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"A COMPARATIVE STUDY OF BUPIVACAINE 0.5% AND ROPIVACAINE 0.75% FOR INTERSCALENE BRACHIAL PLEXUS BLOCK USING PERIPHERAL NERVE STIMULATOR IN ADULT PATIENTS UNDERGOING ELECTIVE UPPER LIMB SURGERIES"

Anaesthesiology

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ABSTRACT

Backgrounds -Interscalene brachial plexus block with the use of peripheral nerve stimulator provide assured access and precise block in upper limb surgeries. Ropivacaineis one of the most widely used aminoamide local anesthetic which has less cardiotoxic effects when compared to other amide local anaesthetics. Hence it was required to study the efficacy of Ropivacaine for brachial plexus block and to compared it with regularly used Bupivacaine.

Aim;- A prospective randomized double blind study was undertaken to compare the sensory and motor blocking properties of 0.75% Ropivacaine and 0.5% Bupivacaine both 0.4ml/kg for interscalene brachial plexus block using nerve stimulator for elective upper limb orthopaedic surgeries.

Material and Methods;- After Institutional Ethics Committee approval, 72 patients aged between 18 – 60 years belonging to ASA class I and II posted for elective upper limb orthopaedic surgeries were randomly divided into two groups. Each analyzed group consisted of 30 patients who received interscalene brachial plexus block with 0.4ml/kg of Ropivacaine 0.75% (group A) and 0.4ml/kg of bupivacaine 0.5% (group B). All blocks were given with the use of peripheral nerve stimulator.

Results;- The onset of sensory and motor blockade, duration of analgesia and motor blockade, adverse events and haemodynamic parameters were evaluated.There was no statistically significant difference in both Ropivacaine 0.75% and 0.5% bupivacaine (p value > 0.05) in the onset of sensory and motor block, duration of sensory and motor blockade with no adverse events/hemodynamic instability noted in either group.

Conclusion;-we concluded that Ropivacaine 0.75% 0.4ml/kg or 0.5% Bupivacaine 0.4ml/kg for interscalene brachial plexus block produced satisfactory and comparable sensory and motor blockade.

KEYWORDS

Ropivacaine, Bupivacaine, peripheral nerve stimulator,brachial plexus block.

Introduction

With the introduction of newer and safer local anaesthetics and better advantages, regional anaesthesia has taken over as the principle technique for upper limb surgeries.

Brachial plexus block[1] is the most widely used approach for upper limb surgeries as an alternative to general anaesthesia or in combination with general anesthesia to achieve ideal operating conditions by providing adequate intraoperative analgesia, hemodynamic stability and unwanted side effects of general anaesthesia. So it can be used as the sole anesthetic technique or in combination with general anesthesia for perioperative analgesia.

Brachial plexus block also reduces postoperative pain and requirement of rescue analgesia [2] The upper limb blocks mainly avoid the consequences of general anesthesia like multiple use of drugs, stress response to laryngoscopy etc [3,4,5]

It is beneficial due to its effectiveness in terms of cost, margin of safety, along with good postoperative analgesia. In clinical practice the approaches to brachial plexus which have been described are: interscalene approach, axillary approach, supraclavicular approach, infra-clavicular approach.

There are many advantages of brachial plexus block for upper limb surgery over general anaesthesia as effective analgesia with good motor blockade, awake patient, extended postoperative analgesia, early ambulation, early resumption of oral feeding, minimal number of drug used, no airway manipulation, less incidence of postoperative nausea and vomiting, and ideal operating condition can be met.[6,7]

Traditional land mark approach and elicitation of paraesthesia necessitates multiple attempts, resulting in procedure related complications such as pain, blood vessels, intravascular injection, phrenic nerve block, pneumothorax, hematoma, infection, Horner's syndrome and nerve injury.

An interscalene brachial plexus block is indicated for procedures involving the shoulder and upper arm, roots involving C5-7 are most densely blocked with this approach, the ulnar nerve originating from C8 and T1 may be spared therefore interscalene block are not appropriate for surgery at or distal to the elbow.

In 1962, Greenblatt and Denson devised a portable transistorized nerve stimulator which stimulated further use of nerve stimulators in regional anaesthesia. Initially non insulated needles were used for nerve stimulation but now insulated needles are used.

Various local anesthetics have been used to produce brachial plexus block. Bupivacaine 0.5% is one of the most popular drug used because of its higher potency and prolonged duration of action. One of the drawbacks of bupivacaine is its cardiotoxicity especially when injected accidently in vertebral or subclavian artery.

Ropivacaine [8]is one of the most widely used aminoamide local anesthetic which has similar structure as bupivacaine, has all its advantages like longer duration of action varying from 5 to 8 hours and also has less cardiotoxic effects when compared to other amide local anaesthetics[9].

Our current study was designed to test the hypothesis that the effect of Bupivacaine 0.5% and Ropivacaine 0.75% in interscalene brachial plexus block for onset of sensory and motor block as well as duration of analgesia and duration of motor blockade.

Material and methods

Study Population(Sample size):

A total of 72 individuals were recruited in the study. In the present series, the trial was conducted in patients undergoing various elective upper arm surgeries under brachial plexus block via interscalene approach using peripheral nerve stimulator.

SELECTION OF CASES

Inclusion Criteria:

1. Adult patients (aged 18 years to 60 years) undergoing various elective upper arm surgeries under brachial plexus block.
2. Patients consenting for the study.

Exclusion Criteria:

Patient refusal, infection at injection site, Pregnancy, any major respiratory or haematologic abnormality.

Ethical Approval was taken from the Institutional Ethical Committee (No./S-1/2020/4748) after explaining the Aims and Objectives of the Study.A written Informed Consent was obtained from each patient before starting the procedure. The involvement of the subject was voluntary and deliberate.

Method of Data Collection:

Patients were assigned in Group A and Group B.

- **Group A:** Received brachial plexus block with 0.4 ml/kg of 0.75% Ropivacaine (analyzed patients = 30)
- **Group B:** Received brachial plexus block with 0.4 ml/kg of 0.5% Bupivacaine (analyzed patients = 30)
- Baseline vital parameters were measured before performing block injection.

Motor Block : Assessed by modified Bromage score

Assessment of motor blockade was done using 3-point modified Bromage score: 0 − normal motor function with full extension and flexion of elbow, wrist, and fingers, 1−decreased motor strength, with ability to move only fingers, 2−complete motor block with inability to move elbow, wrist, and fingers.

Sensory Block: **Assessed by pin-prick method**. Sensory block was assessed by pinprick test using a 3-point scale:

- 0 = normal sensation
- 1 = loss of sensation of pinprick (analgesia)
- 2 = loss of sensation of touch (anesthesia).

The detailed PAC was done including height and weight. A careful and thorough systemic examination was done to rule out any cardiovascular, respiratory and neurological disorder. Airway examination was done at PAC clinic Other Investigations included Hemoglobin (Hb),Total Leucocyte Count,Differential Leucocyte Count,Bleeding Time,Clotting Time Platelet Count,Blood Sugar,Blood Urea,Serum Creatinine,X-ray chest and ECG (electrocardiogram)

Anesthetic Technique:

The patient was placed in the supine position with his/her head turned in opposite direction to the arm to be blocked and was placed in an anatomical neutral position as far as possible, along the body and the head rotated slightly towards the opposite side.

After securing a 18-gauge IV cannula in the unaffected forearm, midazolam 0.05 mg/kg IV will be given as premedication, and standard monitors will be placed, including non-invasive arterial blood pressure, heart rate, and pulse oximetry. After local skin infiltration with 20 mg of 2% lidocaine, the interscalene groove will be identified using the landmarks, the plexus located with an 18-gauge, 5cm-long insulated Tuohy needle connected to a nerve stimulator (stimulation frequency, 2 Hz; duration of the stimulating pulse, 0.1 ms).The placement of the needle was judged to be successful when a muscle twitch was observed with threshold intensity <0.5 mA. After the proper motor response at the deltoid and/or biceps muscle will be observed, the study solution will be then injected slowly, with multiple negative aspirations for blood.[4]

The principal investigator who was blinded to the drugs administered in the brachial plexus block carried out the above assessment.

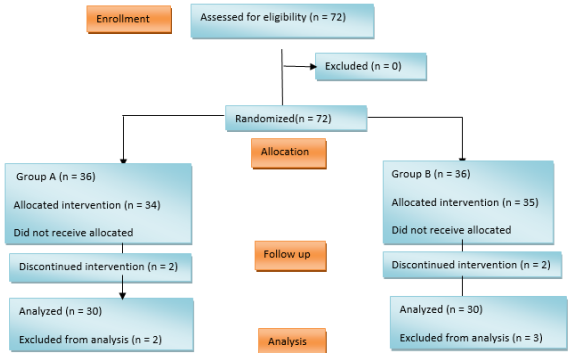
Statistical Analysis:

Statistical analysis was performed using SPSS (Statistical Package for the Social Sciences) for Windows (version 16.0). Categorical variables were described as frequency (percentage), mean ± standard deviation was used for continuous parameters. Differences between two groups were compared by the Student T test. For non-parametric variables, the data are presented as median (min-max). In this case, the nonparametric Mann–Whitney test was used for statistical comparisons. Categorical variables were compared between two or more groups using the Chi-square test. For all analyses, a two-tailed p-value of <0.05 was considered statistically significant.

OBSERVATIONS AND RESULTS

The study was carried out among 72 ASA grade I and II patients aged between 18-60 year admitted in SVBP Hospital associated to LLRM Medical college Meerut ,voluntarily consenting to be a part of the study. These patients required upper limb surgeries as per the diagnosis and were given a PNS guided inter scalene brachial plexus block.

Patient Assignment Flowchart



The mean age of the study group A was 42.4 ±10.46 years (mean±s.d.) and group B was 43.47±12.69 years respectively 18-60 years (Table 1).The difference between two study groups was statistically not significant .(p value = 0.36)).The gender wise distribution of study participants showed that males (56.67%) and (43.33%) were females. There were 17 males in Group A and 13 males in Group B. There were 14 females in Group A and 16 females in Group B(figure-1)

(Table 1)
(Table-2)
(Figure-1)

Table 2 shows the physical parameters of the study subjects. The mean weight in Group A was 55.43±8.95 kg and mean weight in Group B was 56.76±5.45kg. The difference between two study groups was statistically not significant ($p > 0.05$).

Figure 2 shows the mean change in heart rates over the follow up period between both study groups. The mean difference between both groups was not significant at any point after administration of the drug .

(Figure-2)

Table 3 shows the mean change in Mean Arterial Pressure (MAP) over the follow up period between both study groups. The mean difference between both groups was significant at baseline, 5 min, 10 min, 30 min and 60 minutes after administration of the drug.

(Table -3)
(Figure-3)

Table 4 shows the mean values on the duration of onset of sensory and motor blocks in both the study groups. The difference between group A and Group B regarding the mean duration of onset of sensory and motor was insignificant. ($p>0.05$).

Table-4

Table 5 shows the description of duration of surgery among study participants. The difference between two study groups was statistically not significant ($p > 0.05$).

(Table-5)

Table 6 shows duration of sensory and motor block did not differ significantly between the Ropivacaine and Bupivacaine groups ($p>0.05$). The duration of analgesia ranged from 400 to 510 minutes for Ropivacaine and 390 to 520 minutes for Bupivacaine, whereas the duration of motor block ranged from 330 to 420 minutes for Ropivacaine and 310 to 440 min for Bupivacaine.

(Table-6)

DISCUSSION

A pilot study was also conducted by us in our hospital, in ten patients using Ropivacaine 0.5% for brachial plexus block. Many of the patients had dermatomal sparing and only paresis at shoulder/ Hand which was inadequate for proposed surgery requiring general anaesthesia. Because of all the above reasons we selected 0.75% instead of 0.5% Ropivacaine to be compared with 0.5% bupivacaine.

In our study, the drugs selected for brachial plexus block were Bupivacaine and Ropivacaine.Ropivacaine has been found to be equally effective as bupivacaine for brachial plexus block by various authors.[10,11,12,13,14,15] Ropivacaine has been compared with

bupivacaine in many clinical trials involving most forms of regional anaesthesia.[16.17,18] Most of the studies have shown that the onset of sensory and motor block, potency and duration of sensory and motor block are almost similar to those of bupivacaine.

However, the development of minimal local anaesthestic concentration [MLAC] has suggested that Ropivacaine is approximately 40% less potent than bupivacaine with respect to sensory block[19,20].

Various authors have used different volumes of Ropivacaine and Bupivacaine for brachial plexus block. Vagadhia et al[21]30 ml, Laura Bertini et al[22]32 ml, Raeder JC et al[23] 40 ml, Min Park et al[24]30 ml,Piangatelli et al[25] 30ml.have used 0.4ml/kg as a dose for Bupivacaine and Levobupivacaine for brachial plexus block. In our study we have used 0.4ml /kg of study drug uniformly as study done by Cox CR et al[26].

Demographic data on comparing age, sex, weight, height shows no statistically significant differences between both the groups.

The onset of sensory block in our study was studied at shoulder and hand. The onset of sensory block in ropivacaine group was 7.46 minutes and bupivacaine group was 7.8 minutes. There was no statistically significant difference ($p > 0.05$) between 0.75% Ropivacaine and 0.5% Bupivacaine regarding the onset of sensory block.

Similar observations were found in the studies conducted by Misiolek et al[27] where there was no statistically significant difference between the onset of sensory block among ropivacaine group and bupivacaine group which compares with our study.

The time of onset of sensory block in the study conducted by Raeder JC et al.is 5 min with both ropivacaine and bupivacaine group which compares with our study.

The duration of analgesia was 433.83+_50.50 minutes in ropivacaine group and 443.50 +_30.31 minutes in bupivacaine group which was not statistically significant.

The studies conducted by Misiolek et al.[27] there was no statistically significant difference in the duration of analgesia between ropivacaine and bupivacaine group for brachial plexus block. The above studies are comparable with our study.

The onset of motor block in our study was studied at shoulder and hand. The onset of motor block in ropivacaine group was 12.7±1.60 minutes and bupivacaine group was 13.13±1.59 minutes. There was no statistically significant difference ($p > 0.05$) between the two groups regarding the onset of motor blockade.

Similar observations were found in the studies conducted by Laura Bertini et al[22].(14±3, 22±8),and Vaghadia et al[21](7±4, 9±6), in ropivacaine group and bupivacaine groups respectively, where there was no statistically significant difference between the two groups regarding the onset of motor block which is comparable with our study.

The duration of motor blockade was 369.16±21.01 min in ropivacaine group and 376.5±33.71 minutes in bupivacaine group which is not statistically significant. Comparable values were also noted in the study by Laura Bertini et al[22]. (492 ±162, 666±210) which does compare with our study. There was no statistically significant difference in the duration between the ropivacaine group and bupivacaine group in the study conducted by Vaghadia et al[21].(782min -840min in R group) however the duration was longer than that observed in our study. The duration of motor block in the study by Misiolek et al[27].(R: 456 ± 186, B: 570 ± 192) had significant statistical difference between the ropivacaine and bupivacaine group which does not compare with our study.

The incidence of hematoma, pneumothorax, accidental intravascular injection, Post block vomiting/convulsions/neuralgia were nil in either group. Intraoperative nausea was seen in one patient in group A and two patients in group B, which was mild and did not required any intervention.

Hemodynamic parameters like HR/BP/SPO_2 were within normal limits in both groups. No patient required any intervention.

Conclusion:-

when 0.75% Ropivacaine was compared with 0.5% Bupivacaine, we were not able to demonstrate any differences in onset or duration of block as might have expected with 50% higher dose in Ropivacaine group. Both agents were found to have similar effects with no differences in terms of onset and duration of sensory and motor blockade with no adverse events noted in either group. All patients had a complete sensory and motor blockade.Our study shows that concentration of 0.75% Ropivacaine is equally potent as 0.5% Bupivacaine when compared with the onset and duration sensory and motor blockade. The same observation has been observed by many authors.

There was no statistically significant difference (p value > 0.05) in the onset of sensory and motor block, duration of sensory and motor blockade in both groups with no adverse events/hemodynamic instability noted in either group.

So we cam conclude that Ropivacaine 0.75% 0.4ml/kg or 0.5% Bupivacaine 0.4ml/kg for interscalene brachial plexus block produced satisfactory and comparable sensory and motor blockade.

Table 1: Age wise distribution of study participants (n=60)

		Age (years)
GROUP A	Mean	42.4
	Std. Deviation	10.47
GROUP B	Mean	43.47
	Std. Deviation	12.69
t Test for Equality of Means		P=0.36

Figure -1

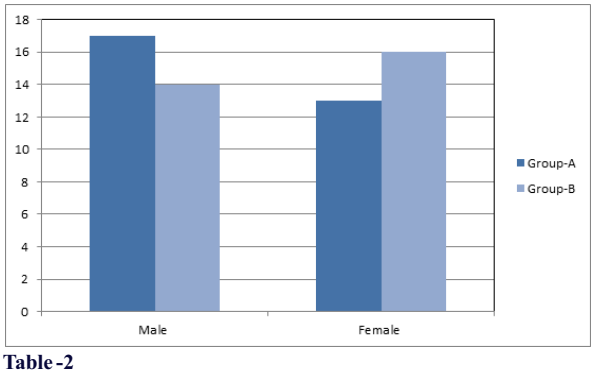


Table -2

	MEAN Weight (Kg)	SD	P value
Group A	55.43	8.95	0.244
Group B	56.76	5.45	

Figure -2 Heart rate at different time interval

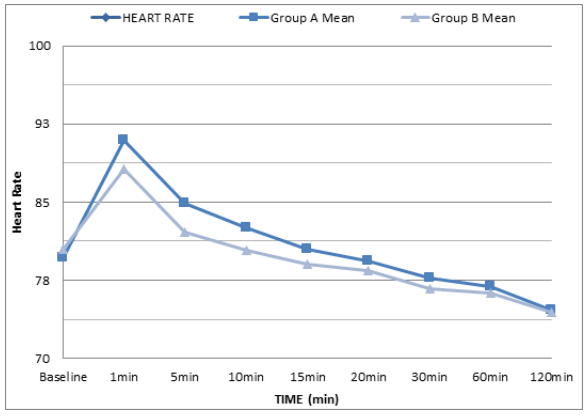


Table-3 Mean arterial pressure(MAP) in different time interval

MAP (mmHg)	Group A		Group B		p-value
	Mean	SD	Mean	SD	
At Baseline	91	4.28	96.36	3.37	0.0001*
1 min	104.22	3.38	103.28	3.61	0.153
5 min	103.11	2.82	99.12	2.53	0.0001*
10 min	99.05	3.16	95.84	3.56	0.0002*
15 min	95.58	2.96	94.70	2.87	0.121

20min	93.74	3.001	93.11	2.59	0.192
30min	91.72	2.98	93.51	2.96	0.011*
60 min	89.76	3.406	92.20	2.906	0.002*
120 min	88.77	2.69	89.82	3.17	0.873

Figure-3

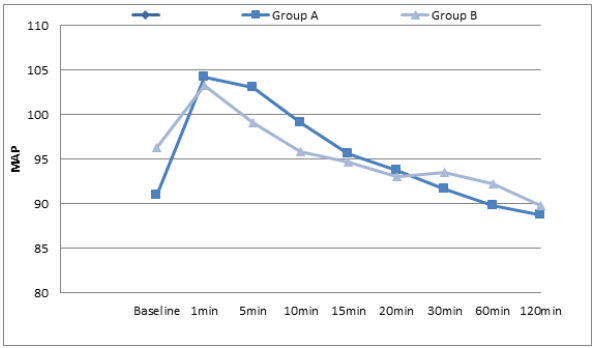


Table-4 Onset of Sensory and Motor block

ONSET (min)	GROUP	N	Mean	SD	p-Value
Sensory Block	Group A	30	7.46	0.93	0.063
	Group B	30	7.8	0.71	
Motor Block	Group A	30	12.7	1.60	0.148
	Group B	30	13.13	1.59	

Table- 5 Shows the description of duration of surgery

	Group	N	Mean	SD	p-value
Duration of Surgery	**Group A**	30	96.33	14.73	0.118
	Group B	30	91.66	15.55	

Table-6 shows analgesia and motor block

Duration (minute)	GROUP	N	Mean	SD	p-Value
Analgesia	Group A	30	433.83	30.50	0.11
	Group B	30	443.50	30.31	
Motor Block	Group A	30	369.16	21.01	0.15
	Group B	30	376.50	33.71	

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