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Original Research Article

Intraperitoneal instillation of bupivacaine in gallbladder fossa and at trocar sites in reduction of postoperative pain after laparoscopic cholecystectomy: a prospective randomized controlled double blind trial

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ABSTRACT

Background: Pain relief remains landmark achievement attributed to laparoscopic cholecystectomy. Post laparoscopic cholecystectomy patient still complains of incisional pain, shoulder pain and vague upper abdominal pain. A simple method of portal or incisional infiltration and intraperitoneal spraying of a local anaesthetic agent over gall bladder fossa can reduce postoperative pain. The mean duration of action of bupivacaine hydrochloride is 8.07 hours which is 2-3 times longer than lignocaine.
Methods: This study was conducted to determine whether local infiltration of bupivacaine at trocar sites and gall bladder fossa has any effect in postoperative pain relief. This prospective study was conducted on 60 patients (3 groups) undergoing laparoscopic cholecystectomy. In group A, 20ml of 0.25% bupivacaine was instilled subcutaneously at all trocar sites. In group B, 20ml of 0.25% bupivacaine was instilled in gallbladder fossa after removal of gall bladder. In group C, 20 ml bupivacaine was instilled at the gall bladder fossa and 20% was instilled at the trocar sites as mentioned for group A.
Results: Chi square analysis of NRS of pain at 1, 6, 12, 24 hours post operatively shows significant improvement in NRS scores in group A and C compared to group B.
Conclusions: Infiltration of 0.25% bupivacaine at all trocar sites with or without infiltration in gall bladder fossa is an effective method of postoperative pain relief when compared to infiltration of gall bladder fossa alone.

Keywords: Bupivacaine, Peritoneal analgesia, Trocar site analgesia, Trocar site pain

INTRODUCTION

The type of pain after laparoscopic cholecystectomy differs from open cholecystectomy. In laparoscopic cholecystectomy, visceral pain is more important cause of post-operative pain rather than parietal pain due to the smaller incisions of laparoscopic cholecystectomy.[1] Whilst pain relief remains landmark achievement attributed to laparoscopic cholecystectomy, post laparoscopic cholecystectomy patient still complains of incisional pain, shoulder pain and vague upper abdominal pain in the epigastric region and hypochondriac region not attributed to the incision. One of the primary objectives of the patient's choice for a laparoscopic procedure is the perceived lesser post-operative pain. Thus, every effort should be made to decrease the post-

operative pain. Pain after laparoscopic cholecystectomy involves 3 components with different intensity, time course and patho-physiological mechanisms. These pain components are incisional pain which is the parietal pain component, deep intra-abdominal pain which is the visceral pain component and shoulder tip pain which is presumably referred pain. The visceral pain post laparoscopic cholecystectomy is experienced early in the postoperative period and its intensity decreases after 24 hours. The pain increases in intensity after cough but it does not change after mobilization. However, shoulder pain which is mild during early postoperative period starts to increase on 2nd postoperative day.[2,3] This shoulder pain is secondary to diaphragmatic irritation due to CO_2 insufflation for creation of pneumoperitoneum. Several mechanisms of post laparoscopic pain generation have also been proposed such as ruptured blood vessels resulting from the rapid distension of the peritoneum, traumatic nerve traction, release of inflammatory molecules, trauma to the abdominal wall, trauma occurring with the removal of the gallbladder from the abdomen, pneumoperitoneum created by utilizing CO_2, maintenance of high abdominal pressure, irritation of the phrenic nerve, and application of cold CO_2.[4] Out of these components, incisional pain dominates over deep intra-abdominal and referred pain.[5] An improper control of postoperative pain leads to number of reflex phenomenon that are distention and inadequate digestion by the gut, oliguria, thrombophlebitis and embolism. Moreover, delayed muscle activity leads to muscle wasting and weakness thereby necessitating a long convalescence.[6] As pain is multifactorial, any consensus has not been reached regarding effective postoperative pain relief for patients who have undergone laparoscopic cholecystectomy which can be applied for all patients with maximal pain relief and minimal side effects such as sedation, nausea, paralytic ileus and other systemic complications like gastritis and cardiovascular complications. Satisfactory pain relief has been a difficult problem.

Many methods have been tried for pain relief. These include patient controlled intravenous anaesthesia, oral opioids and opioid like pain killers, non-steroidal anti-inflammatory drugs, intravenous corticosteroids. All these drugs have their associated systemic side effects. The premise of any pain relief method should follow the dogma of maximal local action and minimal systemic side effect. A very simple method of portal or incisional infiltration and intraperitoneal spraying of a local anaesthetic agent over gall bladder fossa is easy to perform and does not require special equipment. The drug acts by blocking transmembrane sodium channels. This results in blockade of action potential transmission across sensory nerves. The transmembrane pore of sodium channel is formed by transmembrane S5 S6 helices that form the P loop. Amino acid residues in these short segments are the most important determinants of the ion conduction and selectivity of the channel. As it opens, the sodium channels inactivate within a few milliseconds due to closure of the inactivation gates. Amino acid residues important for local anaesthetic binding are found in S6 segments in domains I, III, IV.[7,8] The duration of action of bupivacaine is significantly longer than other local anaesthetics with or without adrenaline. The mean duration of action of bupivacaine hydro chloride is 8.07 hours which is 2-3 times longer than lignocaine.[9-10] Tucker and Mather have reported that bupivacaine is 90% protein bound in plasma thus is a very safe drug as the active component is the unbound form.[11] The only side effect of cardiotoxicity limits its use which can be prevented if the following precautions are taken.

- Intravascular administration should be avoided.
- It shouldn't be used on pregnant females as the effect on foetal development has not been established.
- Dose should be modified in the acutely ill, old or debilitated patients.

Two main toxic effects of bupivacaine use have been described:

CNS toxicity

According to Scott, when the local anaesthetic drugs are given by intravenous infusion a general pattern of increasing signs and symptoms of toxicity is discernible.[12]

These signs and symptoms are numbness of tongue and mouth, light headedness, tinnitus, visual disturbances, muscular twitching, irrational conversation, unconsciousness, grand-mal convulsions and apnea.

CVS toxicity

Liu et al found profound hypotension as a result of cardio-depression.[13]

Nath et al found that the drugs exert a dose dependent depression of the left ventricle in the same ratio as their anaesthetic potency (bupivacaine:lidocaine- 4:1) when the drugs were injected directly into the left descending coronary artery in pigs.[14]

The recommended maximum dosage for a period of 6 hours is 2mg per kg (equivalent to 25-30ml of 0.5% solution for an adult weighing 65-75kg). However, Widman gave 6 healthy non-premedicated volunteers 0.75mg per kg of 0.5% bupivacaine intravenously in a period of 3.45 seconds no cardiovascular changes were observed by him.[15] An increase in the dose of bupivacaine while maintaining the same volume of injectate resulting decrease latency, improved incidence satisfied analgesia and increased duration of sensory analgesia. Another fact which has been observed in the use of bupivacaine is that there is a period of analgesia that persists after the return of sensation and during this period either no analgesia is required or a less strong analgesia is required to relieve the residual pain.

Thus, we did a study to determine whether local infiltration of bupivacaine at trocar sites and gall bladder fossa has any effect in postoperative pain relief.

Aims and objectives

To evaluate the effect of instillation of bupivacaine at 1) trocar sites, 2) gall bladder fossa and 3) both sites on postoperative pain relief in patients undergoing laparoscopic cholecystectomy.

METHODS

This prospective study was conducted on 60 patients undergoing laparoscopic cholecystectomy who gave a written consent.

Exclusion criteria included a documented allergy to bupivacaine or after skin testing, history of cardiovascular disease which required treatment, history of chronic pain disease other than that related to gallstone, pregnancy.

Inclusion criteria were patients with gallstone disease who underwent standard 4 port laparoscopic cholecystectomy with a 10mm epigastric and umbilical port and two 5mm working ports. A standard 10mm supraumbilical incision was given after induction of anaesthesia with endotracheal intubation and patient in 30degree Trendelenburg position.

A Veress needle was used to create pneumoperitoneum with CO_2 insufflator to create a pneumoperitoneum of 10mmHg intra-abdominal pressure at a flow rate of 1litre/min. The patients were randomized into three groups of twenty cases each by draw of lots. In patients of group A, 20ml of 0.25% bupivacaine was instilled subcutaneously at all trocar sites. At each of the 10mm sites, 7ml was infiltrated and at each of the 5mm sites, 3ml was infiltrated. In patients of group B, 20ml of 0.25% bupivacaine was instilled in gallbladder fossa after removal of gall bladder. In group C, 20ml bupivacaine was instilled at the gall bladder fossa and 20ml was instilled at the trocar sites as mentioned for group A.

Pain intensity was measured at 1,6,12 and 24 hours post operatively. Post-operative pain was evaluated using 10 points NRS (numerical rating scale).

Table 1: Numerical rating scale for pain and correlation with requirement of analgesia.

NRS score	Grade	Medication required
O	No pain	No
1-3	Mild	No
4-6	Moderate	Yes
7-10	Severe	Yes

Grade 0- corresponded to no pain and grade 10 was given to the worst pain the patient had ever experienced.

Statistical analysis was done using the Chi-Square test and a P value of less than 0.0005 was considered significant.

RESULTS

Comparison of pain at 1 hour showed that 100% in group A (n=20) experienced a pain ranging from 1-3 on the NRS. In Group B, 50 percent of the patients (n=20) had an average score ranging between 7 to 10, 40 percent of the patients had NRS between 4-6. Remaining had a score between 1-3. In group C, 95 percent of the patients had a score of 1-3. Remaining had a score of 4-6.

Table 2: Comparison of postoperative pain over 24 hours.

Time after surgery	% of patients in Group A		% of patients in Group B		% of patients in Group C	
	Mild pain	Moderate to severe	Mild pain	Moderate to severe	Mild pain	Moderate to severe
1 hour	100	0	10	90	95	5
6 hour	90	10	15	85	90	10
12 hour	95	5	15	85	95	5
24 hour	95	5	40	60	100	0

Comparison of pain at 6 hours post operatively showed that in Group A 95% patients had NRS 1-3. In group B, 60 percent of the patients had a score between 4-6 and 25 percent between 7-10. In group C, 95 percent had NRS 1-3.

Comparison of pain at 12 hours showed that in group A, 95 percent of the patients had NRS of 1-3. In group B, 75 percent of the patients had score of 1-3. In group C, 95 percent had a score of 4-6.

Comparison of pain at 24 hours showed that in Group A, 95 percent of the patients had NRS of 1-3. In group B, 45 percent of the patients had score between 4-6 and 40 percent of the patients had score between 1-3. In group C, 100 percent of the patients had a score between 1-3.

A Chi square analysis showed the difference to be significant at all times of follow-up.

DISCUSSION

Laparoscopic cholecystectomy is one of the commonest elective laparoscopic surgeries done in our setup. We found that post-surgery most of the patients complain of incisional pain at port sites and right shoulder tip pain. Often there is need of rescue intravenous and intramuscular analgesic. This study was done to analyse whether incision site bupivacaine with or without intra-abdominal bupivacaine given intra operatively has any influence in decreasing post-operative pain in the early post-operative period. Sarac et al conducted a study with conclusion that periportal local anaesthetic reduced the requirement of postoperative analgesic.[16] Alexander and colleges have also shown the same results. Pasqulaucci et al have shown that intraperitoneal instillation of local anaesthetic is not as effective and easy to execute as periportal injection however it also decreases anaesthetic requirements when compared to placebo. We also found that trocar site infiltration of bupivacaine is effective. In present study additional infiltration of the gallbladder fossa does not provide a superlative pain relief once trocar sites have been infiltrated.

However, present sample size is limited to have a final word on intra-abdominal infiltration. The timing of administration of local anaesthesia is of fundamental importance to pre-empt postoperative pain. Bisguard et al has also shown that combination of local and intraperitoneal anaesthetic is effective in decreasing incisional pain but not in visceral or shoulder pain. Lee et al conducted a study which showed that combination of incisional and intra-abdominal local anaesthetic treatment reduced incisional pain but had no effect on intra-abdominal pain, nausea or shoulder tip pain in patients receiving pre-emptive analgesia.[17] Scheinin et al conducted a study here they found that even while using 10ml of 0.15% bupivacaine with adrenaline (150mg) intraperitoneally there were no side effects such as circumoral numbness, tinnitus, muscle twitches or cardiac arrhythmias.[18] Weber et al also reported no adverse effects due to bupivacaine in patients receiving 10ml of 0.5% bupivacaine intraperitoneally.[19]

In present study also there was no incidence of these aforementioned side effects in all the three groups. Thus, we find that port site infiltration of bupivacaine is a safe and effective method of achieving post-operative analgesia after laparoscopic cholecystectomy.

CONCLUSION

Infiltration of bupivacaine at port sites is effective in providing postoperative analgesia that lasts up to 24 hours. Combining intraperitoneal instillation does not provide any advantage in terms of decreasing postoperative analgesic requirement. Thus, we recommend routine infiltration of bupivacaine at all port sites.

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