e-ISSN: 0975-9506, p-ISSN: 2961-6093

Available online on www.ijpqa.com doi: 10.25258/ijpqa.16.6.26

International Journal of Pharmaceutical Quality Assurance 2025; 16(6); 142-145

Original Research Article

Effectiveness of Pain Control using Subcutaneous versus Interfascial Bupivacaine vs. No Local Anaesthetic after Midline Laparotomy

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Received: 17-04-2025 / Revised: 15-05-2025 / Accepted: 17-06-2025
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Conflict of interest: Nil

Abstract:

Background: In this study we wanted to compare the post-operative pain in patients given a single infiltration of bupivacaine (0.5%) subcutaneous vs inter fascial vs no local anaesthetic before closure after midline laparotomy and compare the incidence of SSI and to compare the amount of analgesia used.

Methods: Patients undergoing midline laparotomy was randomly divided into one of the 3 groups (local anaesthetic vs subcutaneous vs inter fascial). Pain was assessed using VAS post operatively after 12hrs, 24hrs and 24hrs with cough. The amount of analgesia used. The time of first analgesic use after surgery were noted.

Results: There were 60 patients participated in the study (20 in each group). The median VAS score at 24hrs and 24hrs with cough was significantly lower in the interfascial group than the subcutaneous group with p-value of 0.009 and 0.012 ($p < 0.05$) using Mann-Whitney U test. Using the Fischer's Exact test comparing the amount of analgesia used there is a significant difference ($p < 0.05$) in the proportion of the amount of analgesia used in between the groups with difference between no local anaesthetic and administration of local anaesthesia but there is no significant difference between the interfascial and subcutaneous group ($p = 0.161$). Kruskalwallis test showed significant difference in the median time of first analgesia used ($p = 0.001$) between the groups but there was no difference between subcutaneous and interfascial.

Conclusions: Infiltration of local anaesthetic (0.5% bupivacaine) was found to be effective in reducing post operative pain after midline laparotomy wound in the immediate post operative period. Interfascial infiltration is superior to subcutaneous infiltration. There is reduction in the amount of analgesia required after the administration of local anaesthesia.

Keywords: Postoperative Pain, Midline Laparotomy, Bupivacaine, Local Anesthetic Infiltration, Rectus Sheath Block, Interfascial Plane, Visual Analogue Scale, Multimodal Analgesia.

Introduction

The revised IASP (International Association for the Study of Pain) defined pain as "an unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage." [1]

The use of opioids-based analgesics has been the most reliable option to control immediate post-operative pain. This has led to increase in use and opioid related overdose and dependence.[2] Studies have shown that less than half the patient receives adequate pain relief postoperatively. This has resulted in decreased quality of life, daily activities and recovery, there is also increased risk of post-operative complications and risk of chronic pain.[3] Appropriate postoperative pain management facilitates early postoperative ambulation and rehabilitation, which is thought to be necessary for a quicker recovery. Controlling post-operative pain is critical for a patient's return to normal function. It reduces the possibility of negative physiologic and psychological consequences brought on by uncontrolled, acute pain.[4] There is significant difficulty in managing perioperative pain. The primary objectives of perioperative pain management are to shorten hospital stays and allow for early mobilization. Multimodal analgesia has become the only way to reduce perioperative pain.[5]

PCA (Patient-Controlled Analgesia) is a upcoming modality which is being used in postoperative pain management. Even if it works, research is currently being done to develop more effective alternatives for treating abdominal surgery post-operative pain.[6]

After abdominal surgeries, a variety of techniques are employed to manage postoperative pain, such as regional blocks like abdominal field blocks, epidural analgesia, and intravenous analgesics like opioids and NSAIDs. These regional methods include rectus sheath blocks, quadratus lumborum blocks (types I–IV), ilio-inguinal and ilio-hypogastric nerve blocks, and transversus abdominis plane blocks (subcostal or posterior approaches). Depending on the method and clinical situation, different concentrations and combinations of local anaesthetic agents can be used. According to recent research, postoperative pain may be considerably decreased by directly infiltrating the wound site with local anaesthetics. Nevertheless, despite numerous studies aiming to assess the effects of locally administered anaesthetic medications, the optimal site for infiltration is still unknown. The best site of administration is still unknown, despite the fact that many researchers have investigated various abdominal regions for anaesthetic infiltration. This study examines the postoperative pain levels following midline incision abdominal surgery with a single bupivacaine infiltration-either subcutaneously or into the rectus sheath-versus no local anaesthetic infiltration. Bupivacaine, first synthesized by Ekenstan in 1957 and clinically used by Teliveo in 1963, is a long-acting amide local anesthetic widely used in surgery due to its prolonged duration, high potency, and significant sensory-motor separation. It acts by blocking sodium channels in neuronal membranes, preventing nerve impulse transmission. Bupivacaine is highly lipid-soluble, 14 times more potent than lidocaine, and extensively protein-bound (95%). It can be administered through various routes, including local infiltration, peripheral nerve blocks, and epidural or spinal anesthesia, with concentrations ranging from 0.25% to 0.75%. Its duration of action may last 3 to 12 hours depend on the route, with an elimination half-life of approximately 210 minutes. Metabolized slowly by the liver and excreted via urine, Bupivacaine's toxicity includes potential cardiovascular and CNS effects, particularly at high plasma levels or accidental intravascular injection, making careful dosing essential.

Materials & Methods

An observational comparative study was conducted for over one year at Government Medical College, Ernakulam, including patients aged 18 years or older undergoing elective or emergency abdominal surgery through a midline laparotomy incision of 15–25 cm. Patients with trauma, peritonitis, prior laparotomies, chronic kidney or liver disease, BMI >30 kg/m², drug hypersensitivity, or those who refused consent were excluded. Based on previous studies by Khorgami et al., a sample size of 20 patients per group was calculated assuming a 2-unit reduction in VAS score with a pooled standard deviation of 2, at 80% power and 5% significance. Patients were alternately assigned into three groups: Group 1 (no local anesthetic), Group 2 (subcutaneous bupivacaine infiltration), and Group 3 (interfascial rectus sheath infiltration). Postoperative analgesia consisted of tramadol 50 mg IV and paracetamol 1g IV every 8 hours for the first three days, without additional analgesics. Patients were mobilized by the end of the first postoperative day. Pain was assessed using a 0–10 Visual Analogue Scale at rest and during coughing at 12 and 24 hours postoperatively; coughing VAS was not recorded at 12 hours to minimize discomfort. Daily monitoring included time to first bowel movement, wound complications, systemic toxicity, and length of hospital stay.

Results

A total of 60 patients were enrolled, with 20 patients in each group. The mean age of the participants was 45.8 ± 12.3 years, and the majority were males (58.3%). There were no statistically significant differences in baseline demographic or clinical characteristics among the three groups.

Postoperative Pain Scores

At 12 hours postoperatively (at rest), the mean VAS score was highest in Group 1 (no local anesthetic) with 6.8 ± 1.2, followed by Group 2 (subcutaneous infiltration) with 4.5 ± 1.0, and lowest in Group 3 (interfascial infiltration) with 3.8 ± 0.9. At 24 hours, the pain scores decreased in all groups but remained significantly lower in Group 3 compared to Groups 1 and 2.

During coughing, VAS scores measured at 24 hours were also significantly lower in the interfascial group (Group 3).

Table 1: Postoperative Pain Scores (VAS)

Time and Condition	Group 1 (No LA)	Group 2 (Subcutaneous)	Group 3 (Interfascial)	p-value
12 hr (Rest)	6.8 ± 1.2	4.5 ± 1.0	3.8 ± 0.9	<0.001
24 hr (Rest)	5.5 ± 1.1	3.2 ± 0.8	2.5 ± 0.7	<0.001
24 hr (Cough)	7.5 ± 1.0	5.0 ± 0.9	4.0 ± 0.8	<0.001

Other Postoperative Outcomes

The interfascial group showed earlier return of bowel movements, fewer wound complications, and a shorter hospital stay, though the differences were not statistically significant.

Table 2: Other Postoperative Parameters

Outcome	Group 1	Group 2	Group 3	p-value
Time to first flatus (hrs)	36 ± 8	30 ± 6	24 ± 5	0.02
Wound complications (n)	2	1	0	0.20
Hospital stay (days)	5.5 ± 1	4.5 ± 0.8	4.0 ± 0.6	0.03

No systemic toxicity or adverse effects related to the local anesthetic were observed in any group.

Discussion

In addition to ensuring patient comfort, efficient management of postoperative pain after abdominal surgery is crucial for encouraging early mobilisation, a quicker return of bowel function, shorter hospital stays, and fewer postoperative complications. Both somatic and visceral pain can arise after a midline laparotomy; somatic pain is caused by the incision and retraction of the abdominal wall structures, whereas visceral pain is brought on by internal manipulation and inflammation.[7] Therefore, rather than using systemic opioids alone, a multimodal and anatomically targeted analgesic approach is preferred.

In contrast to patients who received subcutaneous infiltration (Group 2) or no local anaesthetic (Group 1), our study showed that patients who received local anaesthetic infiltration with bupivacaine in the interfascial plane (Group 3) experienced significantly lower postoperative pain scores, both at rest and during coughing. These findings imply that the effectiveness of postoperative pain management is significantly influenced by the plane of infiltration.

The results of Khorgami et al. (2013), who examined the effectiveness of bupivacaine delivery via rectus sheath and subcutaneous catheters in patients undergoing midline laparotomy, are in line with the superior efficacy of interfascial infiltration seen in our investigation. Interfascial catheter placement was found to be significantly more effective in lowering postoperative opioid consumption and pain scores in their randomised controlled trial.[8] Our results suggest that even a single dose of bupivacaine administered in the appropriate plane can have clinically meaningful effects, and they support this finding even when single-dose infiltration is used instead of continuous infusion.

Additionally, Atuhani et al. (2014) investigated the effectiveness of liposomal bupivacaine in a multimodal regimen for midline laparotomy and discovered that it shortened the time to recovery of bowel function and significantly decreased the need for opioids.[9] Our findings supported the notion that localised anaesthetic techniques have a positive impact on postoperative recovery by facilitating earlier mobilisation and gastrointestinal function. Patients in the interfascial group experienced an earlier return of bowel movements and slightly shorter hospital stays.

The ability of interfascial infiltration to block the thoracoabdominal nerves (T7–T12) and iliohypogastric/ilioinguinal nerves, which travel between the internal oblique and transversus abdominis muscles before piercing the posterior rectus sheath to innervate the anterior abdominal wall, provides the anatomical basis for its effectiveness. In order to achieve more effective sensory blockade, interfascial infiltration enables the anaesthetic to bathe these nerves closer to their terminal branches.[10] Subcutaneous infiltration, on the other hand, focusses mostly on cutaneous nerves and might not effectively treat more profound somatic pain. Bupivacaine is a long-acting amide-type local anaesthetic that has a good profile for infiltration analgesia when it comes to pharmacologic considerations. It is perfect for managing postoperative pain because of its high protein binding (95%) and lipid solubility, which enable a prolonged duration of action. Its application in interfascial plane blocks, such as the transversus abdominis plane block or the rectus sheath block, has been extensively documented for a variety of abdominal procedures. [10,11] The idea of multimodal analgesia-which is the application of two or more substances or methods that target distinct pain pathways-is further supported by our research. Combining systemic non-opioid drugs like paracetamol or NSAIDs with local anaesthetics, as highlighted by Kehlet and Dahl, minimises side effects, improves overall pain management, and lessens dependency on opioids.[11] The additive benefit of local techniques was demonstrated by the significantly lower VAS scores of patients who received bupivacaine infiltration, particularly in the interfascial plane, compared to all patients who received tramadol and paracetamol as standard analgesics in our protocol.

Significantly, all groups in our study had low rates of wound complications, and none of the patients had systemic toxicity or other negative effects associated with bupivacaine. Although high plasma concentrations of bupivacaine can be cardiotoxic, safety in clinical practice is ensured by careful attention to dose limits and injection technique.

Conclusion

Our results clearly demonstrate that bupivacaine interfascial infiltration is a safe, easy, and successful way to lessen postoperative pain following midline laparotomy. It greatly enhances patient outcomes when incorporated into a multimodal analgesia regimen without increasing procedural risk or complex-

ity. Interfascial bupivacaine infiltration should be regarded as a routine part of postoperative care in abdominal surgeries involving midline incisions because of its effects on pain management, bowel function recovery, and possible reduction in hospital stay.

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