

# Infiltration of Suture Sites With Local Anesthesia for Management of Pain Following Laparoscopic Ventral Hernia Repairs: a Prospective Randomized Trial

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## ABSTRACT

**Background:** Postoperative pain control after laparoscopic ventral hernia repairs remains a significant clinical problem. We sought to determine the pain-sparing efficacy of local anesthetic infiltrated into the abdominal wall wounds created by the placement of transabdominal sutures used to ensure adequate fixation of the mesh during laparoscopic ventral hernia repair.

**Methods:** Patients undergoing laparoscopic ventral/incisional hernia repair were randomized to receive local anesthesia (0.25% bupivacaine with epinephrine) into all layers of the abdominal wall to the level of the parietal peritoneum at suture fixation sites immediately before suture placement (Group I; n=9) or no local anesthesia (Group II, control; n=9). The anesthetic technique was otherwise standard for both groups. Postoperatively, pain was assessed with a 10-point visual analogue scale (VAS) at 1, 2, 4, and 24 hours. Analgesic use and hospital stay were also recorded.

**Results:** The groups were similar in age, sex, ASA, and size of hernia defect. The operative times were not statistically different between the 2 groups (Group I, 118±12 minutes; Group II, 144±21 minutes; P>0.05). Group I had a statistically significant decrease in the pain scores compared with Group II (2.2±0.8 vs. 6.4±0.9; P<0.05) at 1 hour postoperatively. At 2 and 4 hours, the mean pain scores were decreased but not statistically different. Similarly, the cumulative consumption of pain medication at 1, 2, and 4 hours postoperatively as well as the average hospital stay (Group I, 2.0±0.4; Group II, 2.4±0.4 days) were lower but not statistically significant in patients in Group I compared with those in Group II.

**Conclusion:** This small, randomized study demonstrates that infiltration of suture fixation sites is effective in reducing early postoperative pain but not analgesic consump-

tion following laparoscopic incisional and ventral hernia repairs. A larger study is required to investigate this strategy on later postoperative pain and hospital stay.

**Key Words:** Local anesthesia, Laparoscopic ventral hernia repair.

## INTRODUCTION

Ventral hernia repairs are often associated with substantial postoperative pain, frequently requiring narcotic analgesics. Although early postoperative pain is less intense with laparoscopic techniques compared with that in open repair, early postoperative pain after laparoscopic ventral hernia repair remains an issue. Early postoperative pain can decrease early ambulation, delay the return of bowel function, and be a major problem in the acceptance of early discharge by patients.<sup>1-3</sup> Thus, attenuation of early postoperative pain remains an important concern for surgeons.

Opioids are often used to decrease pain following surgery but are associated with many unwanted side effects and may not be completely effective. Local anesthetic may offer a reasonable alternative to opiate use. Because of its simplicity, safety, and low cost, intraoperative instillation of local anesthesia is increasingly being used by many surgeons in an effort to alleviate the postoperative pain experienced after laparoscopic procedures.<sup>3-6</sup> Despite widespread use of local anesthesia, there is still little consensus on when (ie, pre- or postincisional), where (ie, anatomic tissue space) and after which surgical procedures local anesthesia may provide clinically relevant alleviation of postoperative pain. To our knowledge, no study has investigated the benefit of local anesthetic infiltration in reducing the postoperative pain experienced after laparoscopic ventral hernia repairs. We hypothesize that part of the pain experienced after this procedure stems from the trauma caused to the anterior abdominal wall by the placement of the transabdominal sutures used to fix the mesh material across the hernia defect. Therefore, in the present study, we sought to determine the effect of bupivacaine infiltrated at all transabdominal su-

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ture fixation sites during laparoscopic ventral hernia repair on postoperative pain.

## METHODS

Our Institutional Board Review approved the study, and all patients gave written informed consent. All patients with an incisional or ventral hernia defect  $\geq 9$  cm<sup>2</sup> were considered for enrollment into this study. Patients with a history of alcohol or drug abuse, chronic pain, pregnancy, or intolerance or adverse reaction to bupivacaine were excluded from the study. Eligible patients were randomized using a computer-generated randomization schedule into one of 2 groups. Group I (treatment) received 0.25% bupivacaine with epinephrine at all transabdominal suture fixation sites down to the level of the parietal peritoneum before suture placement. Group II (no treatment; control) received no bupivacaine injections.

All patients underwent mechanical bowel preparation with one gallon of polyethylene glycol one day before surgery. Patients were instructed preoperatively concerning the use of a 10-point linear visual analog pain scale (VAS) (0=no pain to 10=excruciating pain). Patients were given a second-generation cephalosporin as antimicrobial prophylaxis before induction of anesthesia and 24 hours postoperatively. Anesthesia was induced with propofol (2 mg/kg to 3 mg/kg) and fentanyl (1.5 mg/kg). After intubation, anesthesia was maintained with isoflurane (1%), O<sub>2</sub>/N (30%/70%). No additional narcotics were given in the operating room.

One surgeon (C.B.) performed the laparoscopic ventral hernia repairs. Nasogastric suction and bladder catheterization were used for the duration of the operation. A 12-mm port was placed away from the hernia defect in the left hypochondrium by using the open technique (Hasson's trocar). Pneumoperitoneum was then established by CO<sub>2</sub> insufflation and maintained at intraabdominal pressures of 10mm Hg to 12mm Hg. Four accessory trocars (5 mm) were then inserted under direct vision. Adhesiolysis and reduction of the hernia sac were performed using sharp dissection. After complete reduction of the hernia sac and contents, the hernia defect was measured, and the mesh was prepared.

Polytetrafluoroethylene (PTFE) mesh (Gore-Tex Du-alMesh Plus Biomaterial, WL Gore, Flagstaff, AZ) was used to repair all hernia defects. The mesh was tailored to overlap the hernia wall defect circumferentially by at least 4 cm. Four nonabsorbable Gore-Tex sutures were placed in the mesh, and the mesh was introduced through the

12-mm trocar into the abdominal cavity and positioned intracorporeally. In Group I, the transabdominal suture fixation sites were injected with local anesthesia. The injection was performed using a 20-gauge spinal needle inserted down to the level of the parietal peritoneum. The peritoneum was infiltrated under direct vision and a peritoneal bleb was created at each site of injection. The needle was then withdrawn while the local anesthesia was continuously injecting up to the level of the skin. A total of approximately 10 mL of 0.25% bupivacaine was injected at each site. The sutures were then pulled through the abdominal wall using a Gore suture passer. In every case, the transabdominal sutures were placed every 5 cm to 6 cm apart, and helicoidal clips (Protack, 5 mm; Autosuture USSC) were placed every 2cm circumferentially.

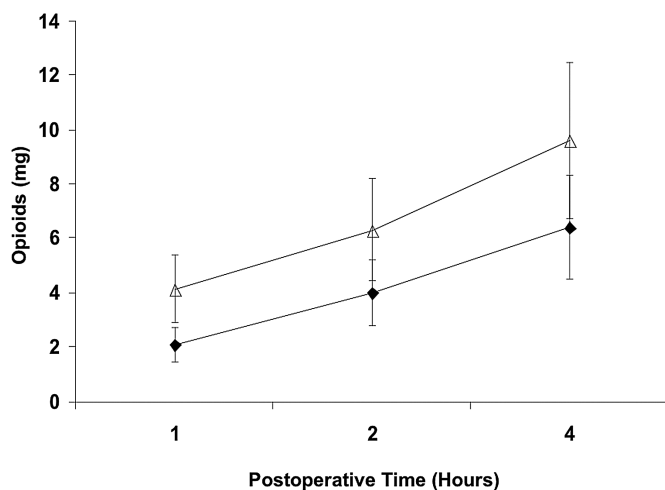
Immediately on arrival to the recovery room, morphine was given in increments of 1mg every 6 minutes as needed for analgesia until patients were comfortable. Pain intensity was scored using the 10-point visual analogue score (VAS) at 1, 2, 4, and 24 hours postoperatively from the time of extubation. At 1, 2, 4, and 24 hours after surgery, the presence of nausea, vomiting, or both, and cumulative consumption of analgesic were also recorded. The time to first analgesia use was documented. A research assistant who was blinded to the treatment received, carried out all data collection. After the discharge from the recovery room, all patients were connected to a patient-controlled analgesia (PCA) device set to deliver 1 mg of morphine every 6 minutes, without basal infusion for the first 24 hours. Patients were then changed to oral pain medication as tolerated. After discharge, patients were scheduled for a 2-week clinic visit at which time complications were recorded.

## Statistical Analyses

Data are reported as the mean  $\pm$  standard error of the mean. Statistical analysis was performed using a Mann-Whitney U-test, or unpaired Student *t* test as appropriate. Analyses were performed using a statistical package (In-Stat).  $P \leq 0.05$  was considered statistically significant.

## RESULTS

Nineteen patients were enrolled in the study. Sixteen were considered morbidly obese as assessed by body mass index  $>30$ . The body mass index range was 27 to 60, with a mean of  $38.1 \pm 2.2$ . Age ranged from 32 to 83 years of age, with a mean of  $55.5 \pm 3.9$  years. Ventral hernia presentation was primary in 9 patients (50%) and incisional in



**Figure 1.** Cumulative narcotic use after laparoscopic ventral hernia repairs in Group I (bupivacaine; closed diamonds) and Group II (control; open triangles). The cumulative dose is expressed in milligrams. The difference between the groups at all time points was not statistically significant ( $P>0.05$ ;  $n=9$  in each group).

9 patients (50%). Hernia defects ranged from 12 cm<sup>2</sup> to 270 cm<sup>2</sup>, with a mean of 94.7±19.8.

Nine patients were randomized to receive local anesthesia (0.25% bupivacaine with epinephrine) into all layers of the anterior abdominal wall to the level of the parietal peritoneum at suture fixation sites immediately before transabdominal suture placement (Group I) and 10 to receive no local anesthesia (Group II, control). One patient in Group II failed extubation, leaving 9 patients randomly assigned to each group for analysis. The groups did not differ in age, body mass index (BMI), ASA status, or hernia defect size (cm<sup>2</sup>) (**Table 1**). There were 4 females in Group I and 7 in Group II (**Table 1**).

A mean of 99.7±5.1 mL of local anesthetic was used per patient in Group I, and there were no significant side effects from the administration of bupivacaine. The mean duration of surgery, and the number of transabdominal sutures was found to be comparable between the 2 groups (**Table 2**). All cases were completed laparoscopically without any intraoperative complications or need for conversion to an open operation. Six patients experienced nausea after the operation (**Table 2**). Of these, only one experienced an episode of vomiting. One Group II death occurred due to pulmonary embolism.

Following our laparoscopic ventral hernia repair, more patients in the control group (56%) complained of intense postoperative pain, defined by a VAS >7, during the first

hour than in our treatment group (11%). Moreover, as shown in **Table 3**, the mean VAS pain scores at one hour postoperatively were significantly lower in Group I (treatment) compared with that in Group II (no treatment, control). These pain scores continued to be lower on average in Group I at 2 and 4 hours after the operation compared with those in Group II; however, this difference was not statistically different ( $P>0.05$ ; **Table 3**).

Fewer patients in Group I requested narcotics within the first hour postoperatively (66%) compared with patients in Group II (100%), and the time to first request for analgesics was longer in Group I (**Table 2**). The cumulative consumption of parenteral opioids at 1, 2, and 4 hours postoperatively (**Figure 1**) was also lower on average in Group I, although not statistically significant. The mean

**Table 1.** Demographic and Clinical Characteristic Data on the 2 Groups of Patients

Characteristics	Group I N=9	Group II N=9	P Value
Age (years)	51.1±4.3*	59.9±5.6*	0.23
Sex (M/F)	5/4	2/7	
ASA (median)	3 <sup>†</sup>	2 <sup>†</sup>	
BMI (mean±SEM kg/m <sup>2</sup> )	41±3.4*	35.3±8.1*	0.21
Hernia type (incisional/ventral)	3/6	6/3	
Hernia defect (cm <sup>2</sup> )	72.8±27.9*	116.8±27.6*	0.28

\*Mean±SEM.

**Table 2.** Operative and Postoperative Details on the 2 Groups of Patients

Patient Details	Group I	Group II	P Value
Operative Time (mean±SEM min)	118±12.2	144.1±20.9	0.30
Suture fixation sites (mean±SEM)	9.0±0.7	10.9±0.9	0.12
N/V (#)	2/0	4/1	
Hospital Stay (mean±SEM days)	2.0±0.4	2.4±0.4	0.49
Patients not requiring postoperative analgesia (#)	1	1	
Time delay to first postoperative analgesia (mean±SEM min)	57.5±14.1	30±8.0	0.11

**Table 3.**  
Visual Analogue Scores (VAS) of Pain Obtained Postoperatively on the 2 Groups of Patients

VAS Scores	Group I (mean±SEM)	Group II (mean±SEM)	P Value
At 1 hr	2.2±0.8	6.4±0.9	0.006
At 2 hr	3.1±0.9	3.9±1.1	0.66
At 4 hr	1.1±0.4	2.6±0.9	0.27
At 24 hr	2.3±0.8	2.3±1.0	0.93

total parenteral opioid use at 24 hours was also not significantly different between the 2 groups (24.1±7.2mg Group I, vs. 26.3±9.2mg Group II; P>0.05). Despite a trend towards reduced analgesia requirements in Group I, the mean hospital stay was not significantly different (**Table 2**).

On 2-week follow-up, seroma formation was found in 2 patients (11%; one in each group), both of which resolved with conservative management.

## DISCUSSION

Pain remains a relevant complaint during the early postoperative period leading to the increased consumption of pain medications, delayed bowel function, and extended hospital stays. In an effort to address these pain-related complications, a number of clinical studies have been conducted using local anesthetics infiltrated at various times and anatomic locations during several types of open and laparoscopic surgery.<sup>3-12</sup> However, reported results from these studies are inconsistent, ranging from considerable pain reduction to no significant pain reduction. Furthermore, the clinical benefit of any reduction in postoperative pain is questionable because only small reductions in supplemental analgesic use were observed,<sup>10-12</sup> and hospital stays were not significantly reduced.<sup>6,7</sup> Consequently, the debate continues not only for which surgical procedures local anesthesia may provide clinically relevant alleviation of postoperative pain but also when (ie, timing of infiltration), where (ie, anatomic site), and how much (ie, dosage) local anesthesia should be used. Notably, one surgical procedure where the efficacy of local anesthetics has not been investigated is laparoscopic ventral herniorrhaphy.

Our clinical observation suggests that patients often have considerable discomfort after laparoscopic ventral hernia repair. It has been stated that several mechanisms are responsible for pain after laparoscopy. One mechanism is

trauma/injury to the abdominal wall. During laparoscopic incisional hernia repair, mesh is used to guarantee a tension-free repair of the hernia defect. Unfortunately, injury to the anterior abdominal wall is created in large part by the placement of the transabdominal sutures used to ensure adequate fixation of this mesh material. This mesh fixation is critical because it reduces the rate of recurrent hernia formation.<sup>13</sup> We hypothesized that application of local anesthetics to these suture fixation sites could attenuate the associated pain.

Our findings indicate that bupivacaine infiltration into all layers of the anterior abdominal wall, including the cutaneous tissue, muscle and parietal peritoneum, at the suture fixation sites significantly reduces the early postoperative pain after laparoscopic ventral hernia repair. A number of published studies have strongly suggested that the anatomic application site of the local anesthetic has a great contribution to its effectiveness in reducing postoperative pain. For example, Yndgaard and colleagues<sup>14</sup> demonstrated that lidocaine was more effective when applied subfascially compared with subcutaneously after inguinal hernia repair.<sup>14</sup> Furthermore, other investigators have demonstrated that infiltration of the parietal peritoneum after laparoscopic cholecystectomy and appendectomy was more effective in the control of postoperative pain compared with subcutaneous infiltration only.<sup>15,16</sup> It would not be unreasonable to expect additional pain relief if the parietal peritoneum is also infiltrated, because it is richly innervated with somatic nerve fibers.

In our study, the patients may have gained additional benefits not only from the anatomic location of the administered local anesthesia but also from its infiltration into the tissue before it was damaged by the placement of the transabdominal sutures. The theory behind preincisional infiltration of local anesthetics is that it blocks the nociceptive impulses from reaching the central nervous system and thereby suppresses the increased excitability of the spinal cord neurons, which are responsible for intense pain, that are triggered by these afferent impulses.<sup>17-19</sup> Although a debatable topic, the administration of local anesthetics into wounds before the incision has been demonstrated to significantly reduce postoperative pain in many kinds of surgery.<sup>20-22</sup> Moreover, several investigators have noted that postoperative pain was better controlled with preincisional than postincisional infiltration of local anesthesia.<sup>23,24</sup> In fact, Lee and colleagues<sup>25</sup> demonstrated lower pain scores and less narcotic requirement after laparoscopic cholecystectomy when the local anesthetic injections were given before the actual skin incision, trocar placement, or both.<sup>25</sup>



Bupivacaine is easy to use with virtually no side effects; however, its effectiveness in reducing postoperative pain appears short-lived. From reviewed trials, reported doses, ranging up to 150mg have been shown to be safe during laparoscopic procedures,<sup>4</sup> but the pain reduction generally persists for only 1 hour to 8 hours postoperatively.<sup>5,6,26,27</sup> In our study, an average dose of 90mg was used, and none of our patients experienced toxic side effects to bupivacaine. However, the analgesic effect was brief with pain scores only significantly reduced in the first hour after the operation. These data may reflect the pharmacological properties of bupivacaine which, depending on the dose and local tissue absorption, have an elimination half-life of only 1.5 hours to 5.5 hours.<sup>28</sup> In theory, a continuous infusion of bupivacaine may provide longer-lasting pain reduction. Currently, infusion pumps are available that can deliver a constant rate of local anesthesia via specialized catheters placed into surgical incisions. Several recent studies have demonstrated significant pain reduction (up to 24 hours) after inguinal hernia repair using a continuous infusion of local anesthesia.<sup>29,30</sup> Accordingly, we attempted to laparoscopically place these infusion catheters just above the parietal peritoneum after a laparoscopic ventral hernia repair, but found significant leakage of the local anesthesia from the catheter site, as well as, the inability to infuse the local anesthesia, thus we abandoned this technique.

In our study, reduced pain scores were associated with a clear trend towards reduced narcotic consumption; however, this difference in narcotic administration did not reach statistical significance. These data are consistent with data from other trials, evaluating the effectiveness of local anesthesia after laparoscopic cholecystectomy.<sup>10–12,31</sup> The results from our series also did not translate into a significant reduction in hospital stay. However, it is conceivable that a larger study on the effects of local anesthesia after ventral hernia repair could detect significant improvement in narcotic consumption and hospital stay.

## CONCLUSION

The current situation in postoperative pain management after laparoscopic ventral hernia repair indicates room for improvement. This study suggests that patients experience a significant amount of subjective acute pain relief when the transabdominal suture fixation sites are infiltrated with local anesthesia, before placement, to the level of the parietal peritoneum during laparoscopic ventral herniorrhaphy. We believe that this infiltration of local anesthetic may be a useful adjunct as part of a multimodal

analgesic regimen to further alleviate the postoperative pain experienced after this procedure. Because bupivacaine is inexpensive, easy to use, readily available, and has limited side effects, this technique can be easily adopted. Our results while interesting must be interpreted cautiously within the context of this relatively limited series of patient. This area needs larger randomized trials to enable clinicians to establish whether this method has a role in daily practice.

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