Original Research Article

Comparison of levobupivacaine vs bupivacaine in thoracic spinal anaesthesia for laparoscopic cholecystectomies

Loveleen Kour*, Madan Lal Katoch

Department of Anaesthesia, Government Medical College, Jammu, India

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*Correspondence:
Dr. Loveleen Kour,
E-mail: loveeenkour@gmail.com

ABSTRACT

Background: Levobupivacaine is the pure S enantiomer of racemic bupivacaine. It is a long acting variant that is less toxic to the heart and central nervous system. It has gained relevance and popularity in the modern anaesthetic practice. Thoracic spinal anaesthesia has been shown to an effective and safe anaesthetic approach for a varied spectrum of surgeries including laparoscopic cholecystectomies. Incorporation of epidural catheter adds flexibility and the provision of postoperative analgesia. To adopt thoracic combined spinal epidural anaesthesia for laparoscopic cholecystectomies was chosen in the study. This study aimed at comparing the efficacy of levobupivacaine and bupivacaine in thoracic combined spinal epidural anaesthesia for laparoscopic cholecystectomies.
Methods: Total 60 ASA 1 and 2 patients scheduled for laparoscopic cholecystectomies were chosen for the purpose of this study extending from January 2019 to May 2019. They were randomly divided into two groups - group L and group B. Both the groups received thoracic combined spinal anaesthesia using 2ml of 0.5% isobaric levobupivacaine and 25 µg (0.5ml) fentanyl in group L and 2ml of 0.5% isobaric bupivacaine and 25 µg (0.5ml) fentanyl in group B. The duration of sensory and motor block, peak block height, maximum motor block achieved, haemodynamic variables and any postoperative neurological complications were evaluated.
Results: Both the groups showed similar onset of sensory and motor block. The duration of motor block was similar in both the drug groups; however, levobupivacaine showed a significantly loner duration of sensory block. There were no significant haemodynamic differences between the two groups and no postoperative neurological complications were seen in any patient.
Conclusions: Levobupivacaine was found to be slightly better than bupivacaine in thoracic combined spinal epidural anaesthesia.

Keywords: Bupivacaine, Epidural anaesthesia, Laparoscopic cholecystectomy, Levobupivacaine, Thoracic combined spinal

INTRODUCTION

The introduction of thoracic spinal anaesthesia dates back to more than a century. This was when Thomas Jonnesco in 1909 proposed puncture of the spinal cord at two levels- T1-T2 and T12-L1. However, his approach was heavily criticised and eventually rejected because the introduction of the needle above the cord termination evoked the fear of cord injury. This belief was called into question when thoracic spinal anaesthesia was safely performed without any complications in morbid patients who were unfit for general anaesthesia.[1,2] This was followed by a multitude of studies which demonstrated the efficacy of thoracic spinal anaesthesia as a routine anaesthetic technique in ASA 1 and 2 patients.

Levobupivacaine is the pure S-enantiomer of racemic bupivacaine. It has been shown to have decreased

cardiovascular and central nervous system toxicity, making it an attractive alternative to bupivacaine.[3-6] In the past, studies have been conducted comparing bupivacaine and levobupivacaine in lumbar spinal anaesthesia. Most of them have shown the two agents to be equally effective. One exception was described for lumbar epidural anesthesia, in which the sensory blockade lasted significantly longer with levobupivacaine than with racemic bupivacaine which might be attributable to a greater intrinsic vasoconstrictor potency of levobupivacaine.[7,8]

However, these results pertain to the use of these agents in lumbar subarachnoid space. Thoracic thecal space is different from lumbar. The CSF in thoracic region being lesser and the thoracic roots being thinner than lumbar roots.[9,10] Hence, the aim of this study was to compare the behaviour of bupivacaine and levobupivacaine in thoracic spinal anaesthesia for laparoscopic cholecystectomies.

METHODS

This study was done after approval from the institutional ethical committee in the department of anaesthesia. GMC Jammu from January 2019 to May 2019. A total of 60 patients scheduled for elective laparoscopic cholecystectomy were divided into two groups- group B and group L. Group B received 2 ml of 0.5% isobaric bupivacaine and 25 µg (0.5 ml) fentanyl. Whereas group L received 2 ml of 0.5% isobaric levobupivacaine and 25 µg (0.5 ml) fentanyl in thoracic spinal anaesthesia.

Inclusion criteria

ASA 1and 2 patients, age between 18-65 years, BMI < 30kg/ m2 and normal coagulation status.

Exclusion criteria

ASA status 3 and 4, acute cholecystitis, acute pancreatitis, severe cardiovascular/renal disability and BMI >30 kg/m^2. They were divided randomly by computer generated numbers into two equal groups.

Patients were kept fasting six hours prior to surgery and premedicated with tablet alprax 0.25 mg, pantoprazole 40 mg and domperidone 10 mg on the night prior to surgery. Patients were informed about CSE in detail and assured that any anxiety, discomfort or pain during surgery would be dealt with by intravenous medication and about the probability of conversion to GA, if needed.

On the morning of the surgery, every patient received pre-loading with Ringer lactate 10 ml/kg over 30 minutes and premedication with Ondansetron 0.1 mg/kg and Ranitidine Hydrochloride 50 mg intravenously. Then the patients were shifted to operation theatre and all routine monitoring namely, noninvasive blood pressure (NIBP), pulse oximetry (SpO2), end tidal Carbon dioxide (ETCO2) and electrocardiogram (ECG) was started. Inj.

Midazolam 1mg IV was given to the patient just prior to the start of the procedure in order to allay the anxiety and apprehension.

In both the groups: group L and group B, thoracic spinal anaesthesia was performed at the T9-T10/T10-T11 interspace with the patient in the sitting position. In case of group B, 2 ml of isobaric preservative free bupivacaine 0.5% (5 mg/ml)+0.5 ml (25µg) of Fentanyl was injected into the subarachnoid space using 27gauge pencil point whitacre spinal needle and then the spinal needle was removed. In case of group L, 2 ml of 0.5% hyperbaric bupivacaine (5mg/ml) and 0.5ml (25µg) fentanyl was given into the subarachnoid space.

Immediately, the patient was turned to the supine position with a 10 -20 degrees head down tilt. Oxygen at four to five litres/minute was given to the patient by the face mask. Diverting type EtCO2 monitoring system was used, using nasal prongs applied inside the face mask. Onset of sensory block was assessed every 2 minutes bilaterally (upper and lower levels) in midclavicular line till there was no sensation to pinprick with hypodermic needle.

Onset of motor block was assessed every two minutes till complete motor block (grade 3) was achieved and graded according to modified Bromage scale. The time to reach T4 dermatome sensory block, peak sensory block height, the lowest segment blocked and the maximum motor block achieved was recorded before surgery. Once the desired sensory block (minimum block T4-T12 as assessed by pinprick) was achieved, surgery was commenced.

After visualization of the abdominal cavity, lidocaine 1% 10 ml was sprayed under the right side of diaphragm. Intraoperative parameters (heart rate, SBP, DBP, MAP, SpO2, respiratory rate and ETCO2) were recorded in all patients every two minutes for first ten minutes, every five minutes for next fifteen minutes and every ten minutes thereafter till the completion of surgical procedure.

Intraoperative anxiety was treated with Midazolam 1 mg intravenous boluses upto total 5mg, any referred shoulder pain inspite of lidocaine instillation with reassurance and Fentanyl 25µg intravenous boluses upto total 100µg, hypotension (decrease in mean arterial pressure more than 20% from baseline value) with fluid bolus 10 ml/kg ringer lactate or Mephentermine 6 mg boluses upto total 30mg and bradycardia (heart rate below 20% of baseline) with atropine 10 µg /kg intravenously.

The surgical technique involved two major modifications-Using lower levels of intra-abdominal pressure upto maximum of 10 mm Hg and providing minimal right up tilt to the table to minimize diaphragmatic irritation. The patients were monitored in

PACU till sensory level regressed two dermatomes below the peak block height.

Duration of the sensory block was taken as the time from the onset of sensory block at T4 dermatome to the time when the sensory block regresses to T12 dermatome and duration of motor block as the time from the previous recorded motor block till the patient regained the ability to raise extended legs.

Statistical analysis

The nonparametric data was compared using Chi-square test and Mann- whitney U test. Parametric data was analysed using student t test using SPSS 16.0 software.

RESULTS

A total of 60 patients were enrolled in the study and no patient was excluded. No difference was observed between the groups with respect to gender, age, height and weight (Table 1).

Table 1: Demographics.

	Group bupivacaine	Group levobupivacaine	p value
Age	46.33	45.30	0.724
Weight	75.83	72.81	0.657
ASA (1/2)	19/11	18/12	0.634
Sex(F/M)	16/14	14/16	0.352

Table 2: Block characteristics.

	Group bupivacaine	Group levobupivacaine	p value
Onset of sensory block(min)	2.07	2.03	0.562
Time to T4 (min)	4.03	4.06	0.432
Peak block height(T2/T3/T4)	15/12/3	14/8/8	<0.0001
Time to peak block height(min)	4.8	5	0.652
Max motor block (B1 /B2/B3)	15/9/6	19/8/3	0.562
Sensory block duration(min)	140.10	180.03	<0.0001
Motor block duration (min)	90.33	92.10	0.363

The onset of analgesia was fast and similar among the two solutions - 2min (Table 2). The peak block height achieved was also similar (T2-T3) with both bupivacaine and levobupivacaine. The time taken to reach peak block height was slightly lesser with levobupivacaine (4.8 min) than with bupivacaine (5 min); however, the difference was statistically insignificant. Lowest segment blocked ranged from L3-L4 in group B and from L4-L5 in group L. Maximum motor block achieved was similar in both the groups with bromage I grade seen in majority of the patients in group B and group L.

Time to reach maximum motor blockade was also similar in levobupivacaine (6min) and bupivacaine (6.8min) (Table 2). The duration of motor block with levobupivacaine (92 min) is similar to bupivacaine (90 min). Whereas the duration of sensory block with levobupivacaine (180 min) was significantly longer than with bupivacaine (140 min) (Table 2).

There was no significant difference in incidence of bradycardia and hypotension between the two groups. Author observed overall 5 patients (8.2%) had bradycardia which responded to a single dose of atropine. In group B, 3 patients had bradycardia whereas in group L, 2 patients developed bradycardia. The overall incidence of hypotension was 11.6%, 4 patients in group B and 3 patients in group L developed hypotension. All

of them responded to fluid bolus and none required mephenteramine.

No patient developed headache. All patients developed spinal anesthesia; there were no patchy blocks and in no case conversion to GA was done. No patient who experienced paresthesia complained of neurological symptoms at follow-up. There were no serious complications such as epidural hematomas, infection, or permanent nerve injuries in any patient.

DISCUSSION

This study showed that both isobaric bupivacaine and levobupivacaine showed fast onset, similar peak block height, minimal haemodynamic variability and similar duration of motor block. It is, however, the duration of sensory block which is significantly longer with levobupivacaine than with bupivacaine. Since the duration of analgesia is longer with levobupivacaine, author concluded that levobupivacaine is better than bupivacaine in thoracic spinal anaesthesia for laparoscopic cholecystectomies.

The safety of thoracic spinal anaesthesia has been a matter of debate for quite some time. However recent studies by Imbelloni et al, who studied the anatomy of the spinal cord using MRI studies found that the space

between the duramater and spinal cord in the thoracic region measured with MRI was 5.19 mm at T2, 7.75 mm at T5, and 5.88 mm at T10.[11] This means that posterior separation between thoracic cord and the duramater is more than at lumbar level. In addition, the thoracic vertebral spines are set at 50 degrees oblique angle which necessitates the introduction of the spinal needle at an oblique angle of almost 50 degrees. This further elongates the distance from the tip of the needle to the posterior surface of the cord, thus increasing the margin of safety. Lee et al, investigated the human anatomic positions of the spinal canal (spinal cord, thecal tissue) in various postures with magnetic resonance imaging and found that in a head-down sitting posture, the posterior separation of the duramater and spinal cord is increased.[12] These data suggest the safety of thoracic puncture. This was further verified by studies which showed a very low incidence of paraesthesias in patients given thoracic spinal anaesthesia .[13,14]

The time of onset of sensory block was similar with both the solutions - 2 min. This can be explained by the lower amount of CSF in the chest region compared to the lumbar segment.[9] This produces lesser anaesthetic dilution per segment from the site of injection. Lesser dilution increases the concentration and potency of a given dose of drug in CSF. Also, thoracic roots have been shown to be thinner compared to lumbar and cervical roots.[10] This makes them prone to easy and efficient blockade. This result is similar to other studies comparing thoracic spinal anaesthesia in patients undergoing different laparoscopic surgeries.[15,16]

The peak sensory level attained was also similar in both bupivacaine and levobupivacaine (T2-T3). The time taken to reach the peak block height was also similar between the two solutions. Both the solutions showed a similar spread with lowest segment blocked ranging from L3-L5. This can be seen as an advantage of thoracic spinal anaesthesia. The thoracic approach allows deposition of the drug close to the target dermatomes. This confers many benefits. A lesser dose of the drug is needed to produce the necessary effect. Also, because both the drugs are isobaric; they show a segmental blockade with block centered around upper thoracic and upper lumbar dermatomes which are close to site of drug deposition.

The duration of motor block is similar in both the solutions. However, levo bupivacaine showed longer sensory block. This could be explained by the greater intrinsic vasoconstrictor potency of levobupivacaine.[8] Results were similar to a study examining lumbar epidural anaesthesia.[7]

Both the groups showed minimal haemodynamic variability. This is considered an advantage of thoracic spinal anaesthesia. Because of proximity of drug deposition site to the target site, thoracic spinal anaesthesia requires lesser drug dose to achieve the desired effect. The hypotension caused by spinal anaesthesia is due to sympathectomy resulting in vasodilatation with corresponding decrease in venous return. More segments blocked means more sympathocoliosis, more vasodilatation and hence more haemodynamic changes.[17] Segmental blockade provided by thoracic spinal anaesthesia has advantage of limiting sympathectomy to fewer segments with consequent less vasodilatation than lumbar spinal anaesthesia and thus less hemodynamic changes.

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