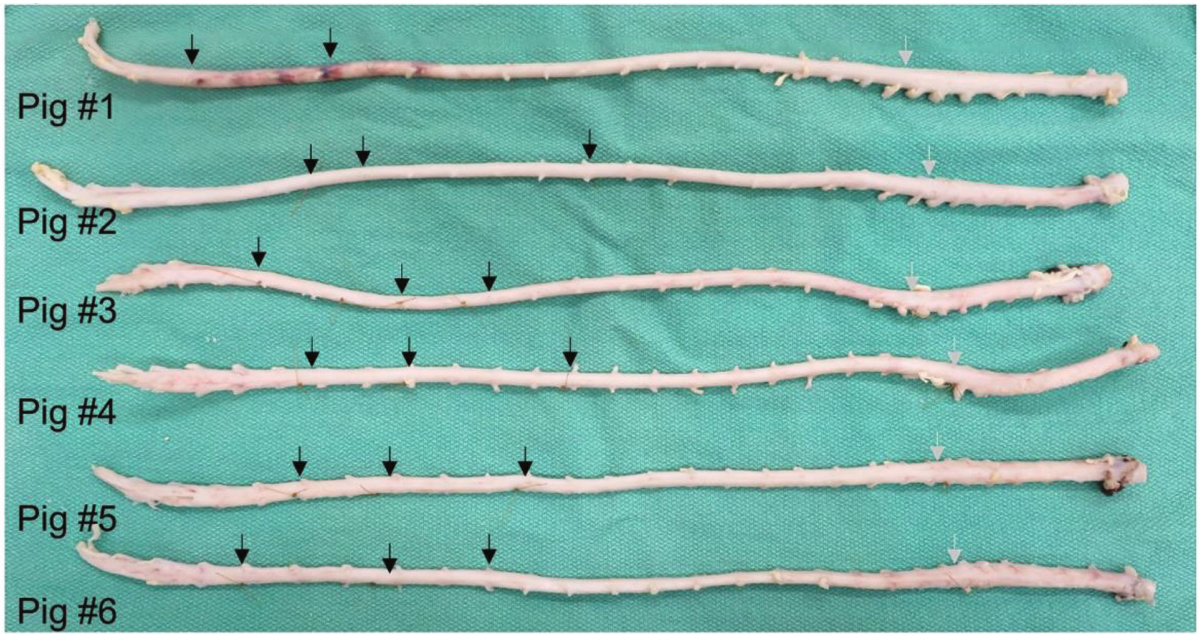
**Figure** Formalin-fixed spinal cords of all studies animals




*Black arrows indicated catheter entry point; grey arrows indicated the first thoracic spinal roots. Note the gross hemorrhage near the catheter entry points in Pig # 1.

# Systemic heparinization after neuraxial anesthesia in vascular surgery: a retrospective analysis

**Submission ID**

16

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**INTRODUCTION**

Neuraxial anesthesia (NA) constitutes an excellent anesthetic option with well-established perioperative benefits during vascular surgery.[1] To mitigate the risk of spinal hematoma (SH)—a potentially devastating complication—the American Society of Regional Anesthesia and Pain Medicine (ASRA) guidelines recommend intravenous heparin be held for at least one hour following an atraumatic NA technique (grade 1A recommendation).[2] If traumatic and/or difficult NA, a collaborative risk benefit decision involving the surgical team is recommended.

This recommendation is largely based on a 1981 study (*N* = 684) where 342 patients in emergency departments were given intravenous heparin for 10–14 days following diagnostic lumbar puncture (LP) in the context of acute cerebral ischemia,[3] and isolated case reports and closed claims.

During vascular surgeries where heparin is typically required soon after induction, some anesthesiologists may avoid NA altogether, whereas others may elect to proceed after weighing the risks against a general anesthetic.

**METHODS**

To test the hypothesis that anesthesiologists often overlook the ASRA guideline, we conducted a retrospective chart review at two separate institutions. We measured median time interval from NA placement to intravenous heparin administration (primary outcome) in adult patients (> 18 yr old) undergoing vascular surgeries (endovascular aneurysm repair [EVAR], femoral-femoral bypass, and femoral-popliteal or femoral-tibial bypass) between April 2012 and December 2022. The incidence of SH (secondary outcome) was also recorded.

Patients who received both NA and intravenous heparin were included in the final analysis. At each institution, the following data were extracted by two independent reviewers at each centre: anesthetic type (general anesthesia [GA] *vs* epidural *vs* spinal anesthesia); surgical procedure and duration; details of NA technique (time, number of attempts, any

immediate complications); time and dose of intravenous heparin; and patient's demographics (age, sex, body mass index, and American Society of Anesthesiologists Physical Classification). We recorded the time interval between NA and first heparin administration. If NA time was not specified, we measured the time interval between the first recorded blood pressure and heparin administration.

**RESULTS**

At Institution A, 125 charts (from a total of 322 reviewed) involved NA technique with subsequent heparin administration and were therefore included in the final analysis. The vast majority (83.8%) of patients received intravenous heparin within one hour. An average of 41.85 ± 23.11 min elapsed between NA and heparin administration, with 10 (8.13%) being ≤ 19 min. Patients undergoing EVAR received the highest heparin dose (8400 ± 1,813 units) in the shortest interval (30.18 ± 12.36 minutes) post-NA.

At Institution B, 608 charts (from 996 reviewed) fit inclusion criteria and were analyzed. Only 42.3% received intravenous heparin within one hour. An average of 66.8 ± 28.3 min elapsed between NA and heparin administration, with only 5 (0.8%) being ≤ 19 min. Time elapsed was similar between surgical subgroups.

No patients analyzed at either institution developed a spinal hematoma.

**DISCUSSION**

Our results show that anesthesiologists commonly overlook ASRA recommendations to wait one-hour post-NA prior to administering intravenous heparin, especially during EVARs. Nevertheless, rates of adherence to ASRA guidelines differ by institution. Institution B has a vascular surgery residency program, which may contribute to delayed heparin administration. NA has been associated with fewer postoperative complications and shorter surgical time and hospital stay compared with GA in EVAR patients,[4] and the risk-benefit ratio for these comorbid patients may favor NA; however, the risk of SH is not negligible. Anesthesiologists may modify their practice by delaying heparin, or pre-emptively opting for GA.

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# The effect of dexamethasone on the incidence and severity of rebound pain after regional anesthesia for ambulatory surgery: a retrospective cohort study

**Submission ID**

109

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## INTRODUCTION

Rebound pain after peripheral nerve block (PNB) is a rapid increase in the severity of pain shortly after the block wears off and has been recognized as a significant and common issue after single-shot PNBs in ambulatory patients.[1–3] Previous studies have identified dexamethasone administration as one of the modifiable factors to reduce the risk of rebound pain, with a recent meta-analysis of randomized control trials reinforcing its role in rebound pain prevention.[4] The primary objective of this retrospective cohort study was to determine the optimal dose and timing of dexamethasone associated with a reduced incidence and severity of rebound pain in ambulatory surgery patients. We also investigated the practice pattern of dexamethasone use in regional anesthesia at our centre over time.

## METHODS

Following the institutional research ethics board and waiver of consent approvals, we performed a retrospective cohort study of adult patients who received a single-shot peripheral nerve block for ambulatory surgery at Queen Elizabeth II Health Sciences Center in Halifax, NS, Canada, between March 2017–December 2022. We excluded patients planned for overnight hospital admission, highly opioid-tolerant patients, and patients who received a continuous peripheral nerve catheter. The primary outcome was rebound pain, as defined by Barry *et al*. as the transition from well-controlled pain (numerical rating scale [NRS] < 3) to severe pain (NRS > 7) within 24 hr of block performance.[1] The secondary outcome was rebound pain score (RPS), which is the difference in maximum PACU pain score and maximum pain score at home within the 24-hr follow-up period. Data was obtained from hospital medical record databases (Innovian, Dragerwerk AG & Co., Lubeck, Germany) and questionnaire-based sources. Statistical analysis was performed in RStudio (PBC, build 554) and IBM SPSS Statistics (Version 28).

**RESULTS**

A total of 4,352 patients were identified for inclusion in the study, with 3,756 patients having available primary outcome data (596 [13.7%] patients lost to follow-up). Dexamethasone was given to 1,425 patients: 1,389 intravenous, 27 perineural, and nine cases where the route was not indicated. Dexamethasone administration was associated with a reduction in rebound pain incidence in multivariable logistic regression (OR, 0.39; 95% confidence interval [CI], 0.33 to 0.47; $P < 0.001$) when including previously described risk factors age, sex, and bone surgery.[1] A higher dexamethasone dose was associated with reduced RPS but not incidence of rebound pain when including the covariates. There was an increase in rebound pain incidence (OR, 1.30; 95% CI, 1.05 to 1.61; $P = 0.015$) and RPS (slope 0.51 [NRS score per hour]; 95% CI, 0.19 to 0.84; $P = 0.002$) the later it was given after PNB.

**DISCUSSION**

Dexamethasone is currently one of the known modifiable factors that appears to reduce the rate and severity of rebound pain after PNB. This retrospective cohort study showed a dose-dependent association between dexamethasone and reduced rebound pain incidence and severity. Rebound pain was also increased the later dexamethasone was given after the time of PNB performance. The results of this study suggest that dexamethasone given in doses higher than 4 mg and close to the time of PNB may be best to prevent rebound pain.

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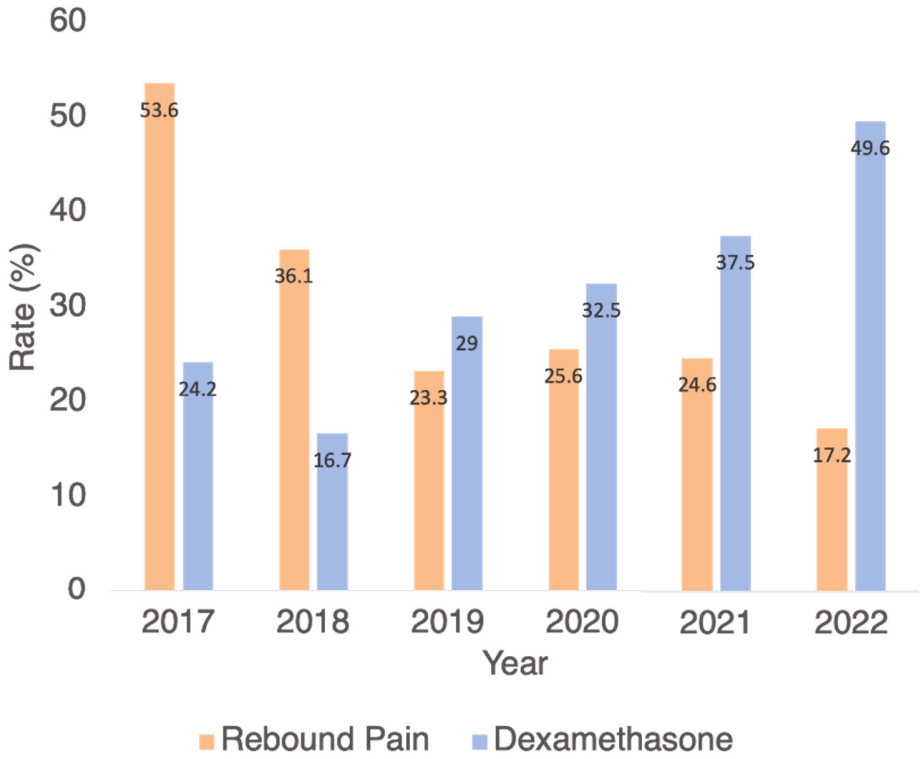
**Figure**


60
50
40
30
20
10
0
Rate (%)
53.6
24.2
36.1
16.7
23.3
29
25.6
32.5
24.6
37.5
17.2
49.6
2017
2018
2019
2020
2021
2022
Year
Rebound Pain
Dexamethasone

# The role of short-term long-acting hydromorphone in acute pain management following open abdominal urologic surgeries

**Submission ID**

27

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## INTRODUCTION

Opioids are commonly used for pain control postsurgery, including short-acting and long-acting formulations. Although the use of long-acting opioids has been reduced because of the risk of adverse events and overdose when used for chronic pain, evidence is lacking to support the short-term use of a low dose long-acting opioid for acute pain control in a monitored setting.[1,2] Long-acting opioids are still commonly used, especially in orthopedic surgery, with more rapid functional recovery following total knee arthroplasty.[3] In a recent, large, retrospective cohort study, persistent postoperative opioid use appeared to be lower for long-acting tapentadol compared with long-acting oxycodone for opioid-naïve patients and opioid-experienced patients.[4] The objective of this study is to evaluate whether low dose, long-acting hydromorphone short term (two days) combined with short-acting hydromorphone as required offers better pain control postoperatively to allow earlier ambulation after major urologic surgeries compared with short-acting opioid alone.

## METHODS

Following ethics approval and obtaining written informed patient consent, a randomized, double-blind, controlled trial was conducted assessing all adult patients undergoing elective open abdominal urologic surgeries with an American Society of Anesthesiologist Physical Status score of I–III who met the inclusion criteria. Patients were excluded from analysis in the following circumstances: refusal, history of chronic pain, allergy to hydromorphone, local anesthetic or acetaminophen, severe postoperative nausea and vomiting, inability to swallow tablets, and severe renal failure. Patients were randomized into two groups: long-acting hydromorphone on a regular basis for two days with short-acting hydromorphone available on an ‘as required’ basis (long-acting group) or short-acting hydromorphone on an ‘as required’ basis only (short-acting group). All patients were given general anesthetic and intravenous

opioid at the discretion of the anesthesiologist in the operating room. The primary outcome measure was the time (days postoperatively) to achieve adequate pain relief to get up and walk three steps. Secondary outcomes included pain scores recorded in the post anesthesia care unit (PACU) and 24/48/72 hr postoperatively, opioid consumption intraoperatively, in the PACU and 24/48/72 hr postoperatively, nausea, vomiting, loss of sleep, patient satisfaction, and other adverse events.

**RESULTS**

Eighty patients were recruited, and the final analysis included 32 patients in the long-acting opioid group and 35 patients in the short-acting opioid group. Thirteen patients were excluded from analysis after recruitment because of postoperative surgical complications, opioid sensitivity, severe vomiting, patient withdrawal, or other clinical reasons unrelated to the study. There was no statistically significant difference in the time to first mobilization, opioid consumption, or pain scores at any time point between the two groups. There were trends toward more nausea on postoperative days one, two and three, as well as more severe loss of sleep the first night after surgery in the short-acting group, although the differences did not reach statistical significance. Both groups reported similar levels of satisfaction with their pain control. No other adverse effects were noted.

**DISCUSSION**

Our study suggests that patients who received low dose, long-acting hydromorphone did not mobilize earlier than those who received short-acting hydromorphone in the immediate postoperative period following open abdominal urologic surgery. Opioid consumption and pain scores were comparable between groups. This refutes the concept of more stable analgesia and less frequent dosing with long-acting opioids, as well as a previous study showing benefits of long-acting opioids in early rehabilitation after arthroplasty surgery.[3,5] Although not statistically significant, there appeared to be more nausea and disturbed sleep in the short-acting hydromorphone group immediately postoperatively. A larger sample size is warranted.

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# The use of simulation in ultrasound guided regional anesthesia training: a Canadian national survey

**Submission ID**

22

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**INTRODUCTION**

Traditionally, training in ultrasound-guided regional anesthesia (UGRA) has followed the "see one, do one, teach one" approach. Nevertheless, this method presents potential risks for patients, particularly when residents in the early stages of their training begin performing these procedures.[1,2] The literature shows considerable variability in the comfort levels of graduating trainees when performing UGRA.[3] Simulation-based medical education (SBME) is a valuable tool that can supplement real clinical exposure and provide opportunities for deliberate practice in a controlled environment with no risk to the patients.[2,4] Simulation use in UGRA can also lead to improved knowledge acquisition and patient outcomes.[4] Despite its potential benefits, there is currently a lack of clarity regarding the scope and approach of simulation-based UGRA training in Canada. This study aims to investigate the current state of UGRA simulations within Canadian anesthesiology residency programs, examining both facilitators and barriers to its implementation.

**METHODS**

Approval was obtained from the University of Ottawa Research Ethics Board. An initial structured survey was developed based on prior surveys related to medical education and simulation in UGRA training. The survey was modified based on gaps identified within the Canadian context by the study authors, whose collective experience included expertise in simulations, medical education, UGRA, and survey methodologies. The survey was pilot-tested with a faculty member who has expertise in SBME. The resulting feedback was incorporated into a final version, which was approved by all the study authors prior to the recruitment. The survey focused on various aspects of simulation use in UGRA training, including program demographics, types of modalities employed, hours of exposure, and its use for resident assessment. It also explored the facilitators and barriers to using UGRA simulation, as well as opinions on using simulation for training and assessment. This survey was distributed via email

to simulation and/or UGRA education leads in all 17 Canadian anesthesiology residency programs. The responses were anonymously collected over four months, and only one response per institution was allowed. The quantitative results were summarized using frequencies, percentages, and median (range) where appropriate.

**RESULTS**

Out of 17 Canadian anesthesiology programs, 15 responded to the survey. Among them, 53% employ simulations for UGRA technical training, and 60% for nontechnical skills. Most programs (93%) do not use simulations for resident assessment. Live-model scanning was the most widely used simulation modality, followed by gel phantom models, screen-based teaching, and part-task trainers. The primary barriers to using simulations were lack of funding, faculty availability and simulator availability. Key facilitators were improved patient safety and interest from residents. When asked about increasing simulation exposure in UGRA, 47% of respondents agreed, 7% disagreed, and 46% remained neutral. On necessity of using simulations to show UGRA proficiency before clinical practice, opinions were split with 33% agreement, 33% disagreement, and 34% neutrality. The effectiveness of simulations in enhancing UGRA skills saw 66% agreement, 20% disagreement, and 14% neutrality. Lastly, 60% supported standardizing UGRA simulations, with 33% neutral, and 7% opposing the idea.

**DISCUSSION**

Simulation-based UGRA training varies widely in implementation and perception across Canada. The USA is ahead of Canada, with 80% of residency programs using SBME in UGRA.[5] Nevertheless, both countries face similar barriers, such as a lack of funding and simulator. Many respondents were not optimistic about further using UGRA simulation for assessment. Despite greater SBME use in U.S., the percentage of programs using simulation for assessment was similar to Canada.[5] SBME is an ideal tool to supplement clinical experience.[2,4] Nevertheless, its resource-heavy nature warrants investigations to identify the most effective way to implement UGRA simulation into the current curriculum.

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# Transversus abdominis plane block catheters following renal transplantation: a retrospective cohort study

**Submission ID**

18

**AUTHORS**

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**INTRODUCTION**

The mainstay of postoperative analgesia for renal transplantation patients is opioid delivered via patient-controlled analgesia (PCA) pumps, despite well-documented opioid-related adverse effects and health care cost. Renal transplant patients are at an increased risk of adverse opioid-related outcomes secondary to altered drug metabolism.[1] Opioid use may impair gastrointestinal recovery and impede early postoperative physical rehabilitation and subsequent postoperative activities of daily living.[2] Opioid use following renal transplantation is also associated with an increased risk of death and graft failure in the first year after transplant.[1] Local anesthetic infusion through transversus abdominis plane (TAP) catheters has been shown to enhance pain control and reduce opioid requirements following various surgical procedures,[3] yet the role of surgically-initiated TAP catheters for renal transplantation has not been comprehensively investigated.[4] The aim of our study is to examine the efficacy of TAP catheters in reducing cumulative opioid consumption following renal transplantation.

**METHODS**

Following research ethics board approval, a retrospective cohort study was conducted by reviewing the electronic medical records of patients ≥ 18 yr old who underwent renal transplantation at our institution between January 2020 and June 2023. Patients who underwent renal transplantation between August 2021 to June 2023 received a TAP catheter, and were compared with a historical control group of patients who underwent renal transplantation between January 2020 to July 2021 without the use of TAP catheters. This study excluded pediatric recipients, patients with end-stage liver disease, patients with a non-Gibson transplant incision, patients experiencing pretransplant chronic pain, and those undergoing multi-organ transplant. The primary outcome of this study was cumulative opioid consumption at 48 hr, expressed as oral morphine equivalents. Several secondary outcomes were analyzed, including the cumulative opioid consumption by postoperative day 7, the primary opioid

administration mechanism (PCA *vs* oral-based), adverse postoperative events, and analgesic adjunct usage.

**RESULTS**

Patient data (*n* = 344) was analyzed using descriptive and comparative statistics as appropriate (174 patients with TAP catheters *vs* 170 patients without TAP catheters). The demographic details are shown in Table 1. Cumulative opioid consumption at 48 hr was not significantly different between groups (170 mg *vs* 167 mg; TAP *vs* No TAP; *P* = 0.86). Notably, the opioid consumption at 48 hr was significantly higher with the use of a PCA when compared with oral opioid administration on an 'as required' basis (183 mg *vs* 118 mg; PCA *vs* no-PCA; *P* = 0.007), irrespective of TAP catheter status. Secondary outcomes indicated no significant difference between the groups in rates of renal graft failure, postoperative reintubation, depressed respiratory rate (< 10 breaths/min), or increased oxygen demand beyond postoperative day two. Severe surgical complications, defined as single or multisystem organ failure, admission to ICU with a life-threatening complication, or patient mortality were also not significantly different between groups.

**DISCUSSION**

Our study did not find any significant difference in opioid consumption at 48 hr between the TAP group and the no-TAP group. Our results showed a significantly higher opioid consumption associated with PCA use compared with alternative oral routes on an 'as required' basis, which is supported by existing literature.[5] Our study was limited by the retrospective design and the use of a historical control group. Prospective randomized control trials are required to further elucidate the role of TAP catheters in optimizing postoperative pain management in renal transplantation.

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## Figure

| Demographic | TAP Block *(n=174)* | No TAP Block *(n=170)* |
|---|---|---|
| Sex - *Male/Female* | 106 (60.9%) / 68 (30.1%) | 114 (65.5%) / 56 (32.9%) |
| Age (years) | | |
| *18-40* | 38 (21.8%) | 32 (18.8%) |
| *41-60* | 74 (42.5%) | 83 (48.8%) |
| *60-80* | 60 (34.5%) | 55 (32.4%) |
| *>80* | 2 (1.2%) | 0 (0%) |
| Weight (kg) - *Range (Mean)* | 41.8 - 148.4 (78.8) | 38.4 - 125.9 (82.1) |
| Height (m) - *Range (Mean)* | 1.39 - 1.96 (1.7) | 1.46 - 1.96 (1.71) |
| Opioid Use 7 Days Prior to Transplant - *Yes/No* | 11 (6.3%) / 163 (93.7%) | 15 (8.8%) / 155 (91.2%) |

# RESIDENT COMPETITION

## Evaluation of a formal resilience curriculum for novice physicians-in-training on self-reported resilience: a randomized controlled trial

**Submission ID**

67

**AUTHORS**

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**INTRODUCTION**

Physician wellness continues to be an important topic, especially concerning mental illness and burnout.[1] In addition to detrimental effects on physician well-being, burnout is associated with an increased risk of patient safety incidents.[2] The Road to Mental Readiness (R2MR) military curriculum was developed to 'build awareness of mental illness and operational stress injuries through education with a goal to improving short-term performance and long-term health outcomes.'[3] Simulation Training for Resilience in Various Environments (STRIVE), an adaptation of R2MR, provides formal resiliency training to augment medical professional preparedness and positive adaptation in challenging clinical environments. Physicians-in-training have been identified as an at-risk population for burnout.[4] After initially completing a pilot study for feasibility, this randomized controlled trial (RCT) assesses the impact of the STRIVE course on self-reported resilience in junior residents. We propose that formal STRIVE training may improve self-reported resilience in physicians-in-training.

**METHODS**

Institutional research ethics board approval (REB 122259) was obtained. This is a single-centre RCT with a 1:1 allocation ratio. Participants were a convenience sample of first- and second-year residents from our institution's anesthesia and emergency medicine residency programs. A power calculation determined a sample size of 48 participants to detect statistical significance ($P < 0.05$, power 80%). This was achieved over a period of three academic years with two cohorts. Consented participants were randomized using REDCAP sequence generation.

Participants randomized to STRIVE received a four-hour interactive workshop on wellness strategies followed by high-fidelity simulations to reinforce and apply learned techniques. Participants randomized to the control group received information regarding available resilience resources for self-study. Study design and intervention details were concealed from control group participants to minimize subject bias. Self-reported resilience was quantified using the validated Connor-Davidson Resilience Scale (CD RISC-10). Scores range from 0–40 with higher scores indicating greater perceived resilience.[5] Anonymous surveys were electronically distributed to all participants prior to the course delivery (baseline) and at 3-months postintervention. Resilience scores at three-months were compared between groups using an ANCOVA model with baseline scores from respective groups used as a covariate. Data are presented as mean [interquartile range (IQR)].

**RESULTS**

A total of 54 residents were consented from 58 potential participants. The STRIVE course was completed by all participants randomized to the intervention group ($n$ = 27). Follow-up surveys were completed by 96% (26/27) of the STRIVE group and 85% (23/27) of the control group. Baseline resilience scores between groups were similar (STRIVE: 27 [5.25]; control: 29 [6]). Reported resilience scores three-months postintervention increased in the STRIVE group (30.5 [4.75]) while remaining similar in the control group (29 [7]). After adjustment for baseline resilience scores, there was a statistically insignificant increase in three-month resilience scores in the STRIVE group compared with the control ($P$ = 0.114). In the postintervention survey, 96% of respondents reported that skills learned during the STRIVE course had positively contributed to coping strategies employed during stressful clinical situations.

**DISCUSSION**

This study demonstrates statistically insignificant improved self-reported resilience scores in anesthesia and emergency medicine residents who participated in the STRIVE course. In addition, 96% of respondents of the intervention group reported the skills learned during the STRIVE course to positively contribute to coping strategies employed during stressful clinical situations. While not statistically significant, it is encouraging to see a trend towards benefit in the intervention group. A final survey will be obtained at the six-month postintervention timeframe to see if this trend continues. This study supports the consideration for introducing the STRIVE curriculum into formal postgraduate education curriculum.

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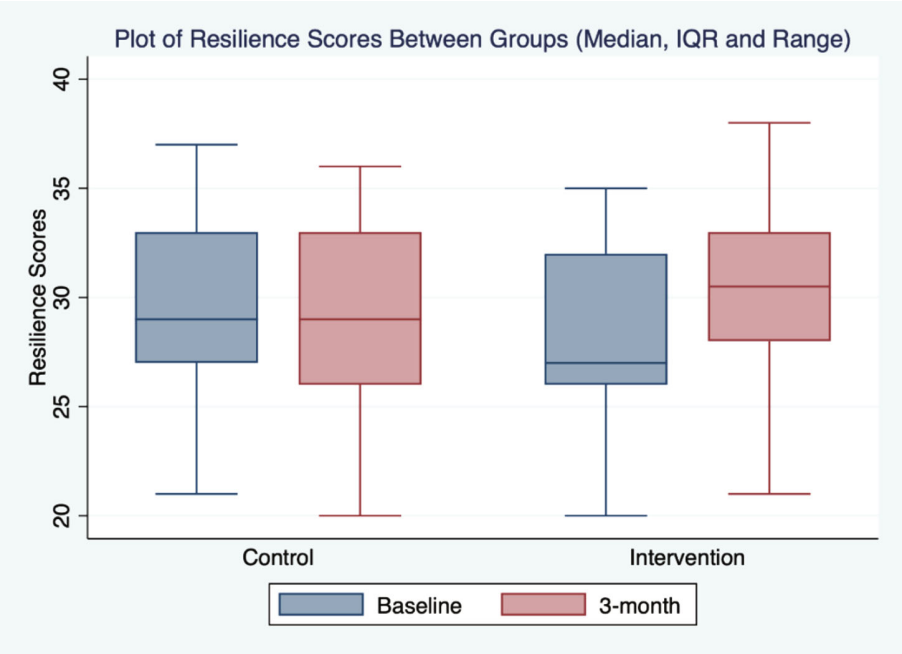
**Figure**



# Facilitators and barriers to performing ultrasound guided regional anesthesia by nonregional expert anesthesiologists: a qualitative study using the theoretical domains framework

**Submission ID**

91

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**INTRODUCTION**

Ultrasound-guided regional anesthesia (UGRA) has become the preferred technique for performing regional blocks and is recognized as a requisite skill all anesthesiologists should possess.[1] Though peripheral nerve blocks have compelling evidence to support their use across different populations, many patients who would otherwise benefit from regional anesthesia may not have access to these procedures.[2] Regional anesthesia experts have identified potential facilitators and barriers to the provision of UGRA,[3] although the perspectives of nonregional trained anesthesiologists have yet to be explored. Given that nonregional experts make up the majority of anesthesia providers, this study aimed to apply the Theoretical Domains Framework (TDF)[4] to qualitatively investigate the facilitators and barriers of nonregional anesthesiologists performing UGRA procedures during the perioperative period.

**METHODS**

After Research Ethics Board approval, we recruited staff anesthesiologists from both academic and community centres within Canada, excluding participants who possessed a regional anesthesia fellowship. Participants engaged in semistructured interviews based on the TDF, aimed at elucidating barriers and facilitators to UGRA. The interview guide was adapted from previous TDF studies within the field of anesthesiology and further informed by experts in regional anesthesia, qualitative research, and behaviour change. The interview guide was piloted to ensure the questions were clear. All study authors approved the final interview guide before recruitment. Using direct content analysis, interview transcripts were deductively coded into the relevant TDF domains, with an average percent agreement of 96% between the two coders. Subsequently, these codes were used to generate specific belief statements within each

TDF domain. TDF domains were classified as relevant, or more likely to influence behaviour, by the two coders and confirmed by a TDF expert. A domain was considered relevant based on the frequency of specific beliefs across interviews, the number of beliefs in each domain, the presence of conflicting beliefs signaling variation in beliefs and attitudes, and evidence of strong beliefs that could directly influence the performance of UGRA.

**RESULTS**

Data saturation was achieved after 14 interviews. Subsequently, the following eight TDF domains were identified as relevant: skills, beliefs about capabilities, beliefs about consequences, memory/attention/decision-making, environmental context and resources, social/professional role/identity, social influences, and behavioural regulation. Our results reinforced that nonregional trained anesthesiologists view UGRA as a critical component of the anesthesiologist's professional role, and as a worthwhile skill that benefits patient outcomes. Facilitators to UGRA provision included access to dedicated block rooms, pre-emptive scheduling for block patients, dedicated pathways that incorporate regional anesthesia, and availability of further skill-based training in regional anesthesia (either formal or informal). Several barriers were identified, including a perceived lack of adequate facilities, a lack of up-to-date patient outcome evidence for various blocks, skilled support staff, and sufficient opportunities to provide UGRA. Further, surgeons' expectations around UGRA provision were identified as a social barrier to regional anesthesia.

**DISCUSSION**

This study identified key facilitators and barriers to UGRA provision by nonregionalists, informing potential future interventions. Specifically, access to human and physical resources, such as block rooms and anesthesia assistant support, was identified as an environmental intervention to facilitate UGRA administration. Many nonregionalists wanted consensus regarding evidence, indication, and type of block to help facilitate decision-making. Interestingly, one barrier was a lack of opportunity to practice regional anesthesia, which was more common in centres with fellowship-trained regional anesthesiologists. There was a strong desire for more training opportunities to hone regional skills, and mentorship from those with more regional experience.

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# Management of incidental findings within point-of-care ultrasound training programs: a survey of Canadian anesthesia residency training programs

**Submission ID**

104

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## INTRODUCTION

An incidental finding is any unanticipated discovery made by an imaging modality, conducted for an unrelated reason.[1,2] The frequency of incidental findings uncovered by point-of-care ultrasound (POCUS) is reported to be between 1.6–26%.[3] POCUS trainees detect higher rates of incidental findings compared with experienced POCUS users.[2] Tewari *et al*. found that emergency medicine residents identified incidental findings in 26% of POCUS scans performed, with 66% concordance with radiologists.[2] Most findings were deemed "not clearly benign" and were subsequently confirmed by additional investigations.[2] Therefore, resident detected incidental findings are common and may have important clinical implications for patients. As POCUS becomes a standard of practice in anesthesia, residency programs and the Royal College have responded by creating formal POCUS education curriculums.[4] We conducted a survey of Canadian anesthesiology POCUS program leads to determine how incidental findings are managed. Our goal was to develop a formal incidental findings protocol.

## METHODS

We surveyed the POCUS education leads of all 17 Canadian anesthesia residency programs. The internet-based survey asked POCUS leads to report on the frequency of incidental findings encountered by residents, and the presence and structure of an incidental findings protocol within their program. Survey responses were summarised using descriptive statistics and presented as a percent of total responses for each survey question.

## RESULTS

The survey was completed by ten out of 17 Canadian anesthesia residency programs. Ninety percent of programs reported encountering incidental findings in perioperative patients who volunteered for POCUS scans for resident learning. Of programs that had identified incidental

findings, 56% ordered formal imaging, 33% referred the patient to their family doctor or specialist for follow-up, and 11% ordered formal imaging and referred the patient for follow-up. Despite this, 50% of anesthesia programs did not have a protocol in place for addressing incidental findings identified by resident learners. Only 20% of programs had formal incidental findings protocol and 30% of programs had informal protocols. The POCUS education leads of all ten programs agreed that a formal incidental findings protocol should exist as part of a formal POCUS training program.

**DISCUSSION**

Anesthesia residents are encountering incidental findings during POCUS training. Despite this, most anesthesia POCUS curriculums across Canada have not implemented a formal incidental findings protocol. Our proposed incidental findings protocol emphasizes documentation, recommends collaborative decision making, considers anesthesia specific patient care settings, as well as implications on anesthetic care (Figure).[5]

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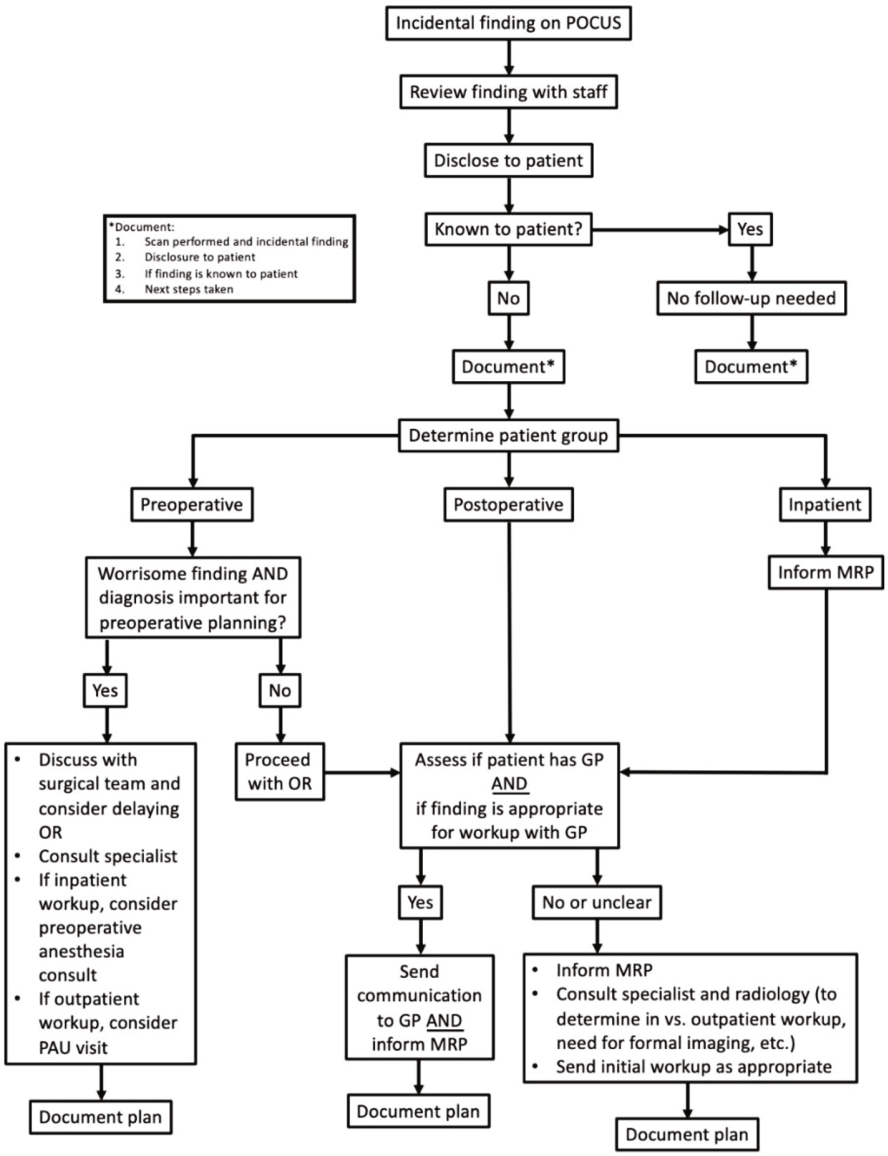
**Figure** Proposed incidental findings protocol




GP = general practitioner; MRP = most responsible physician; OR = operating room; PAU = pre-admission unit; POCUS = point-of-care ultrasound

# Perioperative benzodiazepine administration and patient-reported recovery outcomes

**Submission ID**

116

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**INTRODUCTION**

Benzodiazepines are administered during the perioperative period to improve the patient experience. Nevertheless, recent studies have suggested that perioperative benzodiazepines may be associated with harm, including postoperative delirium and cognitive dysfunction. We conducted a systematic review and meta-analysis to assess the safety and efficacy of perioperative benzodiazepine administration. Here we report on four patient-reported outcomes: postoperative pain, anxiety, satisfaction, and quality of recovery. Patient-reported outcomes are important measures that may differ from clinician-measured outcomes and provide important patient perspectives of treatment benefits and harms.

**METHODS**

We searched Cochrane CENTRAL, MEDLINE, Embase, PsychINFO, CINAHL, Web of Science, clinical trial registries, and reference lists from included articles from inception to September 2023 using a search strategy developed by a medical librarian. We included randomized controlled trials (RCTs) of all languages comparing administration of benzodiazepines to other agents or placebo in adults undergoing inpatient surgery. Two reviewers independently screened and extracted data from included studies; disagreements were resolved by consensus. We evaluated the effects of perioperative benzodiazepines on each outcome in the short- (< 24 hr postoperative) and long-term (> 24 hr postoperative). We converted reported data to a 0–10 Visual Analogue Scale for pain, QoR-15 for quality of recovery, State-Trait Anxiety Scale for anxiety, and 0–10 Visual Analogue Scale for patient satisfaction. We pooled data using a random-effects model and assessed the quality of evidence for each outcome using the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) approach.

**RESULTS**

We screened 32,384 full texts and included 102 RCTs. Patient satisfaction and anxiety were evaluated only in the short-term because of an insufficient number of studies. We found that perioperative benzodiazepines, compared with another agent or placebo, were associated with higher anxiety (mean difference [MD], 2.37; 95% confidence interval [CI], 1.15 to 3.60). Benzodiazepine administration did not improve short- (MD, 0.02; 95% CI, -0.26 to 0.29) or long-term pain (MD, −0.01; 95% CI, −0.33 to 0.30), short- (MD, −1.74; 95% CI, −7.44 to 3.96) or long-term quality of recovery (MD, −0.33; 95% CI, −7.58 to 6.92), or satisfaction with anesthesia (MD, −3.71; 95% CI, −9.14 to 1.73).

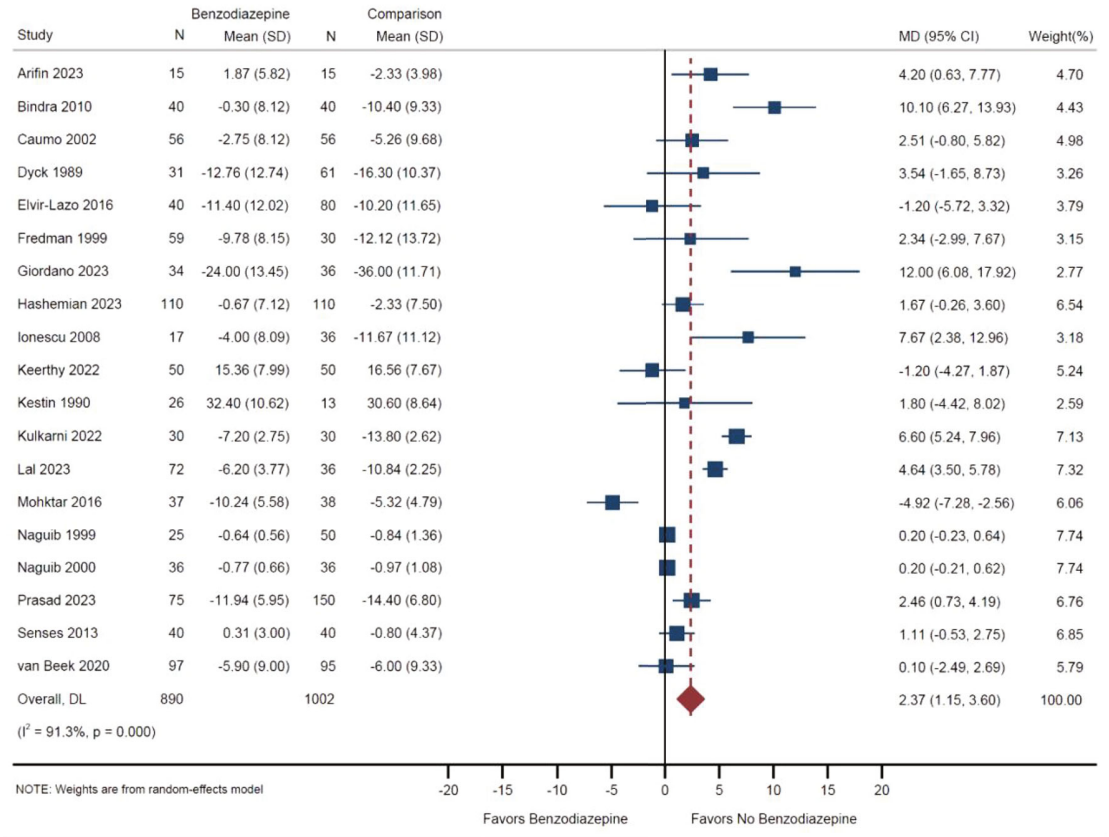
**DISCUSSION**

Based on data from 102 RCTs including a total of 10,573 patients, we found that perioperative benzodiazepines may increase patient-reported postoperative anxiety and have no effect on postoperative pain, quality of recovery, or satisfaction with anesthesia. Given the previously reported relationship of benzodiazepines with adverse postoperative neurocognitive outcomes, avoidance of perioperative benzodiazepines should be considered.

**REFERENCES**

No references.

## Figure


Study
Benzodiazepine N Mean (SD)
Comparison N Mean (SD)
MD (95% CI)
Weight(%)
Arifin 2023 15 1.87 (5.82) 15 -2.33 (3.98) 4.20 (0.63, 7.77) 4.70
Bindra 2010 40 -0.30 (8.12) 40 -10.40 (9.33) 10.10 (6.27, 13.93) 4.43
Caumo 2002 56 -2.75 (8.12) 56 -5.26 (9.68) 2.51 (-0.80, 5.82) 4.98
Dyck 1989 31 -12.76 (12.74) 61 -16.30 (10.37) 3.54 (-1.65, 8.73) 3.26
Elvir-Lazo 2016 40 -11.40 (12.02) 80 -10.20 (11.65) -1.20 (-5.72, 3.32) 3.79
Fredman 1999 59 -9.78 (8.15) 30 -12.12 (13.72) 2.34 (-2.99, 7.67) 3.15
Giordano 2023 34 -24.00 (13.45) 36 -36.00 (11.71) 12.00 (6.08, 17.92) 2.77
Hashemian 2023 110 -0.67 (7.12) 110 -2.33 (7.50) 1.67 (-0.26, 3.60) 6.54
Ionescu 2008 17 -4.00 (8.09) 36 -11.67 (11.12) 7.67 (2.38, 12.96) 3.18
Keerthy 2022 50 15.36 (7.99) 50 16.56 (7.67) -1.20 (-4.27, 1.87) 5.24
Kestin 1990 26 32.40 (10.62) 13 30.60 (8.64) 1.80 (-4.42, 8.02) 2.59
Kulkarni 2022 30 -7.20 (2.75) 30 -13.80 (2.62) 6.60 (5.24, 7.96) 7.13
Lal 2023 72 -6.20 (3.77) 36 -10.84 (2.25) 4.64 (3.50, 5.78) 7.32
Mohktar 2016 37 -10.24 (5.58) 38 -5.32 (4.79) -4.92 (-7.28, -2.56) 6.06
Naguib 1999 25 -0.64 (0.56) 50 -0.84 (1.36) 0.20 (-0.23, 0.64) 7.74
Naguib 2000 36 -0.77 (0.66) 36 -0.97 (1.08) 0.20 (-0.21, 0.62) 7.74
Prasad 2023 75 -11.94 (5.95) 150 -14.40 (6.80) 2.46 (0.73, 4.19) 6.76
Senses 2013 40 0.31 (3.00) 40 -0.80 (4.37) 1.11 (-0.53, 2.75) 6.85
van Beek 2020 97 -5.90 (9.00) 95 -6.00 (9.33) 0.10 (-2.49, 2.69) 5.79
Overall, DL 890 1002 2.37 (1.15, 3.60) 100.00
($I^2$ = 91.3%, p = 0.000)
NOTE: Weights are from random-effects model
-20 -15 -10 -5 0 5 10 15 20
Favors Benzodiazepine
Favors No Benzodiazepine

# Preoperative malnutrition screening: a window of opportunity

**Submission ID**

40

**AUTHORS**

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**INTRODUCTION**

Between 15–40% of cancer patients are malnourished at diagnosis, and this proportion increases to 40–80% throughout disease treatment.[1] Perioperatively, these patients are at increased risk of infection, impaired wound healing and decreased functional capacity.[2] Early identification of patients at risk of malnutrition with validated screening tools and referral to a dietitian has been shown to improve outcomes.[3] Despite this, adoption of screening practices remains low.[4] Our goals were to answer the following research questions: to what extent 1) are patients at malnutrition risk before cancer surgery in our tertiary care centre? 2) are at-risk patients referred to a registered dietitian (RD)/ prehabilitation program before surgery? 3) does malnutrition risk predict clinical outcomes postoperatively? 4) does referral of at-risk patients change their clinical outcome postoperatively?

**METHODS**

A retrospective chart review was conducted for all patients undergoing elective thoracic and abdominal cancer surgeries between July 2019 to 2020 at our tertiary care centre. Our local research ethics board authorized the study (registration number 2021-7108). Patients with benign pathologies were excluded. Malignant pathologies were divided into 4 cancer groups: upper gastrointestinal (UGI), lower gastrointestinal (LGI), lung/thoracic and other. Two to four weeks before surgery, all patients completed a validated nutrition risk screening tool, Malnutrition Screening Tool (MST), composed of two questions: 1) decreased appetite 2) unintentional weight loss. A “yes” answer to both questions (MST = 2) denoted greatest nutrition risk and MST = 0 signified no risk.[5] Measured outcomes included nutrition consult before surgery (maximum three months prior), length of primary admission (LOS), complication

rate, number of emergency department (ED) visits as well as readmissions within 30 days of surgery. Statistical analysis was done using Stata version 14. Categorical variables were analyzed using Chi square test. Continuous variables were analyzed using multivariate negative binomial analysis (i.e., LOS reported using incidence risk ratio [IRR]), or analyzed using logistic regression (i.e., complication rates reported with odds ratio [OR]). These variables were adjusted for type of cancer, age, sex, neoadjuvant therapy, and number of comorbidities.

**RESULTS**

Five hundred and nineteen patients were included. Altogether, 28% (*n* = 146) of patients had some malnutrition risk (MST = 1–2). 38% of at-risk patients (MST = 1–2; *n* = 56), and 63% of highest risk patients (MST = 2; *n* = 27) had a referral to a RD/prehabilitation. In unadjusted analysis, LOS significantly increased from median 3 [2–5] to 4 [2–7] to 7 [5–10] days with increasing nutrition risk severity. Compared with the no risk group, MST = 2 was associated with more ED visits (19% *vs* 8%; *P* = 0.04), greater incidence of any complications (60% *vs* 34%; *P* = 0.002) including surgical (23% *vs* 7%; *P* = 0.001), serious (30% *vs* 8%; *P* < 0.001) and infectious complications (14% *vs* 3%; *P* = 0.008). In the adjusted analysis, LOS was significantly increased in the at-risk groups compared with the no risk group, MST = 1–2 (IRR, 1.4 [1.14 to 1.62]; *P* < 0.001) and MST = 2 (IRR, 1.8 [1.4 to 2.4]; *P* < 0.001). Nevertheless, increased incidence of any complication was associated only with the MST = 2 group (OR, 2.2 [1.1 to 4.5]; *P* = 0.024). Referral for nutrition consultation did not modify outcomes.

**DISCUSSION**

One-third of preoperative cancer patients were at risk of malnutrition. The majority of highest risk patients were referred for nutrition consultation. Malnutrition risk was associated with higher LOS, increased ED visits, greater incidence of complications, including surgical, infectious, and serious complications. Referral to RD/prehabilitation did not modify clinical outcomes. Malnutrition risk was not assessed post referral, and thus we were unable to determine the effectiveness of the nutritional intervention. These findings highlight the importance of identifying cancer patients with malnutrition preoperatively. Interventions that modify malnutrition, such as prehabilitation, in the short window of opportunity before surgery should be further investigated.

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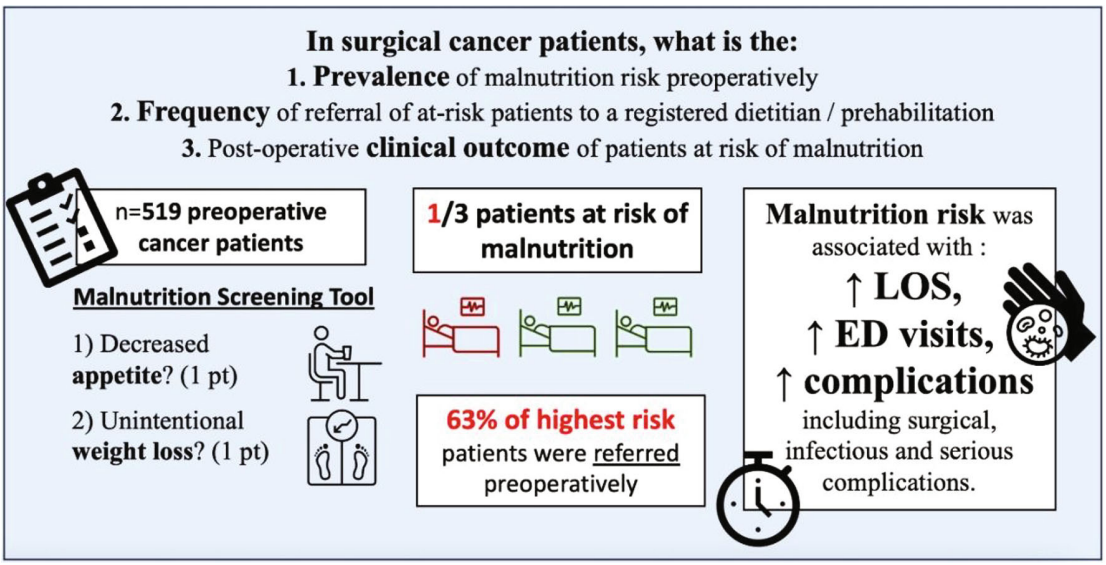
**Figure**



# Surgical Apgar Score and Shock Index are associated with acute deterioration after major abdominal surgery

**Submission ID**

124

**AUTHORS**

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**INTRODUCTION**

Patients undergoing major abdominal surgery are at high risk of postoperative clinical deterioration.[1] Currently there are limited tools to help guide postoperative disposition decisions (e.g., transfer to intensive care unit [ICU] *vs* high-acuity unit *vs* surgical ward). Traditional risk factors such as advanced age, surgery type, and comorbidities are neither sensitive nor specific in predicting postoperative clinical deterioration. This project sought to determine if readily available intraoperative hemodynamic parameters, such as the Surgical Apgar Score (SAS)[2] and Shock Index (SI),[3] were associated with clinical deterioration (unplanned ICU admission and/or rapid response team activation) in the first 72-hr after major abdominal surgery.

**METHODS**

We conducted a matched case-control study of patients who underwent major abdominal surgery between 2012–2018 at a large quaternary trauma centre. The centre includes a 33-bed ICU with a rapid response team but no high acuity or step-down unit. Major abdominal surgery was defined as any open laparotomy general or hepatobiliary procedure. Cases were defined as patients who were discharged from the postanesthetic care unit (PACU) to the surgical ward and then experienced an unplanned ICU admission or code/rapid response team activation in the first 72-hr postoperatively. Controls were defined as patients who underwent major abdominal surgery without clinical decompensation. Cases were matched 1:1 with controls using Canadian Classification Intervention procedure code, age, sex, American Society of Anesthesiologists (ASA) Physical Status classification, emergency status, epidural analgesia, and year of surgery. An SAS was calculated using the lowest heart rate, lowest mean arterial pressure, and estimated blood loss. A score less than 7 was defined as high risk.[4] An SI was calculated by dividing heart rate by systolic blood pressure. An SI greater than 0.9 was defined

as high risk.[3] Conditional logistic regression models for matched case-control groups were created adjusting for confounders.

**RESULTS**

We included 164 patients (82 cases and 82 controls) incorporating more than 65,000 hemodynamic measurements. The median age was 68 (interquartile range [IQR], 57–76) and 102 (62%) were male. A total of 116 (71%) patients were ASA III/IV with 126 (77%) having two or more significant comorbidities. All surgeries were either general surgical (102 [62%]) or hepatobiliary (62 [38%]) procedures. The primary surgical indication was malignancy in 114 (70%) and 54 (33%) were emergency cases. Among cases, 42 (51%) patients deteriorated respiratory failure and 21 (26%) from hypotension. A SAS less than 7 was strongly associated with a statistically significant increase in the odds of acute decompensation (adjusted odds ratio [aOR], 6.78; 95% confidence interval [CI], 2.96 to 15.5). Both intraoperative and PACU mean SI above 0.9 were associated with a statistically significant increase in the odds of acute decompensation (aOR, 3.71; 95% CI, 1.15 to 12.0 and aOR, 2.72; 95% CI, 1.22 to 6.07 respectively).

**DISCUSSION**

In this matched case-control study of 164 patients undergoing major abdominal surgery both the SAS and SI were strongly associated with acute decompensation in the first 72 hr postoperatively. Our cohort included highly comorbid patients that underwent high risk abdominal surgery but met criteria to be discharged from the PACU to the general surgical ward. Previously, the SAS and SI have been demonstrated to predict postoperative complications but not acute postoperative decline.[4] The SAS and SI may be a powerful tool to inform postoperative disposition. Larger studies are needed to further validate these results.

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# RICHARD KNILL COMPETITION

## Chronic postsurgical pain after ambulatory surgeries: a prospective cohort study

**Submission ID**

21

**AUTHORS**

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**INTRODUCTION**

Chronic postsurgical pain (CPSP) is a recognized complication after various surgical procedures, with an incidence ranging from 5% to 50%.[1] Patients having outpatient surgery may experience significant postdischarge pain, as noted by a systematic review in which only 42% of studies evaluated postdischarge pain and reported an overall incidence of approximately 45%.[2] Most of these studies had a short follow-up period of 24 hr to 7 days. Hence, there is a need to evaluate the incidence of CPSP after outpatient surgeries and elucidate factors associated with it.[3] Our primary objective was to determine the incidence of CPSP. Secondarily we assessed the intensity of CPSP, incidence of moderate-to-severe CPSP, and explored the factors associated with it.

**METHODS**

This is a prospective cohort study of adult patients having outpatient surgeries with a potential to cause moderate-to-severe postoperative pain, such as cholecystectomy, appendectomy, ovarian cystectomy, and hernia repair. Patients having a nerve block or neuraxial analgesia were excluded. Preoperatively we collected anxiety and depression scores (Hospital Anxiety and Depression Scale); pain catastrophizing (Pain Catastrophizing Scale); presence and intensity of preoperative pain (mild/moderate/severe) within the surgical area; and presence of chronic pain in other body parts. All patients had general anesthetic and participated in a previous

randomized controlled trial (RCT) comparing morphine or hydromorphone used in recovery unit and showed no difference in the rate of achieving satisfactory analgesia, defined as pain intensity of < 4/10 (0–10 numerical rating scale [NRS]).[4] Patients were followed up by a phone call after 24 hr and study outcomes were collected at three months by a mailed package with prepaid envelopes or by a backup phone call. Incidences of CPSP were reported as rate (%) with 95% confidence interval (CI), and intensity using a 0–10 NRS (95% CI). We used logistic regression to explore factors associated with CPSP adjusting for baseline catastrophizing and depression.

**RESULTS**

Among 402 RCT patients, 208 completed our 3-month follow-up and were included in the analysis. Included patients mostly had cholecystectomy (33%), inguinal hernia repair (22%), and gynecological surgeries (e.g., ovarian cystectomy, salpingectomy, or salpingo-oophorectomy [26%]). Majority (197 [95%]) were laparoscopic. Incidence of CPSP was 18.8% (39/208), 95% CI 13.7–24.7%, with the mean (95% CI) intensity being 5.5 (4.7–6.4). Seventy-eight percent (28/39) reported having moderate-to-severe CPSP. Rates of CPSP with cholecystectomy (21%) and inguinal hernia (22%) repair were similar. At baseline (Figure), patients reporting CPSP had higher anxiety (median, interquartile range [IQR], 8 [4–10]; $P = 0.04$); depression (3 [1–5]; $P = 0.01$); and catastrophizing scores (12 [5–21]; $P = 0.04$). Nevertheless, none of them were significant in an adjusted model. Every unit increase in pain over the first 24 hr was significantly associated with increased odds of moderate-to-severe CPSP at three months; odds ratio, 1.28; 95% CI, 1.04 to 1.58 (Figure).

**DISCUSSION**

In our cohort study of 208 patients having outpatient surgery, nearly one-fifth (19%) patients reported to have CPSP at three months and more than two-thirds (72%) of them had moderate-to-severe pain. Although higher anxiety, depression, and catastrophizing preoperatively were associated with CPSP in univariate analyses, adjusted analysis did not show such association. Nevertheless, higher postoperative pain score over the first 24 hr indicated a higher risk of moderate-to-severe CPSP. As there are no formal care pathways to address the need to prevent CPSP after outpatient surgeries, studies need to focus on feasible strategies to provide continuing care.[5]

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**Figure** Baseline characteristics and regression analysis of predictive factors

**Baseline characteristics between patients with and without CPSP at 3 months**

| Baseline characteristics | | Total (n=208) | CPSP absent (n=169) | CPSP present (n=39) | *P* Value |
|---|---|---|---|---|---|
| Age, years, mean (SD) | | 48.4 (13.8) | 49.2 (13.4) | 44.8 (15.1) | .07 |
| Female sex, n (%) | | 134 (64.4) | 109 (64.5) | 25 (64.1) | .96 |
| Anxiety score, median (IQR) | | 6 (3–9) | 5 (3–9) | 8 (4–10) | .04 |
| Depression score, median (IQR) | | 2 (1–4) | 1 (0–4) | 3 (1–5) | .01 |
| Catastrophizing score, median (IQR) | | 9 (2–16) | 9 (2–15) | 12 (5–21) | .04 |
| Preoperative pain in the area of surgery, n (%) | | 85 (40.9) | 65 (38.5) | 20 (51.3) | .14 |
| Moderate-to-severe preoperative pain, n (%) | | 42 (20.2) | 32 (18.9) | 10 (25.6) | .38 |
| Chronic pain in other parts, n (%) | | 30 (14.4) | 20 (11.8) | 10 (25.6) | .03 |
| Chronic moderate-to-severe pain, n (%) | | 13 (6.3) | 9 (5.3) | 4 (10.3) | .27 |
| Type of surgery, n (%) | Laparoscopic | 197 (94.7) | 158 (93.5) | 39 (100.0) | .22 |
| | Open | 11 (5.3) | 11 (6.5) | 0 (0.0) | – |
| Duration of surgery, min, median (IQR) | | 53.0 (35.5–76.0) | 53.0 (35.0–75.0) | 53.0 (39.0–79.0) | .50 |
| Highest pain in PACU, median (IQR) | | 5 (4–7) | 5 (4–7) | 7 (5–7) | .06 |
| Highest pain in DSU, median (IQR) | | 3 (2–4) | 3 (2–4) | 4 (2–5) | .20 |
| Average pain score over the last 24 hours, median (IQR) | | 4 (2–5) | 4 (2–5) | 5 (4–6) | .02 |

**Adjusted association of patient factors with CPSP and moderate-to-severe CPSP**

| | Any CPSP | | Moderate to severe CPSP | |
|---|---|---|---|---|
| **Factors** | **OR (95%CI)** | **P Value** | **OR (95%CI)** | **P Value** |
| Depression score | 1.07 (0.94–1.21) | 0.30 | 1.14 (1.00–1.31) | 0.06 |
| Pain catastrophizing score | 1.03 (0.99–1.07) | 0.15 | 1.01 (0.96–1.05) | 0.72 |
| Average pain score during the first 24 hours | 1.19 (0.99–1.42) | 0.06 | 1.28 (1.04–1.58) | 0.02 |

*Every one-unit increase. CI, confidence interval; CPSP, chronic postsurgical pain; DSU, day surgery unit; IQR, interquartile range; OR, odds ratio; PACU, post-anesthetic care unit; SD, standard deviation

# Frailty and decisional regret after elective noncardiac surgery: a multicentre prospective cohort study

## Submission ID

71

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## INTRODUCTION

Frailty is a multidimensional state that results from the accumulation of age and disease-related deficits.[1] Preoperative frailty increases the likelihood of postoperative mortality by more than 2-fold and postoperative loss of independence by nearly 5-fold.[2] Decisional regret is "a negative, cognitively-based emotion that we experience when realizing or imagining that our present situation would have been better had we acted differently."[3] In health care, regret can occur following a treatment decision.[4] Patients with surgical diagnoses face a difficult choice between invasive treatments with relatively high short-term risks (e.g., having surgery) *vs* more conservative options with uncertain longer term risks (e.g., medical management or watchful waiting). After surgery, experiencing a postoperative complication is regularly cited as a predictor of decisional regret.[5] Despite the strong association between frailty and increased risk of postoperative adverse events,[2] the association between frailty and decisional regret in patients who have undergone elective noncardiac surgery remains largely unaddressed.

## METHODS

Research ethics was obtained prior to conduct of this secondary analysis of a prospective, multicenter cohort study of adults ≥ 65 yr who underwent elective, inpatient noncardiac surgery. A protocol was prespecified and registered. Frailty assessments were conducted by trained research assistants or the primary investigator. The presence of frailty was classified using a Clinical Frailty Scale (CFS) score of ≥ 4. Decisional regret about undergoing surgery was collected after surgery in-person or by phone at 30, 90, and 365 days (primary ascertainment point). Decisional regret was measured on a 3-point ordinal scale (no, unsure, yes).

Unadjusted and adjusted associations of frailty and decisional regret were estimated as odds ratios (OR) and 95% credible intervals (CrI), along with estimating the probability of a nonnull association (*P* [OR > 1]), using Bayesian ordinal logistic regression under weakly

information priors. Best practices in Bayesian workflows were followed. Prespecified primary adjusted analysis were conditional on age, sex, surgical specialty, and risk of depression or anxiety. Sensitivity analysis additionally adjusted for the baseline number of comorbidities and disability score. Effect modification of frailty by surgery type was evaluated. In addition to binary frailty status, we also tested the association of different frailty levels with decisional regret risk.

**RESULTS**

We included 669 patients having elective, noncardiac surgery; 293 (43.8%) lived with preoperative frailty. Mean age was 73 (SD 6) yr, 317 (47.9%) were female, and 325 (48.6%) underwent orthopedic surgery. The unadjusted OR for decisional regret at 365 days in patients with frailty compared with those without was 2.21 (95% CrI, 0.98 to 5.09; *P* [OR > 1] = 0.97), and after adjustment OR = 1.68 (95% CrI, 0.84 to 3.36; *P* [OR > 1] = 0.93). Results were similar in direction and strength or association at 30 and 90 days.

Sensitivity analysis additionally adjusting for comorbidities and disabilities estimated the frailty-decisional regret association as OR = 0.89 (95% CrI, 0.37 to 2.12; *P* [OR > 1] = 0.39). There was strong evidence of effect modification by surgery type (nonorthopedic, OR = 1.90; OR (95% CrI, 1.00 to 3.59; *P* [OR > 1] = 0.98); orthopedic, OR = 0.87 (95% CrI, 0.41 to 1.91; *P* [OR > 1] = 0.36). There was also evidence of greater decisional regret at higher CFS scores than lower (CFS ≥ 5; OR = 2.06 (95% CrI, 0.81 to 5.43; *P* [OR > 1] = 0.94; CFS, 4; OR = 1.61 (95% CrI, 0.61 to 4.33; *P* [OR > 1] = 0.83).

**DISCUSSION**

We found moderate strength evidence that frailty was associated with greater decisional regret (93% adjusted probability of any association). Sensitivity analyses suggested complexity in this association. We found that adjustment for co-existing comorbidity and baseline disability, which are intricately linked to frailty, almost entirely attenuated the frailty-decisional regret association. In addition, we found a high probability that decisional regret was greater in those with frailty having nonorthopedic procedures, and some evidence that decisional regret with frailty was lower in orthopedic surgeries. Results highlight the need for careful, individualized discussions of the risks and benefits of surgery amongst patients with frailty.

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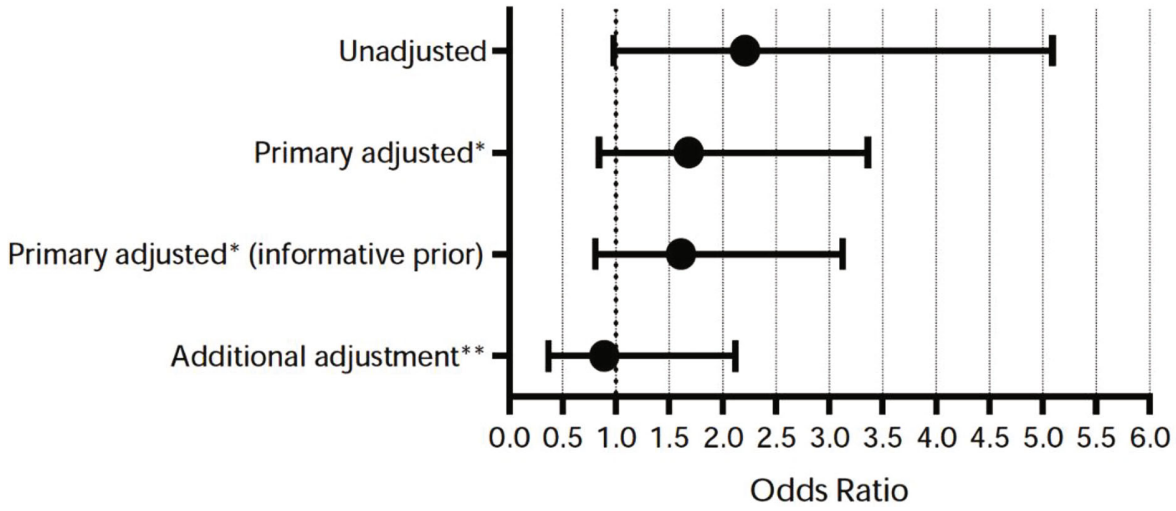
**Figure** Unadjusted and adjusted association of frailty with decisional regret severity one year after surgery




Data are presented as generalized odds ratio and 95% credible intervals
*Primary adjustment: age, sex, depression or anxiety, surgery type
**Additional adjustment: primary adjustment plus baseline comorbidity count and disability score
*Primary analyses used weakly informative prior distributions (normal distribution, mean = 0, SD = 1)
Informative prior distribution was a normal distribution with 95% of probability mass between an odds ratio of 1.28 to 3.28, centred at a mean of 2.0

# Identifying relative efficacy of components of prehabilitation in adult surgical patients: preliminary results

**Submission ID**

107

**AUTHORS**

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**INTRODUCTION**

Over 500,000 Canadians undergo major surgery annually.[1] While most patients benefit from surgery, complications (20%),[2] new disability (10–20%),[3] and impaired functional recovery (50%)[4] are common. This is partly due to surgical stress, which is akin to running a marathon. Much like a runner training for a race, surgical patients can prepare for surgery through prehabilitation (a complex, multicomponent intervention comprised of one or more of preoperative exercise, nutrition, cognitive, or psychosocial interventions) to build reserve and improve postoperative recovery. Though promising, an umbrella review of 55 systematic reviews conducted by our team found that existing evidence supporting the efficacy of prehabilitation is low to very low certainty.[5] The two major issues are: heterogeneity in multicomponent prehabilitation interventions and poor review quality. As such, we sought to conduct a high-quality systematic review and component network meta-analysis (CNMA) to estimate the relative efficacy of different prehabilitation intervention components.

**METHODS**

Ethical review was not required for this systematic review and CNMA, which was conducted according to Cochrane collaboration recommendations. Using a PRESS-reviewed search strategy, we completed duplicate review of citations identified in Medline, Embase, CINAHL, PsychINFO, Web of Science, and the Cochrane Database (inception–February 2023). We included randomized controlled trials (RCTs) addressing a population of adults (≥ 18 yr) undergoing elective surgery where patients were exposed to a prehabilitation intervention for ≥ 7 days before surgery, compared with standard care or other prehabilitation interventions, and which reported ≥ 1 critical outcomes (complications, length of stay [LoS], physical recovery, patient-reported recovery), identified using integrated knowledge translation methods with patient partners and other knowledge users. Risk of bias assessment was performed. As

prehabilitation trials test both uni- and multicomponent interventions, we used additive CNMA models (which assumes that the total effect of an intervention will be equal to the sum of the relative component effects) to estimate the relative efficacy of pre-specified prehabilitation components (exercise, nutrition, cognitive, psychosocial) in improving critical outcomes, along with *P* scores to estimate the probability that a given intervention component was most efficacious. A full NMA model was also estimated to investigate whether evidence of interaction between prehabilitation components was present.

**RESULTS**

Review of 5,518 citations yielded 1,013 articles for full text review, and final inclusion of 329 unique RCTs. The median (range) sample size was *n* = 56 (10–668); oncologic, orthopedic, and major nononcologic surgical populations were most common. Complications were reported in 104 RCTs (*n* = 8,343). Unimodal nutrition and exercise were the most common components; exercise+nutrition+psychosocial was the most common multicomponent intervention. Exercise was the component with the highest efficacy (OR, 0.57; 95% confidence interval [CI], 0.45 to 0.72); nutrition also had significant efficacy (OR, 0.70; 95% CI, 0.56 to 0.86). Length of stay was reported in 113 RCTs (*n* = 9,258). Unimodal exercise and nutrition were the most common components; exercise+nutrition+psychosocial was the most common multicomponent intervention. Exercise (MD, –0.9 days; 95% CI, –1.2 to –0.5) and nutrition (MD, –0.7 days; 95% CI, –1.2 to –0.2) were similarly efficacious. Considering possible component interactions, exercise and exercise+nutrition had the highest probability of efficacy (complications), and for LoS, exercise+psychosocial or psychosocial.

**DISCUSSION**

Preliminary analyses conducted to estimate what prehabilitation components, or combinations of components, reduce complications and LoS with greatest efficacy suggest that exercise and nutrition provide large effect sizes in RCTs of adult surgical patients. In aiming to reduce length of stay, the role of psychosocial preparation alone, or in combination with exercise, should also be strongly considered. These results inform current prehabilitation practice and implementation, as well as design of enhanced prehabilitation interventions most likely to show efficacy in future trials. Updating of our search and analysis of patient-reported and physical recovery outcomes is ongoing.

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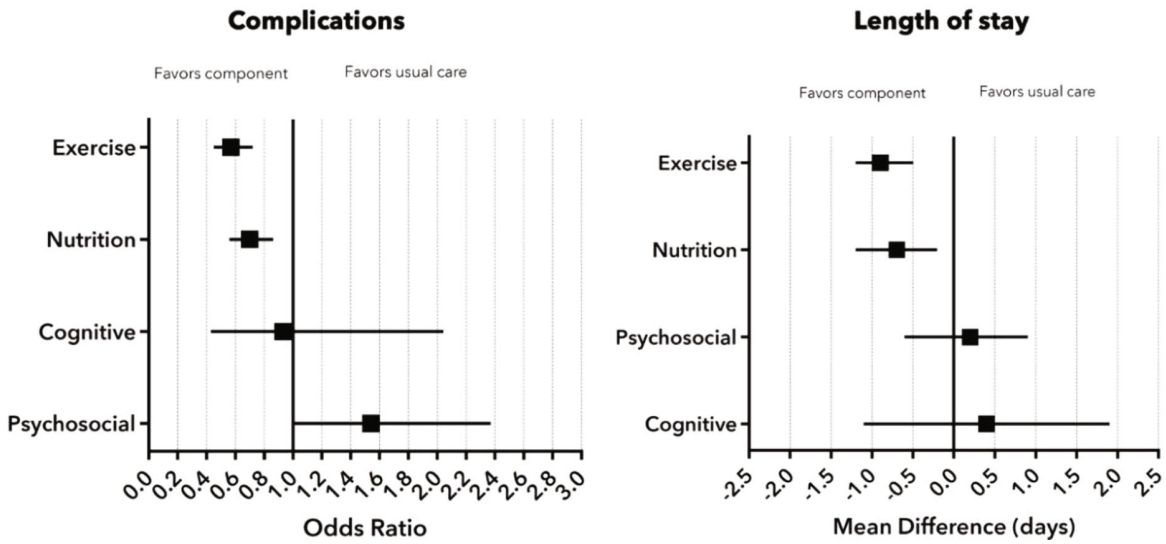
**Figure** Forest plots of the relative efficacy of prehabilitation components for reducing complications (left panel) and length of stay (right panel)




Estimates represent odds ratios (complications) and mean difference in days (length of stay), along with 95% CIs compared to usual or standard care. Results were estimated from an additive component network meta-analysis model, allowing information to be pooled across all comparators in the network.

# Impact of short-term spinal cord stimulation for refractory neuropathic pain on sleep health parameters

**Submission ID**

119

**AUTHORS**

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**INTRODUCTION**

Neuropathic pain, which can often be refractory to treatment, is estimated to affect approximately 7–18 % of the population.[1] Sleep disturbances are a common comorbidity of the condition, with pain often worsening during the night. In addition, there is a bidirectional relationship between worsening pain and poor sleep, with each adversely affecting the other.[2,3] While previous research shows a beneficial effect of spinal cord stimulation (SCS) on sleep quality, its effect on various sleep health domains has not been shown via actigraphy. Our study aims to investigate the effects of short-term spinal cord stimulation on sleep health in individuals with refractory neuropathic pain using raw-data based actigraphy.

**METHODS**

Following institutional research ethics board (REB) approval, adult patients 18–80 yr of age with chronic, refractory neuropathic pain were enrolled after written, informed consent. Participants underwent an SCS trial with 96 hr of paresthesia-based SCS followed by equal periods of paresthesia-free SCS and placebo. Participants wore an actigraphy device (GENEActiv®, Activeinsights, Cambridge, UK) through the duration of the trial to study the effects on SCS on sleep. Sleep metrics were derived from the raw actigraphy data and included total sleep time (TST), wake after sleep onset (WASO) and sleep efficiency (SE). Actigraphy data from the preprocedure period was compared with data from day 12 after SCS insertion. The SCS was determined to be successful if there was a > 50 % reduction in numerical rating scale (NRS) scores for pain with SCS. Univariate analyses were run to determine whether the sleep metrics were different between successful (responders) and unsuccessful (nonresponders) trials. Following SCS implantation, actigraphy data was subjected to paired *t* tests within each group (responders and nonresponders), comparing it to pre-intervention baseline parameters.

## RESULTS

Out of the 149 participants who were enrolled, 111 were found to have valid actigraphy data. There were no significant differences in demographic characteristics between responders and nonresponders. Univariate analysis did not reveal significant differences between participants with successful and unsuccessful trials. In participants with successful trials, TST (6.91 ± 2.09 *vs* 5.80 ± 2.22; $P < 0.001$) and WASO (1.11 ± 1.29 *vs* 0.94 ± 1.35; $P = 0.046$) showed significant reductions. Similar reductions of smaller magnitude were also found in nonresponders, but these were not statistically significant. No difference was found in SE before and after the trial.

## DISCUSSION

Our results show that a successful SCS trail significantly improves sleep of individuals with refractory neuropathic pain, as evidenced by a reduction in WASO. These results are consistent with results in other studies that have examined this relationship using actigraphy. Future studies should be designed to look at longitudinal patterns and long-term impact on sleep health, pain, and quality of life.

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**Table** Within-group sleep parameters before and after SCS trial in responders and nonresponders

| | Before SCS trial | After SCS trial | P value |
|---|---|---|---|
| **Responders (n=83)** | | | |
| ***Patient reported*** | | | |
| ODI score (0-100) | 24.70±8.58 | 20.98±7.32 | <0.001 |
| PSQ3 score | 182.80±78.72 | 146.89±90.45 | 0.005 |
| PDI score | 43.62±39.74 | 39.74±14.89 | 0.022 |
| TST (hr) | 7.34±2.34 | 6.13 | <0.001 |
| SE (%) | 85.09±7.89 | 85.69±8.54 | 0.584 |
| WASO (hr) | 1.27±0.82 | 1.04±0.73 | 0.053 |
| ***GENEActive data*** | | | |
| Total sleep time (hr) | 6.91±2.09 | 5.80±2.22 | <0.001 |
| Sleep efficiency (%) | 86.96±11.76 | 87.06±12.74 | 0.914 |
| WASO (hr) | 1.11±1.29 | 0.94±1.35 | 0.046 |
| Physical activity-MVPA (min) | 53.71±69.84 | 57.69±50.69 | 0.615 |
| **Non responders (n=28)** | | | |
| ***Patient reported*** | | | |
| ODI score (0-100) | 26.05±8.27 | 24.57±6.40 | 0.442 |
| PSQ3 score | 184.44±93.21 | 145.33±90.20 | 0.064 |
| PDI score (0-70) | 45.00±12.25 | 45.17±11.03 | 0.935 |
| TST (hr) | 7.65±2.26 | 6.55±1.81 | 0.029 |
| SE (%) | 86.27±6.92 | 86.30±7.10 | 0.985 |
| WASO (hr) | 1.24±0.70 | 1.08±0.64 | 0.358 |
| ***GENEActive data*** | | | |
| Total sleep time (hr) | 6.73±2.62 | 6.04±3.39 | 0.423 |
| Sleep efficiency (%) | 87.14±11.66 | 89.46±9.00 | 0.471 |
| WASO (hr) | 0.99±0.88 | 0.62±0.49 | 0.98 |
| Physical activity -MVPA (min) | 69.39±87.22 | 54.15±40.76 | 0.423 |

MVPA = moderate to vigorous physical activity in minutes; ODI = Oswestry Disability Index; PDI score = Pain Disability Index; PSQ-3 = pain and sleep questionnaire – 3 item; SE = sleep efficiency; TST = total sleep time; WASO = wakeup after sleep onset

# Incidence and relative risk of delirium after major surgery for patients with preoperative depression: a systematic review and meta-analysis

**Submission ID**

63

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**INTRODUCTION**

Delirium is associated with a 2- to 5-fold increased likelihood of experiencing major postoperative complications.[1,2] It can lead to functional decline, higher health care expenses, long-term cognitive dysfunction, and greater mortality.[3,4] Hospitalized patients with a history of depression or clinically significant depressed symptoms have an increased risk of experiencing delirium. While the incidence of delirium after cardiac surgery for patients with preoperative depression was assessed,[5] a general estimate is lacking for adults undergoing various surgeries. We conducted a systematic review and meta-analysis to estimate the incidence and unadjusted relative risk (or relative odds) of postoperative delirium for all adults with preoperative depression undergoing a broad range of surgical procedures.

**METHODS**

Medline (OVID), Embase (OVID), Cochrane Controlled Register of Trials (CENTRAL), and PsycINFO databases were searched from inception to 30 June 2023. Studies included defined depression as formal pre-existing diagnosis, or the presence of clinically significant depressive symptoms assessed through patient-reported tools before surgery. Multilevel random effects meta-analyses were used to estimate the pooled incidence and relative risk of delirium. Subgroup analyses was conducted to identify important moderators of pooled estimates among various study-level covariates such as country of study, study design, inclusion of only older adults (≥ 65 yr), inclusion of only cardiac surgery procedures, inclusion of nonelective procedures, and use of formal instruments. The quality of the studies was assessed using the Risk of Bias in Non-Randomised Studies-Exposure tool. The quality of evidence for our study

objectives was assessed using the Grading of Recommendations Assessment, Development, and Evaluation criteria, modified for observational studies.

**RESULTS**

Forty-two studies (*n* = 4,664,051) were included in this review. The prevalence of postoperative delirium for patients with preoperative depression was 29% (95% confidence interval [CI], 17 to 43%; *I2* = 99.0%), compared with 15% (95% CI, 6 to 28%); *I2* = 99.8%) in patients without preoperative depression. The overall incidence in the combined cohorts was 21% (95% CI, 11 to 33%; *I2* = 99.8%). Patients with preoperative depression had a 1.91-fold increased risk of delirium (95% CI, 1.68 to 2.17; *I2* = 42.0%) compared with those patients without preoperative depression. Study-level covariates such as country of study, study design, inclusion of only adults, inclusion of only cardiac surgery, inclusion of only nonelective procedures, and use of validated instruments were all found to have a significant moderating effect in bivariate meta-regression models. Publication bias seemed to be present amongst the pooled studies. The certainty of evidence was "moderate" for the pooled incidence and "high" for the unadjusted relative risk between preoperative depression and postoperative delirium.

**DISCUSSION**

Patients with a preoperative history of depression or clinically significant depressive symptoms have a greater risk of developing post-operative delirium after surgery. Considering the frequency of preoperative depression and the significant complications associated with post-operative delirium,[4,5] greater attention in screening may allow for better informed risk assessment and discussions with patients. Future efforts should focus on developing and testing risk mitigation strategies for surgical patients with psychiatric comorbidities.

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**Figure** Forest plot of the multilevel random-effects meta-analysis for the incidence (1A) and relative risk (1B) of postoperative delirium for patients with preoperative depression

**Figure 1A.**

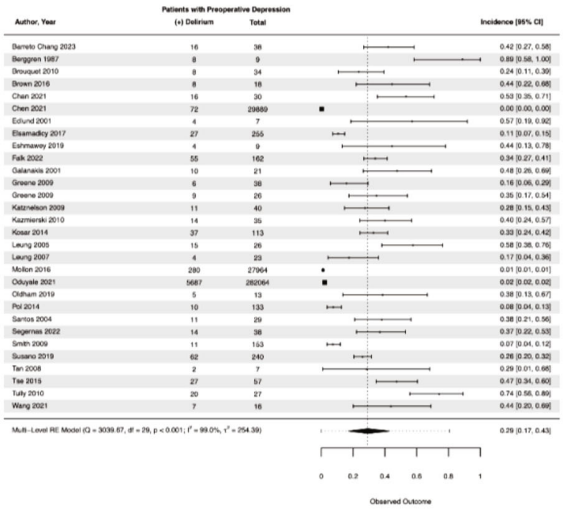
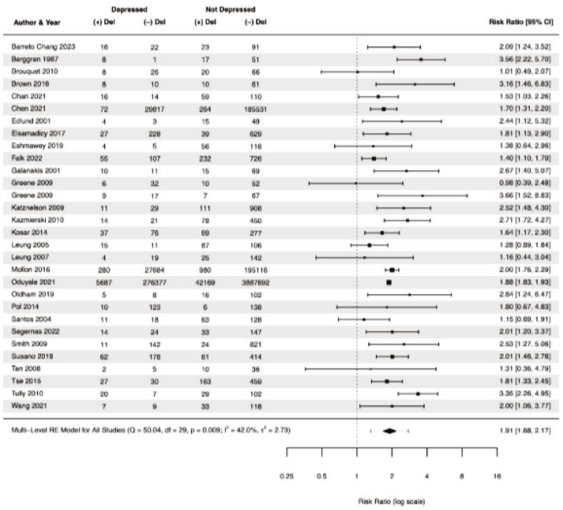



**Figure 1B.**



# Quaternary lidocaine derivatives QX-314, QX-222, and QX-572 produce robust, long duration, concentration-dependent nociceptive blockade *in vivo*

**Submission ID**

112

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**INTRODUCTION**

The utility of currently available tertiary aminoamide local anesthetics (LAs), such as lidocaine, bupivacaine, and ropivacaine, is limited in terms of duration of action after a "single shot," undesired motor blockade, and inherent systemic and local tissue toxicity. This there is a need for a more ideal agent for clinical use. Recent preclinical research with quaternary derivatives of existing tertiary LAs heightened expectations of more "ideal" agents that produce long-lasting, nociceptive-specific blockade with low toxicity upon a single injection. Such an agent is expected to improve the quality of analgesia and pain outcomes while reducing the need for opioids in postoperative pain control. Here, we sought to investigate the relative concentration-dependent pharmacological profiles of three quaternary lidocaine derivatives, QX-314, QX-572, and QX-222, as potential long-duration alternatives to conventional tertiary aminoamide LAs.

**METHODS**

With institutional Animal Care Committee approval, we conducted an *in vivo* animal study with female CD-1 mice (weight, 25–35 g). We used two antinociceptive assays in the context of a sciatic nerve block model: the intraplantar hypertonic saline assay and the hot plate analgesic assay. For blockade, we performed perineural injections to animals' right sciatic nerve with a 30G hypodermic needle. In the intraplantar saline assay, hypertonic saline was injected into the middle of the ventral aspect of the footpad of the right paw. Following injection, mouse behavior was observed for five minutes, and the total amount of time the animal spent exhibiting nociceptive behavior was recorded. In the hot plate assay, animals were placed on a hot plate preheated to 50 °C. The latency to a previously defined response to the heat exposure was recorded. Each test was repeated at hourly intervals for four hours, with a sample size of 8. We used the time for responses to the nociceptive stimuli as the measure used to test for analgesic responses and the null hypotheses were that the test compounds would not produce any time-dependent analgesia whereas the scientific hypothesis was the counter one.

## RESULTS

In the *in vivo* assays, all three quaternary lidocaine derivatives concentration-dependently produced robust, long-duration nociceptive blockade when compared with lidocaine. QX-572 produced the greatest efficacy, but also exhibited the most prolonged onset of action. Unlike all other drugs tested, QX-572 did not show significant effects until one hour after injection in both assays. At each time interval in the hypertonic saline assay, QX-314 produced analgesic responses of similar magnitude to those of lidocaine. Nevertheless, unlike lidocaine, its antinociceptive effects did not significantly decrease over the four-hour test period in both assays. QX-314 also produced divergent effects with regards to the two assays, showing a significant decrease in nociceptive signals between 10- and 30-mM concentrations during the hypertonic saline assay only ($P = 0.026$; $n = 8$). QX-222 was the least analgesic of all drugs tested, in both assays including when compared with lidocaine.

## DISCUSSION

In the present *in vivo* animal study, the quaternary LA analogues produced effects homologous to those expected of standard tertiary LAs but with different dose and temporal relationships. The results reaffirm that quaternary agents produce long-duration sensory and nociceptive blockade. QX-572's greatly delayed onset of action compared with other tested agents is consistent with the literature. The divergent pharmacological profile of QX-314 with regards to thermal and inflammatory stimuli is consistent with the notion that a slight variation in structure can result in varying efficacies in ameliorating different modes of pain.

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# The aggregate mortality risk of propofol *versus* volatile anesthesia incorporating the environmental impacts of both: a decision analysis

**Submission ID**

20

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## INTRODUCTION

Evidence suggests that the use of propofol for anesthesia maintenance is associated with an increased mortality compared with volatile anesthetic agents.[1] Volatile agents, on the other hand, are known to worsen climate change,[2] which has its own well-described adverse effects on human health including death. Which, we wondered, is more harmful overall? Our aim was to compare the aggregate mortality (direct plus indirect through environmental change) when propofol or volatile agents are used for anesthesia maintenance. We employed Decision Analysis, an analytic approach that has been used in other anesthesia scenarios:[3] the probability of the outcome of interest associated with each possible decision sequence is laid out, and the probabilities are arithmetically combined to yield the optimum strategy.

## METHODS

After checking for updates, we examined a 2023 meta-analysis of randomized control trials comparing mortality from propofol and extracted the relative risk of death in surgical models compared with volatile agents. We then performed our own systematic review to find data describing the carbon footprint of isoflurane, sevoflurane and desflurane per MAC-hour of use and unit of fresh gas flow. We used published estimates of the mortality attributable to unit rise in environmental carbon dioxide.[4] We sought data on the indirect human mortality cost of propofol from waste drug pollution and the carbon cost of disposables. Finally, we combined these data into a decision analysis model with death as the outcome of interest. Since all estimates used in the model had wide ranges, we ran the model multiple times to capture both extremes in each estimate.

## RESULTS

The quoted mortality risk ratio when propofol is used for maintenance compared with volatile agents is 1.25 (1.06–1.47). Our calculated annual mortality risk attributable to increases in environmental carbon dioxide levels from volatile agent use varies from 4.26 x $10^{-6}$ to 1.27 x $10^{-5}$ lives per MAC-h, depending on which agent is considered and which extreme of the published range of carbon dioxide thus generated is used.

## DISCUSSION

While the use of volatile anesthetic agents is associated with an indirect increase in human (and presumably therefore, nonhuman) mortality mediated by increases in atmospheric carbon dioxide levels, it is many orders of magnitude smaller than the additional direct mortality risk associated with the use of propofol. Climate change brings many different types of adverse consequences, but if reduction in human mortality is the outcome of interest, switching from volatile agents to propofol for anesthesia maintenance will not achieve the desired objective. Our analysis suggests that methods that avoid both modalities, such as regional anesthesia, might be better.

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