

A Comparative Study Of 0.5% Bupivacaine Vs 0.75% Ropivacaine For Analgesic Efficacy Under Supraclavicular Brachial Plexus Block

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Abstract:

Background: Brachial plexus block (BPB) is a widely utilized regional anaesthesia technique for upper limb surgeries, offering effective intraoperative anaesthesia and postoperative analgesia. The supraclavicular approach is particularly favoured due to its rapid onset and dense blockade, making it suitable for procedures involving the arm, forearm, and hand. Recent studies have explored variations in SBPB techniques to enhance efficacy and safety. For instance, the intertruncal approach, targeting the divisions between the trunks of the brachial plexus, has been investigated for its potential to provide effective anesthesia with possibly reduced complication rates. We compared the duration of analgesic efficacy for supraclavicular brachial plexus procedures using 30 ml of Bupivacaine 0.5% and 30 ml of Ropivacaine 0.75% in this study.

Materials and Methods: In this prospective randomized controlled study, 50 patients of ASA physical status I and II belonging to age group of 18-60 years undergoing elective upper limb surgery under supraclavicular brachial plexus procedures were randomly allocated into 2 groups of 25 patients each, Group A was given 30 ml of 0.5% injection Bupivacaine. And Group B was given 30 ml of 0.75% injection Ropivacaine. The onset and duration of sensory and motor blockade, duration of postoperative analgesia, side-effects and haemodynamic parameters were compared between the groups.

Results: Ropivacaine (0.75%) exhibited a significantly faster onset of sensory and motor blockade than bupivacaine (0.5%) ($p=0.00$). Sensory block duration was significantly longer with ropivacaine ($p=0.04$), while motor block duration was comparable. Postoperative analgesia lasted longer with ropivacaine ($p=0.04$). Both drugs maintained stable hemodynamic parameters ($p>0.05$).

Conclusion: This study confirms that 0.75% ropivacaine provides a faster onset of sensory and motor blockade, a longer duration of sensory blockade, and superior postoperative analgesia compared to 0.5% bupivacaine for supraclavicular brachial plexus block.

Key Word: Supraclavicular brachial plexus block; Bupivacaine; Ropivacaine; Analgesic efficacy.

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I. Introduction

Regional anaesthesia has an important place in anaesthesia, both as an integral component of anaesthetic technique and post-operative analgesia. The advancements in technique, equipment's and our understanding of the indication has increased the practice of regional anaesthesia. Long lasting pain relief, low incidence of post operative nausea and vomiting, sparing of airway and early hospital discharge are some of the clinical advantages which merit the use of regional anaesthesia among patients (1).

Brachial plexus block (BPB) is a widely utilized regional anaesthesia technique for upper limb surgeries, offering effective intraoperative anaesthesia and postoperative analgesia. The supraclavicular approach is particularly favoured due to its rapid onset and dense blockade, making it suitable for procedures involving the arm, forearm, and hand (2).

Supraclavicular brachial plexus block is a widely utilized regional anesthesia technique for upper limb surgeries, offering effective anesthesia and postoperative analgesia. Supraclavicular brachial plexus block (SBPB) is a regional anesthesia technique that provides effective anesthesia and analgesia for surgeries of the upper extremity, particularly from the mid-humerus to the hand. First introduced by Kulenkampff in 1911, the technique has evolved significantly, especially with the advent of ultrasound guidance, enhancing both its safety and efficacy (3).

SBPB offers several advantages:

Rapid Onset and Dense Blockade: Due to the compact arrangement of nerve fibers at this level, SBPB provides a quick onset of anesthesia with dense sensory and motor blockade (4).

Reduced Local Anesthetic Requirement: Ultrasound guidance allows for precise deposition of anesthetic, potentially reducing the volume required to achieve effective blockade (5).

High Success Rate: The proximity of the brachial plexus at the supraclavicular level results in a reliable and consistent block, suitable for a wide range of upper limb surgeries (6).

Recent studies have explored variations in SBPB techniques to enhance efficacy and safety. For instance, the intertruncal approach, targeting the divisions between the trunks of the brachial plexus, has been investigated for its potential to provide effective anesthesia with possibly reduced complication rates (7). We compared the duration of analgesic efficacy for supraclavicular brachial plexus procedures using 30 ml of Bupivacaine 0.5% and 30 ml of Ropivacaine 0.75% in this study

II. Material And Methods

Study design: A prospective, randomized clinical Study:

The patients were split into two separate groups of thirty each, and local anaesthetic medications were given via supraclavicular brachial plexus block as described below.

- Group A was given 30 ml of 0.5% injection Bupivacaine.
- Group B was given 30 ml of 0.75% injection Ropivacaine.

Study duration: 1 year

Study area- KATIHAR MEDICAL COLLEGE, KATIHAR

Study population- Patients scheduled for elective upper limb surgeries

- **Inclusion criteria.**

- ✓ Patients of any sex who fall between the ages of 18 and 60.
- ✓ ASA risk category I and II.
- ✓ Scheduled for elective surgery under brachial plexus block
- ✓ There was no prior history of allergy or reaction to any of the tested local anaesthetics.

- **Exclusion criteria.**

- ✓ Patients who did not give consent.
- ✓ People who suffer from severe cardiac, renal, endocrine, or pulmonary disorders.
- ✓ Patients in physical status ASA grade 3 or higher.
- ✓ Patients who have localised skin infections at the injection site.
- ✓ Patients taking anticoagulants, powerful antiplatelets, or those who have coagulopathy.
- ✓ Patients allergic to the trial drugs.
- ✓ patients who had surgery on the side opposite to their hemi diaphragmatic paralysis.
- ✓ Patients who suffer from psychological illnesses.

Sample Size- Required sample size per group = 25

Parameters studied-

- ✓ Onset time of Sensory blockade.
- ✓ Onset time of Motor blockade
- ✓ Duration of Sensory blockade
- ✓ Duration of the Motor blockade
- ✓ Duration of Analgesia

Study Tool-

- ✓ Antiseptic solution
- ✓ Two 20-mL syringes with desired local anaesthetic solution
- ✓ A 2-mL syringe and a 27-gauge needle with local anaesthetic (1-2% Lignocaine) for skin infiltration.
- ✓ A 5-cm, 22-gauge, short bevel, insulated needle.
- ✓ Peripheral nerve stimulator.

- ✓ Gauze pieces and sterile towel for draping.
- ✓ All equipment and drugs necessary for resuscitation should be kept at hand.
- ✓ Monitoring equipment.

Drugs-

- ✓ Injection 0.5% Bupivacaine
- ✓ Injection 0.75% Ropivacaine

Study Technique- The Hospital Ethical Committee's approval was sought prior to starting the study. 50 participants with ASA I and ASA II participated in the trial. The study did not accept participants who were contraindicated for brachial plexus block.

Preanesthetic preparations

Every case was subjected to a pre-anesthetic assessment after going through the medical history. A complete systemic examination was carried out to identify any systemic disorders that may be present. As required, routine and unique investigations were carried out. To rule out any indications of infection, prior damage, or past deformity, a local examination of the block site was carried out. Patients were kept off oral nutrition six to eight hours prior to the regional block.

The patient was educated about the block technique and given a chance to write down their agreement. As soon as the patient enters the operation room, multiparameter monitors were used to record baseline values for their respiration rate, pulse rate, noninvasive blood pressure, SPO₂, and ECG. The 18G venous cannula used to attach the intravenous line was used to administer any necessary intravenous fluids to the patients.

Landmarks and Patient Positioning.

The patient was seated with one shoulder pushed down and the other shoulder turned away from the restricted location. The major anatomical features for this block are the clavicle and the location of the sternocleidomastoid muscle's lateral insertion. Light premedication (e.g., 0.2 mg/kg Midazolam and 0.5–1 mg/kg IV Fentanyl) will be given.

Technique.

After appropriate positioning of the patient the subclavian artery was palpated 1cm above the midpoint of the clavicle. An insulated 1.5inch 25G needle was introduced just lateral to the subclavian pulsation in backward, downward and medial direction. The nerve stimulator is connected to the stimulating needle and set to deliver a 0.8 to 1.0 mA current at 1 Hz frequency and 0.1 ms of pulse duration. Once the contraction of muscle below the deltoid in the upper extremity was observed, intensity of current was decreased in 0.02mA decrements while advancing the needle, until maximum contraction is elicited with minimal possible current. This technique ensures close proximity of the needle tip to the brachial plexus. At this point, 30 ml of the drug was injected after gentle aspiration as per the group assigned.

All patients were continuously monitored for pulse rate, BP, respiratory rate and oxygen saturation. After completion of the surgery patients will be observed in the recovery room and ward.

Assessment of the block

Sensory and motor blockades were monitored every two minutes for the first 15 minutes, then every five minutes for the remaining 30 minutes.

Sensory Blockade

- (i) The sensory block was assessed following the drug injection in the dermatomal regions of the median, radial, ulnar, and musculocutaneous nerves.
- (ii) The Hollmen scale, which is a three-point scale based on pinprick testing, was used to assess sensory block: 0 – Sharp pain; 1 – Dull pain (analgesia); 2 – No pain (anaesthesia).
- (iii) The commencement of sensory block was taken into consideration when there is total lack of sensation to a pin prick.

Motor Blockade.

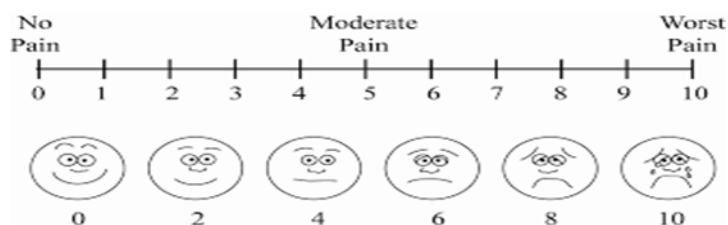
- (i) The beginning of the motor blockade is defined as the period of time between the injection and the patient's inability to raise their hand or move their fingers.
- (ii) The following motor functions were tested for motor block using the Modified Bromage scale every two minutes for the first 15 minutes:
 - ✓ Flexion of elbow and pronation of forearm (musculocutaneous nerves)

- ✓ Extension of the elbow, wrist and thumb abduction (radial nerve)
- ✓ Opposition of thumb and index finger (median nerve)
- ✓ Thumb adduction (ulnar nerve).

(iii) According to the Modified Bromage scale, motor block was evaluated:

- ✓ 0 is No Block (full muscle activity)
- ✓ 1 – Partial Block (decreased muscle activity)
- ✓ 2 – Complete Block (no muscle activity).

Postoperatively, pain was assessed using a visual analog scale(VAS) score explained to the patient preoperatively where 0 represented no pain and 10 meant worst possible pain



Postoperatively, when VAS score equal to or more than 5, injection diclofenac sodium 1 mg/kg IV was given as rescue analgesic.

Statistical Analysis

After completion of the assessment, data was unblinded and entered into the statistical software package SPSS16 for Windows. Data have been summarized by routine descriptive statistics. Numerical variables were compared between groups by independent samples t-test. Categorical variables like ASA status, sex, postoperative analgesic requirement and adverse effects were compared between groups by Chi-square test. All the values were expressed as Mean $\pm$ Standard deviation, statistical comparison was performed by Student's t-test. A two-tailed p-value of >0.05 was considered to be statistically not significant, a p-value of <0.05 as statistically significant, a p-value of <0.01 as statistically highly significant a p value of <0.001 as statistically very highly significant.

III. Result

Males constituted 76% in the bupivacaine group and 64% in the ropivacaine group, while females were 24% and 36%, respectively. This distribution does not indicate a significant gender-based effect on outcomes. ASA status distribution, with similar percentages in both groups (ASA I: ~50%, ASA II: ~50%). The mean age was 40.28 ± 17.52 years in the bupivacaine group and 38.84 ± 10.50 years in the ropivacaine group, with no significant difference ($p=0.75$).

Table no 1: Comparison of mean Sensory Onset Time (mins) and mean Motor Onset Time (mins) in two groups

Group Statistics	Group	N	Mean	Std. Deviation	Std. Error Mean	p-value
SOT (min)	B	25	23.680	3.2368	.6474	0.00
	R	25	13.160	2.6564	.5313	
MOT (min)	B	25	25.040	3.2975	.6595	0.00
	R	25	18.040	2.3180	.4636	

The mean sensory onset time was significantly shorter in the ropivacaine group (13.16 ± 2.65 min) compared to the bupivacaine group (23.68 ± 3.23 min, $p=0.00$), indicating a faster onset with ropivacaine. Motor onset time was also significantly shorter in the ropivacaine group (18.04 ± 2.31 min) versus the bupivacaine group (25.04 ± 3.29 min, $p=0.00$). The mean duration of surgery in Group B was 99.2 minutes and group R was 91.2 minutes. Both were comparable statistically ($p\text{-value} > 0.05$).

Table no 2: Comparison of mean Duration of Sensory Block (mins) and mean Duration of motor block (mins) in two groups

Group Statistics	Group	N	Mean	Std. Deviation	Std. Error Mean	p-value
Duration of sensory block (min)	B	25	676.400	111.9014	22.3803	0.04
	R	25	719.000	37.0810	7.4162	
Duration of motor block (min)	B	25	637.320	92.5427	18.5085	0.78
	R	25	646.600	37.4700	7.4940	

Duration of sensory block was significantly longer in the ropivacaine group (719 ± 37 min) compared to bupivacaine (676.4 ± 111.9 min, $p=0.04$). Duration of motor block was comparable between groups (646.6 ± 37.4 min vs. 637.3 ± 92.5 min, $p=0.78$).

Duration of post-operative analgesia was longer with ropivacaine (746 ± 39.6 min) compared to bupivacaine (697.08 ± 112.4 min, $p=0.04$), suggesting superior analgesic duration with ropivacaine.

Figure 1: Comparison of trend of mean heart rate in both the groups

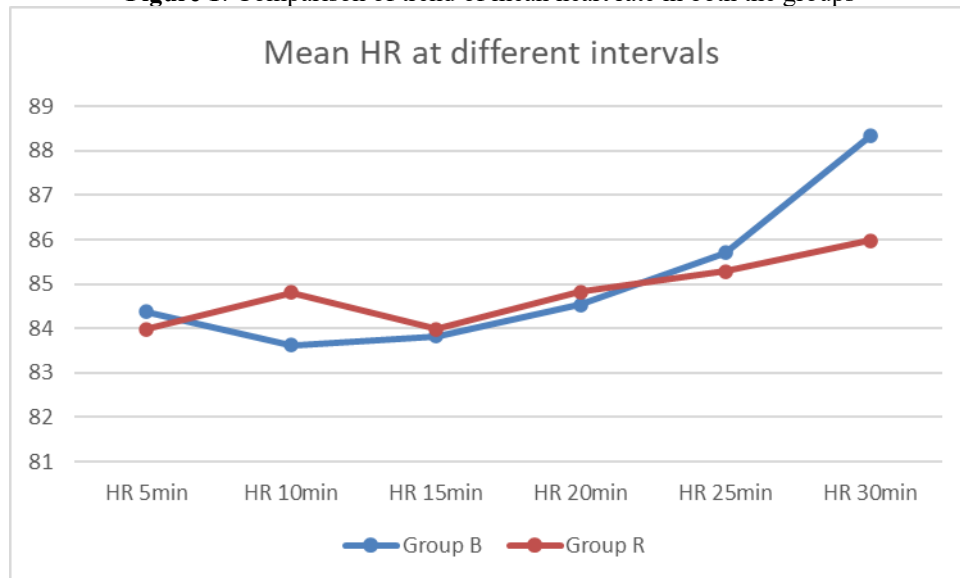
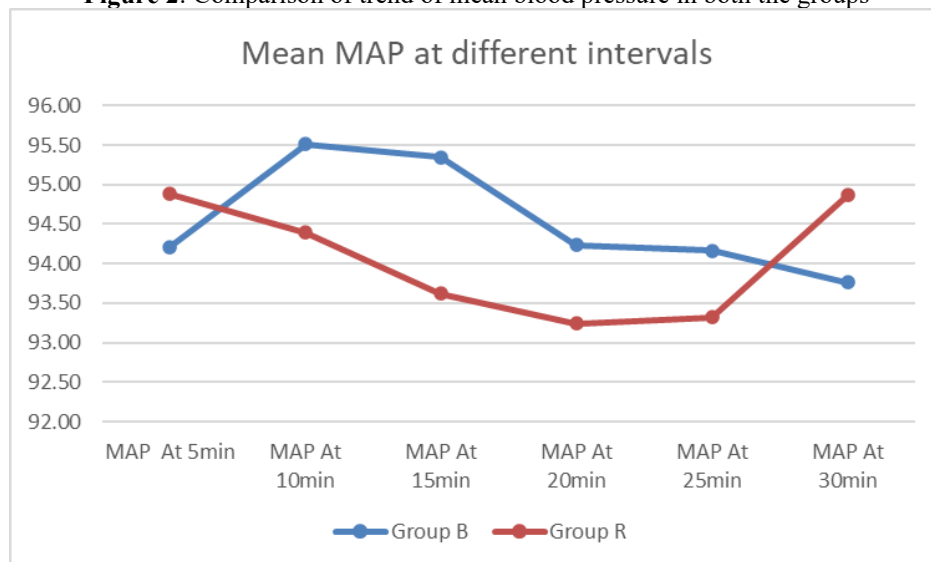


Figure 2: Comparison of trend of mean blood pressure in both the groups



No significant differences were observed in heart rate (HR) or blood pressure (BP) trends between the two groups during the perioperative period. This indicates both techniques maintain similar hemodynamic profiles.

IV. Discussion

The study was a prospective, randomized study carried out at Katihar Medical College & Hospital Bihar. Fifty ASA 1 and ASA 2 patients undergoing elective upper limb surgeries lasting more than 30 minutes were included in the study. Patients were divided into 2 groups of 25 each. (Group A and Group B).

Group A received supraclavicular Brachial plexus block with 30 ml of 0.5% Bupivacaine. Group B received supraclavicular Brachial plexus block with 30 ml of 0.75% Ropivacaine. Parameters observed included Onset time of sensory block, Onset time of Motor block, Duration of Sensory block, Duration of Motor block, Duration of Analgesia and Side effects.

The findings of this study reinforce the advantages of 0.75% ropivacaine over 0.5% bupivacaine in supraclavicular brachial plexus block. The significantly faster onset of sensory and motor blockade with ropivacaine ($p=0.00$) is in agreement with studies by Gahlot et al. (2024) and Wu (2023), which also reported quicker onset times. This can be attributed to the differential pharmacokinetic properties of ropivacaine, which facilitate a faster diffusion into nerve fibers (8,9). The longer sensory blockade duration observed with ropivacaine ($p=0.04$) is consistent with the results reported by Venkatesh et al. (2016) (10), where 0.75% ropivacaine demonstrated prolonged sensory effects compared to 0.5% bupivacaine. Interestingly, motor blockade duration remained comparable between the two groups ($p=0.78$), supporting findings by Shivakumara et al. (2021) (11) and Joshi (2021) (12), who suggested that while ropivacaine provides effective sensory blockade, it facilitates early motor recovery, making it a preferred choice for procedures requiring postoperative mobility. Additionally, our study observed extended postoperative analgesia with ropivacaine ($p=0.04$), aligning with reports by Kumari et al. (2017) (13) indicating that ropivacaine provides superior pain relief without increasing adverse effects. Hemodynamic parameters remained stable across both groups, confirming findings from Tripathi et al. (2012) (14) and Casati et al. (1999) (15), who also reported minimal cardiovascular variations with these agents. These findings collectively support the growing preference for ropivacaine as an alternative to bupivacaine due to its favorable safety profile, reduced motor blockade duration, and prolonged analgesic effect, making it an ideal choice for outpatient and ambulatory settings.

Our study included 50 patients, evenly distributed between two groups. The mean age was 40.28 ± 17.52 years in the bupivacaine group and 38.84 ± 10.50 years in the ropivacaine group, with no significant difference ($p=0.75$). Similarly, mean weight was comparable between the groups (70.44 ± 7.21 kg vs. 71.36 ± 6.84 kg, $p=0.89$).

Onset Time: Our study found a significantly faster sensory onset time with 0.75% ropivacaine (13.16 ± 2.65 min) compared to 0.5% bupivacaine (23.68 ± 3.23 min, $p=0.00$). This aligns with findings by Gahlot et al. (2024), who reported an onset time of 6.7 ± 0.63 min with ropivacaine vs. 7.9 ± 0.76 min with bupivacaine ($p>0.05$) (82). Similarly, Wu (2023) confirmed that 0.75% ropivacaine provides a faster onset than 0.5% bupivacaine (9).

Duration of Sensory Block: In our study, ropivacaine provided a longer sensory blockade duration (719 ± 37 min) than bupivacaine (676.4 ± 111.9 min, $p=0.04$). This is in agreement with findings from Venkatesh et al. (2016), who observed 721 ± 45 min with ropivacaine versus 685 ± 50 min with bupivacaine ($p=0.02$) (10).

Duration of Motor Block: The motor blockade duration was comparable between the two groups (646.6 ± 37.4 min vs. 637.3 ± 92.5 min, $p=0.78$). Shivakumara et al. (2021) and Joshi (2021) reported similar results, showing no significant motor block prolongation with ropivacaine (11,12).

Postoperative Analgesia: Our study demonstrated prolonged postoperative analgesia with ropivacaine (746 ± 39.6 min) compared to bupivacaine (697.08 ± 112.4 min, $p=0.04$). Similar results were reported by Kumari et al. (2017), who found a mean analgesia duration of 750 ± 35 min with ropivacaine and 710 ± 50 min with bupivacaine (13).

Overall, our findings align with existing literature, reinforcing the benefits of 0.75% ropivacaine in terms of faster onset, prolonged sensory blockade, and extended postoperative analgesia without hemodynamic instability.

Strengths:

Randomized Study Design: The prospective, randomized nature of the study minimizes bias and enhances the reliability of findings. **Use of Standardized Protocols:** A consistent methodology was employed in administering and assessing the block, ensuring comparability of results.

Comparison with Recent Literature: The study's findings align with recent research, reinforcing its validity.

Comprehensive Outcome Assessment: Multiple parameters, including sensory and motor onset, duration of blockade, postoperative analgesia, and hemodynamic changes, were evaluated.

Limitations:

Small Sample Size: The study was conducted on a limited number of patients (50 total), which may limit its generalizability.

Single-Center Study: Conducted at one institution, reducing external validity.

Lack of Long-Term Follow-Up: The study primarily focused on intraoperative and immediate postoperative outcomes, without long-term follow-up on patient recovery and complications.

V. Conclusion

This study confirms that 0.75% ropivacaine provides a faster onset of sensory and motor blockade, a longer duration of sensory blockade, and superior postoperative analgesia compared to 0.5% bupivacaine for supraclavicular brachial plexus block. Both agents demonstrated comparable motor block durations and hemodynamic stability. These findings align with recent literature, reinforcing ropivacaine's efficacy and safety profile as a preferable alternative in regional anesthesia.

References

- [1]. Sarath Surendran, Dhanya Rajeev, Raju Rajan, Et Al., Supraclavicular Brachial Plexus Block By PNS Or USG, An Observational Cross -Sectional Study, 10.7860/JCDR/2022/59153.17173
- [2]. Franco CD, Vieira ZE. Supraclavicular Brachial Plexus Block: What's The Best Technique? Reg Anesth Pain Med. 2000; 25 (4): 306-310.
- [3]. Duggan E, El-Beheiry H, Perlas A, Lupu CM, Nuica A, Chan VW. Ultrasound-Guided Supraclavicular Block Performance In Trainees: A Randomized Trial. Br J Anaesth. 2009;102(5):633-638.
- [4]. Karmakar MK, Kwok WH, Ho AM. Ultrasound-Guided Supraclavicular Brachial Plexus Block. Anesth Analg. 2002;94(1):119-123.
- [5]. Williams SR, Chovinard P, Arcand G, Et Al. Ultrasound Guidance Speeds Execution And Improves The Quality Of Supraclavicular Block. Anesth Analg. 2003;97(5):1518-1523.
- [6]. Siddiqui AK, Khan FA. Ultrasound-Guided Supraclavicular Brachial Plexus Block For Upper Limb Surgery: A Randomized Trial Of Two Techniques. Saudi J Anaesth. 2010;4(2):55-59
- [7]. Kang RA, Chung YH, Ko JS, Et Al. Reduced Hemidiaphragmatic Paresis With A "Corner Pocket" Technique For Supraclavicular Brachial Plexus Block: Single- Center, Observer-Blinded, Randomized Controlled Trial. Reg Anesth Pain Med. 2018;43(7):720-4. <https://doi.org/10.1097/AAP.0000000000000795>
- [8]. Gahlot H , Gaur N , Shazia S , Asad M. Comparative Study Of Analgesic Efficacy Of 0.5% Bupivacaine And 0.75% Ropivacaine In USG Guided Supraclavicular Brachial Plexus Block. Int J Acad Med Pharm 2024; 6 (5); 473-476.
- [9]. Wu L, Zhang W, Zhang X, Wu Y, Qu H, Zhang D Et Al: Optimal Concentration Of Ropivacaine For Brachial Plexus Blocks In Adult Patients Undergoing Upper Limb Surgeries: A Systematic Review And Meta-Analysis. Front Pharmacol 2023, 14:1288697. Pmid:38035018
- [10]. Venkatesh RR, Kumar P, Trissur RR, George SK. A Randomized Controlled Study Of 0.5% Bupivacaine, 0.5% Ropivacaine And 0.75% Ropivacaine For Supraclavicular Brachial Plexus Block. Journal Of Clinical And Diagnostic Research: JCDR. 2016; 10(12): UC09.
- [11]. Shivakumara KC, Arun N. Comparative Study On Efficacy Of Ropivacaine And Bupivacaine For Supraclavicular Brachial Plexus. International Journal Of Medical Anesthesiology 2021; 4(3): 162-164
- [12]. Joshi V, Chande H. Comparative Analysis On Efficacy Of Ropivacaine And Bupivacaine For Supraclavicular Brachial Plexus Block: Randomized Study. Medpulse International Journal Of Anesthesiology. March 2022; 21(3):141-144. [Http://medpulse.in/anesthesiology/index.php](http://medpulse.in/anesthesiology/index.php)
- [13]. Kumari A, Rajput A , Mahajan L, Gupta R, Sarangal P. A Study To Evaluate The Effectiveness Of Bupivacaine (0.5%) Versus Ropivacaine (0.5%, 0.75%) In Patients Undergoing Upper Limb Surgery Under Brachial Plexus Block. Indian Journal Of Clinical Anaesthesia, 2017;4(2): 153-159
- [14]. Tripathi D, Shah K, Shah C, Das E. Supraclavicular Brachial Plexus Block For Upper Limb Orthopedic Surgery: A Randomised, Double Blinded Comparison Between Ropivacaine And Bupivacaine. The Internet Journal Of Anesthesiology 2012, 30(4).
- [15]. Casati A, Fanelli G, Cappelleri G, Beccaria P, Magistris L, Albertin A, Torri G. Clinical Comparison Of 0.5% And 0.75% Ropivacaine For Axillary Brachial Plexus Block. Acta Anaesthesiol Scand. 1999;43(8):794-797.