REVIEW ARTICLE

Local Anesthetic Use for Pain Relief Following Laparoscopic Ventral Hernia Repair: A Systematic Review

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Abstract

Aim: To assess the effectiveness of the addition of local anesthetic (LA) techniques in reducing pain and morphine consumption in the first 24 hours following laparoscopic ventral hernia repair (LVHR) in adults.

Background: Ventral hernias (VH) are a common condition; with risk factors (including obesity), the incidence of VH is projected to increase. Surgical VH repair is required for symptom relief and to prevent related complications. LVHR has significant advantages over open repair, with reduced infectious complications, shorter hospital stays, and more favorable outcomes in obese patients. However, in comparisonto open repair LVHR patients often experience severe pain post-LVHR. LA is an important part of multimodal analgesia regimes and their use in the context of post-operative LVHR pain management is growing in importance.

Review results: A systematic review was performed according to PRISMA using search terms related to LA, LVHR post-operative pain, and morphine consumption; studies were limited to adults (>18 years) and randomized control trials (RCT). Four RCT met the inclusion criteria. All studies compared bupivacaine with normal saline, one also used bupivacaine with epinephrine; varying LA interventions were used. One study showed a statistically significant, but small (0.08 mg) reduction in pain scores at 24 hours, which is likely to be clinically insignificant. Three studies showed an overall reduction in morphine consumption at 24 hours, with only one reaching statistical and clinical significance.

Conclusion: Bupivicaine LA interventions post-LVHR did not reduce pain scores at 24 hours, but morphine consumption appeared to have been reduced.

Clinical significance: Despite some evidence of reduction in morphine consumption in the first 24 hours post-LVHR, further investigation is required regarding post-operative LVHR pain management using LA, including agent and mode of delivery.

Keywords: Analgesia, Laparoscopy, Outcomes, Ventral hernia.

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Background

A ventral hernia (VH) is a fascial defect in the anterior abdominal wall. Primary VH includes epigastric, umbilical, and spigelian hernias. A secondary defect, or incisional hernia, is one that develops at a previous surgical incision site.[1] VH are a common condition and risk factors include obesity, previous abdominal surgery, and chronic elevated intra-abdominal pressure.[2] With the current obesity epidemic, the incidence of VH formation is projected to increase.[3,4] Consequently, the optimization of postoperative care following VH repair is critical to the effective management of this increasingly significant issue.

VH require surgical repair to relieve symptoms and prevent complications, such as uncontrolled pain and hernia strangulation.[5,6] Open mesh repair has been the gold standard since it has been provedto be superior to open suture repair owing to significantly lower recurrence rates.[7] However, LVHR has grown in popularity since its introduction in 1993.[8] Multiple studies have demonstrated a number of advantages of LVHR over open repair, including decreased infectious complications and shorter hospital admissions.[9–12] Furthermore, LVHR appears to be favorable in obese patients owing to lower complication rates.[13–16]

Laparoscopic surgery has long been considered less painful in comparison with open surgery, yet trials have reported no difference in acute or chronic pain between open and LVHR.[17–19] In fact, patients often experience severe pain following LVHR and this remains a significant clinical problem. It is hypothesized that this severe pain is attributable to techniques of mesh fixation during ventral herniorrhaphy.[20–22] Mesh may be secured with sutures or tacks, which pass through the peritoneum, fascia, and muscle of the anterior abdominal wall. Both techniques are associated with significant abdominal wall pain impacting on short- and long-term patient wellbeing, recovery, and satisfaction.[23]

Local anesthesia has become an important addition to multimodal analgesia regimens for postoperative pain. Local anesthesia prevents afferent nociceptive nerve transmission from the surgical site to the spinal cord, reducing the local inflammatory response and pain perception. This is clinically achieved by neuraxial blockade with epidural anesthesia, wound instillation, or compartment blocks.[24] The objective of this systematic review was to assess the effectiveness of the addition of LA techniques in reducing pain and morphine consumption in the first 24 hours following LVHR in adults.

Methods

A systematic review was performed in accordance with the preferred reporting items for systematic reviews and meta-analyses (PRISMA)

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statement where possible.[25] Two authors (JR and VA) independently performed electronic searches of four databases (MEDLINE, EMBASE, Cochrane Central Register of Controlled Trials, and Google Scholar). With the assistance of a subject librarian, the first author (JR) collated a list of keywords and search terms to incorporate them into the strategies adapted for each database. The search terms combined the concepts of LA, LVHR, post-operative pain, and morphine consumption (Table 1). Results were limited to adults (>18 years) and randomized controlled trials (RCT). No other limitations were applied. Search results were downloaded and managed with RefWorks citation management software (ProQuest LLC, USA).

Study Selection

Abstracts were screened and full-text papers obtained to identify primary research studies reporting the effectiveness of the addition of LA techniques in reducing pain scores and morphine consumption in the first 24 hours following LVHR. All published studies comparing LA modalities for post-operative pain relief following LVHR by randomized trial were included. The primary outcomes of interest were pain scores at rest and total morphine consumption in the first 24 hours following LVHR. Exclusion criteria included nonrandomized studies, pediatric studies, and those articles for which full-text publications were not available (e.g., conference abstracts). Three reviewers (JR, LP, and VA) independently performed the searches and examined titles and abstracts to exclude irrelevant reports and produce a list of studies for full-text review in an iterative process. Any disagreement over inclusion or exclusion was discussed with the senior author (AGH) and a consensus reached. Additional articles and abstracts were retrieved by manually examining reference lists of relevant publications. The last search was performed on June 19, 2018.

Data Extraction

Data extraction for morphine consumption and pain scores in the first 24 hours was performed independently by two reviewers (JR and VA) and entered into predesigned electronic tables. Data were reported as mean ± standard deviation (SD) where possible. Morphine consumption within the first 24 hours following surgery was reported as morphine equivalents where possible and as reported by individual trials. The median score was used as an estimate of the mean where the latter was not reported.

Table 1: Search strategy used in OVID Medline® in-process and other non-indexed citations (search strategy was modified as required for each database used. exp. exploded MeSH term, mp key word, mt methods)

Search terms
(postoperat* or post-operat* or postoperative pain or postoperative pain or pain*).mp
and
exp. analgesics, opioid/or placebo.mp or morphine.mp or opiate*.mp or opioid*.mp or analg*.mp
and
Anesthesia, local/mt or local anesth*.mp or local anesth* or ropivacaine.mp or bupivacaine.mp or lidocaine.mp or lignocaine.mp or procaine.mp
and
"laparoscopic ventral hernia repair".mp or exp. hernia, ventral/mt OR ventral hernia.mp.
and
exp. laparoscopy/mt or laparoscop*.mp or endoscop*.mp

SD measures were attempted based on the methods described in the Cochrane Handbook of Systematic Reviews of Interventions, where attempts to contact authors for clarification were unsuccessful (up to two emails).[26]

Risk of Bias Assessment

The Cochrane Collaboration tool for assessing risk of bias was implemented and generated by RevMan 5.1.[27] Two reviewers (JR and LP) independently assessed the methodological quality of trials for sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting, lost to follow-up, intention-to-treat, and financial conflicts.[28]

Review Results

The literature search identified 637 records in the initial database search. A PRISMA flow diagram for the systematic review is presented in Flowchart 1. Four RCT met the inclusion criteria and were included in the review.[29–32] All four studies compared bupivacaine with normal saline and only one of these studies used bupivacaine with epinephrine (Table 2). All studies were classified as having a low risk of bias (Fig. 1). Variations in the timing of outcome measures, the duration and type of the intervention and the study cohorts limited meaningful synthesis of the data. The data are therefore presented as a narrative review.

Pain Scores

There was variation in the types of post-operative pain-scoring questionnaires used in the included studies. Two studies utilized visual analog scores (VAS),[29,30] one study used a numerical rating scale (NRS),[31] and the remaining study used VAS and present pain intensity (PPI) scores.[32] Only one trial, the largest of the included studies, demonstrated a statistically significant difference in pain scores at 24 hours.[30] This trial was assessed as having a low risk of bias and bupivacaine was comparedwith saline using a laparoscopic transverse abdominis plane (TAP) block and only a very small difference (0.08 mg) was noted in pain scores, which is unlikely to be clinically significant. However, a statistically and clinically significant difference in morphine consumption clearly favored the TAP block with bupivacaine (see below). Three trials showed a significant reduction in the reported pain scores at the one-hour mark, of which two reached statistical significance in favor of the intervention group at one hour post-surgery.[29–31]

Morphine Consumption

Three of the four included studies demonstrated decreased morphine consumption in the intervention group at 24 hours, of which only one reached statistical and clinical significance.[30] The remaining study reported a statistically insignificant increase in morphine use in the intervention group at 24 hours following LVHR and did not provide a measure of variance.[32]

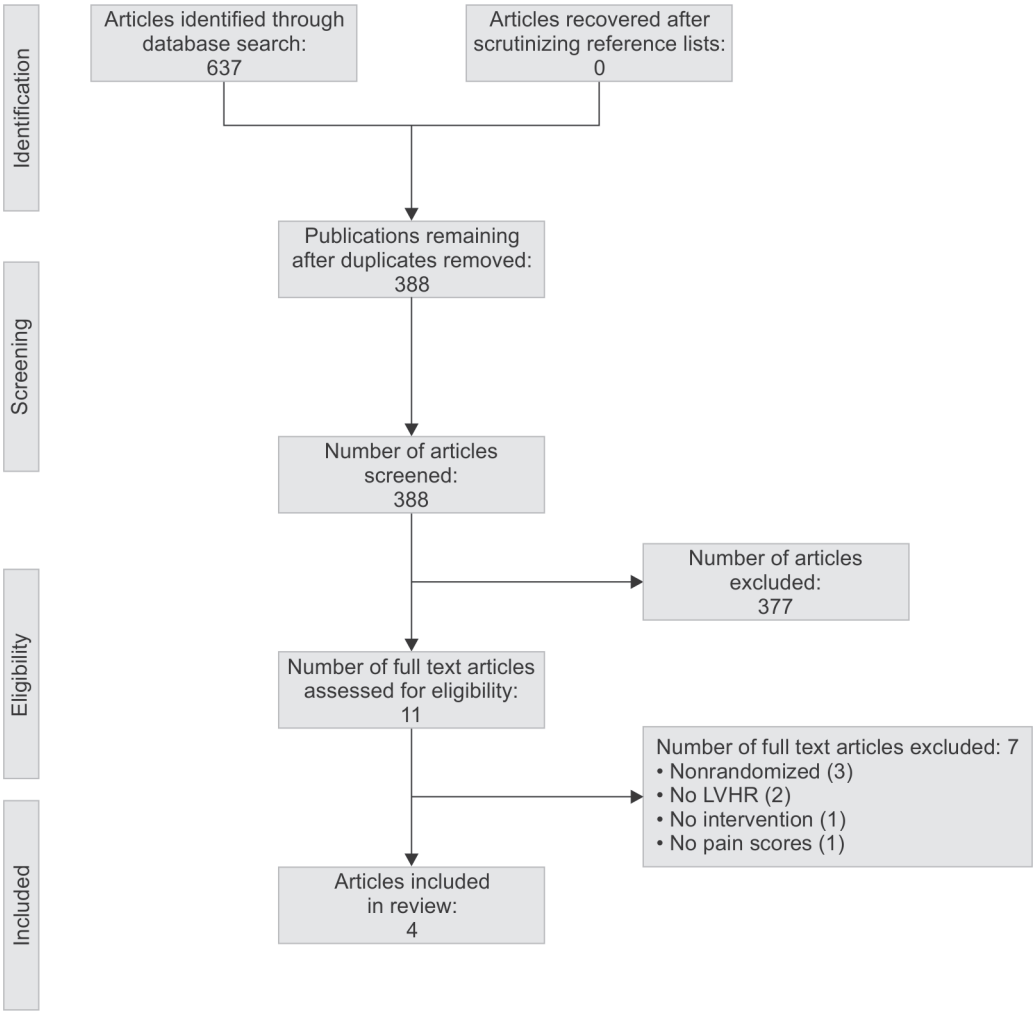
Complications and Adverse Effects

There were no reports of adverse events following the application of LA interventions. None of the trials reported plasma levels of LA agents. Only one study reported a major complication: a single case of mesh infection with methicillin-resistant *Staphylococcus aureus*.[32]

Discussion

This systematic review includes four trials comparing various bupivacaine interventions to usual/standard care or a saline control

Flowchart 1: PRISMA flow diagram of study selection



for improving postoperative pain and morphine consumption following LVHR.[29–32] These interventions included peripheral nerve blockade, continuous intraperitoneal LA infusion, and single-shot intraperitoneal LA instillation techniques. Although the use of bupivacaine did not seem to significantly improve pain score measures, it did seem to reduce morphine consumption at 24 hours.

Although all included trials compared different interventions, bupivacaine was consistently the chosen LA agent. Bupivacaine is a long-acting LA agent that is easily used with minimal side effects.[33] Among other factors, the analgesic efficacy of bupivacaine depends on the method of delivery and the desired effect site. In addition, it has a rapid onset of action and, depending on dosage and concentration, an elimination half-life ranging from 1.5 to 8 hours.[34–36] Interestingly, the single trial that used bupivacaine with epinephrine did not show a prolonged analgesic effect as would be expected. Given these pharmacokinetic properties, it is unsurprising that patients experienced less pain in the early postoperative phase within the three trials that compared single-injection LA analgesic interventions.[29–31] These findings suggest that single-bolus LA analgesic interventions with bupivacaine may be limited principally by the short duration of the analgesic agent.

Previous studies have shown successful prolongation of LA analgesic effects with continuous LA infusions via perineural catheters and mechanical pain pump devices.[37,38] Despite this, Rosen et al. were unable to demonstrate a difference in post-operative pain scores and morphine consumption following LVHR, using this technique.[32] A possible reason for the negative findings in this trial may lie with the technical aspects of catheter placement. With the successful implementation of LA infusions in other procedures, the development of this technique should be explored further with attention to the insertion technique and LA effect site.

The administration of LA agents to wound sites improves pain and morphine use after laparoscopic surgery owing to ease of application, effective afferent nociceptive blockade, and reduction in the local inflammatory response.[39–41] While opioid analgesics are the mainstay of postoperative analgesia following LVHR and cannot be eliminated from multimodal regimens of analgesia, there are many unwanted adverse effects associated with their use which can hinder recovery.[42] Despite no significant difference in pain scores in the included trials, an overall reduction in total morphine consumption was observed in the intervention group in three of the trials.[29–31] While there are multiple factors at play during postoperative recovery, an observation between all interventions compared was that patients were less likely to ask for additional analgesia in the early post-operative phase following LA application. Bellows and colleagues noticed that patients requested the majority of pain relief in the first four hours post-surgery in the control group.[29] The opposite was seen in the intervention group.

Table 2: Study characteristics of included trials comparing LA interventions for postoperative pain up to 24 hours following LVHR

Study	*Design, N [intervention/ control]*	*Intervention*	*LA agent, control*	*Mean morphine consumption in 24 hours (mg) [intervention/ control]*	*Pain score measure (0–10)†*	*Mean pain scores at rest [intervention/ control]*	*Main findings of intervention*
Bellows[29]	RCT, 9/9	Trans-abdominal LA injected at suture sites prior to suture placement	10 mL 0.25% bupivacaine with epinephrine, no control	24.1 ± 7.2/ 26.3 ± 9.2	VAS	1 hours: 2.2 ± 0.8/ 6.4 ± 0.9* 2 hours: 3.1 ± 0.9/ 3.9 ± 1.1 4 hours: 1.1 ± 0.4/ 2.6 ± 0.9 24 hours: 2.3 ± 0.8/2.3 ± 1.0	Significant reduction in pain scores at one hour after surgery
Fields[30]	RCT, 52/48	Laparoscopic assisted TAP block	50–60 mL 0.25% bupivacaine, 0.9% normal saline	25.64/42.56*	VAS	1 hours: 5.19 ± 0.39/ 6.46 ± 0.38* 24 hours: 4.60 ± 0.39/4.52 ± 0.31*	Significant reduction in pain scores and total morphine consumption in 24 hours
Gough[31]	RCT, 42/38	Peri-prosthetic LA injection, with all patients receiving LA port site injections	0.5% bupivacaine, 0.9% normal saline	4.8 ± 17.3/ 6.7 ± 15.4	NRS	<1.5 hours: 4.4 ± 2.4/ 4.8 ± 2.2 22.5–24.5 hours: 3.6 ± 2.5/2.7 ± 1.4	Reduced pain scores and total morphine consumption (not significant)
Rosen[32]	RCT, 37/36	Continuous elastomeric pain pump infusion of LA for 48 hours above the mesh in the hernia sac	0.5% bupivacaine, 0.9% normal saline	52.2/44.5	VAS	0:1.7/2.3 8 hours: 5.7/5.5 16 hours: 5.4/5.6 24 hours: 5.0/6.0	No advantage in reduction pain scores and total morphine consumption in 24 hours

VAS, visual analog scale; LA, local anesthetic; LVHR, laparoscopic ventral hernia repair; TAP, transverse abdominis plane; NRS, numerical rating scale; VRS, verbal rating score; PPI, present pain intensity; RCT, randomized controlled trial.
†All pain scores use a 0–10 point scale with a score of 10 signifying the worst possible pain.
*p <0.05.

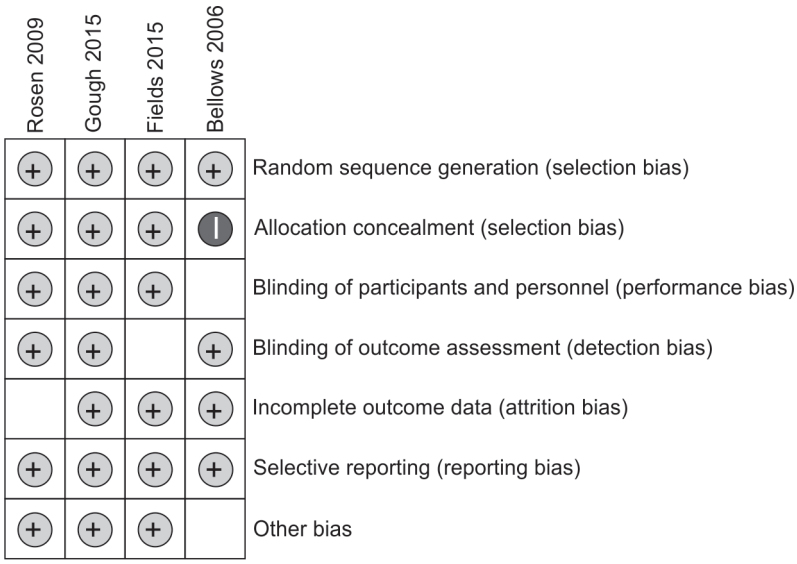


Fig. 1: Cochrane risk of bias figure

This particular study demonstrates that the early postoperative phase serves as the best time for single-shot LA interventions to be effective.

Limitations

The present review was limited by the lack of available trials. All included studies were heterogeneous comparing different interventions; hence, no quantitative analysis or meta-analysis was possible.

Conclusion

While bupivacaine interventions did not improve early post-operative pain scores, they appeared to reduce the amount of morphine consumed in the first 24 hours following LVHR. Further definitive conclusions cannot be made owing to the limited and heterogeneous nature of the available evidence. The management of pain following LVHR would benefit from further good quality trials investigating LA agents and their mode of delivery.

Clinical Significance

Despite some evidence of reduction in morphine consumption in the first 24 hours post-LVHR, further investigation is required regarding postoperative LVHR pain management using LA, including agent and mode of delivery.

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