A Randomized Study to Compare Different Doses of Dexmedetomidine Combined with Ropivacaine to Assess Post-Operative Analgesia Using Ultrasound-Guided Supraclavicular Brachial Plexus Block in Upper Limb Surgeries

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Abstract

Background: Ultrasound-guided supraclavicular brachial plexus block is widely used for upper limb surgeries because it provides effective anaesthesia, prolonged postoperative analgesia, stable haemodynamics, and reduces opioid requirements. Ultrasound guidance improves block success while minimizing complications. Ropivacaine is a long-acting local anaesthetic with lower cardiotoxicity and neurotoxicity than bupivacaine. Dexmedetomidine, an α_2-adrenergic receptor agonist, prolongs postoperative analgesia and improves block characteristics; however, higher doses are associated with bradycardia and hypotension. Therefore, comparing different doses is clinically important.

Objectives: The purpose of this study was to compare analyse the efficiency of 2 different doses (25 µg and 50 µg) of dexmedetomidine mixed with ropivacaine 0.5% in ultrasonography guided supraclavicular brachial plexus block performed for upper limbs surgical procedures. In addition, the study attempted to determine the onset/duration of sensory / motor block, post-op pain scores, sedation level, hemodynamic parameters and adverse effects for the two study groups.

Materials and Methods: The study employed a prospective randomized comparative clinical study of 70 patients with elective surgeries to the upper limbs that were performed under ultrasound-guided supraclavicular brachial plexus block. The patients who were undergoing elective surgeries to the upper limbs under ultrasound-guided supraclavicular brachial plexus block were enrolled in this prospective randomized comparative study 70 patients. The subjects were divided randomly into two groups. Group A was given 0.5% of ropivacaine along with 25 µg of dexmedetomidine and Group B was administered 0.5 % of ropivacaine along with 50 µg dexmedetomidine. The primary outcomes measured were the duration of the postoperative analgesia and Numeric Rating Scale (NRS) postoperative pain scores. Secondary variables were the time to sensory blockade, the time to motor blockade, sedation scores, hemodynamic variables, and the complications rate. Data obtained from the two groups were analysed statistically and compared.

Results: Compared with 25 µg dexmedetomidine, 50 µg combined with 0.5% ropivacaine produced a significantly faster onset of sensory and motor blockade and significantly prolonged motor block duration and postoperative analgesia ($p < 0.001$). Patients in the 50 µg group also demonstrated lower postoperative Numeric Rating Scale (NRS) pain scores, indicating superior analgesic efficacy. Haemodynamic parameters, including heart rate, blood pressure, oxygen saturation, and sedation scores, remained comparable between the groups, with no clinically significant increase in adverse events such as bradycardia, hypotension, or nausea.

Conclusions: When 50µg dexmedetomidine was added to 0.5% ropivacaine, to ultrasound-guided supraclavicular blocked brachial plexus, postoperative analgesia was prolonged, sensory and motor blockade times were shorter and there were no statistically significant side effects that were clinically noticeable. Thus, the 50 micrograms dose of dexmedetomidine seems to be more effective and safer in ULSs than the 25 micrograms dose.

Keywords: Ultrasound-Guided Supraclavicular Brachial Plexus Block, Dexmedetomidine, Ropivacaine, Postoperative Analgesia, Upper Limb Surgery, Regional Anaesthesia

1. INTRODUCTION

The widespread use of regional anaesthesia in today's anaesthetic practice stems from its ability to deliver effective anaesthetic effect during surgery while limiting postoperative pain to the surgical site. This targeted treatment will decrease the use of perioperative opioids and help patients move more quickly and achieve better outcomes after surgery. Peripheral nerve blocks offer better analgesia than general anaesthetic, avoid systemic exposure to anaesthetic agents and enhance patients function and comfort post-surgery compared to GA [1]. The supraclavicular brachial plexus block (SNPB) is one of the most popular regional nerve block types for surgery of the upper extremity (UE), as it provides rapid onset of anaesthetic, good surgical conditions, and dense sensory blockade [2].

The use of ultrasound guidance has made a major step forward in the development of regional anaesthesia and provides direct visualization of the brachial plexus, adjacent blood vessels, pleura, and needle track throughout the procedure. This on-line imaging has the advantage of giving more accuracy to the deposition of the local anaesthetic, improving the success of the block and minimising the risk of complications (vascular puncture, pneumothorax and nerve injury) [3]. Nerve blocks using the ultrasound technique are estimated to be more successful, require fewer needle insertions, are quicker to perform, and cause less patient discomfort than either landmark-based or nerve stimulator-guided nerve blocks [4]. In view of the advantages of consistent block achieved by supraclavicular brachial plexus block and favorability of the peri-operative safety profile, ultrasound guided supraclavicular brachial plexus block has emerged as the preferred method for both elective and emergency surgery of upper limb [5]. In peripheral nerve blocks, ropivacaine is often chosen because of its sensory-motor differential blockade, long duration of action and low risk of cardiotoxicity and neurotoxicity when compared with bupivacaine [6]. However, ropivacaine alone may not provide a sufficient duration of analgesia after major orthopaedic surgeries and in these cases, its use in conjunction with other 'adjuvant' agents to help reduce the toxicity of local anaesthetic agents as well as prolonging the efficacy of the anaesthetic [7]. One of the most promising adjuvants seems

to be dexmedetomidine, a highly selective α_2-adrenergic receptor (AR) agonist that hastens sensory and motor blockade, extends postoperative analgesia, reduces the need for rescue analgesics, and maintains respiratory stability. The inclusion of dexmedetomidine to local anaesthetics in ultrasound-guided brachial plexus block has been shown to produce a good-quality block and better patient satisfaction in several clinical studies [8-10]. But the best dose is not yet clear, as higher doses have been shown to have a higher risk of side effects such as hypotension, bradycardia, and too much sleepiness [9]. Hence, the present study aimed at comparing the efficacy and safety of two doses of dexmedetomidine (25 and 50 (μg)) in combination with 0.5% ropivacaine in supraclavicular ultrasound-guided brachial plexus block for upper extremity surgery in terms of analgesic efficacy and safety outcomes, with particular attention to their durations of action [10].

2. MATERIALS AND METHODS

To evaluate the efficacy and safety of ultrasound-guided supraclavicular brachial plexus block (US-BP) with 0.5% ropivacaine in combination with dexmedetomidine in different doses in surgical procedures of the upper limb [11]. They paid attention to the duration of the postoperative analgesia, onset of the sensory and motor blockade, postoperative pain intensity, haemodynamic stability, sedation profile, and adverse events of dexmedetomidine's use in the perioperative situation [12]. Safety and suitable clinical efficacy in these two commonly examined doses of dexmedetomidine (25 μg and 50 μg) have been suggested in previous studies, so these doses were given special consideration. Information was gathered from a broad spectrum of information using a variety of approaches including randomised controlled trials, prospective comparative studies, observational studies and systematic reviews. All available evidence was pulled together and analyzed for trends of clinical outcomes, determination of whether dexmedetomidine could be used as an adjuvant to produce local anaesthetic effect, and determining the relative effectiveness of various dosing regimens to produce anaesthetic effect. Review methodology was carried out using the guidelines established for the identification of evidence, selection of studies, data extraction and qualitative evidence synthesis in research in regional anaesthesia, which ensures uniformity of methodology and methodological rigor [13].

A. Study Design

A narrative evidence synthesis approach was used to critically review previously published clinical articles to establish advantages and disadvantages in the adjunct use of dexmedetomidine for ultrasound-guided supraclavicular brachial plexus block [14]. This paper consisted primarily of randomized controlled trials (RCTs), prospective comparative studies (PCS), and systematic reviews (SRs) of elective surgery of the upper extremity in adults [15]. The procedural morbidity parameters evaluated in the studies analyzed in this review, consisting of clinical measures, included onset and duration of sensory and motor blockade, postoperative pain scores, hemodynamic parameters, sedation level, or block success and failure (with different dose combinations of dexmedetomidine and ropivacaine or levobupivacaine) [16]. If standardized, validated assessment tools measured pain intensity and/or motor blockade, they were used to enable: standardized interpretation of such measurements, and standardized comparisons of findings across studies [17]

B. Data Sources and Literature

A systematic literature search was conducted on potentially relevant articles related to the use of dexmedetomidine as an adjunct to ultrasound-guided supraclavicular brachial plexus block. Clinical trials reporting perioperative outcomes following a peripheral nerve blockade were eligible for inclusion, including randomized controlled trials and prospective comparative trials. Some studies reported sensory or motor block characteristics, post-surgical analgesia duration, need for post-surgical rescue analgesics, patient comfort, haemodynamic stability, sedation, and the safety of the procedure as special focus [18]. To make meaningful comparisons on clinical outcome, studies that compared different perineural doses or any mode of administration (patch/bolus) of dexmedetomidine were prioritized. Due to the dose dependency, studies that made meaningful comparisons between different dose levels of dexmedetomidine in the perineural region, or between different administration routes of dexmedetomidine in the perineural region, were prioritized for meaningful comparisons of dose-dependent clinical outcomes [19, 20]. These reference lists were then manually reviewed with the aim of not missing out critical evidence, and more papers that were relevant were located to keep within the inclusion criteria.

C. Inclusion Criteria

Patients fulfilling all of the following criteria were included in the study:

- Adults aged 18-60 years.
- Either sex.
- Patients scheduled for elective upper limb surgeries.
- American Society of Anesthesiologists (ASA Physical Status I or II).
- Body weight between 40 and 70 kg.
- Patients who provided written informed consent.

D. Exclusion Criteria

Patients meeting any of the following criteria were excluded:

- Non-cooperative patients.
- Patients with severe systemic illness or bleeding disorders.
- Pregnant women.
- Known hypersensitivity or allergy to ropivacaine, dexmedetomidine, or other study drugs.
- Patients with pre-existing sensory or motor neurological deficits.
- Infection, deformity, or other pathology at the proposed injection site.

E. Study Selection

It was a prospectus comparative study and performed in Department of Anaesthesiology (SMS medical college and Attached hospital) in January 01, 2024 to 31 December 2024. Patients older than 15 that were scheduled for elective orthopaedics surgery on the shoulder/arm with a planned brachial plexus ultrasound block were included. All patients who met the criteria for inclusion and exclusion were recruited with a

written informed consent. The number of the participants of the study was 70 who were eligible. All patients had a comprehensive pre-anaesthetic evaluation with demographic profiling, medical history, physical examination, routine laboratory investigations, and baseline vital parameter assessment to ascertain their suitability for regional anaesthesia prior to surgery. The patients who enrolled were then randomly split into two sets of 35 patients. Patients enrolled for this trial were then randomized into 2 groups of 35 patients. After this, the patients enrolled were randomly divided into 2 groups of 35 patients. Then, the enrolled patients were randomly labeled into 2 groups – A and B, with 35 patients in each group. 35 patients were given 20 mL of 0.5% ropivacaine and dexmedetomidine 25 μg in 1 mL of normal saline (Group A), and 20 other patients were given 20 mL of 0.5% ropivacaine and dexmedetomidine 50 μg in 1 mL of normal saline (Group B).

To decrease selection bias and to collect comparable baseline characteristics between the two groups, random allocation was used. All the patients enrolled were successfully given the intended supraclavicular brachial plexus block as per the study protocol. There was no exclusion of participants after randomisation, and all 70 data points were included in the final statistical analysis. Next, a comparative assessment was conducted for the block properties, haemodynamic parameters, postoperative pain scores, sedation scores, duration of analgesic effects, and adverse events associated with the procedure.

F. Data Extraction

Demographic data such as age, sex, body weight, ASA physical status, medical history, and pre-procedural haemodynamic parameters, including peripheral oxygen saturation, heart rate, and blood pressure (systolic, diastolic, mean), were obtained. The second assessment was sensory blockade using a sensory block scale; the third assessment was motor blockade using the Modified Bromage Scale, taken every 3 minutes until it was completely blocked. Intra-Operative haemodynamic parameters were taken at 5-minute intervals for 30 minutes and then every 15 minutes until the end of the surgery.

G. Outcome Measures

The main outcome was the time to first rescue analgesic requirement (NRS ≥4), which was considered as postoperative analgesia. Secondary outcome measures comprised time to onset and duration of sensory blockade, duration of motor blockade, NRS scores at postoperative periods, Ramsay Sedation Score, serial haemodynamic parameters, requirement for additional analgesics and occurrence of adverse events, such as, bradycardia, hypotension, respiratory depression, nausea, vomiting, pneumothorax, local haematoma, allergic reactions, and neurological complications. Systematic observations were made and documented in a master database for statistical analysis of data.

H. Data Synthesis and Quantitative Assessment

Frequencies and percentages are provided for basic data on the occurrence of adverse events (such as bradycardia, hypotension, oppression of the respiratory centre, nausea, vomiting, allergic reaction, pneumothorax, local haematoma) and on sex distribution. Basic data on the occurrence of adverse events such as bradycardia, hypotension, oppression of the respiratory centre, nausea, vomiting, allergic reaction, pneumothorax, local haematoma, and on sex distribution are presented as frequency and percentage. The

quantitative observations made in the intra-operative period and post-operative period of both groups, respectively, were analyzed statistically to compare the efficacy and safety of the two. The clinical outcomes were expressed as percentages of the number of patients with each of them:

$$\text{Percentage (\%)} = \frac{\text{Number of patients with the outcome}}{\text{Total number of patients}} \times 100$$

Similarly, the mean value for each continuous variable was determined using:

$$\bar{X} = \frac{\sum X}{n}$$

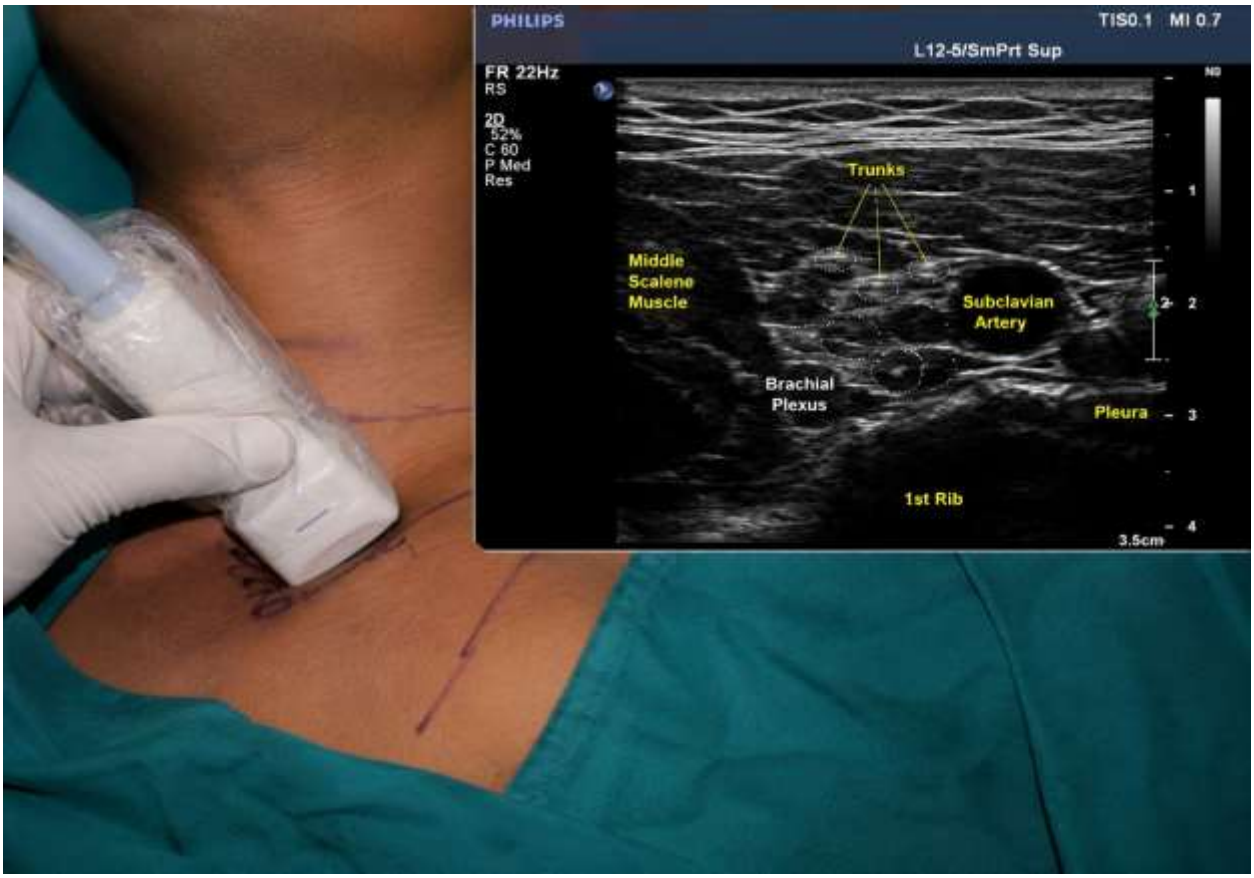
3. EXPERIMENTAL EVALUATION

In this prospective, randomized comparison, the efficacy and safety of 25 and 50-µg dexmedetomidine added to a 0.5% ropivacaine for ultrasound-guided supraclavicular brachial plexus block were assessed in elective surgeries of the upper limb. After a pre-anaesthetic assessment including demographic assessment, medical history and physical examination, routine investigations, classification of ASA physical status and a baseline haemodynamic evaluation, eligible patients were subjected to a standardised ultrasound-guided block, performed by experienced anaesthesiologists. Standardisation of the procedure reduced the technical variability and allowed a standardised administration of the drug perineurally. The efficacy and safety of both dexmedetomidine doses were assessed through different parameters during both the intra- and post-operative period, including the characteristics of sensory and motor block, duration of postoperative analgesia, pain intensity, haemodynamic parameters, sedation scores, requirement of rescue analgesics and complications of the procedure.

Figure 1. Anatomical Organization of the Brachial Plexus Relevant to the Supraclavicular Approach

The brachial plexus is the union of the anterior primary rami of the C5-T1 spinal nerves, and subsequently splits into a number of roots, trunks, divisions, cords and terminal branches that supply the upper limb with sensory and motor innervation. This anatomical association has to be understood in detail in order to perform a successful supraclavicular blockade of the brachial plexus (PNBP), which is essential to achieve the localization of the neural bundle; that is, a successful block involves less risk of damaging the neighbouring vascular structures and the pleura. The demonstration of anatomical orientation also assists in locating key anatomical landmarks, including, but not limited to, the subclavian artery, first rib, scalene muscle, and pleural dome, which are important when conducting regional anaesthesia under ultrasound guidance. The knowledge of these anatomical landmarks helps in creating and maintaining procedural accuracy and patient safety.

Figure 2. Ultrasound Visualization of the Supraclavicular Brachial Plexus



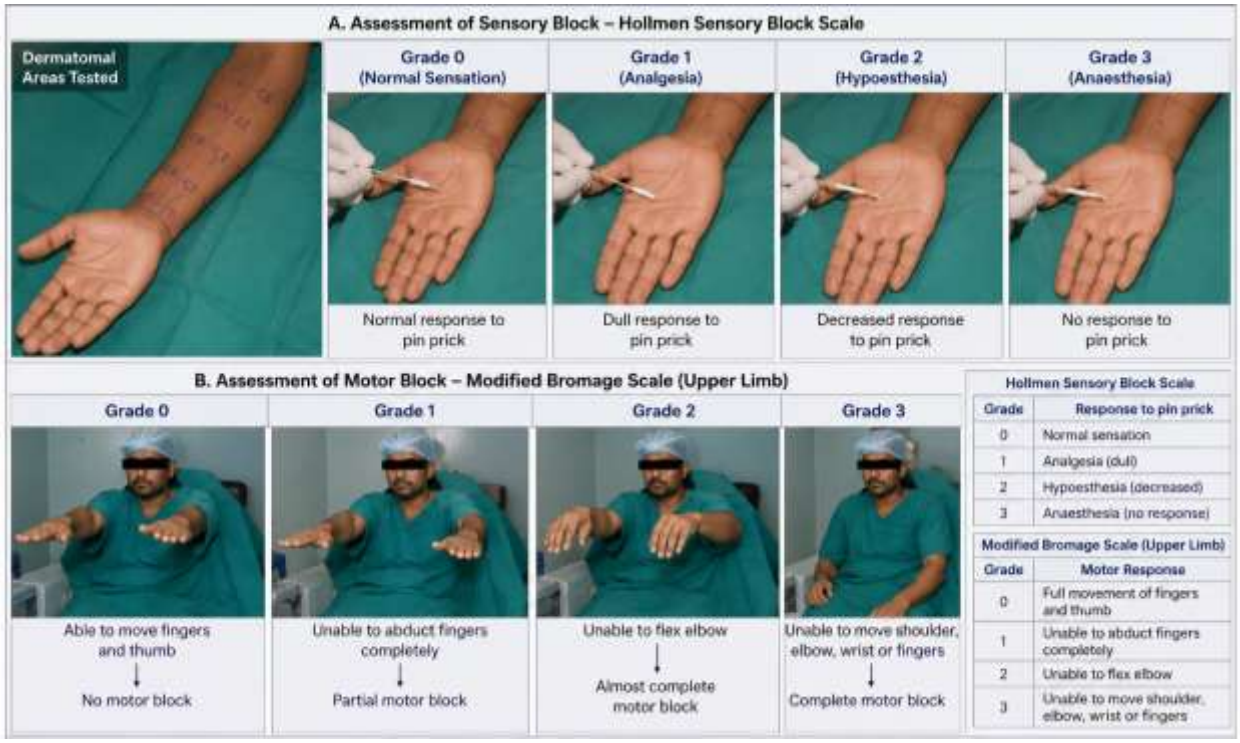
A systematic sonographic survey was performed prior to the insertion of the needles, which comprised identification of the brachial plexus, subclavian artery, first rib, pleura, and surrounding soft tissue. The neural and non-neural structures are viewed dynamically and in real time with the aid of high-resolution ultrasonography and can also be followed during the procedure. With respect to techniques that rely on landmarks alone, ultrasound guidance is more accurate to achieve block, helps prevent needle redirections, decreases procedure duration, and prevents nerve injury, vascular puncture, and pneumothorax. Real-time

visualization also ensures the correct needle insertion and proper spreading of local anaesthetic (la) infiltration around the neural sheath, which increases the probability of successful blockade.

Figure 3. Ultrasound-Guided Needle Placement and Perineural Drug Administration

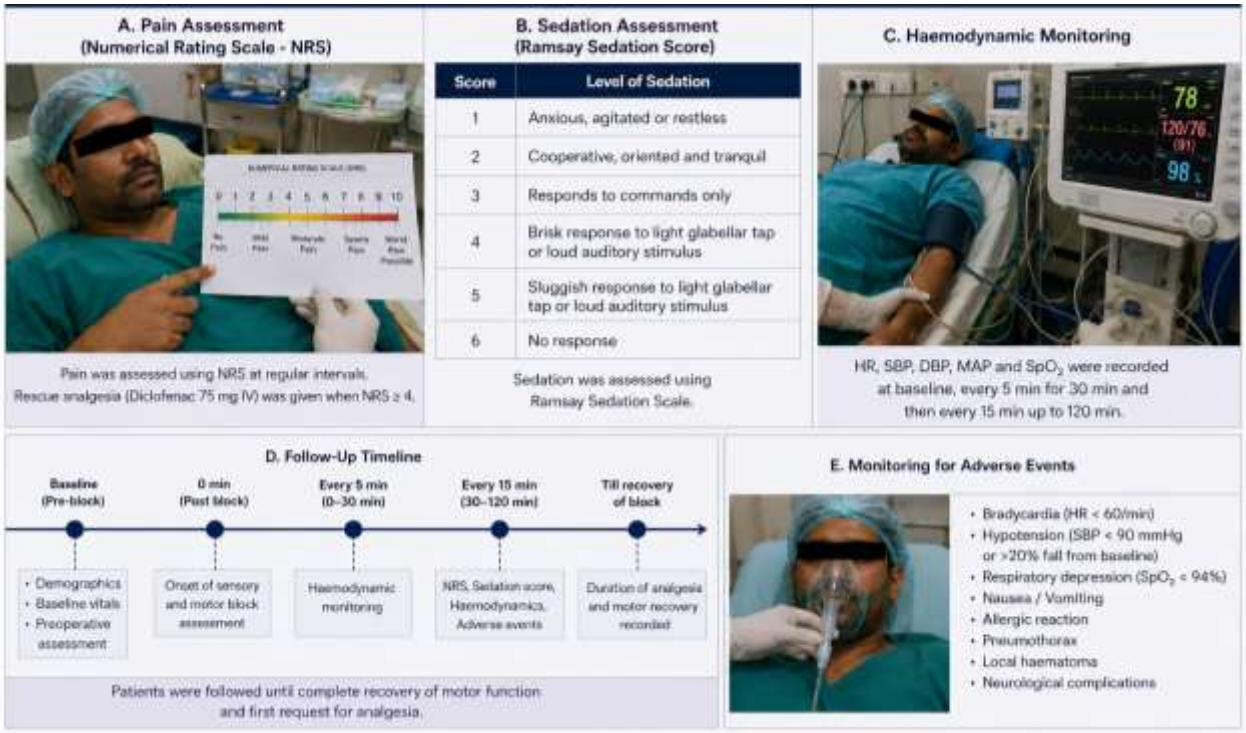
By using the in-plane ultrasound-guided technique, an insulated block needle was advanced while maintaining continuous visualization of the needle tip, which led to satisfactory visualization of the brachial plexus. Adverse damage to neighbouring elements of anatomy was reduced by continuous needle tracking. The study drug (20 mL of 0.5% ropivacaine injected with 25 or 50 µ of dexmedetomidine, each in 1 mL of normal saline (total volume 21 mL)) was injected circumferentially around the brachial plexus. The spread of the injected substance around the neural structures was evidence of good perineural spread. This technique also minimised the risk of a partial blockade, of intravascular injection, of puncturing the pleura and of maldistribution of the local anaesthetic, and increased the likelihood of a good blockade.

Figure 4. Assessment of Sensory and Motor Block



Previously validated neurological blockade clinical assessment tools were adhered to after introducing the study medication. The sensory block scale was used to evaluate sensory block and the Modified Bromage Scale for the upper extremity to evaluate motor block. The onset time, maximal block intensity, duration of blockade, and duration of postoperative analgesia were measured objectively by serial assessments at specified intervals, revealing the properties of the block. Data collection was standardized to ensure standardized interpretation of such measurements and standardized comparisons of findings across studies, and in both groups of treatment, data collection was consistent. Neurological assessments were also repeated, and this data proved to be significant information in regard to both block characteristics and suitability for surgery, as well as postoperative analgesia and efficacy for the regional anaesthetic technique used.

Figure 5. Postoperative Clinical Evaluation and Follow-Up



Patients were followed post-surgery to compare the effectiveness and safety of the anaesthetic technique and recovery profile. The intensity of the pain was measured on the Numerical Rating Scale (NRS 0–10) and the level of sedation on the Ramsay Sedation Score. Haemodynamic parameters like blood pressure (systolic, diastolic, mean arterial pressure), respiratory status and peripheral oxygen saturation (SpO_2) were noted at predefined intervals. Duration of the postoperative analgesics, time to the first rescue requirement of an analgesic, and overall recovery profile were recorded. If the NRS score was ≥4, rescue pain/kindling was given. Systematic documentation of all adverse events taking place during the surgery, such as bradycardia, hypotension, respiratory depression, nausea, vomiting, allergic reaction, pneumothorax, haematoma, Horner's syndrome, vascular puncture, local anaesthetic systemic toxicity, and neurological complications, was performed. To minimize procedural variability and to facilitate comparison of the efficacy and safety of both 25 µg and 50 µg dexmedetomidine used as adjuvants to 0.5% ropivacaine, all procedures were standardized, and the blocks were performed with ultrasound guidance, validated assessment scales, and uniform postoperative monitoring protocols.

4. RESULTS

Statistical analysis was performed to compare the efficacy and safety of both 25 µg and 50 µg dexmedetomidine as adjuvants to 0.5% ropivacaine in an ultrasound-guided supraclavicular brachial plexus block in the present investigation. Demographic parameters, block characteristics, postoperative analgesia,

postoperative haemodynamics, postoperative pain scores, and adverse events were recorded and analyzed. Data for continuous variables were reported as quantitative observations, and the two groups were analyzed statistically to compare the efficacy and safety of the two. Clinical outcomes were expressed as percentages of the number of patients with each outcome.

Figure 6. Anatomical Landmarks of the Supraclavicular Brachial Plexus and Ultrasound Probe Positioning

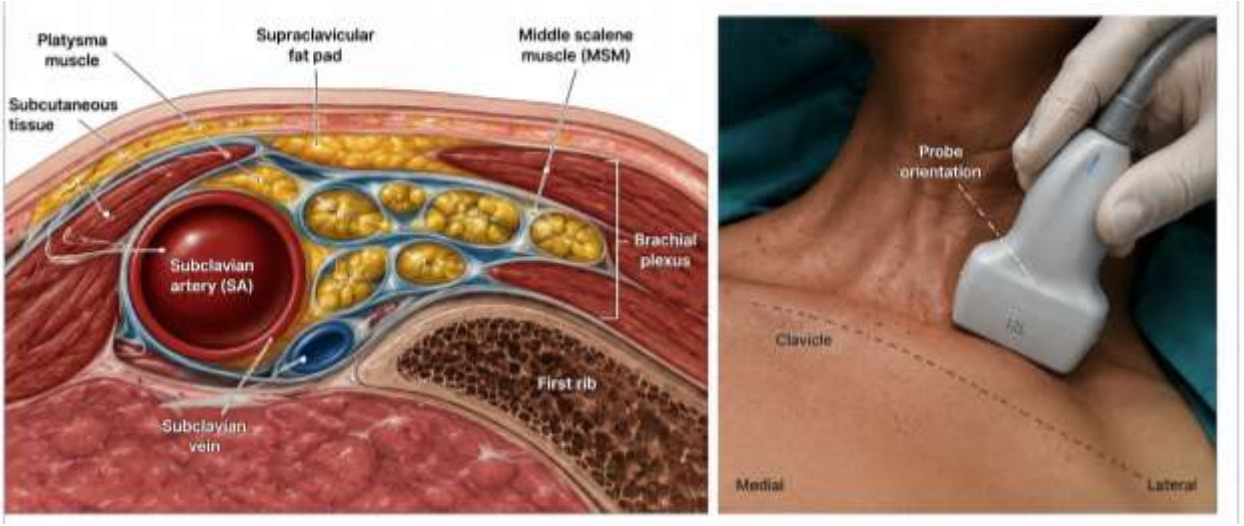
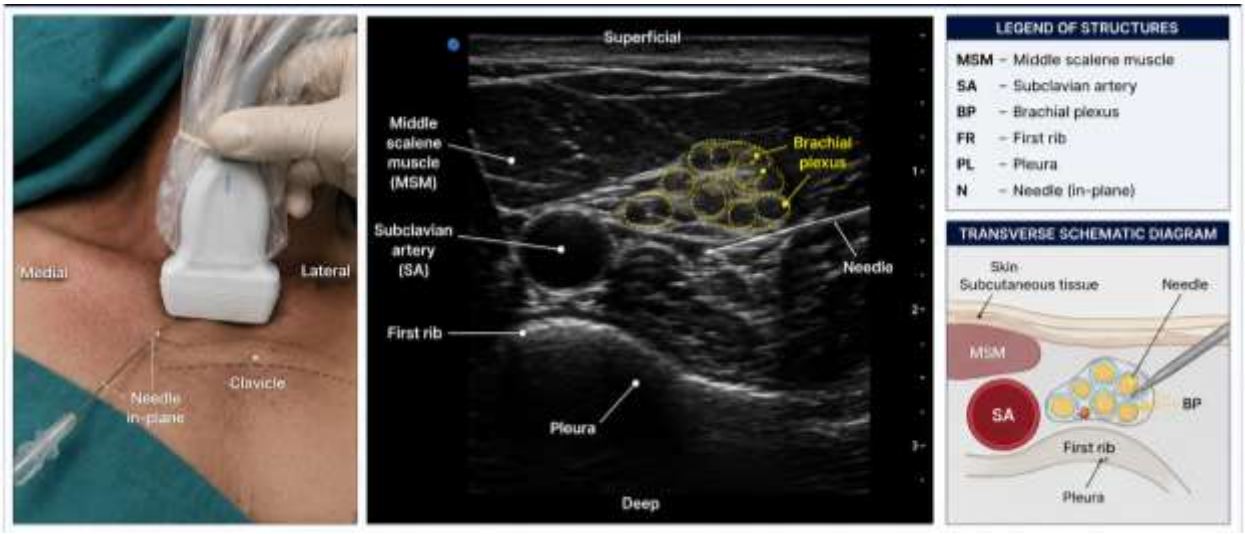


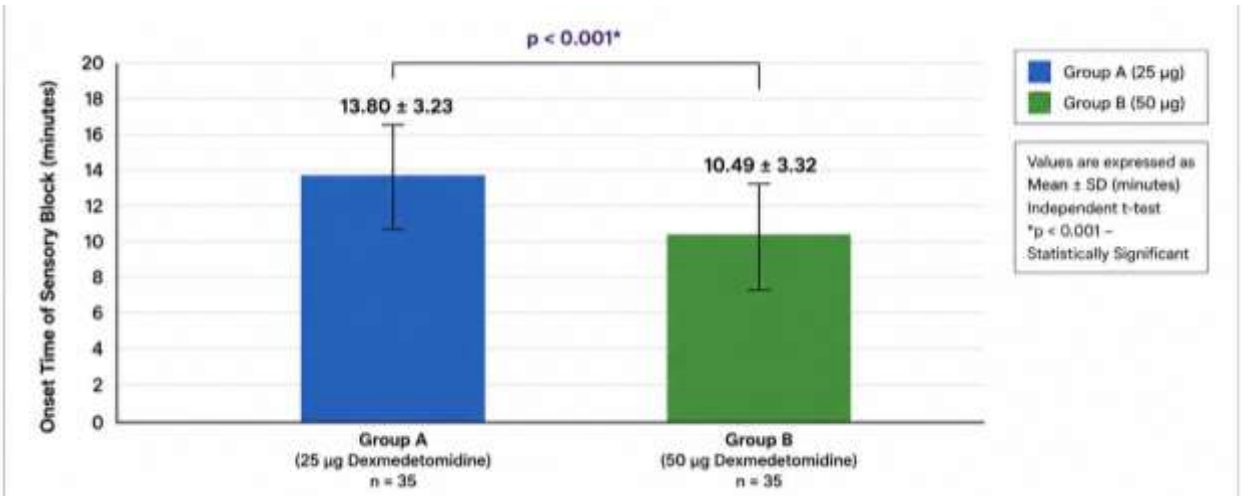
Figure 6 shows the anatomy pertinent to the supraclavicular brachial plexus block used in the study. The brachial plexus is seen laterally and superficial to the subclavian artery (SA), just superior to the first rib, and the middle scalene muscle (MSM) is an important landmark to orient the needle. Clinical image to illustrate position of high frequency linear ultrasound transducer over the supraclavicular fossa prior to block administration. Identification of the neural bundle and adjacent vascular structures and surrounding soft tissues is crucial to ensure proper movement of the block needle and accurate perineural study drug deposition. The standardisation of this ultrasound-guided approach in all patients enrolled into the study reduced procedural variation, improved the accuracy of the block sites to be injected and minimised the risk of complications including inadvertent vascular puncture, pneumothorax and incomplete nerve blockade, which allowed for reliable comparisons of the clinical outcomes of the two groups of patients receiving dexmedetomidine.

Figure 7. Real-Time Ultrasound Identification of the Brachial Plexus Prior to Local Anaesthetic Administration



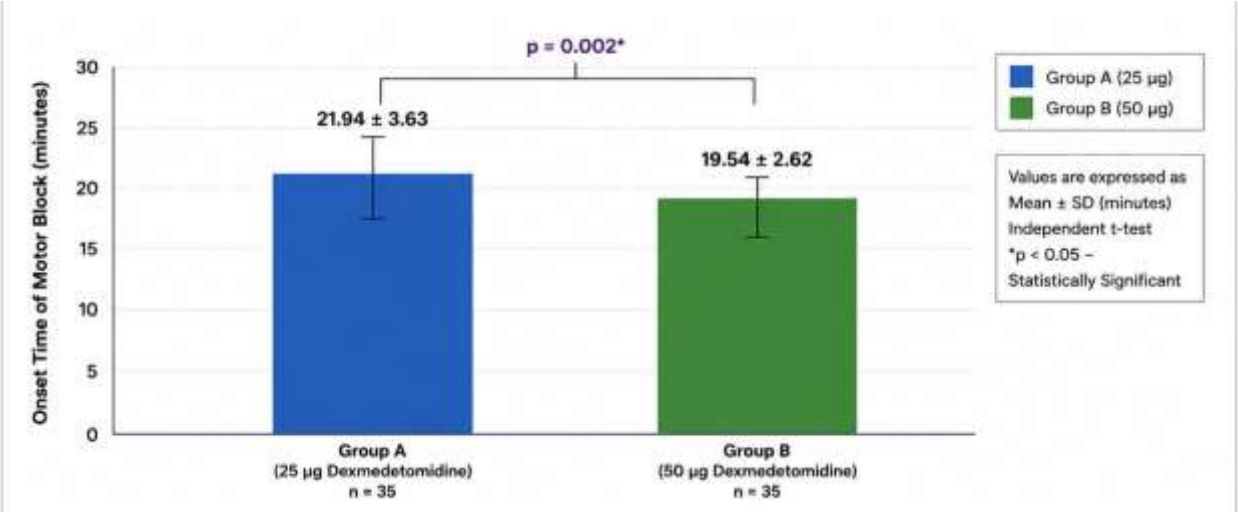
The real-time ultrasonographic visualization of the brachial plexus immediately before giving the study drug is shown in the figure. By using an ultrasound machine, continuous identification of the neural bundle, subclavian artery, first rib, and the interface with the pleura was achieved, and needle placement and the appropriate spread of the local anaesthetic solution were confirmed. Using ultrasound guidance improves block success, the safety of the block, and the complication rate of traditional landmark-based techniques. It is important to point out that this imaging-guided technique was standardized across both study groups so that the observed differences in sensory block onset, motor block onset, duration of blockade and postoperative analgesia were likely due to the different doses of dexmedetomidine as opposed to procedural variation.

Figure 8. Descriptive Statistical Comparison of Sensory Block Onset Between the Study Groups



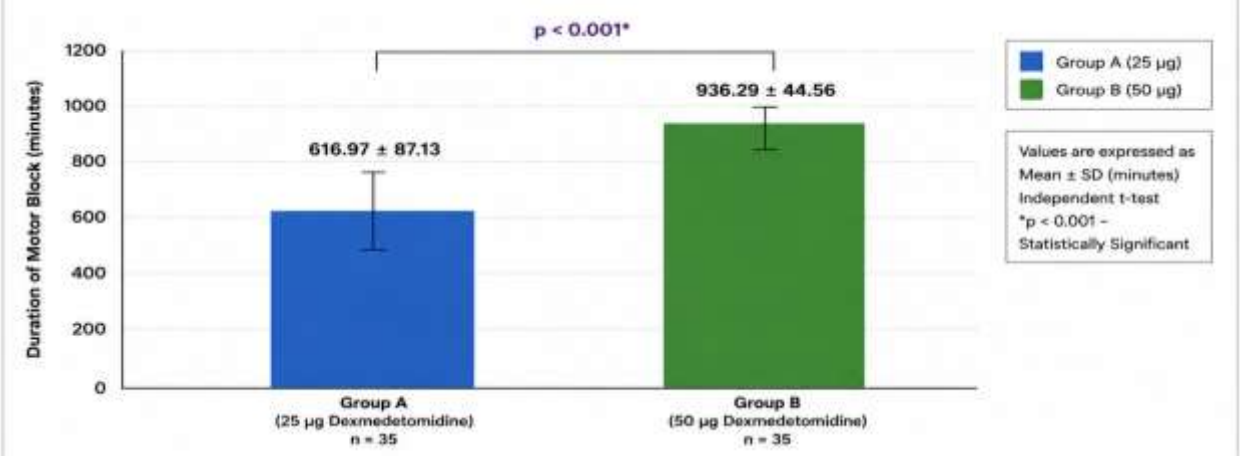
The results of descriptive statistical comparisons between the onset times of sensory blockade in both intervention groups are shown in the figure. Patients receiving 50-µg dexmedetomidine had a shorter mean onset of sensory anaesthesia than did those receiving 25-µg dexmedetomidine (10.49 ± 3.32 minutes versus 13.80 ± 3.23 minutes, respectively). The standard deviation error bars indicate that there is moderate variation in each group; the lower mean value in Group B further substantiates the block onset properties of Group B. The difference was significantly high ($p < 0.001$) when compared from a statistical point of view.

Figure 9. Descriptive Statistical Comparison of Motor Block Onset Between the Study Groups



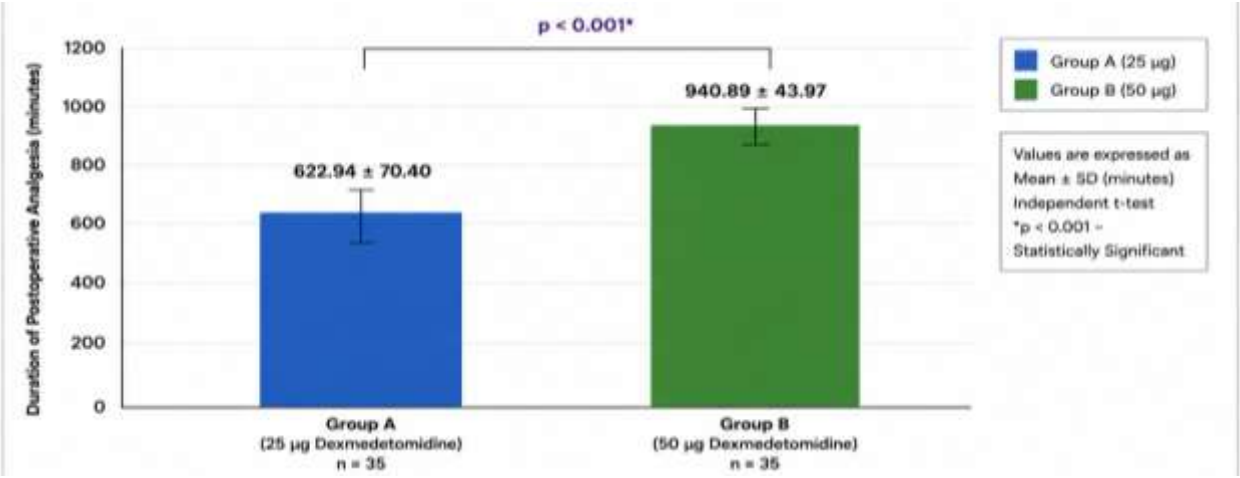
The Descriptive statistical analysis of motor block onset is shown in the figure. Group B exhibited a shorter mean onset time (19.54 ± 2.62 minutes) than Group A (21.94 ± 3.63 minutes). The smaller block onset standard deviation in Group B suggests more uniformity of block onset among patients. Inferential analysis did confirm that the reduction in onset time of motor blocking was statistically significant ($p = 0.002$), indicating a beneficial effect of a higher dexmedetomidine dose.

Figure 10. Descriptive Statistical Comparison of Motor Block Duration Between the Study Groups



The time of motor blockade was compared among the study groups as illustrated in Figure 10. Some degree of motor block was prolonged with evening 50 µg dexmedetomidine (936.29 ± 44.56 minutes) as compared to 25 µg dexmedetomidine (616.97 ± 87.13 minutes). The mean duration was significantly longer for Group B, but the SD was relatively smaller, suggesting less variability and a more consistent clinical effect. The difference between the two groups was highly significant ($p < 0.001$).

Figure 11. Descriptive Statistical Comparison of Duration of Postoperative Analgesia



Both descriptive statistical analyses of postoperative analgesic duration were compared in a similar manner (see Fig. 11). The mean duration of analgesia for Group B (940.89 ± 43.97 minutes) was significantly longer than that of Group A (622.94 ± 70.40 minutes). Error bars of one standard deviation on the graph show the extent of variability within the groups; the smaller the error bars for Group B, the more consistent the weak-stinging levels of disinfectant being provided to patients at the higher dexmedetomidine dose. The improvement in postoperative analgesia reported was highly significant ($P<0.001$).

Figure 12. Descriptive Statistical Comparison of Mean Postoperative NRS Score

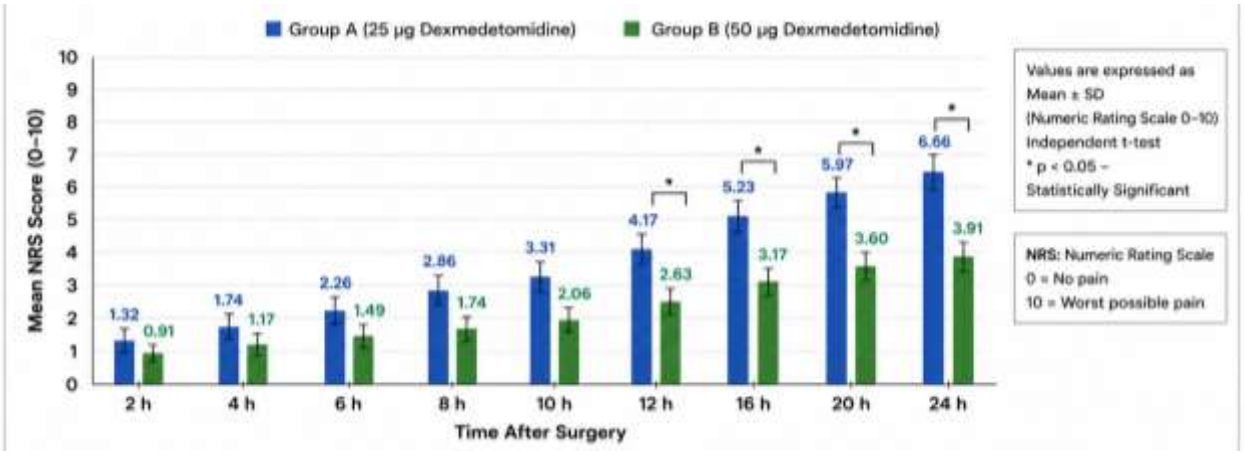
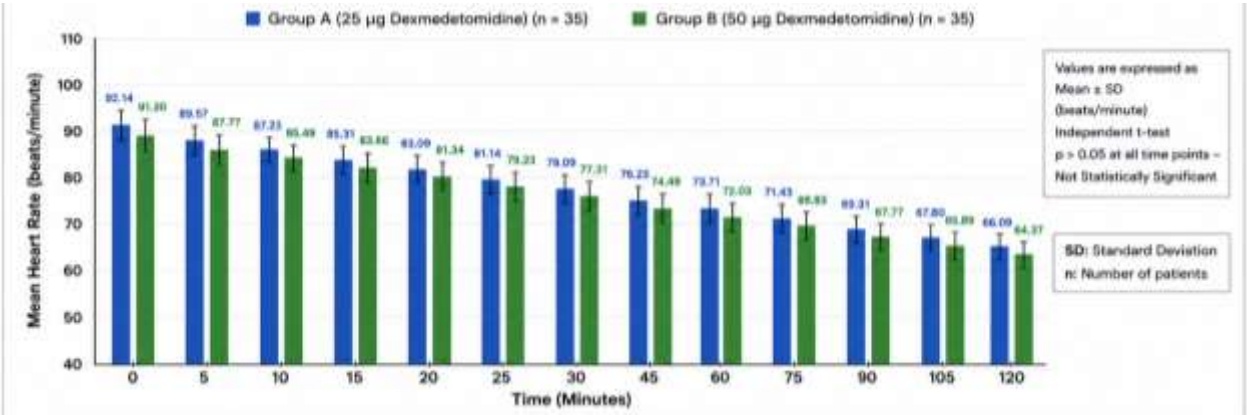


Figure 12 for the mean postoperative Numeric Rating Scale (NRS) pain score by follow-up time. The mean NRS scores were found satisfactory in both groups in early postoperative hours, but Group B showed lower mean NRS scores throughout the latter hours of postoperative recovery. The lower variance among all patients in Group B further confirms the prolonged and more predictable analgesic effect with 50 µg dexmedetomidine. There were clear differences in the late postoperative assessment, which showed superior pain management in the higher dose group.

Figure 13. Descriptive Statistical Comparison of Mean Intraoperative Heart Rate



Throughout the surgical procedure, the heart rate was recorded, and the descriptive statistical analysis of these measurements was summarized in Figure 13. Following block administration, mean heart rate gradually decreased over time in both groups, but the overall trend was somewhat similar across intervention groups. There is little variability as illustrated by the overlapping standard deviation (SD) bars, showing stable haemodynamic responses during the period of surgery. The differences between the two groups were found to be not significantly different ($p > 0.05$) from each other, indicating that a dose of

dexmedetomidine amounting to 50 micrograms would not have any negative impact on cardiovascular stability.

5. DISCUSSION

This study showed that the use of 50 µg dexmedetomidine combined with 0.5% ropivacaine to target ultrasound-guided supraclavicular brachial plexus block resulted in better block characteristics and postoperative anesthesia than did 25 µg dexmedetomidine. Those taking the higher dose had a significantly more rapid onset of sensory and motor blockage, a longer motor block duration, longer postoperative analgesia duration, and lower postoperative Numeric Rating Scale (NRS) pain scores. Fascinatingly, there were no clinically significant differences in haemodynamic parameters, sedation scores or adverse events between the 2 groups following these enhancements. Dexmedetomidine shows greater clinical effectiveness due to its potent and highly selective α_2-adrenergic receptor agonist effects, which aid in local anaesthetic-induced local action by decreasing systemic absorption with local vasoconstriction and preventing nociceptive transmission, and prolonging sensory and motor blockade and local anaesthetic activity.

This is consistent with past randomized clinical trials that have demonstrated an improvement of the block characteristics and prolonged postoperative analgesia with dexmedetomidine as an adjuvant to ropivacaine, without an unacceptable safety risk profile. This dose has also been shown to be the most effective from similar studies, while doses above it may show some benefit, but with the occurrence of more adverse effects that are dose-dependent, such as bradycardia and hypotension. Minimal procedural variability was introduced by using a standardized technique in ultrasound guidance, a uniform perioperative management, validated assessment scales, and structured postoperative treatment. Regarding the use of 50 µg dexmedetomidine in combination with 0.5% ropivacaine for US-guided supraclavicular brachial plexus block in elective upper limb surgery, the present study supports its effectiveness and safety.

6. CONCLUSION

This study established that the dose of 50 µg dexmedetomidine is superior to 25 µg dexmedetomidine as an adjunct in UBPB with 0.5% ropivacaine to lower the local anesthetic requirement for elective surgery performed on the upper limbs. All patients who were given the higher dose had quicker onset of sensory and motor blockade, longer duration of motor blockade, longer postoperative analgesia, and lower postoperative pain score, thus yielding overall better perioperative pain level and patient comfort. Significantly, there were no major procedure-related complications or clinically significant haemodynamic changes. A slight reduction in heart rate and sedation was observed more often in the high dose (50 µg), but their duration was relatively short and mild, and did not warrant strong action. The universal, ultrasound-guided procedure and objective measurement techniques provided uniformity and reliability of the measured effects. Finally, the superiority of the 50 µg dose was further substantiated and confirmed in statistical analysis and graphical representations on various efficacy parameters, showing acceptable variability between the groups. The results extend the results of previously published RCTs and systematic reviews of dexmedetomidine as a perineural adjuvant for brachial plexus block. In summary, there is evidence to support the use of 50 µg dexmedetomidine mixed with 0.5% ropivacaine to achieve an ideal

combination of a favourable safety profile, patient satisfaction, extended postoperative pain, an adequate block, and a good surgical success rate for elective surgical procedures of the upper extremity.

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