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Efficacy of Perineural versus Systemic Dexmedetomidine as an Adjuvant to Bupivacaine for Surgical Anesthesia in Axillary Block

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ABSTRACT

Objective: To compare the analgesic effect of different routes of Dexmedetomidine when given as an adjuvant to Bupivacaine in the axillary block for surgical correction of radius fracture.

Study Design: Quasi-experimental study.

Place and Duration of Study: Pak Emirates Military Hospital, Rawalpindi Pakistan, from Sep 2021 to Feb 2022.

Methodology: The patients were divided into two equal groups. Group-A (Perineural Dexmedetomidine) and Group B (Intravenous Dexmedetomidine). Group-A received 1ug/kg Perineural Dexmedetomidine along with 30ml of racemic Bupivacaine (0.5%), and Group-B participants received 1ug per kg intravenous Dexmedetomidine after axillary block with 30ml of 0.5% perineural racemic Bupivacaine. The mean duration of analgesia was the primary outcome, and adverse outcomes and sedation were the secondary outcomes.

Results: The duration of analgesia was greater in the perineural Dexmedetomidine Group, with a mean duration of 610.20±29.92 minutes in comparison to the systemic Dexmedetomidine Group, which was 449±39.010 minutes, with *p*-value<0.001. Numerical rating scores were higher, and sedation scores were lower in the perineural Dexmedetomidine Group, making it a safer choice.

Conclusion: Perineural Dexmedetomidine is superior to intravenous Dexmedetomidine when used as an adjuvant to Bupivacaine in axillary brachial plexus block. It prolongs analgesia and is a safer alternative to intravenous Dexmedetomidine as an adjuvant.

Keywords: Axillary block, Bupivacaine**,** Dexmedetomidine.

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INTRODUCTION

Axillary brachial plexus block (AXB) is used for surgical anaesthesia and analgesia in elbow, forearm and hand surgery. It covers dermatomes of the upper limb extending from mid-arm to hand.[1,2] Using ultrasound has increased the block's success and ease and reduced its performance time.[3] Different concentrations of Bupivacaine are used for peripheral nerve blocks,[4] which are equally effective as long the total drug mass is unchanged.[5] There are various adjuvants which are used to improve the quality of the block and prolong its duration. These are clonidine, dexamethasone, epinephrine, fentanyl, tramadol, morphine and Dexmedetomidine.[6]

There is sufficient evidence regarding using Dexmedetomidine as an adjuvant to local anaesthetics in peripheral nerve blocks. A meta-analysis of numerous randomized control trials involving over one thousand patients supported Dexmedetomidine as an effective adjuvant to perineural Bupivacaine for surgical anaesthesia. It concluded that Dexmedetomidine enhanced anaesthesia and analgesia without causing significant hemodynamic compromise and excessive sedation.[7] However, the evidence of its use as an adjuvant to Bupivacaine when given through the intravenous route is scarce and somewhat conflicting. Somsunder *et al*. studied intravenous Dexmedetomidine compared to perineural Dexmedetomidin,[8] as an adjuvant to levoBupivacaine in peripheral nerve blocks. They suggested that intravenous and perineural Dexmedetomidine are comparable in terms of analgesic efficacy, but intravenous Dexmedetomidine causes more hemodynamic instability.[9,10]

The rationale of our study was to compare the intravenous versus perineural Dexmedetomidine when given as an adjuvant to Bupivacaine in axillary brachial plexus block under ultrasonographic guidance. There are a few major differences between Somsunder *et al*. and our study. They used a mixture of levo Bupivacaine and lignocaine to block the brachial plexus, while we chose racemic Bupivacaine only. They used the supraclavicular approach, while we used the axillary approach. They used a nerve stimulator while

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we used ultrasonography to apply the block**.** We chose axillary block instead of supraclavicular as it is safer, and we use it routinely. Moreover, Dexmedetomidine is recently available in our setup, and we wanted to study its efficacy when used in our population. The results of our study will add to the existing literature and help us modify our practices.

METHODOLOGY:

The study was conducted at Anaesthesia Department of Pak Emirates Military Hospital, Rawalpindi Pakistan, from September 2021 to February 2022 after Hospital Ethical Committee approval (certificate number A/28/EC/420/2022). WHO sample size calculator was used to calculate a sample size, keeping prevalence of 18%.[8]

Inclusion Criteria: All patients of both genders aged 18 to 65 years, had ASA status I or II with a BMI less than thirty-five were included.

Exclusion criteria: Patients with contraindications to local anaesthetics, coagulopathy and neuropsychiatric disorders were excluded.

Non-probability purposive sampling was used to collect samples from patients booked for elective correction of radius fracture. Written informed consent was obtained from all participants. The patients were separated into two study groups: Group A and Group B. All patients in Group A received a mixture of 0.5% Bupivacaine and 1ug/kg Dexmedetomidine in a volume of 30ml under the ultrasound-guided axillary block. Group B patients only received 30ml of 0.5% racemic Bupivacaine. All patients were counselled and laid supine on the operating table with the arms abducted at 90 degrees. Standard monitoring was applied. After sterilization of the skin with virgin spray, an insulin syringe was used to give local (1ml of 1% lignocaine). Sonoanatomy was visualized through a linear array probe and nerve conduction needle ((Locoprex, VYGON, France) and was guided with the help of ultrasound to block musculocutaneous, median, radial and ulnar nerves. A small amount (2-4ml) was infiltrated in subcutaneous tissue to prevent tourniquet pain. A consultant anesthesiologist gave the block. The patients in Group B were given only 0.5% Bupivacaine in the AXN block. The Bromage score was used to assess block success in both study groups. The patients in Group B were given a loading dose of Dexmedetomidine 1ug/kg in 100ml of normal saline over 10 minutes immediately after Bromage.[1] The Bromage score was defined as 1=unable to move the arm, 2=able to move arm only, 3=able to move arm and elbow and 4=full flexion of at elbow and hand. A successful block was defined as a Bromage score of 1.11 Patients were observed in post anaesthesia care unit for 30 minutes after surgery. A house officer in the ward recorded NRS, who was kept blind.

Statistical Package for Social Sciences (SPSS) version 26.0 was used for the data analysis. Quantitative variables were expressed as Mean±SD and qualitative variables were expressed as frequency and percentages. Chi-square test was applied to explore the inferential statistics. The *p*-value of ≤0.05 was considered statistically significant.

RESULTS

Forty patients completed the study protocol completely. Eight patients were excluded from the sample as they did not achieve a successful block, so they were excluded from the results. The duration of analgesia was greater in the perineural Dexmedetomidine Group, with a mean duration of 610.20±29.92 minutes in comparison to the systemic Dexmedetomidine Group, which was 449±39.010 minutes with *p*-value <0.001 (Table-I).

Table-I: Duration of Analgesia in Both Study Groups (n=40)

	Group A Mean±SD	Group B Mean±SD	*p*-value
Duration of Analgesia (Minutes) Mean±Sd	610.20±29.92	449±39.010	<0.001

Table-II: Distribution of Different Qualitative Variables (n=40)

Parameters	Group-A Mean±SD	Group-B Mean±SD	*p*-value
Age (years)	43.35±8.981	47.75±8.372	<0.425
Weight (Kg)	68.95±6.083	67.80±6.058	<0.792
Onset of Bromage 1 Score (minutes)	12.75±1.860	19.10±2.382	<0.001
Numerical Rating Score At 0hrs	00±.000	00±.000	<1.000
Numerical Rating Score at Rescue Analgesic Demand	6.60±0.754	7.40±0.754	<0.004
Duration of Surgery (Minutes)	70.6±6.785	67.05±4.763	<0.475
Duration to apply (Minutes)	10.83±0.224	11.00±0.447	<0.179

The numerical rating score was comparable in both groups at the start of surgery(0.0hrs). However, it was significantly lower at the demand of the first rescue analgesic, was 6.60±0.754 in the perineural Dexmedetomidine Group versus 7.40±0.754 in the intravenous Dexmedetomidine Group (*p*-value 0.004). The frequency of bradycardia 13(65%) and hypoten-

sion 9(45%) was quite high in the intravenous Dexmedetomidine Group as compared to the Perineural Group, which is 1(5%). The sedation score was also higher in patients with systemic Dexmedetomidine (Table-II & Table-III).

Table-III: Frequencies of Qualitative Variables in Both Groups (n=40)

Parameter		Frequency n(%)		*p*-value
		Group A n=20	Group B n=20	
Gender	Male	4(20)	5(25)	<0.916
	Female	16(80)	15(75)	
Asa status	Asai	13(65)	10(50)	<0.425
	Asaii	7(35)	10(50)	
Bradycardia	Yes	1(5)	13(65)	<0.010
	No	19 (95)	7(35)	
Hypotension	Yes	1(5)	9(45)	<0.000
	No	19(95)	11(55)	
Maximum ricmond score	0	17(85)	1(5)	<0.000
	-1	3(15)	NIL	
	-2	-	10(50)	
	-3	-	9(45)	

DISCUSSION

Our study revealed that perineural Dexmedetomidine produced substantial block prolongation compared to intravenous Dexmedetomidine. The perineural route also proved safer as there were fewer episodes of bradycardia and hypotension than the systemic route. Sedation scores were higher in the intravenous Group. The efficacy of both perineural and neuraxial Dexmedetomidine has been studied extensively by researchers in various parts of the world.[10,11] Similarly, the intravenous route was the subject of interest to Wang *et al*. who studied the intravenous route for elderly and young patients as an adjuvant to peripheral nerve blocks. They suggested that the ED50 of Dexmedetomidine was reduced by thirty percent in the elderly. They only studied its effects intraoperatively and did not include post-operative analgesia.[12] Another study concluded that systemic Dexmedetomidine improved the analgesia by ten percent (10%) compared to perineural Dexmedetomidine, which improved analgesia by sixty percent (60%). The dose of Dexmedetomidine they used was only 20ug.[13] Another study provided evidence to convince that intravenous Dexmedetomidine was non-inferior to perineural Dexmedetomidine. The duration of analgesia provided by the Perineural Group was 10.9 hours versus 9.8 hours in the Intravenous Group.[14] Later on, one study reported that intravenous Dexmedetomidine enhanced the duration of interscalene block considerably without compromising motor function.[15]

The evidence of some older studies mentioned above equates to the perineural and systemic route of Dexmedetomidine in terms of efficacy. Nevertheless, a recent study a systematic review of ten studies comparing systemic and perineural Dexmedetomidine, again favoured the perineural route. They presented moderate quality evidence favouring perineural Dexmedetomidine over the systemic route. They suggested that intravenous Dexmedetomidine proved an inferior quality adjuvant.[16] One study also established that Dexmedetomidine prolonged the motor blockade significantly when given through the perineural route.[17]

Our study showed that the numerical rating score at the start of surgery was equal in both groups. All patients of both groups in whom block was considered successful (Bromage score one) had uneventful completion of the surgery and did not require conversion into general anaesthesia. Eight patients (4 from both study groups) were excluded as they did not achieve Bromage one and required conversion into general anaesthesia. Intra-operative analgesia was also analogous in both groups, as patients in both study groups did not complain of pain throughout surgery (Mean±NRS=0). However, the post-operative analgesia was prolonged in the perineural Dexmedetomidine Group considerably. The patients who received intravenous Dexmedetomidine also had higher sedation scores. Two patients in the intravenous Dexmedetomidine Group required airway support in the form of the nasal airway. The patients in the Perineural Group were comfortable during surgery, and surprisingly, they did not demand any sedative medication. This may be due to the calming effect of systemic absorption of perineural Dexmedetomidine, which is just an observation, and we did not have any scientific evidence to support this observation.

Further studies can be done to study this aspect. The safety of perineural Dexmedetomidine.[18] and its reliable analgesia has convinced us to use it as an adjuvant to local anaesthetics in peripheral nerve blocks. Since the intravenous route offers no benefit over the perineural route, we can do without it. This will also prevent Hassel from an added infusion and save time. After completing our study, we decided to use it routinely to provide improved anaesthesia and analgesia in surgeries that can be done with regional anaesthesia.

LIMITATIONS OF STUDY

Dexmedetomidine has multiple effects, but we studied only analgesic and sedative effects. We did not study its effects on pediatric patients.

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CONCLUSION

The perineural Dexmedetomidine is superior to intravenous Dexmedetomidine when used as an adjuvant to Bupivacaine in axillary brachial plexus block. It prolongs analgesia and is a safer alternative to intravenous Dexmedetomidine as an adjuvant.

Conflict of Interest: None.

Author's Contribution

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

AH: & KM: Data acquisition, data analysis, critical review, approval of the final version to be published.

NUS: & UE: Study design, drafting the manuscript, data interpretation, critical review, approval of the final version to be published.

MFH: & AG: 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.

REFERENCES

1. Shah A, Morris S, Alexander B. Landmark Technique vs Ultrasound-Guided Approach for Posterior Tibial Nerve Block in Cadaver Models. Indian J Orthop 2020; 54(1): 38-42. https://doi.org/10.1007/s43465-019-00012-6
2. Tarıkcı Kılıc E, Akdemir M, S: Comparison of Supraclavicular, Infraclavicular, and Axillary Approaches for Ultrasound-Guided Brachial Plexus Block for Upper Limb Surgeries: A Retrospective Analysis of 182 Blocks. Dubai Med J 2018; 13: 33-37. https://doi.org/10.1159/000496235
3. Hussien R M, Ibrahim D A. Ultrasound Guided Axillary Brachial Plexus Block Versus Supraclavicular Block In Emergency Crushed Hand Patients :A Comparative Study. Open Anesth J 2018; 12(3): 34-41. http://dx.doi.org/10.2174/25896458018124
4. Shafiei FT, McAllister RK, Lopez J. Bupivacaine. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022.
5. Ferraro L, Takeda A, Barreto C, Faria B, Assuncao N. bupivacaine concentrations on axillary brachial plexus block.SBA 2018; 68(2): 115-121. https://doi.org/10.1016/j.bjan.2013.11.007
6. Kirksey MA, Haskins SC, Cheng J, Liu SS. Local Anesthetic Peripheral Nerve Block Adjuvants for Prolongation of Analgesia: A Systematic Qualitative Review. PLoS One 2015: 10(9); e0137312. https://doi.org/10.1371/journal.pone.0137312
7. Ping Y, Ye Q, Wang, W. Dexmedetomidine as an adjuvant to local anesthetics in brachial plexus blocks. Medicine 2017; 96(4): 5846 https://doi.org/10.1097/md.000000000000584
8. Somsunder RG, Archana NB, Shivkumar G, Krishna K. Comparing Efficacy of Perineural Dexmedetomidine with Intravenous Dexmedetomidine as Adjuvant to Levobupivacaine in Supraclavicular Brachial Plexus Block. Anesth Essays Res 2019; 13(3): 441-445. https://doi.org/10.4103%2Faer.AER_105_19
9. Kathuria S, Gupta S. Dexmedetomidine as an adjuvant to ropivacaine in supraclavicular brachial plexus block. Saudi J Anaesth 2015; 9(2): 148-154. https://doi:10.4103/1658-354X.841
10. Hussien R, Ibrahim D. Ultrasound Guided Axillary Brachial Plexus Block Versus Supraclavicular Block in Emergency Crushed Hand Patients: A Comparative Study. Open Anesth J 2018; 12(4): 34-41. http://dx.doi.org/10.2174/258964812010034
11. Wang C, Zhang H, Fu Q. Effective dose of dexmedetomidine as an adjuvant sedative to peripheral nerve blockade in elderly patients. Acta Anaesthesiologica Scandinavica 2018; 62(6): 848-856. https://doi.org/10.1111%2Faas.13087
12. Kirksey MA, Haskins SC, Cheng J, Liu SS. Local anesthetic peripheral nerve block adjuvants for prolongation of analgesia: a systematic qualitative review. PLoS One 2015; 10(9): e0137312. https://doi.org/10.1371/journal.pone.0137312.
13. Hong B, Oh C, Jo Y, Chung W, Park E. The Effect of Intravenous Dexamethasone and Dexmedetomidine on Analgesia Duration of Supraclavicular Brachial Plexus Block: A Randomized, Four-Arm, Triple-Blinded, Placebo-Controlled Trial. J Pers Med 2021; 11(12):1112-1267. https://doi.org/10.3390%2Fjpm11121267
14. Marhofer P, Brummett CM. Safety and efficiency of dexmedetomidine as adjuvant to local anesthetics. Curr Opin Anaesthesiol 2016; 29(5): 632-637. https://doi.org/10.1097/aco.00064
15. Hussain N, Brummett CM, Brull R. Efficacy of perineural versus intravenous dexmedetomidine as a peripheral nerve block adjunct: a systematic review. Reg Anesth Pain Med 2021; 46(8): 704-712. https://doi.org/10.1136/rapm-2020-102353
16. Kang R, Jeong JS, Yoo JC, Lee JH, Choi SJ, Gwak MS, et al. Effective Dose of Intravenous Dexmedetomidine to Prolong the Analgesic Duration of Interscalene Brachial Plexus Block: A Single-Center, Prospective, Double-Blind, Randomized Controlled Trial. Reg Anesth Pain Med 2018; 43(5): 488-495.
17. Abdallah FW, Dwyer T, Chan VW, Niazi AU, Ogilvie-Harris DJ, Oldfield S, et al. IV and Perineural Dexmedetomidine Similarly Prolong the Duration of Analgesia after Interscalene Brachial Plexus Block: A Randomized, Three-arm, Triple-masked, Placebo-controlled Trial. Anesthesiology 2016; 124(3): 683-695. https://doi.org/10.1097/aln.0000000000000983
18. Sane S, Shokouhi S, Golabi P, Rezaeian M, Haki B K. The Effect of Dexmedetomidine in Combination with Bupivacaine on Sensory and Motor Block Time and Pain Score in Supraclavicular Block. Pain Res. Manag 2015, Available at: https://doi.org/10.1155/2021/8858312