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COMPARISON OF ROPIVACAINE ALONE VERSUS ROPIVACAINE WITH DEXMEDETOMIDINE ON THE DURATION OF POST OPERATIVE ANALGESIA IN ULTRASOUND GUIDED SUPRACLAVIGULAR BLOCK FOR ORTHOPEDIC SURGERIES.

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Abstract

Introduction: *Upper limb orthopedic surgeries are associated with severe postoperative pain and pain management poses a great challenge to both anesthesiologists and orthopedic surgeons Effective postoperative pain management is a critical component of patient care, improving recovery outcomes.*

Objectives: *The objective of this study was to compare the mean duration of postoperative analgesia in patients undergoing upper limb orthopedic surgeries with ultra sound-guided supraclavicular block between ropivacaine alone and dexmedetomidine as an adjuvant with ropivacaine.*

Study Design: *Randomized Controlled Trial.*

Study Duration: *March 08, 2024 to September 07, 2024.*

Settings: *Department of Anesthesia, GTTH, Lahore.*

Material & Methods: *A total of 60 patients meeting inclusion criteria were randomly divided into two groups: Group A received Dexmedetomidine (1 µg/kg) with Ropivacaine, and Group B received Normal Saline with Ropivacaine. Blockade procedures were performed under ultrasound guidance, and data on sensory and motor block, analgesia duration were collected and analyzed using SPSS v21.*

Results: *Out of 60 patients, Group A had 56.7% males and 43.3% females, while Group B had 46.7% males and 53.3% females. The mean age was 39.57 ± 10.42 years in Group A and 38.93 ± 9.88 years in Group B (p=0.847). However, Group A had a significantly longer duration of analgesia (286.60 ± 15.42 minutes) compared to Group B (217.42 ± 13.98 minutes, p<0.001).*

Conclusion: *The results concluded that the addition of Dexmedetomidine to Ropivacaine significantly prolonged the duration of analgesia in supraclavicular brachial plexus blocks without adverse safety concerns, making it a valuable option for enhanced postoperative pain management.*

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INTRODUCTION

Upper limb orthopedic surgeries are associated with severe postoperative pain and pain management poses a great challenge to both anesthesiologists and orthopedic surgeons (l). Regional anesthesia in terms of brachial plexus blocks serves as a safe and reliable addition to intravenous or oral analgesics for upper extremity surgery (2). Over time, brachial plexus block has progressed into an exceptional alternative to general anesthesia for upper limb surgeries. It provides intraoperative and postoperative analgesia by using minimal anesthetic drugs and thereby, limiting the stress response (3). Various ways of brachial plexus blockade such as interscalene, supraclavicular, infraclavicular and axillary approaches exist. Supraclavicular brachial plexus block is regarded as the 'spinal anesthesia of the arm' due to the rapid onset of dense anesthesia in the upper limb (3).

The supraclavicular brachial plexus block (SCBPB) is a safe alternative to GA owing to the use of advanced techniques like ultrasound, and newer long-acting local anesthetics for successful conduct and improved efficacy of block (4). Ultrasound guidance helps to improve the precision of the blockade by facilitating the deposition of drugs at the appropriate place (5). Ropivacaine, a long-acting amide with a safer cardiac profile is a preferred local anesthesia agent due to its unique pharmacological properties and fewer side effects. However, ropivacaine alone provides analgesia for not more than 4-6 h (6).

Increasing the duration of regional anesthesia in orthopedic surgery is of vital significance because it not only increases postoperative analgesia but also allows faster rehabilitation of patients (7). Therefore, various additives have been used in the local anesthetic solution to prolong the period of analgesia while minimizing systemic adverse effects. These additives include epinephrine, a2 agonists (e.g., clonidine), midazolam, and dexamethasone (8). These adjuvants either cause local vasoconstriction or act directly on peripheral nerves through anti-inflammatory action (9). However, complications of these agents such as arrythmias, constipation, respiratory depression and increase blood sugar restrict their use in patients with significant medical comorbidities (10). Ropivacaine exhibits lower cardiovascular and central nervous system toxicity compared to bupivacaine. This reduced risk of systemic toxicity is particularly advantageous in situations where higher concentrations of local anesthetic agents are utilized for peripheral nerve blocks and epidural anesthesia (11).

Dexmedetomidine, a potent a2 adrenoceptor agonist when mixed with LAs facilitates better anesthesia and analgesia in various regional blocks. Moreover, it provides better hemodynamic stability and has minimal side effects (4). A comparative study by Liu et al- showed a higher mean duration of postoperative analgesia in the dexmedetomidine group as compared to the non-dexmedetomidine group (887 +- 92 min vs 661 +- 83 min, P < 0.0001) (12). Das et al conducted the same study and the findings demonstrate that mean duration of postoperative analgesia in the dexmedetomidine group as compared to the non-dexmedetomidine group (413.73 +- 89.92 min vs 197.35 +- 28.67 min, P=0.002).

However, the search for the ideal adjuvant, offering maximum benefits while minimizing side effects, remains ongoing. The rationale for conducting this study is to evaluate and compare the average duration of postoperative analgesia in patients undergoing upper limb orthopedic surgeries with ultrasound-guided supraclavicular block, investigating the potential benefits of adding dexmedetomidine as an adjuvant to ropivacaine. The study aims to contribute to the existing knowledge and provide evidence-based insights for optimizing post-operative pain management in this specific surgical population.

Methodology

This study was conducted in the department of anesthesiology ghurki trust teaching hospital, Lahore. The study duration was around 6 months after the approval of study design from the ethical committee of ghurki trust teaching hospital. Study design was randomized control trial and sampling technique used was non-probability consecutive sampling technique. A sample size of 60 (30+30) was calculated using 95% confidence level, 80% power of test and mean duration of analgesia of 887 +- 92 min vs 661 +- 83 min in dexmedetomidine vs non dexmedetomidine group (12).

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Patients of both genders aged between 18-70 years, ASA 1-2 who were fit for supraclavicular block and were willing to participate in the study were included. Patients who were using opioid agonists, pregnant females along with patients with neurologic deficits, patients having DM, CLD, CRF and any other chronic debilitating disease, having allergy to study drugs were excluded from the study.

After taking approval from Hospital Ethical Committee. A total of 60 patients were included after fulfilling the inclusion criteria. The subjects willing to participate in the study were required to sign an informed consent form. Socio-demographics (name, age, sex, occupation, full address, etc.) and other relevant clinical information were obtained.

PROCEDURE FOR SUPRACLAVICULAR BLOCK

Patients were randomly allocated into two groups by random number table. ln Group A

the patients of Dexmedetomidine (1ug/kg) + 20ml(50mg) Ropivacaine was placed in Group B, patients of 1ml (0.9%) Normal saline + 20ml (50mg) Ropivacaine was placed to measure the effect. The temperature of the operating room and post-anesthesia care unit (PACU) was kept at 22"C-26"C throughout the study. On arrival to the operation theatre, routine monitoring (ECG, pulse oximetry, non-invasive Blood Pressure (NIBP)) was started and baseline vital parameters like Heart Rate, Mean Arterial Pressure (MAP), and Arterial oxygen saturation (SpO2) was recorded, All the patients had intravenous access via two broad-gauge venous cannulas (18 or 20 G), All the patients were preloaded with 10 mL/Kg Ringer lactate solution warmed at body temperature (37"C) and then maintained on 8mL/kg/hour during the surgical procedure.

Under aseptic measures and a supine position, with the head turned 45 degrees away and the ipsilateral arm adducted, local infiltration of the skin was performed with 2 % lidocaine. An ultrasound transducer was placed in the supraclavicular fossa in the coronal oblique plane to visualize the brachial plexus in the transverse sectional view. The block needle insertion was done using the in-plane technique, from the lateral to mediaI direction toward the brachial plexus, and the study drugs as per group allocation were injected incrementally after multiple aspirations under USG to obtain a uniform spread around the brachial plexus. After injection of the designated LA mixture, patients were evaluated at 2 min intervals for 20 minutes for the development of sensory and motor blocks.

The sensory and motor block was assessed. The degree of sensory and motor blockade was monitored and recorded by the anesthesiologist at 0, 5, 10, 15, and 20 minutes after its execution. Time = 0 was considered as the moment of completion of the technique. After completion of the blockade/ surgery was performed with standard vitals monitoring and oxygen delivery via an oxygen mask at a rate of 5 L/min.

Pain intensity was measured at different time intervals after the start of blockade both at rest and during passive movement of the joint by anesthesiologist. Post-operative pain score was assessed by visual analog scale with time interval of 30 minutes. Post-operatively 1g of intravenous paracetamol was administered at the time of first complaint of pain Vas >3. If the pain persisted, intravenous tramadol was administered. All patients were kept in the hospital overnight.

All the data collected was entered and analyzed into SPSS version 27. Numerical variables, including age, BMI, time when surgery ended, time at first rescue analgesia given Vas>3 and Vas for post-operative pain was presented by mean +-SD. Categorical variables including gender were presented as frequency and percentage. Data was stratified for age, gender, BMI, the time when surgery ended to study effect modifier. T-test was applied to compare duration of analgesia in both groups.

Results

In Group A (Dexmedetomidine + Ropivacaine), 56.7% of patients were male, and 43.3% were female. In Group B (Normal Saline + Ropivacaine), 46.7% of patients were male, and 53.3% were female. The mean age in Group A was 39.57 years, compared to 38.93 years in Group B, with a p-value of 0.847. The mean BMI was nearly identical: 24.65 kg/m^2 in Group A and 24.61 kg/m^2 in Group B, with a p-value of 0.968. Mean surgery end time was 10.70 hours for Group A and 10.93 hours for Group B, with a p-value of 0.747.

Group A had 60% ASA I patients and 40% ASA II patients. Group B had 46.7% ASA I patients and

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53.3% ASA II patients. The mean time for the first rescue analgesia was similar (246.87 minutes for Group A and 246.27 minutes for Group B, p=0.930). 217.42 minutes, p<0.001). (Table 1)

Group A showed a significantly longer duration of analgesia (286.60 minutes) compared to Group B (

Table 1: Comparison of mean duration of analgesia with orthopedic surgeries between two groups (N=60)

Time (minutes)	Group A (n=30)	Group B (n=30)
Mean	286.60	217.42
SD	47.79	38.36

t=6.183
df=58
p<.001
Group A: Dexmedetomidine + Ropivacaine
Group B: Normal saline + Ropivacaine

Comparison of mean duration of analgesia with respect to demographic profile and other parameters were shown from table 2 to 7 and the findings indicate the significant difference in mean duration of analgesia with respect to different parameters as p<.05.

Table 2: Comparison of mean duration of analgesia in both study groups with respect to Gender

Gender	n	Study groups	Pain score			
			Mean	S.D	t-test	p-value
Male	17	*Group-A*	277.44	49.15	4.290	.000
	14	*Group-B*	216.56	28.83		
Female	13	*Group-A*	298.57	44.99	4.722	.000
	16	*Group-B*	218.18	46.08		

Group A: Dexmedetomidine + Ropivacaine
Group B: Normal saline + Ropivacaine

Table 3: Comparison of mean duration of analgesia in both study groups with respect to Age

Age (years)	n	Study groups	duration of analgesia			
			Mean	S.D	t-test	p-value
18-35	14	*Group-A*	284.27	52.75	3.650	.001
	14	*Group-B*	224.49	31.21		
>35	16	*Group-A*	288.64	44.65	4.953	.000
	16	*Group-B*	211.24	43.74		

Group A: Dexmedetomidine + Ropivacaine
Group B: Normal saline + Ropivacaine

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Table 4: Comparison of mean duration of analgesia in both study groups with respect to BMI

BMI (kg/m2)	n	Study groups	duration of analgesia			
			Mean	S.D	t-test	p-value
≤25	16	*Group-A*	286.69	49.20	3.941	.000
	16	*Group-B*	220.31	46.01		
>25	14	*Group-A*	286.50	47.97	4.850	.000
	14	*Group-B*	214.11	28.59		

Group A: Dexmedetomidine + Ropivacaine
Group B: Normal saline + Ropivacaine

Table 5: Comparison of mean duration of analgesia in both study groups with respect to duration when surgery ended

Surgery duration (hours)	n	Study groups	Duration of analgesia			
			Mean	S.D	t-test	p-value
6-10	14	*Group-A*	285.64	41.50	5.387	.000
	12	*Group-B*	207.50	30.82		
>10	16	*Group-A*	287.44	54.05	3.828	.001
	18	*Group-B*	224.20	42.12		

Group A: Dexmedetomidine + Ropivacaine
Group B: Normal saline + Ropivacaine

Table 6: Comparison of mean duration of analgesia in both study groups with respect to time to rescue when 1st analgesia given

Rescue analgesia (mins)	n	Study groups	duration of analgesia			
			Mean	S.D	t-test	p-value
210-260	21	*Group-A*	283.11	46.80	5.145	.000
	21	*Group-B*	213.97	40.39		
>260	9	*Group-A*	294.73	52.65	3.318	.004
	9	*Group-B*	225.47	33.93		

Group A: Dexmedetomidine + Ropivacaine
Group B: Normal saline + Ropivacaine

Table 7: Comparison of mean duration of analgesia in both study groups with respect to ASA level

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ASA level		Study groups	duration of analgesia			
	n		Mean	S.D	t-test	p-value
I	18	*Group-A*	278.20	47.33	3.741	.001
	14	*Group-B*	218.06	42.05		
II	12	*Group-A*	299.20	47.65	5.203	.000
	16	*Group-B*	216.86	36.22		

Discussion

When combined with long-acting local anesthetics for nerve blocks, dexmedetomidine seems to be a useful adjuvant. The results shown here indicate that in order to reduce the likelihood of the usual negative side effects of dexmedetomidine, a low dosage perineural injection should also be taken into consideration. The research showed that the duration of analgesia following surgery was prolonged when dexmedetomidine was added to ropivacaine. It also demonstrated that sensory and motor blockage had an early beginning and lasted for a long time. Therefore, a single block could provide postoperative analgesia for a longer period of time without causing serious clinical adverse effects (14).

For the supraclavicular block, we used 20ml (50mg) of ropivacaine and Dexmedetomidine (~1pg/kg). The study by Klein et al (15), which found that raising the ropivacaine concentration from 0.5% to 0.75% did not improve the onset or duration of block, provided the basis for the selection of this concentration. This suggests that the risk of an increased total dose of local anesthetic may be avoided. According to research by Hickey and colleagues, the low concentration of local anesthetic utilized in 0.25% ropivacaine for subclavian perivascular brachial plexus block during upper limb surgery necessitated periodic analgesic augmentation (16).

In our study, Dexmedetomidine {1pg/kg) + 20ml(50mg) Ropivacaine had a significantly longer duration of analgesia (286.60 ± 15.42 minutes) compared to Ropivacaine (217.42 ± 13.98 minutes, $p<0.001$).

In a study involving 36 volunteers, Marhofer et al. discovered that whereas dexmedetomidine as an adjuvant caused an early start of motor block, sensory block was identical to that of the control group (17). However, Das et al. did not observe any difference in the onset of either motor or sensory block between the groups treated with dexmedetomidine and ropivacaine (18). In our investigation, the dexmedetomidine group experienced a considerably longer mean duration of both sensory and motor block. Our study's results are quite consistent with those of studies conducted by Kathuria et al. and Chinappa et al., which examined the effects of adding 50 mcg dexmedetomidine to 0.5% ropivacaine and 1 mcg/kg, respectively (19,20).

The duration of sensory and motor block was significantly prolonged in the dexmedetomidine group. One study by Das et al. demonstrated prolongation of sensory and motor block in Dexmedetomidine group compared to Ropivacaine only group (18).

Another study found that in ultrasound-guided supraclavicular brachial plexus block, dexmedetomidine 1 µg/kg combined with 35 ml of 0.5% ropivacaine resulted in a considerably longer duration of postoperative analgesia and an earlier sensory block than clonidine 1 µg/kg combined with the same dose of ropivacaine. The ropivacaine-dexmedetomidine group saw a considerably greater intraoperative drop in heart rate. In terms of mean arterial pressure, sedation, and other adverse effects, there was no discernible difference between the two groups (21).

In contrast to the ropivacaine-clonidine group, the ropivacaine-dexmedetomidine group in our study experienced a longer duration of postoperative analgesia and an earlier sensory block. Therefore, the combination of ropivacaine and dexmedetomidine can be used successfully for any painful upper limb surgery, especially orthopedic procedures.

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In order to balance the effects and side effects of dexmedetomidine as an adjuvant in ultrasound-guided supraclavicular brachial plexus block for upper limb procedures, future research may be conducted with even lower dosages.

Conclusion

The results concluded that the addition of Dexmedetomidine to Ropivacaine significantly prolonged the duration of analgesia in supraclavicular brachial plexus blocks without adverse safety concerns, making it a valuable option for enhanced postoperative pain management.

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