Review Article

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Comparative Assessment of Bupivacaine and Ropivacaine in Upper Limb Surgeries

Venus Sharma[1], Mamta Goda[2], Vineeta Goda[3]

Author's Affiliation: [1,3]Assistant Professor, Department of Anesthesia, Pacific Institute of Medical Sciences, Udaipur, Rajasthan 313015. [2]Medical Officer, Department of Anesthesia, Government Medical College, Dungarpur, Rajasthan 314001, India.

Abstract

Overview: The advent of modern methodologies led to the development of better analgesic and operative techniques. The block technique has been effectively employed since a long time. The present study was formulated to ascertain if any specific drug among the selected ones have a better efficacy in upper limb surgeries.

Methodology: The present study employed a pool of 60 subjects who were randomly divided in two groups. The subjects were evaluated for operative and post operative parameters after administration of Ropivacaine and Bupivacaine respectively.

Results: The study showed a shorter time for induction and regression of both motor and sensory block in Ropivacaine subjects, while Bupivacaine had a longer duration of action.

Conclusion: Ropivacaine proved more efficacious as compared to Bupivacaine.

Keywords: Axillary block; Brachial plexus; Bupivacaine; Forearm; Ropivacaine.

Introduction

The block technique at level of brachial plexus has been used effectively since its widespread acceptance almost a decade back. It has been shown to have an effective level of analgesia at the intra-operative and post-operative stages, providing a surgically efficient scenario for both the anesthetist as well as the surgeon.[1] The drug bupivacaine offers the advantage of a longer duration of nerve block as well as a more appreciative sensory to motor nerve block ratio as compared to older formulations.[2]

The primary mechanism through which bupivacaine acts is by eliciting its depolarizing prevention action through bindings at the intra-cellular sections of the Sodium channels and thereby blocking sodium ions transport inside the cellular matrix. This leads to a disruption in nerve impulse conduction and causes the analgesia. The metabolism of bupivacaine occurs through the glucuronic acid cycle in the liver. Despite this some level of accumulative toxicity was noted in bupivacaine use especially in the cardiac and nervous system tissues.[3,4]

Similar to bupivacaine is a similar amide anesthetic formulation called as Ropivacaine. This is a long acting local anesthetic having a record of lower adverse events as compared to the older

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Corresponding Author: Vineeta Goda, Assistant Professor, Department of Anesthesia, Pacific Institute of Medical Sciences, Udaipur, Rajasthan 313015, India.

Email: vineeta7goda@gmail.com

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bupivacaine.[5] The advantage of ropivacaine also lies in its lower lipophilic nature, which leads to a decreased infiltration along the myelin coated motor fibres. This in turn will cause a reduction in the strength of motor block, while providing a equal or marginally superior sensory block. The postulated cause for this selective motor fibre exclusion is thought to be due to the stereo-selective nature of ropivacaine to target specific pain transmitting fibres.[6]

There have been a few studies on the comparative activity of both ropivacaine and bupivacaine in obstetric as well as laparoscopic cases. The studies have reported that the number of adverse effects on the nervous systems and cardiac activity is lower with ropivacaine as compared to bupivacaine.[7]

Methodology

The present study is a prospective randomized study conducted in the department of anesthesia at Pacific Institute of Medical sciences, Udaipur, Rajasthan over a period of 1 year from January to December 2020. The study included subjects who fulfilled the inclusion criteria and consented for participation. Institutional ethical clearance was obtained prior to commencement of the study.

Inclusion Criteria

- Adult patient above 18 years and below 60 years.
- ASA grades as 1 or 2.
- Elective Surgery cases under brachial plexus block.
- No contraindications for use of anesthetics.

All patients were counselled regarding the study and its objectives. They were made to sign written informed consent forms as well as participant information sheets detailing that their identity and personal details will not be shared. The patients were also apprised of the option to opt out of the study at any stage without compromising their treatment. The total patient sample size was 60 subjects.

The patients were randomly divided into two groups using computerized randomization table.

a. Group B (n=30): Patients proposed to undergo upper limb surgery under brachial plexus block using 30 ml of 0.5% bupivacaine.
b. Group R (n=30): Patients proposed to undergo upper limb surgery under brachial plexus block using 30 ml of 0.5% ropivacaine.

All the patients were asked to remain nil orally 6-8 h prior to surgery.

On the day of surgery patients were admitted to the monitored preoperative holding area and were premedicated with 2 mg of Midazolam intravenously. The operative arm was positioned to expose the axilla. The axilla was prepared using aseptic technique and then axillary artery was identified by palpation.

The skin was anaesthetized with 1ml of 1% lidocaine solution. A 11/4 inch 22 G needle was inserted through the area of anesthetized skin into and through the axillary artery until it is noted that no blood could be aspirated through the needle. This negative aspiration indicated that needle was positioned beyond the posterior wall of the artery and in the brachial plexus sheath, 1ml of test solution was injected to rule out possible intravascular placement of the needle. All subjects were observed for possible intravascular placement of the needle for approx. 1 min following the injection of test solution and then the remaining 30ml of the solution was administered in 5 ml increments following aspiration. The needle was removed and firm digital pressure with gauze piece was held at the site for 5 min to assist in proximal spread of the anaesthetic solution.

Sensory and motor block were evaluated preoperatively to determine a baseline and every 5 min for 30 min or until onset of blockade was noted and thereafter every 60 min

Sensory block was assessed by the pinprick method (22G hypodermic needle). Assessment of sensory block was done in the dermatomal areas corresponding to median nerve, radial nerve, ulnar nerve and musculocutaneous nerve till complete sensory blockade was achieved. Sensory onset was considered when there was a dull sensation to pinprick along the distribution of any of the above-mentioned nerves. Complete sensory block was considered when there was complete loss of sensation to pinprick.[8]

Sensory block was graded as:

Grade 0: Sharp pin felt

Grade 1: Analgesia, dull sensation felt

Grade 2: Anaesthesia, no sensation felt.

A modified Bromage Scale for the upper extremity was used to assess motor function. This scale consists of the following four scores: [9]

- 0 - able to raise the extended arm to 90o for a full 2 sec
- 1 - able to flex the elbow and move the fingers but unable to raise the extended arm.

- 2 - unable to flex the elbow but able to move the fingers
- 3 - unable to move the arm, elbow or fingers

Onset of motor blockade was considered when there was Grade 1 motor blockade. Peak motor block was considered when there was Grade 3 motor blockade.

Block was considered to have failed when sensory anaesthesia was not achieved within 30 min. General anaesthesia was given subsequently to these patients who were then excluded from the study.

Haemodynamic parameters and vitals (Blood pressure, Heart rate, Respiratory rate and Oxygen saturation) were also monitored during the procedure.

Duration of analgesia was assessed by using a 10 point Visual Analogue Scale (VAS)

Duration of sensory block was determined by noting the time when there was return of dull sensation to pin prick and duration of motor blockade was determined by noting the time the patients could first move their fingers.

Side effects such as bradycardia, hypotension, headache and convulsions were looked for.

Observations

The present study was undertaken with an aim to compare the efficacy of Bupivacaine and Ropivacaine for brachial plexus block among patients undergoing upper limb surgery. The demographic details revealed a higher percentage of men in both the sample sub groups. The mean age of the participants was 38.69 ± 14.66 years. There were no discernible statistically significant differences in the weight and age of the participants

The operative assessment revealed that Group R had an earlier onset of sensory block as compared to the Group B. The Group R had a onset of sensory block at 5 mins while Group B had initiation of sensory block at 10 mins. At 10 mins, Group R had achieved a Grade 2 sensory block, while it was still at Grade 1 in Group B. This displayed a statistically significant difference between the two drugs. The regression of sensory block also showed a similar pattern. In the assessment at 7 and 8 hrs, the block had regressed to Grade 0 in Group R, while group B had a mixed block of Grade 1 and 2 in the same duration. Total removal of sensory block in Group B was noted at 9 hours post initiation. (Table 01)

Table 1: Average durations of Sensory Block.

	Time to Onset (mins)	Duration of Block	P value
Group B	13.56 ± 4.16	446 ± 62.6	<0.05
Group R	6.77 ± 1.86	410 ± 31.67	<0.05

In terms of motor block, it was seen that Group R had an onset of motor block at 5 min interval, while Group B had a initiation at 15 mins duration. Till 15 minutes, the mean grade of motor blockade was at 0 in Group B, while in group R mean motor block grade was at 3 in the same time frame. The regressions of motor block showed that Group R was faster in regression. At 6 hours, the mean level of motor block was grade 2 in group R, while group B showed a mean grade of 3. Complete regression was seen in Group R at 7 hrs, while in Group B it took 8 hrs.

Table 2: Average durations of Motor Block.

	Time to Onset (mins)	Duration of Block	P value
Group B	21.56 ± 6.23	410± 41.44	<0.05
Group R	5.67 ± 1.22	382± 29.33	<0.05

In terms of analgesia requirements for post operative care as well as corelations with visual analog scales obtained from patients, it was noted that there were no significant differences in pain levels among the two subgroups.

Similarly an non significant elevation in hemodynamic parameters was noted between the two subgroups.

None of the subjects exhibited any adverse reactions or side effects in the operative or post operative period.

Discussion

Inspite of different approaches available, the practice of using a axillary block is a commonly and standardized technique for various orthopaedic and surgical procedures of the upper limbs.[10] Studies have displayed the effectiveness of using regional anaesthesia as a modality that offers better outcome in the operative and post operative stage to both the patient and the surgeon. The added bonus of a reduced stress of general anaesthesia and its complications has been the reason for wide acceptability of this technique.[11,12]

Among the agents used for regional anaesthesia, bupivacaine has been widely recommended due to a longer duration of activity and good sensory as well as motor block. The major disadvantage though has been the incidence of its toxicity related

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complications. These complications are more often seen when the dosage is higher as in the case of post-operative infusions for analgesia.[2]

In the present study we observed that the onset of sensory block was faster and earlier in subjects who were administered Ropivacaine as compared to Bupivacaine. This onset difference was statistically significant denoting that the quality of sensory block as well as onset was better when the newer drug is used. This is in agreement with studies by authors such as Bertini et al, Mc Glade et al, Klein et al and Kaur A et al.[1, 7, 12-13]

In the present study, the peak sensory block was achieved in both sub groups at 25 min duration but the onset was faster in the sub group subjected to ropivacaine. There have been reports of studies detailing a lower or equivalent efficiency of ropivacaine. Mageswaran and Choy et al reported a mean onset time for sensory block to be 13.5±2.9 min in ropivacaine group as compared to 11.1±2.6 min in levobupivacaine group using infraclavicular approach among a mixed sample population in elective as well as emergency orthopaedic surgery patients.[14]

The present study is in concurrence with findings on motor block as reported by Klein et al and Mc Glade et al. The authors reported that shorter duration of block in Ropivacaine administered cases as compared to Bupivacaine. This indicates that thought the mean duration of analgesia is longer in Bupivacaine, The time of onset is shorter in shorter in ropivacaine.[7,12]

In present study, no difference in VAS scores between two groups was observed at any post-operative time interval. Similarly, no significant difference between two groups was observed for mean duration of analgesic effect. This is in concurrence with studies by Thornton et al., and Mageswaran and Choy et al.[14,15]

Both the groups had good hemodynamic control throughout the study duration and did not show a significant difference at any time interval. No adverse effects of the two drugs on hemodynamic has been reported at the dosages used in present study and our results are also in accordance with the findings reported.

Conclusion

We conclude that in accordance with various above mentioned studies, ropivacaine has proved a faster onset in both sensory and motor block in upper limb surgeries as compared with bupivacaine. This gives an advantage to ropivacaine in terms of a superior quality of analgesia and can be a viable and safer alternative to bupivacaine.

The study is limited by a small sample size and would be better applied to a wider population base if a larger long term study is conducted.

Conflict of Interest: Nil

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