Comparison of 0.5% Ropivacaine and 0.5% Bupivacaine for Epidural Anaesthesia in Patients undergoing Lower Abdominal and Lower Extremity Surgery

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ABSTRACT

BACKGROUND: Ropivacaine, a derivative of mepivacaine like its older counterpart Bupivacaine, has recently been introduced in Indian pharmacopeia. Ropivacaine is an amide local anaesthetic but less cardiotoxic than bupivacaine.

OBJECTIVE: To compare the clinical effectiveness of ropivacaine versus bupivacaine in patients undergoing lower extremity and lower abdominal surgeries

METHODS: 50 patients were randomized to receive 20ml of 0.5% ropivacaine or 0.5% bupivacaine through epidural catheter. Sensory (pinprick) and motor (bromage) measurements were made while the block was in effect, haemodynamic changes; use of additional analgesics and sedatives was noted.

RESULTS: The quality and extent of sensory and motor blockade between the two groups was comparable, although bupivacaine was found to be slightly longer acting. Both had similar motor blocking characteristics, with the exception that bupivacaine had a blockade of slightly longer duration but statistically not significant ($p > 0.05$).

CONCLUSION: Ropivacaine being lesser cardio toxic is the preferred agent for clinical epidural anaesthesia. JMS 2011;14(1):15-18

Key words: Anaesthesia, bupivacaine, ropivacaine, epidural catheter

Ropivacaine has recently been introduced in Indian pharmacopeia. Ropivacaine, the S-enantiomer of N-propylpiperidic acid 2,6-xylylidine, is an amide local anaesthetic that is less cardio toxic than bupivacaine.¹ Like other local anaesthetics ropivacaine elicits nerve block via reversible inhibition of sodium ion influx in nerve fibres. It has lower lipid

solubility and is less likely than bupivacaine to penetrate large myelinated motor fibres. The degree of ropivacaine induced sensory and motor block are dose and age dependant.^{2,3} Ropivacaine presumably produces less central nervous toxicity and cardiac toxicity than bupivacaine.^{2,3} It blocks C-fibres faster than A fibers, but the blockade of A fibers is less with ropivacaine than a similar concentration of bupivacaine, whereas the degree of C-fibre block was similar with both drugs.^{4,5} The analgesic potency of ropivacaine is similar to that of bupivacaine while motor block is less pronounced and of shorter duration.^{6,7} This study was designed in a randomized double blind fashion to compare the clinical effectiveness of ropivacaine and bupivacaine in patients undergoing lower extremity and lower abdominal surgeries.

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Material and Methods

This study was conducted in the Department of Anesthesiology and Critical Care SKIMS, Srinagar. After explaining the whole procedure to the patients consent for the same was sought from all 50 patients, ASA patients physical status I and II patients aged 25 to 65 years were included in this double blind randomized comparative study of ropivacaine and bupivacaine. Patients were excluded if they had any contraindication to extradural anaesthesia or any significant medical history or concomitant disease which would influence postoperative assessments.

Prior to blockade patients received 500ml of crystalloid. Local skin infiltration was done with 2ml of 2% xylocaine and epidural blocks were performed in sitting position with 18 gauge Tuohy needle in L2-L3 or L3-L4 inter space. Following identification of the epidural space with the loss of resistance technique, epidural catheter was threaded in place. After giving test dose of 3ml of xylocaine with epinephrine 1 in 200,000 (5mcg/ml), 20 ml of blinded study drug was injected over 5minutes. Patients were immediately turned supine and block measurements initiated. Repetitive block assessments were done by two blinded observers. These measurements included bilateral upper and lower extents of anaesthesia to pinprick with a blunt 27gauge needle at 5min intervals for 30 minutes and thereafter every 15minutes for 5 hours till sensory blockade resolved. Motor blockade was noted at same intervals using bromage scale. Tourniquet pain was judged as present or absent when applicable. Heart rate and blood pressures were measured prior to administration of epidural and thereafter every 5min intervals for 1 hour and every 30 minutes thereafter for 3hours following completion of block. Epidural catheter was kept in place for providing postoperative pain relief with top up doses of 5 ml of either Bupivacaine 0.25% or 0.2% Ropivacaine. During abdominal surgeries Fentanyl in the dose of 2 microgram/kg was given for visceral pain relief. Additional sedatives and analgesics required during the surgical procedures were tabulated and so were the doses of ephedrine and atropine. All the parameters were recorded and statistically evaluated using Mann-Whitney U test, chi square and ANOVA.

Results

50 patients were included in the study, 25 patients in both the ropivacaine and bupivacaine groups. No differences were found in patient or preoperative characteristics between the two groups (Tables 1-3). The onset of sensory analgesia and peak sensory height did not differ between the two groups. In both the groups sensory blockade of the sacral dermatomes was virtually complete at 20min. The regression of the upper sensory was more rapid with ropivacaine and the duration of sensory block significantly longer in the bupivacaine in the T-12 to S-5 dermatomes ($p = 0.001$). Adequacy of anaesthesia and muscle relaxation on comparison between the two groups was insignificant ($p > 0.05$). The duration of motor block was slightly longer with bupivacaine. Onset of motor blockade, peak motor block bromage score and absence of tourniquet pain was insignificant

TABLE 1: Demographic characteristics in Ropivacaine and Bupivacaine groups.

Variable	Ropivacaine	Bupivacaine	
Age (years)	42.5 ± 15.8	40.8 ± 15.0	(NS)
Height (cm)	173.5 ± 12.1	174.2 ± 7.1	(NS)
Weight (kg)	80.0 ± 12.4	83.3 ± 10.2	(NS)
Gender (M:F)	16:9	18:7	(NS)
ASA physical			(NS)
1	12	11	
2	13	14	

NS = Not significant

TABLE 2: Surgical cases distribution

Operation	Ropivacaine	Bupivacaine
Groin dissection	4	5
Hernia repairs	7	7
SSG lower limbs	6	7
Ano genital surgeries	8	6
Total	25	25

TABLE 3: Block Characteristics and Management Between the Groups

Variable	Ropivacaine	Bupivacaine
Number of patients per site of blockade		
L2-L3	16	15
L3-L4	9	10
Time between injection and operation (min)	43.8 ± 14.7	49.6 ± 25.3
Length of surgery (min)	167 ± 95	191 ± 68

TABLE 4: Peripheral Block Characteristics Between Ropivacaine and Bupivacaine

Variable	Ropivacaine	Bupivacaine	p value
Block onset and peak			
T 10** (min)	10 ± 6.7	12.3 ± 11.2	(NS)
S 5 (min)	19.5 ± 8.5	18 ± 12	(NS)
Peak block height*	T5 ± 3	T5 ± 4	(NS)
Time to peak Block height (min)	48 ± 18	56 ± 24	(NS)
Peak bromage motor block score	1 ± 1	1 ± 1	(NS)
Block regression			
2 dermatome (min)	170 ± 56	180 ± 70	(NS)
T 10* (min)	235 ± 68	259 ± 48	(NS)
No sensory block (min)	330 ± 52	396 ± 51	0.001 **
Duration of motor block (min)	218 ± 54	275 ± 51	0.02 **

*T = Thoracic dermatome; **Mann Whitney U test

on comparison between the two groups.

Haemodynamic parameters; heart rate and blood pressures changes were recorded but no significant differences observed. The measurement of heart rates showed ropivacaine and

bupivacaine at preblock values of 73 ± 12 and 71 ± 13 beats per minute. At 30 and 60 minutes post block the values were 86 ± 11 and 84 ± 13 at 30 minutes and 88 ± 12 and 86 ± 11 beats per minute at 60 minutes respectively. Systolic blood pressure measurement preblock and 30min and 60 minute postblock showed ropivacaine group values of 128 ± 18 and 126 ± 14 mmHg preblock, 118 ± 17 and 115 ± 18 mmHg at 30 minutes and 118 ± 16 mmHg and 114 ± 12 mmHg at 60 minutes postblock respectively. Use of additional sedation, atropine and ephedrine was similar between the groups. Similarly the duration of surgical procedures was similar on comparison.

Discussion

Epidural analgesia with local anaesthetics after lower abdominal surgery is a powerful method of relieving postoperative pain, provided that the catheter is placed at the correct dermatome.⁸ In addition, epidural local anaesthetics may reduce gastrointestinal paralysis and postoperative nausea and vomiting by inhibition of visceral reflex activity and reduced need for perioperative opioids.⁹⁻¹² Ropivacaine is the newest aminoamide local anaesthetic (LA) available for clinical use. Its development was prompted by the need for a wider safety margin while preserving the desirable pharmacodynamic properties of bupivacaine, a potent long acting aminoamide local anaesthetic with a limited safety profile (current drug therapy 2006).

Ropivacaine and bupivacaine are produced when the methyl group ($-\text{CH}_3$) situated on the nitrogen ion of mepivacaine is replaced by a $-\text{C}_3\text{H}_7$ group in the case of ropivacaine and by a butyl group $-\text{C}_4\text{H}_9$ in the case of bupivacaine. Ropivacaine is a pure solution of "S" enantiomer, but bupivacaine is a racemic mixture. In terms of the central nervous and cardiac systems the s-enantiomer are recognised as being less toxic than the bupivacaine.¹³ Ropivacaine is a well tolerated regional anaesthetic effective for surgical anaesthesia as well as the relief of postoperative and labour pain. The efficacy of ropivacaine is similar to that of bupivacaine and levobupivacaine for peripheral nerve blocks and although it might be slightly less potent than bupivacaine when administered epidurally or intrathecally, equi-effective doses have been established.

The problem of persistent motor block limits the usefulness of epidural infusions with local anaesthetics.¹⁴ although controversial, it has been claimed that ropivacaine produces comparable sensory, but less intense, motor block compared with bupivacaine.^{12,15} This has not been investigated in patients undergoing lower abdominal surgery.

Bupivacaine is known to provide a more intense and longer lasting surgical block than ropivacaine in similar doses and concentrations.¹⁶⁻¹⁸ Clinically adequate doses of ropivacaine appear to be associated with a lower incidence or grade of motor block than bupivacaine. Thus ropivacaine with its efficacy, fewer propensities for motor block and reduced potency for CNS toxicity and cardiotoxicity appears to be an important option for regional anaesthesia and for the management of postoperative and labour

pain.¹⁹

In a study conducted using different dosage of ropivacaine for labour analgesia, it was found that 0.2% ropivacaine produced adequate analgesia.²⁰

Our comparison of 0.5% ropivacaine and 0.5% bupivacaine in patients undergoing lower abdominal and lower extremity surgeries suggest that the intensity of sensory anaesthesia is not significantly different at 0.5% concentrations, but bupivacaine tends to provide slightly longer lasting sensory blockade than ropivacaine similar to other studies.^{17,18} The difference is consistent with the results of a study conducted by Brown et al in 1990. In a article by Akerman B *et al*, it has been theorized that the shorter duration is a result of the lesser lipid solubility of ropivacaine. Statistically no significant difference was seen when the motor blockade was compared in the two groups, though bupivacaine patients showed longer lasting motor blockade. This is again comparable with the study conducted by Gerhard *et al* 1999 when 0.2% ropivacaine was compared with 0.175% bupivacaine where it was found that despite higher concentration of ropivacaine the motor recovery was earlier than with bupivacaine. Our findings are also consistent with the findings of the study by Brown *et al*.

In conclusion, since 0.5% ropivacaine produces similar sensory and motor blockade and keeping in view less toxic profile than bupivacaine, ropivacaine can be used with better margin of safety at higher concentrations for a denser sensory blockade. And motor recovery being slightly earlier so can be used safely in higher concentrations as well.

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