Original Research Article

A comparative study of the effect of port-site local anaesthetic application and standard analgesics on postoperative pain management in laparoscopic cholecystectomy

Parin Patel*, Bhavdeep Agarwal, Sameer Parikh

ABSTRACT

Background: Laparoscopic cholecystectomy is the gold standard for treating patients with cholecystolithiasis. It is a minimally invasive technique that reduces surgical trauma with small and more cosmetic incisions, reduces blood loss and is associated with fewer postoperative complications and decreased length of hospital stay. The study was done to evaluate the efficacy of the local anaesthetic infiltrated at the port sites in laparoscopic cholecystectomy, in reducing postoperative pain.

Methods: In the period from July to December 2023, fifty patients who underwent laparoscopic cholecystectomy at Sardar Vallabhbhai Patel Institute of Medical Sciences and Research, Ahmedabad were included in this prospective comparative study. Cases were divided into two groups. Patients who received bupivacaine at the port site were put in the local anaesthetic group and patients who received postoperative analgesia with NSAIDs/Opioids were put into the Standard Analgesia Group. Pain was measured by the Visual Analog Scale in all patients at the 1st, 6th, 12th, and 24th hour postoperatively.

Results: A significant reduction in pain intensity was detected in the Bupivacaine Group compared to the patients in the Standard Analgesia Group at 1st and 6th hour. On the other hand, there was no difference in pain intensity at the 12th and 24th hour. There was delay in the time and total doses of rescue analgesia in the local anaesthetic group.

Conclusion: Applying local anaesthetic to the port sites after laparoscopic cholecystectomy significantly reduces postoperative pain intensity in the first 6 hours and delays the need for rescue analgesia, suggesting potential decrease in analgesic drug usage for postoperative pain management.

Keywords: Bupivacaine, Laparoscopic cholecystectomy, Local anaesthetic infiltration, Postoperative pain

INTRODUCTION

Laparoscopic cholecystectomy (LC) has become the gold standard of treatment for symptomatic gallstones. The laparoscopic approach offers several advantages over open cholecystectomy, including reduced postoperative pain (POP), quicker recovery, improved cosmetic outcomes, lower morbidity, and higher patient satisfaction.1,2 Nonetheless, LC is not entirely free of pain. Despite its minimally invasive nature, many patients experience varying levels of pain shortly after the procedure.3 Postoperative pain following LC can be categorized into three types: visceral pain, parietal pain, and shoulder pain. This pain tends to intensify with activities such as coughing and deep breathing, which can hinder early patient mobilization.4 The entry points of the surgical ports in LC are a common source of parietal pain, and reducing this pain remains a clinical challenge. Typically, pain reaches its peak within six hours after the surgery.5 POP is a major factor in early postoperative
complications and significantly affects the quality of life for surgical patients.6 Various pain relief methods are used to manage postoperative pain (POP) after LC. These methods include systemic opioids, intravenous or intramuscular nonsteroidal anti-inflammatory drugs (NSAIDs), intraperitoneal local anesthesia, epidural or intrathecal opioids, local anesthetic infiltration at the surgical site, intraperitoneal saline, thorough removal of insufflation gas, and the use of heated or low-pressure gas.7,8 Each of these techniques has its own benefits and drawbacks.

Bupivacaine, known for its long half-life among local anaesthetics, is commonly used for pain relief. It has a half-life of 2.5–3.5 hours, and studies have shown that it can effectively reduce pain for approximately six hours. Bupivacaine has a wide safety margin, with an upper safe limit of 2.5 mg per kilogram of body weight.9 NSAIDs are the preferred standard for POP management. Tramadol, a frequently used non-narcotic analgesic in the opioid group, is also commonly utilized for POP relief. NSAIDs help in decreasing the requirement for narcotic pain relievers.10 However, non-selective conventional NSAIDs are associated with side effects such as increased gastrointestinal inflammation, bleeding, platelet dysfunction, and impaired renal function.11,12 The aim of this study was to assess the efficacy of long-acting local anaesthetic (Bupivacaine) infiltrated into port sites for pain control after elective LC. Since pain is a subjective finding, it should be standardized with the visual analog scale (VAS) in a comparative study.

METHODS

This prospective comparative clinical study included 50 patients aged 18–80 years who underwent laparoscopic cholecystectomy between July to December, 2023 at Sardar Vallabhbhai Patel Institute of Medical Sciences and Research, Ahmedabad. Preoperative clinical data, including age, gender, American Society of Anesthesiologists (ASA) score, and predisposing factors (endoscopic retrograde cholangiopancreatography, acute cholecystitis attack, acute biliary pancreatitis, and patients on blood thinners in terms of bleeding risk), were determined. Patients were divided into 1, 2, and 3 groups according to their ASA score. Patients were split into two groups: the Bupivacaine Group (25 patients who received bupivacaine through the port site) and the standard analgesia group (25 patients who received post-operative analgesia with nonsteroidal anti-inflammatory drugs or tramadol). Informed written consent regarding analgesia options was obtained from each patient. Patients with local anaesthetic allergies, infection at the injection site, chronic pain syndromes, prolonged opioid medications, coagulopathy, and patients who took any analgesic 24 hours before surgery were excluded from the study. Patients who did not understand pain scoring with VAS, had a body mass index of >35 kg/m², had severe systemic disease, and underwent LC under emergency conditions were excluded from the study.

The study included patients with symptomatic cholelithiasis who underwent LC under elective conditions. Direct open cholecystectomies and cholecystectomies performed under emergency conditions were not included. LC was performed with standard two 10 mm and two 5 mm trocars under 12 mmHg pressure. Drains were placed in patients whose LC exceeded 1 hour and who had predisposing factors for possible complications. Drains were removed through a 5 mm lateral port. After cholecystectomy, the gallbladder was removed through a 10 mm epigastic or umbilical port, as appropriate. All patients received ceftriaxone 1 g prophylaxis in the first 30 min preoperatively and analgesia with Tramadol before awakening. In patients in the Bupivacaine Group, a total of 20 cc of bupivacaine (diluted 1:1 with physiological saline solution) was injected into the port sites, under the skin, and along the incision depth after the trocars were removed. Local anaesthetic was infiltrated into all layers before suturing the skin, especially at 10 mm trocar sites. No side effects were observed in any patient receiving bupivacaine. The patients in the Standard Analgesia Group received analgesia with the standard pain treatment of our clinic for patients with VAS greater than 7. In the Bupivacaine Group, additionally, NSAIDs were administered i.v. to patients with VAS greater than 3 and 100 mg Tramadol hydrochloride i.v. to patients with VAS greater than 7. All patients received tramadol hydrochloride at 8-h intervals if analgesia was required.

POP was assessed using the VAS, a 10-unit scale representing pain intensity ranging from 0 (no pain) to 10 (most severe pain). 1–3 was considered mild, 4–7 moderate, and >7 severe. Pain was evaluated at the 1st, 6th, 12th, and 24th h postoperatively. POP assessment included port access site, shoulder pain, and abdominal pain. In particular, the trocar entry site pain that the patients were suffering from was recorded. Pain intensity was measured with VAS at the 1st, 6th, 12th, and 24th h postoperatively for all patients. Analgesic drugs administered to all patients were recorded.

Statistical analysis

Collected data was tabulated in an excel sheet, under the guidance of a statistician. SPSS 20.0 software was used for the statistical analysis of the data. The mean and standard deviation were calculated for quantitative variables. A bar graph was used to show the prevalence of pain sites. The statistical significance of the differences between the groups was evaluated using a one-way analysis of variance. p<0.05 was considered statistically significant.

RESULTS

The study was conducted on a total of 50 patients. The Bupivacaine Group and the Standard Analgesia Group were the two groups into which the patients were divided. Age, Gender, body weight, length of hospital stays, and
ASA score did not differ between the two groups. Although the mean operative time was longer in the Bupivacaine Group (48) than in the Standard Analgesia Group (46), it was not statistically significant (Table 1).

**Table 1: Demographic characteristics of patients.**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Bupivacaine group (n=25)</th>
<th>Standard analgesia group (n=25)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (years)</td>
<td>49</td>
<td>47</td>
</tr>
<tr>
<td>Mean weight (kg)</td>
<td>77</td>
<td>76</td>
</tr>
<tr>
<td>Sex Ratio (F:M)</td>
<td>18:7</td>
<td>19:6</td>
</tr>
<tr>
<td>ASA (I)</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>ASA (II)</td>
<td>18</td>
<td>20</td>
</tr>
<tr>
<td>ASA (III)</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Time of operation (minutes)</td>
<td>48</td>
<td>46</td>
</tr>
<tr>
<td>Number of NSAIDs doses administered in the first 24 h</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>Number of Tramadol doses administered in the first 24 h</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Hospital stays (day)</td>
<td>1.5</td>
<td>1.75</td>
</tr>
</tbody>
</table>

NSAIDs were administered as analgesics to all patients in the Standard Analgesia Group for the first 24 h after surgery to manage POP. However, in both the Standard Analgesia Group and the Bupivacaine Group, tramadol was added according to the analgesia needs of the patients. Since NSAIDs and tramadol were not routinely used in both groups, statistical data were not measured in this regard. The number of NSAIDs and tramadol doses administered in the first 24 h is detailed in Table 1 and Figure 2.

**Figure 2: Number of doses of NSAIDs and Tramadol administered in the first 24 hours.**

Commonest site for metastasis was regional lymph node. 8 patients had secondary deposits in liver, 2 were having deposit in anterior abdominal wall and two female were having secondary deposits in both ovaries.

**DISCUSSION**

Laparoscopic cholecystectomy (LC) is widely regarded as the gold standard for treating symptomatic cholelithiasis. Although the pain experienced after LC is generally less intense and shorter in duration compared to open surgery, patients still report varying levels of pain and discomfort. The primary sources of pain following a laparoscopic procedure are typically the port entry sites. Additional pain arises from the gallbladder bed dissection area and the retention of carbon dioxide (CO2) gas in the subdiaphragmatic space. Reduced postoperative pain (POP) facilitates early mobility, shorter hospital stays, and quicker resumption of normal activities, necessitating the use of effective pain management strategies. Studies have demonstrated that bupivacaine infiltration at port sites can significantly alleviate severe pain within the first 6 hours post-surgery and decrease the requirement for narcotic analgesics. Moreover, prior research has indicated that local anesthetic infiltration at the incision site can markedly lessen both the need for analgesics and intervals at the 1st, 6th, 12th, and 24th h postoperative. The difference between the mean pain scores at the 1st and 6th postoperative hours was observed to be statistically significant (p<0.001). There was no significant difference at postoperative 12th and 24th h (Table 2 and Figure 1).

Pain intensity was evaluated using VAS at fixed time intervals at the 1st, 6th, 12th, and 24th hour postoperative. The difference between the mean pain scores at the 1st hour postoperative.

![Figure 1: Vas score in both groups at various interval over time.](image)

F:M: Female: Male; NSAIDs: Non-steroid anti-inflammatory drug; ASA: American society of anaesthesiologists

**Table 2: Mean VAS scores for bupivacaine groups and standard groups postoperatively.**

<table>
<thead>
<tr>
<th>Postoperative assessment time (hours)</th>
<th>Bupivacaine group</th>
<th>Standard analgesia group</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 hour</td>
<td>3.6</td>
<td>7.6</td>
</tr>
<tr>
<td>6 hours</td>
<td>4.4</td>
<td>6.9</td>
</tr>
<tr>
<td>12 hours</td>
<td>2.1</td>
<td>2.3</td>
</tr>
<tr>
<td>24 hours</td>
<td>1.9</td>
<td>2.1</td>
</tr>
</tbody>
</table>

Pain intensity was evaluated using VAS at fixed time intervals at the 1st, 6th, 12th, and 24th h postoperative. The difference between the mean pain scores at the 1st and 6th postoperative hours was observed to be statistically significant (p<0.001). There was no significant difference at postoperative 12th and 24th h (Table 2 and Figure 1).
the intensity of postoperative pain. While some studies have shown an analgesic effect in the early postoperative period (0–6 h), other studies have reported a longer-lasting anaesthetic effect (12–24 h). The anaesthetic applied to port sites should be administered to all layers, not just the subcutaneous tissue. The effectiveness of the anaesthetic in reducing postoperative pain (POP) depends on the depth of the port incision. Suragul et al highlighted the importance of applying the anaesthetic to all layers, particularly at trocar entry sites. In our study, we ensured that epigastric and umbilical trocar incisions included all layers before suturing. However, the pain-reducing benefits of long-acting local anaesthetics at port sites do not extend to pain relief after intraperitoneal application to the gallbladder bed. Parietal pain, which is characterized by sudden, intense, and localized pain, typically occurs after LC due to the incision made for trocar entry at the port site.

In contrast, visceral pain is described as blunt, diffuse, slowly progressive, and challenging to localize, often felt in the midline. This type of pain can result from factors such as contact with chemical irritants like bile, sudden pressure changes, or fluctuations in blood pressure. Referred pain, such as shoulder pain, is felt in a different location than the actual stimulus site. This occurs when the diaphragm muscle is stretched and the phrenic nerve is irritated by CO₂ gas or the gas remaining in the right subdiaphragmatic region, leading to pain in the shoulder area. Since the most common pain experienced by patients is at the trocar ports, our study focused specifically on port site pain. During the first 6 hours postoperatively, pain at the trocar entry sites was noted to be more intense than pain at other sites. Studies by Hussain et al, Nazir and Merdan, and Cantore et al have demonstrated that long-acting local anaesthetic, particularly when applied to early port entry sites, reduce pain. Consistent with these findings, our study observed that pain decreased within the first 6 hours, along with a reduction in the need for analgesics. Similarly, Kotsosovilis et al reported that long-acting local anaesthetics applied to port sites alleviated pain in the initial 6 hours postoperatively. In line with current literature, our study showed a statistically significant reduction in postoperative pain (POP) according to the Visual Analog Scale (VAS) during the first 6 hours and a decrease in analgesic use. However, there was no statistically significant difference in pain scores between the two groups at the 12th and 24th hours of the study. Ali et al also found a decreased need for analgesics in the first 6 hours and no statistically significant difference in VAS scores at the 12th and 24th hours. Roy found no statistically significant difference in pain with bupivacaine application at the port site before and after the incision but noted that pain was less in groups receiving bupivacaine. Conversely, the study by Ke et al reported that infiltrating subcutaneous bupivacaine into the port sites did not significantly benefit pain control after laparoscopy. It has been proposed that the application of local anesthetics at port sites can reduce the necessity for analgesics and contribute to shorter hospital stays. Ali et al reported a reduction in hospitalization duration in their research.

The limitations of the study were conducted at a single centre. The sample size was relatively small, which may limit the statistical power of the study. Pain assessment using the Visual Analog Scale (VAS) is subjective and could be influenced by individual patient perceptions, potentially affecting the consistency of pain measurement.

CONCLUSION

In conclusion, application of a long-acting local anaesthetic (Bupivacaine) to port sites after Laparoscopic Cholecystectomy provides a significant reduction in pain in the first 6-hour postoperative period, and we believe that analgesics (NSAIDs, tramadol, etc.) will be used less in such patients to address Post Operative Pain. We also recommend a full-layer application of local anaesthetic to the port sites.

Recommendations

The important points of reference on the posterolateral surface of the skull are asterion, inion, apex of the mastoid process and suprameatal crest. The objectives of the present study were to determine the type of asterion depending on the presence or absence of sutural bone, to measure the linear distances of asterion from various bony landmarks, the nearest distance of the same from sigmoid and transverse sinus and also the thickness at the centre of the asterion that may be of importance to anthropologists, anatomists, forensic pathologists and neurosurgeons.

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