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ORIGINAL CONTRIBUTIONS

Combined Thoracic Spinal-Epidural Anesthesia for Laparoscopic Sleeve Gastrectomy; One Hundred Case Experience

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Abstract

Background Obesity is a growingly impacting human health concern. Laparoscopic sleeve gastrectomy (LSG) is an effective treatment for morbid obesity. However, the general anesthesia (GA) used in this major surgery has its documented drawbacks in obese patients with high risk. On the other hand, combined thoracic spinal-epidural anesthesia (CTSEA), a modern regional anesthesia procedure, has the advantages of both spinal and epidural anesthesia but without their shortcomings. This prospective study is a case experience that assesses the feasibility of CTSEA as an anesthesia option for laparoscopic sleeve gastrectomy (LSG).

Methods A total of 100 patients were recruited for LSG as a management procedure for morbid obesity, which was performed under CTSEA. Perioperative events, functional parameters, and patients' satisfaction scores were recorded.

Results Our prospective study showed successful use of CTSEA in 99% of the patients, except for one patient (1%) in whom CTSEA was converted into GA due to severe pain and anxiety. Few adverse events occurred and were managed accordingly. The satisfaction score revealed that 94% of the patients were satisfied.

Conclusions CTSEA was a successful anesthetic alternative procedure for LSG surgery.

Keyword Morbid obesity, Laparoscopic sleeve gastrectomy, Combined thoracic spinal-epidural anesthesia

Introduction

One of the most effective and reliable procedures for combating morbid obesity is the bariatric surgery [1]. Laparoscopic sleeve gastrectomy (LSG) is one of the most globally applicated bariatric surgeries [2, 3]. GA is routinely used for LSG. However, patients with obesity often have poor pulmonary functions parameters which could be worsened by GA. Postoperative pulmonary complications are common in morbidly obese patients after laparoscopic bariatric surgery [4, 5]. These complications are implicated in bariatric surgery related to postoperative mortality [6].

Combined thoracic spinal-epidural anesthesia (CTSEA) is a new regional anesthesia procedure that has gained popularity nowadays [7]. It has the advantages of both spinal and epidural anesthesia, including rapid onset, solid block, and limited need of drugs as in spinal anesthesia and extendable duration with the availability of postoperative analgesics administration as in epidural anesthesia. Furthermore, CTSEA does not involve the shortcomings of this anesthesia, such as the missing segments and limited motor blocks in epidural anesthesia and the variable levels among individuals in spinal anesthesia [8].

This study is a case series that assesses the feasibility of CTSEA as an anesthetic technique for LSG. The primary outcome is demonstrating the success rate of the anesthetic

Key Points

- GA carries risks for morbidly obese patients.
- CTSEA is a modern anesthesia procedure that has several advantages.
- The study presented 99% successful rate.
- CTSEA is an alternative technique for patients undergoing LSG.

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technique with the laparoscopic surgical technique. The secondary outcomes are including incidence of intra-operative complications, usage of IV sedation, length of hospital stay, and patient satisfaction.

Patients and Methods

This study was carried out at our bariatric center after obtaining the approval of the regional ethics committee. A total of 100 patients who underwent laparoscopic sleeve gastrectomy as a procedure for morbid obesity between March 2018 and September 2020. A written informed consent was obtained from each patient. Preoperative routine workup was performed. Non-cooperative patients and patients with psychiatric disorders, coagulopathy, known analgesics hypersensitivity, or abdominal surgery history were excluded from the study. The patients were selected either upon their request or in case they have a major respiratory disease that increases the risk with GA.

The participants were dedicatedly informed about the CTSEA procedure and its possible risks, including difficulty of breathing, hematoma formation, headache, urine retention, nerve injury, and incomplete or failed block, as well as other risks of neuro-axial blocks. They were reassured that any intraoperative irritation, anxiety, or pain would be managed accordingly. Moreover, they were informed about the potentiality of transforming CTSEA into GA if indicated.

Preoperatively, IV line was introduced after intradermal infiltration by 1% lidocaine, with the administration of Ringer's Lactate solution (10 mL/kg) over 30 min. Arterial blood pressure, pulse oximetry, and electrocardiography monitoring were commenced. CTSEA was administered with the use of a CTSEA set at the sitting position via a midline approach at the T9-T10 interspace. An 18-G Tuohy needle was introduced at the epidural space, using the method of loss of resistance to saline. When the epidural space was reached, a 27-gauge spinal needle was progressed via the Tuohy needle until the patient felt the dura matter resistance and the subarachnoid space was reached. Once it was ensured that the clear cerebrospinal fluid was flowing, 1.5 mL (7.5 mg) of 0.5% hyperbaric bupivacaine and 0.5 mL (25 μg) of fentanyl were injected. Then, the spinal needle was removed, and the epidural catheter was placed and fixed at 4 cm within the epidural space. Once the epidural catheter was fixed, the patient was kept in the supine position and oxygen was supplemented at a rate of 4 L/min using nasal prong. Immediately, sensory block by pinprick assessment was done to ensure that T4–T12 block was achieved.

In an attempt to reduce the potentiality of significant shoulder pain, ultrasound-guide bilateral superficial cervical plexus blockade was conducted. After aseptic preparation, the ultrasound transducer probe was placed on the lateral neck at the middle point of sternocleidomastoid muscle and the tapering posterior border was identified. After skin infiltration by 1 mL lidocaine 1%, a 22-gauge needle was advanced in plane beneath the muscle and 10 mL of plain bupivacaine 0.125% was injected bilaterally to envelope the plexus. All operations were performed in our center by the same surgical team (a high volume bariatric surgeon with more than 10 years of experience assisted by two experienced bariatric surgeons). During surgery, patients were kept in the supine position with firm securing to the operating table, which allows the anti-Trendelenburg positioning when required. Both arms were left abducted less than 90° to the body, strapped, and supported. A pneumoperitoneum was inducted using veress needle through Palmer's point slowly at low flow rates to avoid shoulder pain during insufflation. The intra-peritoneal pressure was kept between 8 and 12 mmHg during the insufflation and was then gradually increased during the surgery according to the patient's tolerance. Then, 1–2 mg midazolam and/or 50 μg fentanyl was intravenously administered accordingly in case of intolerable referred shoulder pain. A 10-mm trocar was placed approximately 15 cm below the xiphoid process and 3 cm to the left of the midline. A 30°-angled laparoscope was introduced through this port into the peritoneal cavity, and a 12-mm trocar port was placed about 6 cm below the left costal margin in the left midclavicular line. Then, a 5-mm port was positioned in the left lateral flank. Another 15-mm port was positioned at the right side of the patient in the midclavicular line about 6 cm below the costal margin, and a 5–10 mm port was placed just below the xiphoid process for liver retraction. A Ligasure blunt tip device was used to divide vessels along the greater curvature of the stomach and the short gastric blood vessels. The dissection starts at 5 cm from the pylorus and proceeds proximally to the angle of His. A 36-Fr calibrating bougie was introduced by the anesthesiologist intragastric using three puffs of lidocaine 4% local anesthetic oral spray to decrease the gag reflex during the introduction and was then progressed into the pyloric canal and the duodenal bulb along the gastric lesser curve. A linear cutting device was used to divide the stomach along a line parallel to the lesser curvature from a point 4–6 cm proximal to the pylorus on the greater curvature to a point 1–2 cm lateral to the gastroesophageal junction. The bougie was then removed, and the staple line was revised for any bleeding points which was controlled with clips. A hiatus hernia, if present, was repaired using interrupted posterior crural sutures. No drains or naso-gastric tubes were placed. The resected stomach was removed through the 12 mm port without the need to further enlarge it.

The epidural catheter was kept until the following day, and postoperative analgesia was administered when indicated using 0.125% levobupivacaine. Pharmacological DVT prophylaxis started on the day following the surgery, and

the epidural catheter was removed at least two hours prior to it. Patients were inquired about their satisfaction score at the follow-up on day 7 with a score from 1 to 5 as follows: 1, very dissatisfied; 2, dissatisfied; 3, neither satisfied nor dissatisfied; 4, satisfied; and 5, very satisfied.

Results

The surgery was completed in 99 patients based on the technique. CTSEA was converted into GA in one patient only due to intractable shoulder pain and severe anxiety. The CTSEA technique was successfully administered in 91 patients, whereas epidural catheter insertion was not accomplished in nine patients due to technical difficulties and the fact that they had surgery under spinal anesthesia only. The target level between T4 and T12 was achieved in all patients. The intra-peritoneal pressure was maintained at the range of 10–16 mmHg throughout the operation, with a mean of 13.22 ± 1.61 mmHg.

Besides, 71% of the study patients were females. The demographic characteristics and comorbidities of the patients were described in Table 1. Of the study patients, six had simultaneous hiatus hernia repair. No sedation was required in 44 patients, while mild, moderate, and deep sedation was required in 33, 19, and 3 patients respectively (56% of the patients) in whom midazolam (2 mg) and/or fentanyl (25 µg) had to be administered to relieve anxiety.

The total time of the procedure (block and surgery) ranged from 48 to 92 min, with a mean of 61.79 ± 9.61 min. With regard to the hospital stay, one patient required three days stay, two patients required two days, while the others did not exceed one day (97%). Procedure-related times are illustrated in Table 2.

Perioperative adverse events are shown in Table 3, with the most common being intra-operative hypotension which occurred in 82 patients. Moreover, all patients received IV co-loading crystalloid and responded to a single dose of vasopressor (5–10 mg Ephedrine). Intra-operative shoulder pain was experienced by 44 patients; of whom 21 had mild, 20 had moderate, and three had severe pain. However, all of them responded to moderate doses of fentanyl, except for one patient whose severe pain and anxiety required CTSEA's conversion to GA. Other less common intra-operative adverse events occurring in the patients of this study were shortness of breath (14%), gagging reflex (13%), arrhythmia (12%), hypoxia (7%), surgical emphysema (6%), and postoperative bleeding (1%). All were managed accordingly. Two of the three patients with preoperative respiratory failure (Table 1) required postoperative ICU admission for close observation and follow-up.

Postoperative satisfaction scores were evaluated for all the patients. Only 2% of the patients were dissatisfied (score 2), whereas 56% were very satisfied (score 5), 38% were satisfied (score 4), and 4% were neither satisfied nor dissatisfied (score 3).

Table 1 Demographic data of the study patients

Character	Mean (*SD*)
Age (years)	35.69 (9.68)
Weight (kg)	132.48 (22.64)
BMI (kg/m^2)	46.124 (8.62)
Height (m)	1.6994 (0.093)
Gender (F/M) *N* (%)	71 (71%) / 29 (29%)
Associated diseases	*N* (%)
Hypertension	55 (55)
Diabetes mellitus	53 (53)
Bronchial asthma	34 (34)
Respiratory failure	3 (3)
Obstructive sleep apnea	30 (30)

Table 2 Procedure-related times

Item	Mean (*SD*)
Sensory block time (min)	16.05 (3.35)
Surgery time (min)	45.83 (7.45)
Total time (min)	61.79 (9.61)
Hospital stay (days)	1.04 (0.24)

Discussion

Compared to GA, regional anesthesia is associated with fewer pulmonary complications [9]. Little published work assessed the use of regional anesthesia in the field of bariatric surgery. Kanawati et al. (2015) reported LSG in five patients with obesity, provided by paravertebral (PVB) and superficial cervical plexus blockade. In their study, patients, surgeons, and anesthetists were satisfied with the technique

Table 3 Perioperative adverse events

Event	*N* (%)
Hypotension	82 (82)
Hypoxia	7 (7)
Arrhythmia	12 (12)
Shortness of breath	14 (14)
Gagging reflex	13 (13)
Surgical emphysema	6 (6)
Shoulder pain	44 (44)
Intraoperative bleeding	0 (0)
Postoperative bleeding	1 (1)
Postoperative leakage	0 (0)

[10]. Hung et al. (2015) published a report of two cases, evaluating the use of epidural anesthesia in LSG [4]. In the most recent study of El Fawal et al. (2021), they compared the outcome of LSG under PVB to GA, either the pre-, intra-, or the early postoperative. They concluded that both anesthesia procedures had comparable outcomes. However, the GA group showed a significantly higher need for analgesia than the PVB group [11].

This study aimed at evaluating the efficiency of CTSEA in conjunction with superficial cervical plexus blockade as an alternative anesthetic procedure for LSG. The T4–T12 level of sensory block achieved with CTSEA in this study was optimum for the surgery. Intra-peritoneal pressure was maintained at the range of 10–16 mmHg throughout the operation, with a mean of 13.22 ± 1.61 mmHg.

In patients with morbid obesity, increasing the intraperitoneal pressure is mandatory of the laparoscopic surgery in order to provide optimum surgery field. This is amending as short as possible surgery time to avoid the documented undesirable effects of high intra-peritoneal pressure, such as the portal and femoral venous flow reduction, as well as the respiratory and cardiac complications [12].

In this study, we reached an intra-peritoneal pressure of up to 18 mmHg in some cases with no significant adverse events. Our surgical team faced technical difficulties, especially with low intra-peritoneal pressure due to tight working space which was managed by a gradual increase in pressure using sedatives and analgesics. The team faced another challenge during the repair of hiatus hernia when the patient was spontaneously breathing and overcome by the fact that he or she was asked to hold his or her breath for seconds. We did not oversew the staple line as a modification of our usual surgical technique in order to save time and avoid technical difficulties associated with spontaneous breathing patients. Moreover, we could not afford leaving the bougie inside for a long time since the patient was annoyed after a few minutes from the insertion. Symeonidis et al. (2013) reported that patients with obesity had laparoscopic repair of ventral hernia with no intraoperative pulmonary complications [13]. Also, several case reports were published about laparoscopic cholecystectomies under regional anesthesia in patients with severe pulmonary disease without significant adverse events related to pneumoperitoneum [14, 15]. Hung et al. (2015) and Kanawati et al. (2015) reported cases involving bariatric surgery with the use of regional anesthesia, with no significant pulmonary distress events [4, 10].

In this study, the mean total time of the procedure was $61.79 + 9.61$ min, which is much less than that reported with the use of GA. The recent studies of Khalaj et al. (2020) [16] and Sayyouh et al. (2020) [17] reported a mean total surgery time of 161.7 and 97.5 min respectively, which are also less than the mean time reported by El Fawal et al. (2021), that is, 80 ± 20 min for the paravertebral block technique [11].

The most common perioperative adverse event in this study was hypotension which occurred in 82 patients who responded to a single dose of vasopressor. Hypotension is the most prevalent and considerable adverse event associated with spinal anesthesia. It is mainly caused by the neuraxial blockade [18]. However, it can be easily controlled with the vasopressor, as in our case. The hypotension occurrence in LSG under regional anesthesia was also reported by Hung et al. (2015) [4].

Shoulder pain was experienced by 44 patients in this study; of whom 21 had mild, 20 had moderate, and three had severe pain. However, all of them responded to moderate doses of fentanyl, except for one patient (1%) who required GA due to severe pain and anxiety. Shoulder pain is documented to be common in laparoscopic surgeries using regional anesthesia and is attributed to the irritation of the diaphragm that is caused by insufflation gas. Although in most cases, fentanyl administration is enough to alleviate the pain, but conversion to GA may be essential in certain circumstances. In their prospective study on laparoscopic cholecystectomy patients, Bessa et al. (2012) reported 4.4% frequency of conversion to GA owing to intractable shoulder pain [18]. Our results showed less need of conversion to GA as indicated by intractable shoulder pain (only 1% of patients) despite the higher intraperitoneal pressure levels (13.22 ± 1.61 mmHg). This could be explained by the superficial cervical plexus blockade procedure that was conducted preoperatively.

Other less common adverse events that occurred in the patients of this study were shortness of breath (14%) which was resolved by patient reassurance, vomiting (13%) which was only a gaging reflex associated with bougie introduction and managed by good spraying of the oropharynx by Lidocaine, arrhythmia (12%) in the form of tachycardia, premature atrial contractions (PACs), and bradycardia which offset spontaneously without any intervention and was coincidental with surgical traction of the lower esophagus and upper stomach, hypoxia (7%) which was reported when O2 saturation is below 94% and is overcome by high flow nasal O2 or the application of O2 face mask, surgical emphysema (6%), and postoperative bleeding (1%). Nevertheless, two patients required postoperative ICU admission. These complications were comparable to what was described in studies that performed LSG under GA [16, 17].

In this study, one patient required three days of hospital stay, two patients required two days, while all the others did not exceed one day of hospital stay (97%), with mean value of $1.04 + 0.24$. These results were comparable with those of El Fawal et al. (2021) who reported a mean hospital stay time of 1.5 ± 0.7 days and that only one day stay was required for 87.5% of the patients who underwent paravertebral block. However, hospital stay time was considerably less than that reported in the surgery performance under GA.

Gentileschi (2012) reported a median postoperative hospital stay of four days (range of 3 to 62 days) in his case experience series [19], and Khalaj et al. (2020) [16] reported a range of 1 to 29 days with a mean value of 2.5 ± 2.8.

Several advantages of regional anesthesia use in laparoscopic bariatric surgery could be described as follows: (1) the maintenance of preoperative pulmonary function parameters throughout the surgery [14, 15], which is contrary to GA in which pulmonary function parameters may not be recovered to the preoperative levels until day 7 postoperatively [20]; (2) The avoidance of GA-associated tracheal intubation which may elucidate systemic distress response [21] that can be aggravated in patients with morbid obesity and associated with high co-morbidity; and (3) the deep venous thrombosis and pulmonary embolism risk documented as being associated with morbid obesity being lower in regional anesthesia than in GA [22]. In our study, we noticed obvious advantages of regional anesthesia over GA since the patients started to ambulate and administer oral fluid earlier than usual. Furthermore, the need for postoperative opioids and analgesics was less. As a result, the regional anesthesia has a proper impact on the postoperative course.

Strengths and Limitations

The literature evidence for the use of regional anesthesia in the field of bariatric surgery was mainly the work that estimated the use of paravertebral blockade. However, this procedure seems to be more complicated than CTSEA as it requires bilateral multilevel injections of the anesthesia mixture.

The relatively short procedure time experienced in this study allowed the use of high intraperitoneal pressure, which provided comfort surgery conditions without significant adverse events.

Also, to the best of our knowledge, this is the first published case experience that tested the performance of CTSEA in bariatric surgery, more specifically LSG, on such number of cases.

Nevertheless, this case experience includes certain limitations, such as the technical difficulty encountered in the anesthetic technique faced by some patients and the impact of pneumoperitoneum attributed dyspnea in awake patients on the performance of laparoscopic surgery.

Conclusion

CTSEA was a successful anesthetic procedure in performing LSG surgery. However, further careful technique assessment is recommended.

Declarations

Ethical Approval This study has been approved by the appropriate institutional and/or national research ethics committee and has been performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. All the patients were given an explanation of the study and about the investigative and operative procedures with their merits and demerits, expected results, and possible complications.

Informed Consent Informed consent was obtained from all individual participants included in the study and all the patient data was used anonymously.

Conflict of Interest The authors declare no competing interests.

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