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Original Research Article

Comparative Study of Ropivacaine 0.5% with fentanyl and Bupivacaine 0.5% with fentanyl in Interscalene Brachial Plexus Block

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Abstract

Aim and Objective: Aim of the present study was to compare the clinical characteristics of ropivacaine 0.5% and bupivacaine 0.5% with fentanyl when used for interscalene brachial plexus block.

Methodology: In this prospective randomized double blind study, 60 patients were randomly divided into two groups, group BF-bopivacaine with fentanyl and group RF-ropivacaine with fentanyl. Effects in terms of onset, duration and quality of sensory and motor blockade, pulse and blood pressure, respiration were monitored and complications of interscalene brachial plexus block were also noted.

Results: The mean onset time of sensory and motor blockade was 2.65 and 4.31 minutes in group BF and 4.08 and 6.08 minutes in group RF group respectively. The mean duration of sensory and motor block was 644.44 min and 595.55 min in group BF respectively. Whereas, in group RF the mean duration of sensory and motor block was 573.46 min and 513.46 min respectively. Mean VAS preoperatively was comparable among two groups perioperatively and till 7 hr after block placement ($p > 0.05$) all patient depicted a VAS score 0 up to 6 hr. The requirement of rescue analgesic was earlier with ropivacaine as compared to bupivacaine.

Conclusion: Ropivacaine has the margin of safety than bupivacaine. Ropivacaine with an almost comparable blockade profile would be the better choice in view of safety of the patient.

Keywords: Interscalene, brachial plexus block, Ropivacaine, Bupivacaine, fentanyl.

1. Introduction

Pain relief is one of the most important challenges of medical sciences and is the primary aim of an anesthesiologist. Regional anaesthesia, particularly peripheral nerve blockage is often used to provide not only for anaesthesia intraoperatively but also for post operative analgesia after limb surgery.[1] Also it decrease adverse effects compared to systemically used opioids and improve patient outcome and satisfaction [2]. Brachial plexus blocks are among the most commonly performed peripheral neural blocks for upper extremity surgeries in clinical practice.[2]

Interscalene nerve block refers to the technique of anesthetizing the roots and or trunks of the brachial plexus in the neck between the anterior and middle scalene muscles. The procedure was first well described and popularized by Alon Winnie in 1970.[3] Interscalene nerve block is typically performed to provide anesthesia and analgesia for surgery of the shoulder and upper arm.[4-6]

Bupivacaine 0.5% has been most frequently used as local anesthetic agent for brachial plexus block for many years because of its favorable ratio of sensory to motor neural block and longer duration of action. However, bupivacaine has disadvantage of cardiac and central nervous system toxic effects in some patients attributed to its high plasma concentration after accidental intravascular administration.[7] Ropivacaine is an amino-amide local anaesthetic agent with chemical structure, onset and duration of action of brachial plexus block similar to that of bupivacaine.[8] Ropivacaine has been shown to produce less cardiotoxic, even with accidental intravascular administration, and central nervous system toxic effects, less motor block and similar duration of sensory analgesia when compared to bupivacaine.[9,10]

A number of opioids have been used as an adjuvant with the local anesthetics into brachial plexus sheath with possibility of increasing duration, quality of analgesia and to reduce dose of local anesthetic agents. Opioids like morphine, tramadol and fentanyl have been added to enhance the blockade characteristics of local anesthetic agent.[11]

In view of the safety profile of ropivacaine compared to bupivacaine, the present study was thus undertaken to compare effects in terms of onset, duration and quality of sensory and motor block of ropivacaine 0.5% with

fentanyl and bupivacaine 0.5% with fentanyl in interscalene brachial plexus block.

2. Material and Methods

A total of 60 patients aged between 20 and 60 years of either sex, weighing between 50 and 70 kgs, with ASA status I and II, posted for elective orthopedic surgeries of upper limb were included in this prospective randomized double blind study after approval by the institutional ethics committee. The procedure to be performed was explained to each patient and an informed consent was taken. Patients not willing to give written consent, an emergency surgery, contraindications for brachial plexus block such as clotting disorders, cutaneous local infections, anomalies of neck and shoulder, fracture clavicle, known allergic to study drug, with existing cardiovascular and CNS disorders, on psychiatric medications, pregnant and lactating women were excluded from the study. The subjects were randomly divided into two equal groups: Group BF – received 30 ml of injection Bupivacaine 0.5% plus inj Fentanyl 1 mcg/kg (diluted with 0.9% normal saline to make total volume 32 ml) and Group RF – received 30ml of injection Ropivacaine 0.5% plus inj Fentanyl 1 mcg/kg (diluted with 0.9% normal saline to make total volume 32ml). A detailed history was taken and the patients were thoroughly examined on the previous day before the surgery.

Pre-operative pulse rate, blood pressure, respiratory rate, and SPO_2 were noted in pre-anesthetic preparation room. Pre-operative visual analogue score (VAS) was noted. NBM status was confirmed. Before establishing the anesthetic block, intravenous cannula 20G was placed in the opposite hand and IV fluid Ringer lactate was started. The study drug was provided in non-identified syringes, labeled with patient's study number, prepared by another anesthesiologist, not related to this study.

Interscalene block was given by eliciting parasthesia using lower interscalene approach, which consists of inserting the needle more caudally than in the commonly described procedure performed at the level of the cricoid cartilage (Winne procedure). Patient was placed in supine position with the head extended and rotated to contralateral side; arm to be anesthetized was pronated and directed to ipsilateral knee. Under aseptic precautions area was prepared and draped. The posterior border of sternocleidomastoid can be easily palpated when the patient raises head slightly, palpate immediately lateral to sternocleidomastoid for anterior scalene muscle, lateral to it is middle scalene muscle and in between is interscalene groove. In many of the patients, external jugular vein crosses the groove. Sniffing forcefully by patients was helps in easy visualization and palpation of groove.

Stretch the skin gently between two fingers to ensure accuracy in needle placement. 22G needle is inserted 3-4 cm above the clavicle and advanced at an angle perpendicular to the skin in medial, caudal and slightly dorsal direction. The needle is advanced slowly until stimulation of the brachial plexus leading to parasthesia of arm, forearm occurs then needle is stabilized and aspiration was attempted to exclude intravascular needle placement and study drug was injected slowly with repeated aspiration of every 2 ml to rule out accidental intravascular injection. The time of drug injection was noted and other parameters of blockade were evaluated. The four nerves representing upper, middle and lower trunk were evaluated for both sensory and motor blockade. Sensory and motor block was assessed by Hollmen scale.

The parameters noted were onset, time of completion, quality and total duration of sensory and motor block. The duration and quality analgesia along with total duration of surgery was also noted. VAS score was assessed pre-operatively, intra-operatively every 30 min and hourly post-operatively. It was measured from no pain point to the pain estimate on 0 to 4 scales. The patients were observed for vital parameters and any complications postoperatively.

3. Results

After studying 60 cases, the observation and results were summarized in tabulated form. Table 1 shows the distribution of patients according to mean age and mean weight with standard deviation and sex incidence of patients in both the groups with no significant difference.

Table 1: Demographic data of the patients

Variables	Group BF	Group RF	P value
Age (years)	39.5± 9.36	35.5±10.8	0.1279
Weight (kg)	62.4±7.13	61.2±7.06	0.587
Sex ratio (M:F)	1.72:1	1.5:1	0.398

The results regarding characteristics of subarachnoid (sensory and motor) blockade were depicted in Table 2. Ropivacaine has slightly delayed onset of sensory and motor block compared to bupivacaine. In the present study, onset of sensory block preceded the onset of motor block. Time to achieve complete sensory and motor block was slightly delayed with rovivacaine. However mean time to achieve complete sensory block was also less than the time to achieve complete motor blockade in all the patients. The mean duration of sensory and motor block was significantly longer in group BF than group RF ($p < 0.001$). The duration of sensory block is comparatively less with ropivacaine 0.5% compared to bupivacaine 0.5%. Ropivacaine has slightly shorter duration of sensory and motor block as compared to bupivacaine, (Table 2).

Table 2: Summary of results regarding characteristics of spinal blockade

Characteristics (min)	Group BF	Group RF	p-value
Onset of sensory block	2.65±0.570	4.08±0.501	<0.0001
Onset of motor block	4.31±0.49	6.08±0.58	
Time to achieve complete sensory block	13.8±1.37	16.6±1.11	
Time to achieve complete motor block	20.1±1.63	23.9±1.25	
Duration of sensory block	644.44±29.85	573.46±26.74	
Duration of motor block	595.55±32.35	513.46±24	

Table 3 shows the quality of sensory and motor block, was graded from I to IV according to Hollmen scale. Ropivacaine and bupivacaine produced almost similar quality of sensory and motor block but quality of the block was slightly better with bupivacaine.

Table 3: Quality of sensory and motor block

Grade (Hollmen Scale)	Quality of sensory block			Quality of motor block		
	Group BF	Group RF	P value	Group BF	Group RF	P value
I	0	0	-	0	0	=
II	3	4	0.3436	3	4	0.3436
III	5	7	0.2593	19	16	0.2161
IV	22	19	0.2025	8	10	0.2866

Mean VAS was comparable among two groups preoperatively and till 7 hr after block placement ($p > 0.05$) all patient depicted a VAS score 0 up to 6 hr. The requirement of rescue analgesic was earlier with ropivacaine as compared to bupivacaine. Ropivacaine or bupivacaine did not have any significant effect on pulse rate, blood pressure, respiratory rate and on percentage of oxygen saturation when used in interscalene brachial plexus block. In the present study in group BF, three patients required general anesthesia due to failure of block and five patients required sedation intra-operatively. In group RF, four patients required general anesthesia due to failure of block and seven patients required sedation intra-operatively. The difference was statistically not significant between two groups ($p>0.05$).

4. Discussion

Interscalene approach is widely used method for anesthesia because, plexus is superficial, easily accessible and there is less chance of pneumothorax. Interscalene approach is used for anesthesia and perioperative pain management in surgery of shoulder joint like, arthroscopy, acromioplasty, rotator cuff injury and fractures of humerus, elbow joint, Other arm surgery that does not involve the medial aspect of the forearm or hand [4-6]. Ropivacaine is a long-acting amide local anaesthetic with a potentially improved safety profile contrasted to bupivacaine.

In the present study, bupivacaine had early onset of sensory and motor block than ropivacaine and the findings were similar to study by Klien *et al* [2]. In our study, onset of sensory block preceded the onset of motor block. The mean time to achieve complete sensory block was also less than the time to achieve complete motor blockade in all the patients and the findings were similar to study by Mageswaran *et al* [12] and Tawfic *et al* [13]. Ropivacaine and bupivacaine produced almost similar quality of sensory and motor block but quality of the block was little better with bupivacaine. Klien *et al* [2] and Hickey *et al* [14] and Eroglu *et al* [15] also reported the same findings. Ropivacaine has slightly shorter duration of sensory and motor block as compared to bupivacaine. Hickey *et al* [14] reported same observations. Also, ropivacaine has shorter duration of analgesia than bupivacaine. The findings were similar with the studies by Mc Glade *et al* [16] and Vaghadia *et al* [17].

The quality of analgesia was measured in terms of mean VAS scores at various time intervals and was comparable till 6 hour of block but after 6^{th} hour difference was significant with more mean VAS score in group RF than group BF. Requirement of rescue analgesia was early in ropivacaine group than bupivacaine group. Hence the quality of analgesia was better with bupivacaine than ropivacaine.

No significant hemodynamic parameters like pulse rate, blood pressure, respiratory rate, SPO_2 fluctuation were noted in both groups after establishment of block, bupivacaine, ropivacaine and fentanyl did not show any significant effect on hemodynamic and respiratory parameters. No side effect related to opioids like nausea, vomiting, drowsiness, pruritus, respiratory depression etc. or related to high blood level of local anaesthetic like arrhythmias, hypotension, bradycardia, drowsiness, perioral numbness, convulsions, and those associated with interscalene brachial plexus block were observed in the present study.

In view of the lesser potential for toxicity of ropivacaine demonstrated in the volunteer studies, ropivacaine may be advantageous in brachial plexus and other regional blocks in which the potential for intravascular injection exists. It has margin of safety than bupivacaine. Hence, to conclude, ropivacaine with an almost comparable blockade profile would be the better choice in view of safety profile of ropivacaine.

5. Conclusion

Ropivacine has a slower onset, completion and little shorter duration of sensory and motor block than bupivacaine, quality of sensory and motor block was almost comparable without any significant changes in vital parameters.

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