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Efficacy of Dexmedetomidine Combined with Bupivacaine in Supraclavicular Block Versus Bupivacaine alone in Upper Limb Surgery

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ABSTRACT

Objective: To compare the efficacy of Dexmedetomidine combined with Bupivacaine in supraclavicular block versus Bupivacaine alone in upper limb surgeries

Study Design: Quasi-experimental study

Place and Duration Of Study: Anaesthesia Department, Combined Military Hospital Quetta, Pakistan, from Sep to Feb 2022.

Methodology: Patients planning to undergo plating of radius fractures were included. The patients were divided into two equal sets (n=20) by purposive sampling and marked as Group-A and Group-B. Patients in both groups received supraclavicular block under ultrasound guidance and general endotracheal anaesthesia followed by that. In the first Group, Bupivacaine plain (0.125%) was used to block the brachial plexus, and in the second Group, Bupivacaine (0.125%) with adjuvant Dexmedetomidine (1ug/kg) was given respectively. The visual analogue scale was used to measure pain perception in both groups.

Results: The duration of analgesia in the Dexmedetomidine Group was 10 ±0.925 hours and 5.68 ±0.471hours in Bupivacaine Group, which holds statistical significance (p-value<0.001). The demographics, surgery-related parameters (duration and type of surgery), block related parameters (onset of block and time taken to block) were similar in both study groups.

Conclusion: We concluded that Dexmedetomidine prolongs the duration of analgesia significantly when used as an adjuvant Bupivacaine in supraclavicular brachial plexus block.

Keywords: Bupivacaine, Dexmedetomidine, Supraclavicular block.

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INTRODUCTION

The supraclavicular block was once known as the spinal of the arm, and it was first practised by Kulenkampff in 1911 to be used as an alternative to general anaesthesia for surgical interventions done on the upper limb.[1] It became less favourable in the past due to complications of pleural breach and pneumothorax.[2] Bupivacaine is routinely used as a local anaesthetic, and several adjuvants are mixed with it to enhance the duration of analgesia and improve its safety profile, like opioids, alpha 2 agonists, steroids, calcium channel blockers, NSAIDs, ketamine and adenosine.[3,4]

Adequate analgesia is one of the prime responsibilities of anaesthetists. Acute pain management in post-operative wards is limited to intravenous analgesics in our setting.[5,6] Due to a staff shortage, we only provide satellite code blue services, and acute pain management by anaesthetists has yet to evolve.[7] Therefore, we aim to give single-shot peripheral nerve blocks in operation theatres that can provide reliable analgesia in the first 12 to 24 hours of intense pain after surgery.[8] This quest has led us to Dexmedetomidine which is recently available in our set-up and is used for monitored anaesthesia care in selected patients. We were reluctant to use peripheral nerve block due to the side effects of hypotension and bradycardia.[9]

We are interested in its peripheral route for post-operative analgesia as we want to enhance the duration and avoid its intravenous administration for two reasons: firstly, it requires careful titration and sound expertise, and secondly, monitoring in the ward is not up to the level of intensive care units or High dependency units. Therefore, the rationale of our research is to study the effectiveness of Dexmedetomidine as an adjuvant when used in peripheral nerve block in our population. This study will improve our understanding regarding this novel drug and enable us to share our experience. The result of this study will add to the existing literature and help benefit our patients.

METHODOLOGY

The quasi-experimental study was carried out at the Anaesthesia Department, Combined Military Hospital Quetta from September 2021 to February 2022

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after permission from Ethical Review Committee (IERB number 103476/Adm/12). The sample size was calculated by the WHO sample size calculator, keeping prevalence of radius fracture as 44%.[7]

Inclusion Criteria: All patients undergoing procedures in the supraclavicular block, aged 18 to 65 years, were included. All patients included had American Society of Anesthesiology Classification I or II.

Exclusion Criteria: The patients with BMI greater than 35 kg/m2, patients with diabetes, neuropsychiatric disorder, chronic pain, allergic to local anaesthetic, blood dyscrasias and contraindication to regional anaesthesia and nerve block were excluded from the study.

Non-probability purposive sampling was done to collect the sample. Written informed consent was taken from all study participants.The patients were assigned to two groups randomly: Group-A(n=20) and Group-B(n=20). Group-A included patients who only received Bupivacaine, and Group-B included patients who received Dexmedetomidine and Bupivacaine. The patients underwent standard general anaesthesia after ultrasound-guided supraclavicular block.The dose of Bupivacaine was kept constant in both groups, and the anaesthetist was kept blind to prevent bias.

All patients were booked for elective surgery after detailed pre-anaesthetic induction in the pre-anaesthesia clinic. On the day of surgery, patients were given a supraclavicular block in the operation theatre before induction. After explaining the procedure and attaching standard monitoring, all patients were laid supine with arms tucked alongside their bodies and heads turned towards the opposite side. The supraclavicular block was performed under aseptic conditions by consultant anaesthesiologists. After sterilization, the skin was anaesthetized locally with 4ml of 1 lignocaine plain, and the probe was covered with a sterile probe cover. A linear array high-frequency probe (Mindray) was used. The probe was placed in the supraclavicular fossa transversely to visualize the subclavian artery and trunks of the brachial plexus laterally to the artery. After careful aspiration, an 8 cm, 22 gauge insulated needle (Locoprex, VYGON, France) was used to deposit the solution.

The concentration of Bupivacaine was 0.125%, and the volume was 20 ml. The dose of Dexmedetomidine was given as 1ug/kg. The block level was checked with ethyl chloride spray after 15 minutes. The successful block was the absence of cold sensation in C5 to C6. General anaesthesia was induced with 2 to 2.5mg/kg Propofol, 0.1mg per kg Nalbuphine and 0.5mg Atracurium. An appropriately sized Endotracheal tube was passed, & anaesthesia was maintained with Isoflurane (1.2 MAC). All the patients were given 8mg of intravenous Ondansetron as pre-medication. At the end of the procedure, patients were extubated in the operation theatre, and Neostigmine 0.08mg/kg and 0.2mg of Glycopyrrolate were given to reverse the muscle relaxation. Patients were observed in post anaesthesia care unit for thirty minutes and shifted to the ward. All patients underwent the same surgery, which is the radius plating, to prevent bias. The following parameters were recorded for data analysis: Age, ASA status of patients, duration of surgery, presence or absence of successful block, duration of post-operative analgesia and visual analogue scale was recorded at zero hours in post-anaesthesia care unit after recovery and at first demand of rescue analgesic. A visual analogue scale (VAS) was used to quantify pain perception, where 0 meant no pain, and 10 meant the worst possible pain. Rescue analgesia was given at VAS greater than four.[10]

The data was analyzed using Statistical Package for Social Sciences (SPSS) version 26. The time taken to apply the block, starting from needle insertion to removal of the needle, was also noted. Mean±SD were calculated for continuous variables. Frequency and percentage were calculated for categorical variables. The chi-square test and t-test were used for inferential statistics. The *p*-value of ≤0.05 was considered significant.

RESULTS

The primary outcome was the duration of analgesia, and the secondary outcomes were mean visual analogue scores and the onset of block. The duration of analgesia in the Dexmedetomidine Group was 10±0.925 hours and 5.68±0.471 hours in Bupivacaine only Group (*p*-value 0.001) (Table-I).

Table-I: Mean Duration of Analgesia in Study Groups (n=20)

	Group-A Mean±SD	Group-B Mean±SD	*p*-value
Duration of Analgesia (Hours)	5.88±0.993	10.12±0. 96	<0.001

There were 11(55%) ASA-I and 9 (45%) ASA-II patients in Group-A, while there were 13(65%) ASA-I and 7(35%) ASA-II patients in Group-B. Mean weight of patients was 67±6.12 kg in Group-A and 70±5.2 kg in Group-B. The visual analogue score recorded in recovery post-extubation was 0.78±0 in Group-A and 1±0.67 in Group-B, which was comparable. However, the pain recorded at the demand of rescue analgesic

was 7.9±2.43 in Group-A patients and 6±0.888 in Group-B patients (Table-II). Table-III shows the demographic details and association between surgical time and the block's onset.

Table-II: Mean Visual Analogue Scores of study Groups (n=20)

Paramteter	Group-A Mean±SD	Group-B Mean±SD	*p*-value
VAS at 0hrs	0.75 ±0.967	0.50 ±0.688	0.352
VAS at First Rescue Analgesia	7.85 ±0.988	5.90 ±.911	<0.001

Table-III: Association between Demographic and Procedure Related Variables (n=20)

Parameters		Group-A Mean±SD	Group-B Mean±SD	*p*-value
Age (years)		40.7±8.615	44±6.802	0.162
Weight (kg)		67.3±6.28	70±5.4810	0.110
Duration of surgery (min)		52.35±6.784	51.95±6.099	0.846
Onset of block time (min)		33.65 2.433	31.35±2.059	0.003
Time taken to block (min)		14.20±2.01	13.75±1.802	0.461
		n(%)	n(%)	
Gender	Male	7(35%)	10(50%)	0.262
	Female	13(65%)	10 (50%)	
ASA Status	ASA-I	11(55%)	12(60%)	0.500
	ASA-II	9(45%)	8(40%)	

DISCUSSION

Our study provided sufficient evidence for us to believe that Dexmedetomidine was an effective adjuvant to Bupivacaine when given in perineural nerve block. We gave the block with the intention of post-operative analgesia; therefore, we kept the concentration of Bupivacaine at 0.125%. In a study by Agarwal et al., the concentration of Bupivacaine was kept at 0.325%.[11] in the supraclavicular block, and in the study by Nazir *et al*., it was 0.25%.[12] Vorobeichik *et al*. studied thirty-two trials and found that Dexmede-tomidine enhanced analgesia by sixty-three per cent and sensory-motor block by fifty-seven per cent. It also exhibited an opioid-sparing effect. The dose they suggested was fifty to sixty micrograms; however, they also noticed an increased incidence of bradycardia in their study.[13] Packiasabapathy *et al*. analyzed 60 patients in whom Dexmedetomidine was used as an adjuvant to Bupivacaine in the femoral block for knee arthroplasty. They suggested that a 2u/kg dose was superior to 1ug/kg as an adjuvant without much difference in adverse effects.[14]

One study suggested a dose of 0.75ug/kg for Dexmedetomidine as an adjuvant for reliable analgesia and sensory and motor block prolongation. Using ultrasound has helped reduce the time to apply the block to as low as four minutes.[15] The time taken for our study was about 13 minutes. Nearly ten to twelve years back, the use of nerve blocks was rare. In recent years, there has been an increasing trend of ultrasound-guided brachial plexus blocks for surgical anaesthesia and post-operative analgesia. The use of ultrasound has become an integral part of anaesthetists' training. This has led to more skilful operators over time, culminating in a reduction of procedure time. The time to block the brachial plexus in our study was also quite acceptable (13 min approx.) by the operating physician.[16,17]

The safety of Dexmedetomidine was also established when Abdallah et al. used it for daycare surgery in their triple-arm randomized controlled trial and analyzed it in hundred patients undergoing shoulder surgery. They considered the added advantage of not increasing motor blockade a favourable response to make it suitable for same-day surgery.[18] The analgesic effect of Dexmedetomidine is also attributed to its peripheral action, which is the mechanism primarily responsible for the prolongation of blocks.[19] that is probably why it prolonged the analgesia in perineural blocks without substantial systemic effects.

Our experience with Dexmedetomidine was consistent with recent studies. We studied its effects in the same type of surgery as the noxious stimulation can be different in different surgeries, which could have resulted in an error of bias. We tried to keep the bias minimum as we used it in only one technique: a supraclavicular approach to block the brachial plexus. We used a racemic mixture of Bupivacaine, and the dose of Dexmedetomidine was carefully calculated according to body weight instead of a single dose for all patients.

LIMITATIONS OF STUDY

We studied only the analgesic effect of Dexmedetomidine, although it causes sedation. Dexmedetomidine as an adjuvant for surgical anaesthesia could not be studied as patients were in general anaesthesia. We did not study its effects with different doses of Bupivacaine.

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CONCLUSION

We concluded that Dexmedetomidine prolongs the duration of analgesia significantly when used as an adjuvant to local anaesthetic Bupivacaine in brachial plexus block.

Conflict of Interest: None.

Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

AH: Data acquisition, data analysis, data interpretation, approval of the final version to be published.

KM & AA: Study design, drafting the manuscript, data interpretation, approval of the final version to be published.

SQ & AA: Critical review, concept, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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