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Efficacy of Epidural 0.75% Ropivacaine vs. Epidural 0.5% Bupivacaine for Adult Patients undergoing Major Lower Abdominal Surgeries: A Double Blind Randomized Control Study

Prardhana Veerabathula[1], Mir Ahmeduddin Ali Khan[2], Shivakumar Perepu[3], Sherry Mathews[4], Nuthula Satyanarayana[5]

[1,2]Assistant Professor [3]Resident Doctor [4]Professor [5]Professor and Head, Department of Anesthesiology and Critical Care, Shadan Institute of Medical Sciences, Peerancheru, Hyderabad, Telangana 500086, India.

Abstract

Context: In view of the wider application of regional anesthetic procedure in modern anaesthesia practice, there is a need for local anesthetic with desirable properties like longer duration of sensory blockade for post operative analgesia and moderate duration of motor paralysis for surgical relaxation. *Null hypothesis:* Epidurally administered 20 ml of 0.75% Ropivacaine is not effective in comparison to 20 ml of 0.5% Bupivacaine for major lower abdominal surgeries in adult patients. *Aims:* To study the efficacy of epidurally administered 20 ml of 0.75% Ropivacaine in comparison to 20 ml of 0.5% Bupivacaine for major lower abdominal surgeries in adult patients. *Settings and design:* Hospital based double blind randomized controlled study carried out at Department of Anesthesiology, Shadan Institute of Medical Sciences, Hyderabad *Methods:* 50 eligible patients were included. They were divided into two groups of 25 each randomly. Group R with 25 patients were given 20 ml of 0.75% Ropivacaine epidurally. Group B with 25 patients were given 20 ml of 0.5% Bupivacaine epidurally. *Results:* There was no statistically significant difference among the two groups in terms of duration, quality and onset of sensory as well as motor blockade. Post operative analgesia duration was also similar among them. Two groups did not differ significantly in terms of side effects and hemodynamic stability. (p value > 0.05; statistically insignificant) *Conclusion:* Our study concluded that 20 ml of 0.75% epidural Ropivacaine produced equally effective and good quality as well as duration of sensory and motor blockade and post operative analgesia when compared to 20 ml of 0.5% epidural Bupivacaine for various lower abdominal surgeries.

Keywords: Epidural Anesthesia; Ropivacaine; Bupivacaine; Surgery; Blockade.

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Introduction

The "International Association for the Study of Pain" "IASP" defines pain as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage". Pain during surgery is often underestimated and under treated. Being purely subjective, pain and its intensity vary widely among patients. The threshold of pain is variable largely because of its emotional component. The relief of pain during surgery is "the raison d' etre" of anesthesiology. It is right to say that the anesthesiologist's experience, acquired in the field, should be extended into the postoperative period, as this has many beneficial effects for the patient [1].

While; the intra-operative pain, experienced by the patient has been underestimated; that of post-

Corresponding Author: Mir Ahmeduddin Ali Khan, Assistant Professor, Department of Anesthesiology and Critical Care, Shadan Institute of Medical Sciences, Peerancheru, Hyderabad, Telangana 500086, India.
E-mail: alikhan1988mir@gmail.com

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operative pain relief been neglected to a large extent. In this context, many anesthesiologists have advocated various methods to counter pain both intra-operatively and extending into the post-operative period much to the satisfaction of the patients. The cost of general anaesthesia, the skill and specialized equipment needed for its administration coupled with an different supply of anesthetic gases and drugs and lack of monitoring equipment especially in peripheral areas in a country like India made Regional Anesthetic techniques as choice because they are relatively inexpensive and easy to administer [2].

Regional anaesthesia is currently the most effective method of reducing the stress response especially in patients with surgical procedures involving the lower body. In view of the wider application of regional anesthetic procedure in modern anaesthesia practice, there is a need for local anesthetic with desirable properties like longer duration of sensory blockade for post operative analgesia and moderate duration of motor paralysis for surgical relaxation. The amide local anesthetics Bupivacaine is the most widely used local anesthetic. It is a racemic mixture of the dextro & levo stereoisomers. However the dextro enantiomer makes Bupivacaine a more cardio toxic drug [3].

In 1979 Albright [4] published an alarming editorial in which he associated long acting local anesthetic Bupivacaine and Etidocaine with cardiac arrest during regional anesthesia for Caesarian section using 0.75% Bupivacaine. It has been proved that it is better to use "single enantiomer compounds" rather than "racemic agents [1]." "Ropivacaine the recently introduced propyl homologue of Bupivacaine is a pure S (-) enantiomer." "It is associated with a reduced incidence of both cardiovascular and central nervous system toxicity, a concern with racemic Bupivacaine [5]."

It is less lipophilic than Bupivacaine. This reduced lipophilicity is responsible for lesser degree of motor blockade, greater differential blockade, less CNS and Cardio toxicity when compared to highly lipophilic Bupivacaine. Present study was carried out to study the efficacy of epidurally administered 20 ml of 0.75% Ropivacaine in comparison to 20 ml of 0.5% Bupivacaine for major lower abdominal surgeries in adult patients.

Materials and Methods

Source of Data

Hospital based double blind randomized controlled study carried out at Department of Anesthesiology, Shadan Institute of Medical Sciences, Hyderabad from July 2016 to June 2017. The study was approved by the Hospital Ethical Committee.

Method of Collection of Data

A total no. of 50 patients, 25 in each group with inclusion and exclusion criteria were selected for the study, patients were randomly allocated to each group by lottery method.

Inclusion Criteria

- ASA grade I and II physical status, aged between 16-45 years, belonging to both the sexes undergoing lower abdominal surgeries.

Exclusion Criteria

- Patients with ASA grade III, IV & V.
- Patients having sensitivity to local anesthetics
- Any Patient found to have local infection at the site of injection
- Uncooperative patients

Methods

Pre-Anesthetic Evaluation

Details of the present study were explained to all patients and then informed consent was taken. Data pertaining to history, general as well as systemic examination was recorded in the pre designed study questionnaire for the present study. All patients were given brief on "linear visual analogue scale (VAS)" "using 10 cm scale."

Premedication

All the patients were pre-medicated with 0.1-0.5 mg/kg Midazolam IM 45-60 min prior to the procedure.

Procedure

Before the start of the case, PR, RR, BP and SpO_2 was assessed. All patients receiced 150-200 ml RL co-load. Epidural anesthesia was given in left lateral position. After local infiltration with 1% Lignocaine, 18 G Tuohy needle was used. L3-L4 interspace was identified. 1% lignocaine was used for local infiltration, by "loss of resistance" technique. 18 G epidural catheter was threaded through the needle

into epidural space for 3-4 cm and secured with adhesive tapes to the back. After negative aspiration for blood and CSF, 3 ml of 1.5% Lignocaine with 15 mcg of Adrenaline 31 was given as test dose and the patient was turned to supine position. After 5 min if there is no adverse reaction for the test dose, intravascular and intrathecal placement was ruled out, and the study drugs and control drugs, were administered.

First group who received 0.75% Ropivacaine epidurally was labeled as Group R having 25 patients. Second group who received 0.5% Bupivacaine epidurally was labeled as Group B having 25 patients.

Patient was asked to respond to pin prick to assess the level of sensory block. SpO_2, PR, RR, BP were monitored regularly. Side effects were noted down.

Modified bromage scale [6] was used to assess onset of motor blockade.

Score	Bromage Scale
0	The patient is able to move the hip, knee and ankle
1	Patient is unable to move the hip but is able to move the knee and ankle
2	Patient is unable to move the hip and knee but is able to move the ankle
3	Patient is unable to move the hip knee and ankle

At the end of the surgery the patients were shifted to post operative ward. They were monitored for every 30 min first six hours and there after every hour for 24 hours period. If there was any fall in blood pressure, intravenous fluids were rushed and if the fall was more than 30% below the baseline value inj. Mephenteramine was given in titrated doses. If the pulse rate was less than 50/ minute inj. Atropine 0.6 mg IV was given. If respiratory rate was less than 10/min then respiratory depression was diagnosed. Once the VAS reading was five or more, analgesia duration was measured.

Statistical Analysis

Sample size determination: The sample size for the study was calculated with the aim of showing a difference between treatments in duration of motor block, with a mean difference of at least one hour. Based on the published literature, the standard deviation of Bromage 1 motor block was assumed to be approximately 0.9 hr. With 25 patients in each group and using a significance level of 0.05, the power of the study was 95%. The calculation was made using the t test, based on the assumptions of normally distributed data, and equal variances. Hence the sample size was chosen as 50.

At the end of the study all the data was compiled and statistically analyzed using Diagrammatic representation, Descriptive data presented as mean ±SD, Continuous data analyzed by paired or unpaired "t" test, Chi–square test to analyze Statistical difference between the two groups.

Results

Table 1 shows age and sex distribution of study subjects. Maximum patients were in the age group of 26-35 years. Females were more than the males. Both the groups were similar in the demographic characteristics.

Table 2 shows anthropometric characteristics of study subjects. Patients from both the groups had similar height and weight. Thus they were comparable to each other.

Table 3 shows types of surgery carried out among the study subjects. Abdominal hysterectomy was the most common surgery performed in both the groups. Both the groups were found to be similar in terms of type of surgery performed.

Table 4 shows comparison of anesthetic characteristics among the two groups. Sensory block onset mean time was 14.2±4.12 min and 14.96±3.16 min in group R & B respectively. It was not much different as seen from "t" test ($p > 0.05$).

Table 1: Age and sex distribution of study subjects

Demographic characteristics		Group R (N = 25)	Group B (N = 25)
Age (years)	16-25	6	8
	26-35	11	10
	36-45	8	7
Sex	Male	9	11
	Female	16	14

Sensory blockade duration was 224.36±26.34 min and 211.06±24.43 min. in group R & B respectively. It was not much different as seen from "t" test ($p > 0.05$).

Analgesia duration was 274±27.44 min and 260.48±22.36 min in group R & B respectively. It was not much different as seen from "t" test ($p > 0.05$). Motor blockade onset was 27.8±7.26 min and 27.6±7.29 min in group R & B respectively. It was not much different as seen from "t" test ($p > 0.05$). Motor blockade duration was 165.8±23.74 min and 174.92±20.10 min in group R & B respectively. It was not much different as seen from "t" test ($p > 0.05$)

Motor blockade intensity was not significantly different among the two groups in group R & B respectively. It was not much different as seen from "t" test ($p > 0.05$).

Table 2: Anthropometric characteristics of study subjects

Anthropometric characteristics		Group R (N = 25)	Group B (N = 25)
Weight (kg)	Range	35-64	35-65
	Mean	47.96	47.28
	SD	20.5	21.21
Height (cm)	Range	145-164	145-168
	Mean	155.76	155.32

Table 3: Types of surgery carried out among the study subjects

Types of surgery	Group R (N = 25)	Group B (N = 25)
Hernioplasty	4	4
Eversion of sac	2	3
Amputation of penis	1	1
Urethroplasty	1	1
Appendicectomy	4	4
Abdominal hysterectomy	6	7
Vaginal hysterectomy	5	2
Ovariotomy	2	3
Total	25	25

Table 4: Comparison of anesthetic characteristics among the two groups

Anesthetic characteristics		Group R (N = 25)	Group B (N = 25)	P value
onset of sensory block	Range	5-25	10-22	> 0.05
(Time in minutes)	Mean	14.20	14.96	
	SD	4.12	3.16	
duration of sensory blockade	Range	175-300	165-240	> 0.05
(Time in minutes)	Mean	224.36	211.06	
	SD	26.34	24.43	
duration of analgesia	Range	230-320	220-300	> 0.05
(Time in minutes)	Mean	274	260-48	
	SD	27.44	22.36	
onset of motor blockade	Range	6-40	15-43	> 0.05
(Time in minutes)	Mean	27.8	27.6	
	SD	7.26	7.29	
duration of motor blockade	Range	126-216	130-210	> 0.05
(Time in minutes)	Mean	165.8	174.92	
	SD	23.74	20.10	
intensity of motor blockade	1	2	2	> 0.05
(Bromage scale)	2	20	22	
	3	3	1	
	4	0	0	
2 segment regression time	Range	95-111	85-130	> 0.05
(Time in minutes)	Mean	105.16	111.64	
	SD	8.64	24.79	

Table 5: Comparison of intra operative hemodynamics among the two groups

	Mean PR	SD	Mean BP	SD	Mean RR	SD	Mean SPO_2	SD
Group R	74	2	110	15	14	1.9	98	0.8
Group B	77	1.8	115	20	15	1.7	99	0.7

Table 6: Comparison of side effects among the two groups

Side effects	Group R		Group B	
	Number	Percentage	Number	Percentage
Bradycardia	1	4	2	8
Hypotension	1	4	2	8
Urinary retention	0	0	1	4

Table 5 shows comparison of intra operative hemodynamics among the two groups. the mean values of pulse, blood pressure, respiration rate and SpO_2 were not much different from each other in either groups.

Table 6 shows side effects of Epidural Anaesthesia among the two groups. Incidence of side effects in both the groups was not difference from each other.

Discussion

Provision of clinically effective and satisfactory intra-operative and post-operative analgesia is not only important on humanitarian grounds but also because of the deleterious effects of pain on various organ system and negative input of pain on post-operative recovery. Regional Anaesthesia is an excellent choice which provides effective intra & post operative analgesia with a single technique which is being possible due to the availability of long acting amidelocal anesthetics like Bupivacaine and Ropivacaine.

Ropivacaine is a new long-acting amide type local anaesthetic that has been the focus of interest because of its increased cardiovascular and Central nervous system safety compared with Bupivacaine. Other advantages of Ropivacaine over Bupivacaine include a greater sensorimotor differential block and shorter elimination half-life (t(1/2)), with a lower potential for accumulation. The most important attribute of Ropivacaine, however, is its increased margin of safety compared with Bupivacaine when given in equal doses [8].

Ropivacaine is pure S enantiomer form and less Cardio-toxic than Bupivacaine. It is less lipophilic than Bupivacaine. This reduced lipophilicity is responsible for lesser degree of motor blockade, greater differential blockade, less CNS and Cardio toxicity when compared to highly lipophilic Bupivacaine. At lower doses Ropivacaine produces greater differentiation between sensory and motor blocks, hence very useful for post-operative analgesia and painless labour where motor block is undesirable.

Many post-marketing studies have focused on the comparisons of efficacy in blocks and toxicity profiles of Bupivacaine versus Ropivacaine. Recent animal toxicity studies confirm the results of original studies showing that Ropivacaine has less cardiovascular toxicity than Bupivacaine with respect to direct myocardial depression, success of resuscitation and arrhythmogenic potential when given in equal doses. Reduced cardiotoxicity may be a distinct characteristic of Ropivacaine. A review of current literature suggests that, at clinically relevant doses, Ropivacaine provides the lowest potential risk of cardiotoxicity for inadvertent intravascular injection [12].

A clinical study by Wolff AP et al. [7] showed that the degree of motor blockade with Ropivacaine increased as the epidural dose increased from 100 mg to 250 mg for hip surgeries.

The maximum recommended dose of Bupivacaine is 150 mg, So that the potential to improve the degree of motor block by simply increasing the dose of Bupivacaine is limited, due to the risk of systemic toxicity A large no. of studies and clinical experience have shown that the efficacy of Ropivacaine is equivalent to Bupivacaine when used in equal doses [8,9].

However, the wider margin of safety of Ropivacaine allows the use of higher doses, thus ensuring effective motor blockade with less risk of toxicity. Kampe S et al. [10] concluded that Ropivacaine 0.75% & Bupivacaine 0.5% produced equally satisfactory epidural block for elective caesarean section.

Hence, in our study we evaluated the efficacy of 20 ml of 0.75% Ropivacaine with 20 ml of 0.5% Bupivacaine to be used as epidural anaesthesia for patients who underwent surgeries of lower abdomen. It was found that both the agents were effective to be used as epidural anaesthesia for patients who underwent surgeries of lower abdomen. Ropivacaine is safer than Bupivacaine and hence can be used in large doses. Though the concentration of Ropivacaine is higher, the equipotent doses of Ropivacaine and Bupivacaine compared in this study produced a sensory block profile that was comparable among the two groups and was not significant statistically.

The duration and intensity of motor block with 0.75% Ropivacaine in our study was similar to 0.5% Bupivacaine and the motor block characteristics of the two drugs appear to be clinically indistinguishable. Many Randomised clinical trials have demonstrated the efficacy of Ropivacaine in providing a profound sensory and motor block suitable for surgical anaesthesia, post operative analgesia & labour pain relief. In our study, the quality of post operative analgesia in both groups was good. A similar degree of pain relief was observed in the two groups with out differences in the volume of local anesthetic consumed. Intra-operative hemodynamics were stable in all the patients of both groups throughout the study period.

The incidence of side effects like hypotension, nausea or vomiting, shivering, urinary retention was very less in both the groups and statistically insignificant.

An ideal local anesthetic for surgery would meet the following criteria.

1. Rapid onset of action
2. Profound sensory blockade and adequate motor blockade
3. Rapid cessation of motor block following surgery allowing early restoration of mobility
4. Well tolerated at high doses with low risk of systemic tonicity

Ropivacaine meets these Criteria by providing effective and well tolerated anaesthesia for surgery. The anesthetic effects are dose-dependent so that the degree of sensory and motor blockade was predictable.

In conclusion, Ropivacaine is a well tolerated regional anesthetic effective for surgical anaesthesia, post operative analgesia & painless labour with slightly less potency than Bupivacaine when administered intra-thecally or epidurally with lesser motor blockade and less systemic toxicity [11].

Our study showed that there were no statistically significant differences in quality and duration of sensory and motor block profiles and proved that 0.75% Ropivacaine is equipotent to 0.5% Bupivacaine but with greater margin of safety.

Conclusion

Our study concluded that 20 ml of 0.75% epidural Ropivacaine produced equally effective and good quality as well as duration of sensory and motor blockade and post operative analgesia when compared to 20 ml of 0.5% epidural Bupivacaine for various lower abdominal surgeries.

Since both Ropivacaine and Bupivacaine are equal in efficacy, Ropivacaine being a pure s-enantiomer carries lesser cardiovascular and central nervous system toxicity, as evident from other studies, hence seems to be a safer alternative.

Key Message

We can say that Ropivacaine as well Bupivacaine can be used depending upon the choice of anesthetist as both are equally effective.

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