ORIGINAL ARTICLE

Comparasion of low dose bupivacaine and ropivacaine in low thoracic combined spinal epidural anaesthesia for laparoscopic cholecystectomy

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Abstract

Laparoscopic cholecystectomy is one of the most commonly performed day care surgeries today. Thoracic spinal anaesthesia provides efficient anaesthesia and early ambulation making it a highly suitable anaesthetic technique for day care surgeries. In this study we aimed at determining whether bupivacaine or ropivacaine proves more efficacious as an anaesthetic agent in thoracic combined spinal epidural anaesthesia.60 patients scheduled for laparoscopic cholecystectomies were divided into two groups : group B and group R. Both the groups were given thoracic combined spinal epidural anaesthesia (CSE) at the T9-T10 / T10-T11 interspace using 2 ml of isobaric bupivacaine 0.5% (5 mg/ml) + 25µg (0.5 ml) of fentanyl in group B and 2 ml of isobaric ropivacaine 0.5% (5 mg/ml) + 25µg (0.5 ml) of fentanyl in group R . We evaluated the degree of analgesia and motor block, haemodynamics and neurological complications.Onset of analgesia was comparable in both the groups - 2min. The duration of sensory block and motor block was less with isobaric ropivacaine than with isobaric bupivacaine. There were no significant differences in haemodynamic variables and respiratory parameters between the two groups and no neurological complication in any patient. By providing a sensory block of longer duration than the motor block isobaric ropivacaine is reflected in a better indication than isobaric bupivacaine for upper abdominal surgeries. Thoracic combined spinal epidural anaesthesia provides excellent anaesthesia for laparoscopic cholecystectomies.

Key Words

Thoracic Spinal Epidural Anaesthesia, Complications, Local Anaesthetic, Isobaric Bupivacaine, Isobaric Ropivacaine

Introduction

Thoracic spinal anaesthesia has come a long way since its introduction by Jonnesco in 1909. As the anaesthesiologists became more familiar and comfortable with this technique the encouraging results prompted the use of thoracic spinal anaesthesia as a routine anaesthetic technique in healthy patients and not just as an alternative salvage option for patients who could not tolerate general anaesthesia (1). Laparoscopic surgeries since their introduction in 1970s have gained immense popularity as one of the most commonly performed day care surgeries. Studies have shown thoracic spinal anaesthesia to provide satisfactory operating conditions and shorter latency of the block with excellent haemodynamic stability for laparoscopic cholecystectomies. We decided to adopt thoracic combined spinal epidural approach to achieve the benefit of a definitive block achieved with spinal alongwith the flexibility afforded by an epidural catheter. This double-blinded randomized controlled study aimed to compare the sensory and motor block characteristics, haemodynamics , neurological and post operative complications during thoracic combined spinal epidural anaesthesia of a patient group undergoing

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laparoscopic cholecystectomy with isobaric bupivacaine to those of another patient group treated with isobaric ropivacaine.

Material and Methods

The study began with approval from the institutional ethics committee and written consent was obtained from all the 60 patients who were scheduled for elective laparoscopic cholecystectomy. They were divided randomly by computer generated numbers in two equal groups.

Inclusion criteria were : age over 18 years with American Society of Anesthesiologists (ASA) physical status I-II, BMI < 30kg / m2 and normal coagulation profile. Exclusion criteria were: ASA status 3 and 4, acute inflammation / acute cholecystitis, severe cardiovascular disability and BMI >30 kg / m2.

All patients received pre-anaesthetic check-up at least one day prior to surgery. Patients were premedicated with tablet alprax 0.25 mg, pantoprazole 40 mg and domperidone 10 mg at bed time on the night prior to surgery and then kept fasting for six hours upto the morning of surgery.

Pre-operatively, every patient received pre-loading with Ringer lactate 10 ml/kg over 30 minutes and premedication with Ondansetron 0.1 mg/kg iv and Ranitidine Hydrochloride 50 mg intravenously.

The patients were then shifted to Operation theatre and all routine monitoring namely,non invasive blood pressure(NIBP), pulse oximetry (SpO2), end tidal Carbon dioxide (ETCO2) and electrocardiogram(ECG) was started. Inj. Midazolam 1mg i.v. 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 B and group R, CSE was performed with the patient in the sitting position. Portex combined spinal/epidural minipack with lock pencil point spinal needle was used to administer thoracic CSE in all the patients. Under all aseptic precautions, combined spinal epidural (CSE) block was administered either at the T9-T10/T10-T11 interspace using a 18 gauge Tuohy needle and a mid-line approach. In case of group B, 1.5ml (10mg) of isobaric preservative free bupivacaine 0.5% (5 mg/ml) + 0.5 ml (25µg) of Fentanyl was injected into the subarachnoid space using 27 gauge pencilpoint whitacre spinal needle and then the spinal needle was removed. In case of group R, 2ml (10mg) of 0.5% isobaric ropivacaine (5mg/ml) and 0.5ml (25µg) fentanyl was given into the subarachnoid space. The epidural catheter was then threaded into place keeping the hub cephalad and fixed at 4 cm within the epidural 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. 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, peak sensory block height, the lowest segment blocked and the maximum motor block achieved was recorded before surgery. Once the desired sensory block (T4-T12) was achieved, surgery was commenced. In both the groups if the sensory block was found inadequate after 15 minutes an attempt to extend the block with 4-8 ml saline topup was made .

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 five minutes, every five minutes for next ten minutes and every twenty minutes thereafter till the completion of surgical procedure

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, i.e. grade 0 of modified Bromage scale. Criteria for conversion to GA were: If the sensory level was found to be inadequate even after 15 minutes of an attempt to extend the block with epidural topup or bleeding was found to be difficult to control and if pt or the surgeon was uncomfortable with regional anaesthesia at any stage of the 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-

Table 1- Demographics

	Group Bupivacaine	Group Ropivacaine	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 3 - Characteristics in perioperative period

	Hyperbaric group	Isobaric group	P value
Surgical time (min)	25	27	0.42
Shoulder pain(no. of patients)	4	6	0.53
Hypotension(%)	16.67%	12%	0.512
Bradycardia(%)	10%	6.67%	0.284
Conversion to GA	nil	nil	

1) Using lower levels of intra-abdominal pressure, less than 10 mm Hg.

2) Providing minimal right up tilt to the table to minimise diaphragmatic irritation.

Post operatively epidural analgesia top-up was given when VRS score > 3 with 0.125 % Bupivacaine 5 ml . Epidural catheter was removed the next morning after surgery. The patients were discharged 24 hours after the procedure after excluding post operative complications and neurological sequelae .

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*). The observed overall incidence of paraesthesia was 2.8% . Thoracic combined spinal epidural block was performed in the first attempt in 58 patients at T9-T10 interspace and in the remaining two patients after the failure of the first attempt a second attempt was made at T10-T11 interspace.

The onset of analgesia was fast and comparable among the two solutions - 2min. The peak block height achieved was similar for both the groups (T2 -T4) . Epidural top up was required in two patients in group R for the extension of the level of block . Time to reach peak block height was similar for both bupivacaine and ropivacaine (4min) (*Table 2*).

Maximum motor block achieved was bromage 1 in 15 patients in group B and bromage 1 in 19 patients in group R (*Table 2*).

Table 2- Block Characteristics

	Group Bupivacaine	Group Ropivacaine	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	4/8/18	<0.0001
Time to peak block height(min)	4.08	4.10	0.652
Max motor block (B1 /B2/B3)	15/9/6	19/8/3	<0.0001
Sensory block duration(min)	160.10	120.03	<0.0001
Motor block duration (min)	90.33	60.10	<0.0001

The duration of motor block was significantly higher with isobaric bupivacaine (90min in isobaric bupivacaine vs 60 min in isobaric ropivacaine) whereas the duration of sensory block was lesser with isobaric ropivacaine (120 min vs 160 min for bupivacaine) with significant inverse correlation (value - $P < 0.001$) (*Table 2*) .

There was no significant difference in incidence of bradycardia and hypotension between the two groups We 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 R , 2 patients developed bradycardia. The overall incidence of hypotension was 13.3% . 5 patients in group B and 3 patients in group R developed hypotension. All of them responded to fluid bolus and none required mephenteramine (*Table 3*).

The overall incidence of shoulder pain was 16.6%. No patient developed nausea , vomiting or pruritis during the surgical procedure (*Table 3*).

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

In this study we showed that both isobaric bupivacaine and isobaric ropivacaine (10mg) showed shorter latency and minimal haemodynamic variability . Isobaric ropivacaine provided a shorter sensory and motor block than isobaric bupivacaine . Thoracic combined spinal epidural anaesthesia could be safely performed in all the

patients with minimal incidence of paraesthesias and no neurological complications .

Contrary to popular belief , workers have shown that at the thoracic level the distance between the dura and spinal cord is more than that at the lumbar level (2) and this margin of safety is increased in the sitting position of the patient where the posterior separation of the duramater and spinal cord is increased (3). This is further substantiated by our study where the thoracic cse was performed in the sitting position and the incidence of paraesthesias was 2.8% ; similar to the low incidence of paraesthesias observed by others working on the thoracic cord (4,5). Our findings suggest that the combined spinal epidural block technique is able to be performed at the lower thoracic level without difficulty, the tenth interspace being chosen as lying in the center of the surgical field (6). This high index of safety could also be because the introduction of the epidural needle at angle of almost 50 degrees further elongates the distance from the tip of the needle to the posterior surface of the cord. Furthermore use of a CSE system which limits the length of needle which can project beyond the tip of the epidural needle also minimizes the risk of contact with neural tissue. This is also reflected in the zero incidence of post operative neurological complications in our study .

The time of onset of analgesia with both bupivacaine and ropivacaine was the same. This can be explained by the lower amount of CSF in the chest region compared to the lumbar segment (7). 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 (8). This makes them prone to easy and efficient blockade . Our results are similar to other studies comparing thoracic spinal anaesthesia in patients undergoing different laparoscopic surgeries (9,10) .

The peak sensory level attained was similar (T2 -T4) and time to reach the desired block height was also similar in both groups (4 min). Epidural topup was required in two patients in group R in whom the desired sensory level could not be reached even after fifteen minutes . Regarding the mechanism of extension of spinal anaesthesia by extradural injection of local anaesthetic, it is partly a volume effect and partly an effect of local anaesthetic itself (11,12) . Bupivacaine showed greater spread and greater degree of sensory and motor block than ropivacaine. This could be attributed to the use of plain solution. Our results are similar to those of Mc Nameet al (13) who compared 0.5 % isobaric bupivacaine and ropivacaine solutions for major orthopaedic surgeries. Gautier and colleagues(14) compared 4 ml of intrathecal hyperbaric 0.2% bupivacaine (8 mg) with 4 ml of 0.2, 0.25,0.3, or 0.35% hyperbaric ropivacaine (8, 10, 12, or 14 mg) in patients undergoing knee arthroscopy. Although the duration of both sensory and motor block was significantly shorter in the ropivacaine group in our study, these differences were not as pronounced as those seen in the above-mentioned study.This may reflect a difference in the dosage use, the baricity of the solution used, the patient position and the population studied. Whiteside and others (15) compared equal doses (15 mg) of intrathecal 0.5% ropivacaine in 10 mg/ml or 50 mg/ml glucose in two groups of patients undergoing a variety of minor surgical procedures. They showed that the onset of sensory block to T10 was significantly faster in the glucose 50 mg/ml group but the maximum extent of sensory block, time to block regression and quality and duration of motor block were similar in both groups.

In another recent study, in patients undergoing transurethral resection of the bladder or prostate, patients were randomized to receive either 5 ml of 0.2% isobaric bupivacaine (10 mg) or 5 ml 0.3% isobaric ropivacaine (15 mg) for spinal anaesthesia (16). Despite the fact that a lower dose of bupivacaine was used in comparison with ropivacaine, there was a significant increase in the cephalad spread of the sensory block in the bupivacaine group. The degree of motor block was similar, which is in accordance with our study, where a lower intensity of motor block was seen with ropivacaine than with bupivacaine with the same dose. While investigating the minimum concentration of a fixed volume of an epidurally administered local anaesthetic required to abolish the pain of the first stage of labour , it was found that ropivacaine is approximately 40% less potent than bupivacaine in this situation (17). However no difference was found between these two agents for epidural analgesia in labour in other studies (18). While there has been no study evaluating the differences in potency of these two agents following intrathecal administration, the difference in the duration of motor and sensory block seen in our study may be due to differences in potency. However these differences were not of the same order as those detected by Polley and co-workers(17).

There was no significant difference in heart rate and systolic ,diastolic and mean blood pressure in the two

groups .The overall incidence of bradycardia was 8.2% and hypotension was 12% . Baricity determines intrathecal spread , more segments blocked means more sympathocoliosis ,more vasodilatation and hence more haemodynamic changes (19) .The low incidence of haemodynamic variability can be explained by the fact that thoracic approach allowed a lower drug dose to be used because of the proximity of the site of drug injection to the target dermatomes . Segmental blockade provided by low dose thoracic spinal anaesthesia has advantage of limiting sympathectomy to fewer segments with consequent less vasodilatation and thus less hemodynamic changes and a shorter duration of sensory and motor block than with the conventional-dose spinal anaesthesia (20). Lesser incidence of hypotension resulted in uneventful post operative recovery with no patient complaining of nausea and vomiting. The low incidence of shoulder pain in our study (16.6%) could be due to intraperitoneal instillation of lignocaine , the lower intra-abdominal pressures used for insufflations and minimal tilting of the operation table to minimize diaphragmatic irritation. Isobaric bupivacaine provides longer sensory and motor block than isobaric ropivacaine. But inspite of being of a longer duration, the motor block seen with isobaric bupivacaine is of lesser degree which does not interfere with early ambulation of the patient. Hence by providing a longer sensory block isobaric bupivacaine is reflected in a better indication in thoracic combined spinal epidural anaesthesia for laparoscopic cholecystectomies.

Conclusion

Isobaric bupivacaine provides a segmental block with early ambulation and a longer duration of sensory block (analgesia). Hence isobaric bupivacaine is better than isobaric ropivacaine in thoracic combined spinal epidural anaesthesia for laparoscopic cholecystectomies.

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