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SCIENTIFIC REVIEW

Evidence-Based Management of Postoperative Pain in Adults Undergoing Laparoscopic Sleeve Gastrectomy

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Abstract

Background Laparoscopic sleeve gastrectomy (LSG) is a common weight loss operation that is increasingly being managed on an outpatient or overnight stay basis. The aim of this systematic review was to evaluate the available literature and develop recommendations for optimal pain management after LSG.

Methods A systematic review utilizing preferred reporting items for systematic reviews and meta-analysis with PROcedure SPECific Postoperative Pain ManagemenT methodology was undertaken. Randomized controlled trials (RCTs) published in the English language from inception to September 2018 assessing postoperative pain using analgesic, anesthetic, and surgical interventions were identified from MEDLINE, EMBASE and Cochrane Databases.

Results Significant heterogeneity was identified in the 18 RCTs included in this systematic review. Gabapentinoids and transversus abdominis plane blocks reduced LSG postoperative pain. There was limited procedure-specific evidence of analgesic effects for acetaminophen, non-steroidal anti-inflammatory drugs, dexamethasone, magnesium, and tramadol in this setting. Inconsistent evidence was found in the studies investigating alpha-2-agonists. No evidence was found for intraperitoneal local anesthetic administration or single-port laparoscopy.

Conclusions The literature to recommend an optimal analgesic regimen for LSG is limited. The pragmatic view supports acetaminophen and a non-steroidal anti-inflammatory drug, with opioids as rescue analgesics. Gabapentinoids should be used with caution, as they may amplify opioid-induced respiratory depression. Although transversus abdominis plane blocks reduced pain, port-site infiltration may be considered instead, as it is a simple and inexpensive approach that provides adequate somatic blockade. Further RCTs are required to confirm the influence of the recommended analgesic regimen on postoperative pain relief.

Introduction

Laparoscopic sleeve gastrectomy (LSG) has been reported to provide significant, sustainable weight loss, and thus has become increasingly prevalent in managing obesity [1]. Whenever feasible, the laparoscopic approach is preferred, as it is associated with reduced postoperative pain and morbidity, as well as earlier recovery and a shorter hospital stay. LSG is commonly performed on an outpatient or overnight stay basis [2]. However, there is a lack of a consensus on an optimal analgesic regimen [3, 4].

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The PROcedure SPECific Postoperative Pain ManagemenT (PROSPECT) Working Group is a collaboration of surgeons and anesthesiologists developing procedure-specific evidence-based recommendations for optimal analgesia regimens for a growing field of procedures [5]. Recommendations seek to critically synthesize procedure-specific evidence and clinical practice focusing on the efficacy and adverse effects of different analgesic techniques (www.postoppain.org) [6].

The aim of this systematic review was to evaluate the available literature on the management of pain after LSG. Postoperative pain outcomes (i.e., pain scores and analgesic requirements) were the primary focus, but other recovery outcomes, including adverse effects, were also assessed, when reported. Also, the limitations of the data were reviewed. The aim was to use the available evidence to develop recommendations for pain management after LSG.

Methods

Search strategy

A systematic review of literature associated with analgesia after LSG was conducted in accordance with the recommendations of the Cochrane collaboration. The preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement was used as a guide for this review [7]. EMBASE, MEDLINE, Pubmed and Cochrane Databases (Cochrane Central Register of Controlled Trials, Cochrane Database of Abstracts or Reviews of Effects, Cochrane Database of Systematic Reviews) were searched for studies published after database inception until 25th September 2018.

The search terms used are as follows; pain OR analgesi* OR anaesthe* OR anesthe* OR vas OR "visual analog*" OR vrs OR mcgill OR epidural OR neuraxial OR intrathecal OR spinal OR caudal OR interpleural OR "peripheral nerve" OR "peripheral block" OR intercostal OR "nerve block" OR NSAID OR COX-2 OR paracetamol OR acetaminophen OR gabapentin OR pregabalin OR clonidine OR opioid OR ketamine OR corticosteroid AND sleeve gastrectom* OR gastric sleeve*.

Inclusion and exclusion criteria

The study included randomized control trials (RCTs) or systematic reviews in English assessing pain management or prevention using analgesic, anesthetic or surgical interventions for adults undergoing LSG. Any included study was also required to measure pain intensity using a numerical linear scoring system, such as the numerical rating scale (NRS) or visual analogue scale (VAS). Studies that reviewed an analgesic intervention in multiple bariatric procedures were excluded. Although authors of these studies were contacted to request data specifically related to LSG and the intended intervention, no responses were received.

A stepwise manner in accordance with the PRISMA checklist was used, which included screening of abstracts of potential articles. This process was undertaken by three reviewers (HM, WX and SS) and the final results of each reviewer were compared. Any discrepancies between results were discussed within the working group and a decision was made on inclusion or exclusion by consensus. The final articles were assessed by three reviewers and again any discrepancies were resolved in the same fashion. Reasons for exclusion were provided for all articles that were excluded in this phase. Reference lists of the relevant articles were individually screened to assess for any additional articles that may have been missed in the initial literature search.

Quality of included studies

Criteria employed in the assessment of the quality of eligible studies (Table 1) included allocation concealment (A—adequate; B—unclear; C—inadequate; D—not used) [8], numerical (1–5) quality scoring system employed by Jadad [9] to assess randomization, double blinding and flow of patients, participant follow-up of greater or less than 80%, and whether the study met the requirements of the Consolidated Standards of Reporting Trials (CONSORT) 2010 Statement [10].

Analysis of outcomes and statistical analysis

Summary information for each included study was extracted and recorded in data tables. This information included timing of the intervention and mode of delivery, pain scores and time intervals of pain measurements, supplementary analgesic use, and time to first analgesic administration. Unless specified otherwise, it was assumed that the pain scores were assessed at rest. Studies were stratified by the timing of intervention (preoperative, intraoperative, and postoperative) and the type of intervention (analgesic, anesthetic or surgical).

Pain intensity scores were used as primary outcome measures. We defined a difference of more than 10 mm on the VAS or NRS as clinically relevant [11]. The effectiveness of each intervention for each outcome was evaluated qualitatively, by assessing the number of studies showing a significant difference between treatment arms ($p < 0.05$ as reported in the study publication). A meta-analysis was not performed due to the limited number of studies with homogenous design and differences in reporting of results, restricting pooled analysis.

Table 1 Relationship between quality of the study and levels of evidence (LoE) and grades of recommendation (GoR)

Study type	Study quality assessments				Grade of recommendation
	Allocation concealment (A–D)	Jadad score	Statistical analyses and patient follow-up	LoE	
Systematic review with homogeneous results	NA	NA	NA	1	A
Randomised controlled trial	A or B	1–5	Statistics reported and >80% follow-up	1	A
Randomised controlled trial	C or D	1–5	Statistics not reported or questionable, or <80% follow-up	2	B
Non-systematic review, cohort study, case study (e.g. some adverse effect guidance)	NA	NA	NA	3	C
Clinical practice information (expert opinion), inconsistent evidence	NA	NA	NA	4	D

Allocation concealment assessment: A—adequate; B—unclear; C—inadequate; D—not used. GoR are based on overall LoE, considering balance of clinical practice information and evidence

NA not applicable

Formulation of recommendations

Recommendations are given when at least two congruent studies support an intervention [6]. Recommendations for optimal pain relief are graded A–D according to the overall level of evidence (LoE), as determined by the quality of studies included, consistency of evidence and source of evidence (Table 1). The methodology of the PROSPECT group is unique in that it aims to synthesize clinical evidence while taking into account the study design as well as considering risks and benefits of interventions [6]. Specifically, the group seeks to determine the relevance of study interventions in current perioperative care practice, and critically evaluate the baseline pain treatment [6]. Interventions were allocated to three broad groups: recommended interventions, not recommended for routine use but may be considered if recommended interventions are not possible, and not recommended for routine administration.

The proposed recommendations were sent to the PROSPECT Working Group for review and comments. A modified Delphi approach [12] was utilized, which included several rounds of individual comments followed by round-table discussions. Once consensus was achieved the lead authors drafted the final document, which was ultimately reviewed and approved by the working group.

Results

PRISMA flow chart demonstrating the search are as per Fig. 1. The methodological quality assessments of the 18 RCTs studies included for final qualitative analysis are summarized in Table 2. The detailed characteristics of the included studies are shown in Table 3.

Systemic non-opioid analgesics

Acetaminophen and non-steroidal anti-inflammatory drugs (NSAIDs)

Acetaminophen IV provided with mixed results [13, 14]. One study [15] found no significant differences in pain scores between a combination of intramuscular diclofenac and tramadol patient-controlled analgesia (PCA) with acetaminophen and a fentanyl PCA.

Gabapentinoids

Overall, preoperative gabapentin and pregabalin allowed lower pain scores and opioid consumption in three studies (Table 3) [16–18].

Alpha-2 adrenergic agonists

In one study, intraoperative dexmedetomidine was inferior to preoperative oral pregabalin over the 24-h study period [18]. Another study [19] found no difference in pain scores at rest between dexmedetomidine and clonidine. However, pain scores at mobilization were significantly lower in the clonidine group, but not in the immediate postoperative period or after 24 h. A study [20] reported significantly lower pain scores and opioid use with propofol and dexmedetomidine compared to desflurane anesthesia.

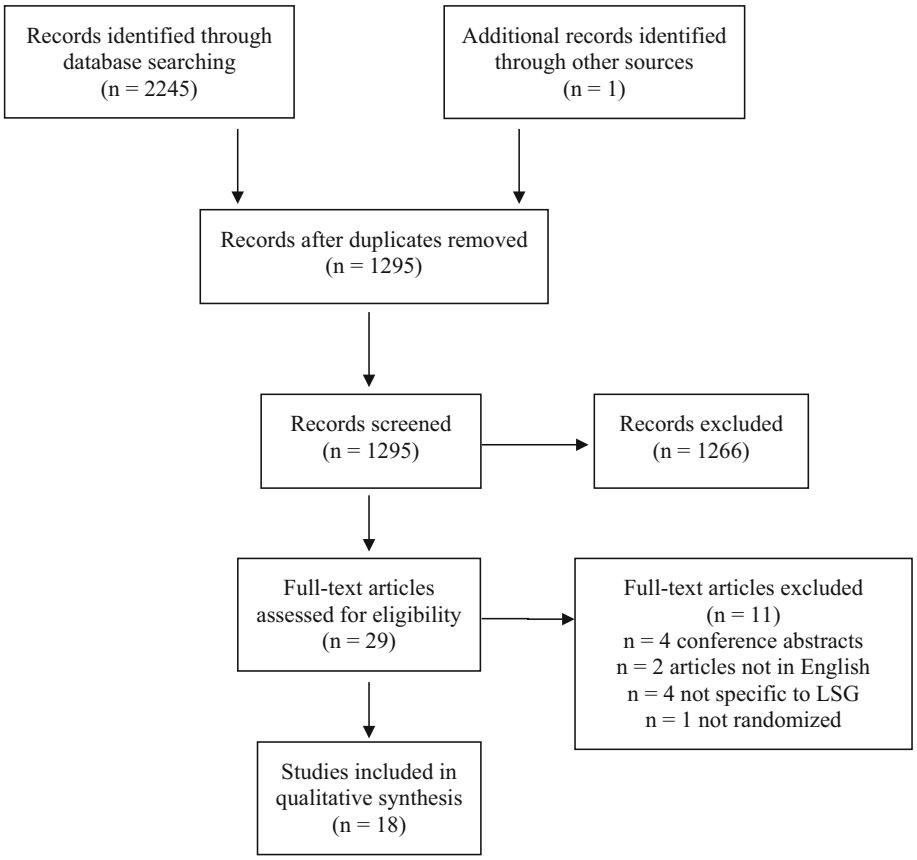

Fig. 1 PRISMA flow diagram

Table 2 Quality assessments and levels of evidence assigned to included trials

Author (reference number)	Allocation concealment	Jadad score	>80% Follow-up	Met consort statement	Level of evidence
Strode [13]	A	3	Yes	No	1
Cooke [14]	A	5	Yes	Yes	1
Mansour [15]	A	5	Yes	No	2
Rupniewska-Ladyko [16]	A	5	Yes	No	1
Cabrera Schulmeyer [17]	A	5	Yes	Yes	1
Salama [18]	A	5	Yes	Yes	1
Naja [19]	A	5	Yes	Yes	1
Elbakry [20]	A	5	Yes	Yes	1
Benevides [21]	A	5	Yes	No	1
Kizilcik [22]	A	5	Yes	No	1
Wassef [23]	A	2	Yes	No	1
Mittal [24]	B	3	Yes	No	1
Said [25]	A	2	Yes	No	1
Ari [26]	A	3	Yes	No	2
Ibrahim [27]	A	5	Yes	Yes	1
Ruiz-Tova [28]	C	2	Yes	No	2
Cleveland [29]	A	4	Yes	No	1
Morales-Conde [30]	C	3	Yes	No	1

Table 3 Study characteristics of the trials included in this review

Study (reference)	Study design	Pain scores	Opioid requirements
Systemic non-opioid analgesics			
Acetaminophen and non-steroidal anti-inflammatory drugs			
Strode [13]	Acetaminophen 1 g q6 h IV for 24 h (n = 18) versus placebo (n = 15)	Favors acetaminophen at 12-, 16-, 20-h time points (p = 0.02, p = 0.03, p = 0.01, respectively)	NS
Cooke [14]	Acetaminophen 1 g q6 h IV for 24 h (n = 64) versus placebo (n = 64)	NS in the PACU, and postoperative day 1 and 2	NS
Mansour [15]	Diclofenac 75 mg IM q12 h for 48 h/tramadol 50–100 mg q12 h IV for 24 h/tramadol PCA 10 mg/mL, dose 1 mL, lock-out interval 6 min (n = 13) versus acetaminophen and fentanyl PCA 10 mcg/mL, dose 1 mL, lock-out interval 6 min (n = 15)	NS	Not reported
Gabapentinoids			
Rupniewska-Ladyko [16]	Gabapentin 1200 mg, PO preoperatively (n = 57) versus placebo (n = 56)	Favors gabapentin group at 4- and 8-h (p = 0.02)	Total 12-h oxycodone dose lower in gabapentin group (26.3 ± 10.55 mg vs. 31.5 ± 10.16 mg, p = 0.0085)
Cabrera Schulmeyer [17]	Pregabalin 150 mg PO preoperatively (n = 39) versus placebo (n = 41)	Favors pregabalin group at 1, 2, 4, 6, 8, 12, 16, 24 h ($p < 0.05$)	24-h rescue morphine favors pregabalin group (11.51 ± 7.93 mg vs. 23.07 ± 9.57 mg, $p < 0.0001$)
Salama [18]	Pregabalin 75 mg PO preoperatively/ dexmedetomidine 0.4 μg/kg/h infusion after 0.5 IV bolus (n = 30) versus placebo/placebo (n = 30)	Favors pregabalin/dexmedetomidine group at 0, 2, 4, 6, 12, 18, 24 h ($p < 0.05$)	Rescue morphine favors pregabalin/ dexmedetomidine group (15.07 ± 2.65 mg vs. 45.93 ± 4.56 mg, $p < 0.001$)
Alpha-2 adrenergic agonists			
Naja [19]	Clonidine 0.8–1.2 μg/kg IV/placebo (n = 30) versus dexmedetomidine 0.5–0.8 μg/kg/h/placebo (n = 30)	Favors clonidine group at 12-h on mobilization (p = 0.014), not significant otherwise	Not reported
Elbakry [20]	Anesthesia maintenance with dexmedetomidine 0.5–1 μg/kg/ h + propofol 100–200 μg/kg/min (n = 50) versus. desflurane (n = 50)	Favors dexmedetomidine/propofol group at all time points ($p < 0.0001$)	Total 24-h morphine consumption favors dexmedetomidine/propofol group (5.36 ± 3.14 mg vs. 10.35 ± 41 mg, $p < 0.0001$)
Dexamethasone, ondansetron, and haloperidol			
Benevides [21]	Dexamethasone 8 mg/ondansetron 8 mg/haloperidol 2 mg (n = 30) versus dexamethasone 8 mg/ ondansetron 8 mg (n = 30) versus ondansetron 8 mg (n = 30)	Favors triple therapy group compared to ondansetron group (p = 0.046). No difference triple therapy and dexamethasone groups	Total 36-h morphine consumption favors triple therapy compared to ondansetron group (p = 0.037)
Magnesium sulphate			
Kizilcik [22]	Magnesium sulfate 30 mg/kg IV bolus and 20 mg/kg infusion for 24 h (n = 40) versus placebo (n = 40)	Favors magnesium sulfate group at all time points (p = 0.001)	Total 24-h morphine consumption favors magnesium sulfate group (21.13 ± 4.33 mg vs. 26.50 ± 5.77 mg, p = 0.001)
Regional analgesic interventions			
Transverse abdominis plane (TAP) block			
Wassef [23]	TAP block with 30 mL ropivacaine 0.2%/hydromorphone PCA (n = 10) versus hydromorphone PCA alone (n = 25)	Favors TAP block at 6 h (p = 0.04); NS for 12 and 24 h	NS
Mittal [24]	TAP block with 40 mL of ropivacaine 0.375%/standard analgesia (n = 30) versus standard analgesia (n = 30)	Favors TAP block on rest and movement at 30 min, 3, 6, 12, 24, 48 h ($p < 0.001$)	Not reported

Table 3 continued

Study (reference)	Study design	Pain scores	Opioid requirements
Said [25]	TAP block with bupivacaine 0.25% infusion at 4 mL/h for 24 h ($n = 45$) versus IV morphine ($n = 45$)	Favors TAP block at 1, 2, 3-h ($p < 0.001$), 4 h ($p = 0.016$), 8 h ($p = 0.01$), 12 h ($p = 0.022$), 24 h ($p < 0.001$)	Favors TAP block (3.0 ± 1.2 vs. 6.1 ± 1.7 mg, $p < 0.001$)
Ari [26]	Subcostal TAP block ($n = 20$) versus subcostal-posterior TAP block ($n = 20$) both with 30 mL bupivacaine 0.2%	NS	NS
Ibrahim [27]	Subcostal TAP block 30 mL bupivacaine 0.25%/placebo ($n = 21$) versus port site infiltration bupivacaine 0.25%/placebo ($n = 21$) versus placebo/placebo ($n = 21$)	Favors TAP block over control at rest at 0, 2, 4, 6, 12, 24 h ($p < 0.05$). Favors TAP block over control on movement at 0, 2, 4, 6, h ($p < 0.05$). Favors port site infiltration over control at 0, 2, 4 h at rest and movement ($p < 0.05$). Favors TAP block over port site at 4, 6 h at rest and movement ($p < 0.05$)	Total 24-h morphine consumption favors TAP block (16.76 ± 2.7 mg) over port site (18.38 ± 4.2 mg) and control (24.76 ± 5.0 mg) ($p < 0.02$, $p < 0.001$, respectively). Favors port site versus control ($p < 0.001$).
Port site infiltration versus *epidural analgesia*			
Ruiz-Tovar [28]	Port site infiltration with 10 ml of bupivacaine 0.25%/IV analgesia ($n = 49$) versus epidural at T6/7 levobupivacaine 0.125% 6 mL/h/IV analgesia ($n = 49$) versus IV analgesia ($n = 49$)	Favors port site infiltration ($p = 0.007$) and epidural ($p = 0.02$) over control at 24 h. NS between port site and epidural	Not reported
Intraperitoneal local anesthetic administration			
Cleveland [29]	Intraperitoneal ropivacaine 0.2% infusion versus placebo	NS	NS
Surgical interventions			
Single-port approach			
Morales-Conde [30]	Single-port approach ($n = 15$) versus multi-port approach ($n = 15$)	Favors single-port approach on movement on day 1 ($p = 0.046$) and day 2 ($p = 0.044$), postoperatively. NS after day 2	Not reported

IV intravenous, *IM* intramuscular, *PCA* patient-controlled analgesia, *PO* per-oral, *IP* intraperitoneal, *TAP* transversus abdominis plane, *VAS* visual analogue scale, *NRS* numerical rating scale, *PACU* post anaesthetic care unit, *NS* not significant

Dexamethasone, ondansetron, and haloperidol

A placebo-controlled study [21] compared ondansetron; ondansetron and dexamethasone; and combinations of ondansetron, dexamethasone and haloperidol. Pain intensity and opioid use was significantly lower in the 3-drug combination group. There were no statistically significant differences in pain intensity between the other groups.

Magnesium sulphate

One placebo-controlled study [22] reported significant reductions in pain scores and opioid consumption with magnesium sulfate.

Regional analgesic interventions

Transverse abdominis plane (TAP) block

The analgesic effects of TAP blocks have been investigated in five studies [23–27]. One study [23] reported significantly lower pain scores for 12 h after ultrasound guided bilateral subcostal TAP blocks. Of note, the surgery was carried out as a single-port laparoscopic approach and the subcostal TAP blocks were applied after emergence from anesthesia. There was no significant difference in total opioid consumption.

Another study [24] found reduced pain scores with postoperative ultrasound guided bilateral TAP blocks

against no block. One study [25] reported significant decrease in pain scores and total opioid consumption with continuous TAP blocks. Another study [26] compared ultrasound guided bilateral subcostal TAP block versus a combination of subcostal and posterior TAP blocks. Similar pain scores and opioid consumption were obtained in the two groups, but statistical analyses were questionable.

One study [27] compared ultrasound guided oblique subcostal TAP (OSTAP) block with bupivacaine and saline port infiltration, saline OSTAP block and port site infiltration with bupivacaine, and saline OSTAP and port site infiltration (placebo group). Compared to placebo, OSTAP block group had significantly lower pain scores at rest at all measured time points and on movement for up to 6 h. The port site infiltration group reported significantly lower pain scores at rest and on movement and lower total opioid consumption when compared to the placebo group. There appeared to be significant reduction on pain and movement at 4 and 6 h only, favoring the OSTAP group when compared with port site infiltration, but this effect did not extend before 4 h or after 6 h. There was significantly lower total opioid consumption for the TAP block against both port site infiltration and placebo.

Port site infiltration versus epidural analgesia

A three-arm study [28] compared IV analgesia (control group), epidural analgesia, and port-site infiltration. Pain was significantly higher in the control group when compared to other two groups. There were no significant differences between the epidural and port-site infiltration groups.

Intraperitoneal local anesthetic infusion

A placebo-controlled study [29] found no improvements in pain scores and opioid use with intraperitoneal ropivacaine infusion.

Surgical interventions

Single-port approach

The use of a single-port approach compared with conventional laparoscopic sleeve gastrectomy was examined in one pilot study [30] with mixed results. Patients that received the single-port approach reported lower pain scores on movement on postoperative day 1 and day 2, but this did not on day 3. There were no significant differences in the groups with pain scores at rest.

Discussion

The strength of this systematic review stems from the PROSPECT methodology which goes beyond making recommendation based on the simple statistical analyses of the available evidence [6]. The included studies are interpreted based on the use of a baseline analgesic technique in the study groups, balance of the benefits and adverse effects of the interventions, and assimilation this information in the current clinical context (i.e., in the setting of LSG). Overall, the PROSPECT recommendations provide clinicians with supporting arguments for and against the use of an analgesic intervention.

Although there was limited procedure-specific evidence for non-opioid analgesics such as acetaminophen and NSAIDs, their analgesic benefits are well described [5, 31]. Therefore, they are considered as "basic" analgesics. Of note, some recommend that NSAIDs should be avoided after LSG due to the risk of ulcer development [32]. However, recently published enhanced recovery pathways recommend the use of NSAIDs [3, 4]. Of note, the evidence suggesting development of marginal ulcers with the use of NSAIDs is predominately from Roux-en-Y procedures rather than LSG. Of note, NSAIDs and cyclo-oxygenase (COX)-2 specific inhibitors have similar analgesic effects. Unlike NSAIDs, COX-2 specific do not have any clinically significant effects on platelet function.

Even though only one study reported the analgesic efficacy of dexamethasone in the setting of LSG, its antiemetic effects are well established and thus, it is likely to be beneficial in this context. Although not investigated in LSG, the anti-inflammatory effects of "high dose" preoperative glucocorticoid may reduce inflammation [33] including peritoneal inflammation [34], which can influence postoperative outcome.

Gabapentinoids allowed significantly lower pain scores, although the doses used varied significantly. However, there are concerns that gabapentinoids might amplify opioid-induced respiratory depression [35], particularly in the obese or obstructive sleep apnea population [36]. Nevertheless, gabapentinoids may be considered with caution when a "basic" analgesic regimen such as acetaminophen and NSAIDs is not possible.

Several studies evaluating TAP blocks showed significant improvements in pain scores [23–27]. However, the techniques used for this field block varied significantly. Some studies used the common ultrasound approach while others used a subcostal approach that is more appropriate from an anatomical point of view. Also, some blocks were performed by anesthesiologists before the surgical procedure while others were performed by surgeons at the end of surgery. Thus, it is not clear which variant of the TAP

block technique is optimal. Despite the reported analgesic benefits of TAP blocks, their use with the laparoscopic approach has been questioned [37]. Port-site infiltration is a simple and inexpensive approach that provides adequate somatic blockade [38]. Therefore, at this time port-site infiltration is recommended over TAP blocks.

Analgesic efficacy of magnesium sulphate was not evaluated over an optimal multimodal analgesic including acetaminophen and NSAIDs [22]. Furthermore, there are concerns of potentiation of muscle paralysis and increased incidence of residual paralysis that has been shown to increase post-discharge complications and 30-day readmission rates [39]. The inconsistent evidence of analgesic benefits of alpha-2 agonists such as dexmedetomidine hinder recommendation. Although dexmedetomidine is used intraoperatively in bariatric surgery to reduce anesthetic and opioid requirements, its lingering sedative and hypotensive effects may hamper early ambulation. Thus, its role it increasingly being questioned. In contrast to the findings of a systematic review which included a wide range of surgical procedures [40], intraperitoneal local anesthetic administration did show analgesic benefit in LSG. The evidence of improved pain relief was lacking with the use of single-port systems, which requires new equipment and is associated with increased costs.

The limitations of this review are related to those of the included studies. There was considerable heterogeneity and design flaws between studies such as variable dosing regimens, variable methods of administration, control groups, and time points of pain assessments. Also, the analgesic interventions were not evaluated against a group that included basic analgesic regimen such as acetaminophen and an NSAID. The small size of most studies has the potential for over or under-estimation of effect. In addition, the studies had inadequate sample sizes to draw valid conclusions concerning the safety profile of the analgesic interventions.

In summary, this review has identified a potential analgesic regimen for optimal pain management after LSG based on a balance of the analgesic efficacy and potential risks of the analgesic intervention (Table 4). Perioperative pain management for LSG should include acetaminophen and unless contraindicated an NSAID administered preoperatively or intraoperatively, and continued into the postoperative period. Even though there is limited evidence, port-site infiltration is a safe and easy procedure and thus may be considered. Opioids should be used postoperatively for rescue analgesia only. Low dose dexamethasone may be administered for its ability to decrease analgesic use and act as an anti-emetic.

Future adequately powered studies should assess the effects of analgesic interventions not only on pain, opioid consumption, opioid-related adverse events and complications associated with the intervention, but also on early recovery outcomes such as time to ambulation, length of hospital stay, and the occurrence of chronic pain or chronic opioid consumption. Furthermore, the influence of analgesic intervention on patient-specific factors such as preoperative chronic pain and chronic opioid therapy need to be assessed.

Table 4 Overall recommendations for pain management after laparoscopic sleeve gastrectomy

Pre-operative and intraoperative period
Acetaminophen (Grade A)
Non-steroidal anti-inflammatory drugs (Grade A)
Single intravenous low dose of dexamethasone (Grade A)
Gabapentinoids, when acetaminophen and/or NSAID are not possible (Grade A)
Postoperative period
Acetaminophen (Grade A)
Non-steroidal anti-inflammatory drugs (Grade A)
Opioid as rescue (Grade A)
Not recommended
Transversus abdominis plane blocks (Grade D)
Alpha-2 adrenergic agonists (Grade D)
Magnesium sulfate (Grade D)
Intraperitoneal local anesthetic instillation (Grade D)
Single-port approach (Grade B)

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Author contribution HM, WX and SS conducted the literature search and analyzed the retrieved articles with AH; HM, WX, SS, AH and GJ wrote the manuscript, which was reviewed and edited by all the other authors who have also participated in the PROSPECT Working Group meetings using a Delphi method.

Compliance with ethical standards

Conflict of interest Andrew Hill has received Honoraria from MSD. Philipp Lirk has no conflicts of interest to declare. Girish P. Joshi has received honoraria from Baxter and Pacira Pharmaceuticals. Francis Bonnet has received honoraria from Pfizer, The Medicine Company, Abbott France, and Nordic Pharma France. Henrik Kehlet has received honoraria from Pfizer and Grunenthal. The Anesthesiology Unit of the University of Western Australia, but not Stephan Schug privately, has received research and travel funding and speaking and consulting honoraria from bioCSL, Eli Lilly, Indivior, iX Biopharma and Pfizer. Narinder Rawal has received honoraria from Baxter and Sintetica. Marc Van de Velde received honoraria from Sintetica, Grunenthal, Vifor Pharma, MSD, Nordic Pharma, Janssen Pharmaceuticals, Heron Therapeutics and Aquettant.

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