



Anaesthesiology

A COMPARATIVE STUDY OF EFFICACY OF IV DEXMEDETOMIDINE VS PERINEURAL DEXMEDETOMIDINE WITH 0.5% ROPIVACAINE IN PROLONGING THE DURATION OF ULTRASOUND GUIDED INTERSCALENE BRACHIAL PLEXUS BLOCK FOR UPPER LIMB ORTHOPAEDIC SURGERIES- A PROSPECTIVE RANDOMIZED STUDY.

Dr. Gonthi Angel Shekina

Final Year Post Graduate

Dr. Shahedha Parveen*

Associate Professor, Dept of Anaesthesia *Corresponding Author

Dr. Jalaja Praveena

Assistant Professor

ABSTRACT **INTRODUCTION:** The quality and duration of analgesia with brachial plexus block may be improved by adding adjuncts to local anaesthetics. When added to the local anaesthetic solution, dexmedetomidine, an alpha 2 agonist, lengthens the time of single-injection peripheral nerve block. This study, which is a randomized control trial, compares the Inter-scalene block properties when dexmedetomidine is added to the block itself vs dexmedetomidine when administered separately as a single intravenous dosage concurrently with the block. **MATERIALS AND METHODS:** A prospective, randomized, double blinded comparative clinical study was conducted in 100 ASA I and II patients of either sex requiring elective upper limb surgeries of shoulder, arm & elbow and forearm. Patients were divided into two equal groups of 50 each. Patients in group DIV were given 15 ml of 0.5% ropivacaine + 1 ml normal saline as block solution and Intravenous solution containing 49 ml normal saline + 0.5 mcg/kg dexmedetomidine diluted to 1 ml. Patients in group DPN were given 15ml Ropivacaine 0.5%+1ml of 0.5 mcg/kg dexmedetomidine as block solution and 50 ml normal saline as IV solution. **RESULTS:** Onset of sensory block occurred at 1.954 ± 0.39, and 2.018±0.36 min in DIV, DPN respectively. Onset of motor block occurred at 2.454±0.39 min in DIV group and 2.518±0.36 min in DPN group, (P<0.001). Time-of rescue analgesia in DIV and DPN are 7.61±0.66 hr and 7.72±0.52 hr respectively. The prolongation of time to rescue analgesia in DPN is slightly higher than that in the DIV group which is statistically significant. **CONCLUSION:** When 0.5 mcg/kg dexmedetomidine is used for Inter-scalene brachial plexus block, either in combination with the block solution or intravenously, it achieves nearly identical block features, including accelerated onset of sensory and motor block and enhanced postoperative analgesia, without causing any negative side effects.

KEYWORDS : Inter-scalene block, brachial plexus block, ropivacaine, dexmedetomidine, ultrasound guided nerve block.

INTRODUCTION :

“For all the happiness, mankind can gain is not in pleasure, But in rest from pain” – John Dryden (1631-1701) Pain is as old as life. It has been man's endeavor to reduce pain from the very early ages. The discovery of chemical compounds that prevent and reduce pain is the most humane application of chemistry for the solace of mankind.

Karl Kohler in 1884 first introduced cocaine into medical practice. The term, “Regional anaesthesia” was first used by Harvey Cushing in 1901. Regional nerve blocks are based on the concept that pain is conveyed by nerve fibers, which can be interrupted anywhere along their pathway.

Practically speaking, the brachial plexus block is considered as the "spinal anaesthesia of upper extremity and a supraclavicular entry point for Interscalene block ensures top-notch anaesthesia for the upper limb. It has several benefits over general anaesthesia, particularly by avoiding the negative consequences of general anaesthesia such as post-operative nausea and vomiting, pulmonary problems, hypertension brought on by an intubation reaction or discomfort, & also among other things, with brachial block, healing time is shortened. Long-lasting postoperative analgesia allows the patient to walk around early. Brachial plexus block hence offers reliable and effective anaesthesia and analgesia for procedures on the upper extremities.

The use of ultrasound aids in better delineating anatomical features, which decreases the number of needle passes, resulting in a more effective analgesia during and after the procedure, and prevents problems.

Ropivacaine is a long-acting amide local anaesthetic with a higher degree of motor to sensory distinction and less lipophilicity, which results in a lower risk of cardiotoxicity and central nervous system toxicity.

For a dense and persistent brachial plexus block, a variety of adjuvants, including opioid and non opioid adjuncts, are used with local anaesthetics. One of these is Dexmedetomidine, an alpha 2

adrenoreceptor agonist which is eight times more powerful and more alpha 2 selective than clonidine. When combined with local anaesthetics, dexmedetomidine increases the length of the nerve block. In many therapeutic situations, intravenous dexmedetomidine has been demonstrated to lessen the requirement for analgesics following surgery. Dexmedetomidine has been shown in studies to prolong postoperative analgesia in a manner that is comparable for both intravenous and perineural administration. Direct injection of dexmedetomidine near nerves is not permitted. The majority of its adjuvant use occurs off-label. It is now time to evaluate the efficiency of intravenous dexmedetomidine to that of perineural.

MATERIALS AND METHODS

After obtaining ethical committee clearance and written informed consent of 100 patients of either sex, in the age group of 18 to 65 years, with ASA status I and II, undergoing elective upper limb orthopaedic surgeries under ultrasound guided interscalene block, were enrolled for this study and randomly divided into two groups, group DIV and group DPN (50 each), using shuffled, closed, opaque envelope method.

INCLUSION CRITERIA:

- Adult patients falling under the age group of 18- 65 yrs of either sex.
- ASA grade I & II patients.
- Patients undergoing elective upper limb surgeries.
- Patients who had given informed consent for the anaesthetic procedure under the study- ultrasound guided Interscalene Brachial Plexus block.

EXCLUSION CRITERIA:

- Patients aged above 65 years and below 18 years.
- ASA grade III & IV patients.
- Patients who refused to give written & informed consent for the anaesthetic procedure under the study- Ultrasound guided Interscalene Brachial plexus block.
- Patients with bleeding disorders or on anticoagulants.
- Patients with local infection, respiratory disease (chronic obstructive disease, hemidiaphragmatic palsy), severe systemic disease (cardiac, hepatic, renal diseases, neurologic, psychiatric,

neuromuscular disorders.

- Pregnant and Lactating patients.
- Patients with known allergy to local anaesthetic drugs.
- Patients with morbid obesity.
- Patients with pre existing neurological disease/ deficit involving operating limb.

PROCEDURE

After proper PAC and Informed & written consent, patients were shifted to OR. Base line vitals like Heart Rate, Respiratory Rate, MAP & SpO2 were recorded in patients of both the groups. An 18G IV Cannula is secured and connected to IV fluids.

- Group DPN: Received 15 ml of 0.5% Ropivacaine with 0.5 mcg/kg dexmedetomidine diluted to 1ml (15+1= 16ml) for Interscalene brachial plexus block and also 50 ml normal saline which is administered as IV infusion over 15 min.
- Group DIV: Received 49ml normal saline with 0.5 mcg/kg dexmedetomidine diluted to 1ml as IV infusion over 15 min and Interscalene brachial plexus block with 15ml of 0.5% Ropivacaine + 1 ml normal saline.
- Onset of sensory block is assessed by pinprick test with a blunt 23 G hypodermic needle in the distribution of all four nerves (ulnar, median, radial and musculocutaneous nerves).
- Onset of motor block is evaluated by thumb abduction (radial nerve) , thumb adduction (ulnar nerve) , thumb opposition (median nerve) , and flexion at elbow (musculocutaneous nerve) on a modified Bromage scale.
- Sensory and motor block along with vitals is monitored every 5 mins in first 15 mins and then every 15 mins till complete blockade occurs.
- Intraoperative monitoring of blood pressure, pulse rate, O2 saturation and respiratory rate were done at 5 min interval.
- Postoperatively duration of motor block was assessed by the time elapsed from the maximum to the lowest Bromage scale.
- Duration & quality of sensory block by pinprick test.
- Sedation score is assessed by Ramsay sedation score.
- VAS score every 15 mins in the first 2 hrs and every 4 hrs till complete regression of block occurs.

SAMPLE SIZE & STATISTICAL ANALYSIS

Confidence Interval (2-sided) 95%, Power of 80% and Mean difference is 9.5 and the total sample calculated is 100. Data analysis was done with the help of computer using SPSS statistical package-Version 17. To compare the means we applied unpaired student t-test. To compare categorical data we used chisquare test, Fishcher exact test for statistical significance.

RESULTS

The present study was done in a sample of 100 patients undergoing upper limb orthopaedic surgeries and the following results have been observed-

Table 1: Comparison of patient characteristics in both groups

Patient characteristics	Group DIV	Group DPN	P value
AGE	47.3 ± 14.76	36.6 ± 12.5	0.241
HEIGHT	162.38 ± 7.01	164.28 ± 6.45	0.865
WEIGHT	68.25 ± 6.89	65.29 ± 4.98	0.865
ASA (I: II)	15:10	11:14	0.25
Duration of surgery	2.42 ± 0.24	2.46 ± 1.95	0.87

GROUP DIV : Faster onset of sensory and motor blockade in Intravenous group.

GROUP DPN : Prolonged Duration of analgesia is noted and time to rescue analgesia is delayed in Perineural group.

Comparison of characteristics in both groups :

	Group DIV	Group DPN	P value
Onset of motor blockade	2.45±0.39	2.518±0.3	0.425
Onset of sensory blockade	1.954 ± 0.39	2.018 ± 0.36	0.406
Duration of motor block	7.52 ± 0.66	7.63± 0.52	0.037
Duration of Analgesia	7.61± 0.66	7.72± 0.52	<0.001
Time for first rescue analgesia	7.61±0.66	7.72±0.52	<0.001

Different vital parameters like Heart rate, Systolic Blood pressure, Diastolic Blood pressure, Mean arterial pressure, are observed in both the groups and they did not show any significant changes from baseline till the first 24 hours of block administration and hence not statistically significant.

Pain scores (Visual Analogue scale) and Sedation scores are noted to be decreased in both the groups and is statistically significant.

DISCUSSION

Peripheral nerve blocks⁵ are cost effective anaesthetic techniques used to provide good quality anaesthesia and analgesia while avoiding airway instrumentation and hemodynamic consequences of general anaesthesia. Patient satisfaction, a growing demand for cost effective anaesthesia and a favorable postoperative recovery profile have resulted in increased popularity for regional techniques.

The key to successful regional anaesthesia is deposition of local anaesthetic(LA) accurately around the nerve structures. The introduction of ultrasound had overcome these problems and helps in real time visualization of deposition of LA and its spread . Hence we choose Ultrasound guided Interscalene approach routinely in our institution for upper limb surgeries and it has proven to be a safe technique as well.

Dose/ volume of the study, drug selected for the study

The local anaesthetic volume of 15ml (lower volume) of 0.5% ropivacaine, is chosen in the present study. 20 to 30 ml is the conventional volume of local anaesthetic used for interscalene brachial plexus block as is evident from the previous studies reviewed by the researcher, namely, Klein SM et al. and Eroglu A et al. The lower volume of 15 ml was chosen based on the studies of Gautier P et al. and Vandepitte C et al. who chose a starting volume of 15ml ropivacaine 0.75%, and decreased it in a step wise manner, to determine the minimum effective volume required in ultrasound guided interscalene brachial plexus block.

Memis, and colleagues first proposed that Dexmedetomidine, an α2 adrenoceptor agonist as an adjuvant capable of prolonging duration of sensory and motor block when used in peripheral nerve blocks.

The first study was an observational trial in healthy volunteers in which Marhofer et al.¹¹ examined the effect of low-dose (20 µg) perineural and IV dexmedetomidine on the duration of sensory blockade after ulnar nerve block. Because no surgical procedures were ever performed in the volunteers, the analgesic effect cannot be discerned, and the findings are not readily generalizable to routine regional anesthesia practice. The second was a study performed in end-stage renal disease patients undergoing construction of arteriovenous fistula in which Rutkowska et al.¹⁰ compared the effects of a continuous infusion of IV midazolam or IV dexmedetomidine on the duration of sensory-motor blockade after supraclavicular block.

Our work is also attempted to show that dexmedetomidine, regardless of the route of administration, produces a differential prolongation of PNB duration (sensory more than motor blockade). A similar phenomenon was detected in our earlier review⁷. This finding contradicts existing data, which suggest that using dexmedetomidine as a PNB adjunct similarly prolongs both sensory and motor blockade duration.^{9, 10,11} Such a discrepancy could be attributed to the fact that earlier studies evaluated healthy volunteers rather than surgical patients¹¹, which did not quantify the actual duration of motor blockade⁹, and used bupivacaine¹⁰, which is known to prolong motor blockade duration compared with ropivacaine.⁸ In addition, our study also showed that dexmedetomidine prolongs the duration of analgesia after ISB for shoulder surgery. A previous study conducted by Fritsch et al.⁹ in the setting of ISB for shoulder surgery was unable to isolate the effect of dexmedetomidine on the duration of analgesia because patients were given postoperative analgesics for non-shoulder-related pain. The potential to prolong the duration of analgesia after single-injection ISB is especially important because the moderate-severe acute postoperative pain of arthroscopic shoulder surgery¹² frequently outlasts the duration of single-injection ISB¹⁴ the occurrence of rebound pain¹³, and the technical difficulties and muted enthusiasm associated with perineural catheters in this patient population.

Perineural dexmedetomidine when compared to intravenous administration have following findings-

- . Duration of motor block was more.
- . Increased duration of analgesia.
- . Pain scores were less when compared.

CONCLUSION

From the above results, it can be concluded that, using dexmedetomidine in interscalene brachial plexus block, either added in the block drug itself or given through intravenous route results in the following :-

- Faster onset of sensory block.
- Faster onset of motor block.
- Prolonged motor block in perineural group.
- Prolongs the time of first rescue analgesia and thus post operative analgesia.
- Both intravenous and perineural dexmedetomidine produces similar effects of prolongation of postoperative analgesia though dexmedetomidine given perineurally has more clinical significance.
- 25 mcg dexmedetomidine did not produce any significant change in hemodynamic parameters i.e., pulse rate, mean arterial pressure in the peri operative period.
- No significant side effects are noted in our study resulting from the use of Dexmedetomidine.
- Intravenous Dexmedetomidine is comparable to Perineural Dexmedetomidine in terms of Onset and Duration of blockade which is devoid of any Neurotoxic features.
- We can also consider the time tested Intravenous route so as to avoid the remote and still unproven complications like Neurotoxicity of perineural dexmedetomidine.

REFERENCES:

1. Kanazi GE, Aouad MT, Jabbour-Khoury SI, Al Jazzar MD, Alameddine MM, Al-Yaman R, Bulbul M, Baraka AS: Effect of low-dose dexmedetomidine or clonidine on the characteristics of bupivacaine spinal block. *Acta Anaesthesiol Scand* 2006; 50:222–7
2. Salgado PF, Sabbag AT, Silva PC, Brienze SL, Dalto HP, Módolo NS, Braz JR, Nascimento P Jr: Synergistic effect between dexmedetomidine and 0.75% ropivacaine in epidural anesthesia. *Rev Assoc Med Bras* 2008; 54:110–5
3. El-Hennawy AM, Abd-Elwahab AM, Abd-Elmaksoud AM, El-Ozairy HS, Boulis SR: Addition of clonidine or dexmedetomidine to bupivacaine prolongs caudal analgesia in children. *Br J Anaesth* 2009; 103:268–74
4. Saadawy I, Boker A, Elshahawy MA, Almazrooa A, Melibary S, Abdellatif AA, Afifi W: Effect of dexmedetomidine on the characteristics of bupivacaine in a caudal block in pediatrics. *Acta Anaesthesiol Scand* 2009; 53:251–6
5. Abdallah FW, Brull R: Facilitatory effects of perineural dexmedetomidine on neuraxial and peripheral nerve block: A systematic review and meta-analysis. *Br J Anaesth* 2013; 110:915–25
6. Al-Metwalli RR, Mowafi HA, Ismail SA, Siddiqui AK, Al-Ghamdi AM, Al-Ghamdi AM, El-Saleh A: Effect of intra-articular dexmedetomidine on postoperative analgesia after arthroscopic knee surgery. *Br J Anaesth* 2008; 101:395–99
7. Abdallah FW, Abrishami A, Brull R: The facilitatory effects of intravenous dexmedetomidine on the duration of spinal anesthesia: A systematic review and meta-analysis. *Anesth Analg* 2013; 117:271–8
8. Das A, Majumdar S, Halder S, Chattopadhyay S, Pal S, Kundu R, Mandal SK, Chattopadhyay S: Effect of dexmedetomidine as adjuvant in ropivacaine-induced supraclavicular brachial plexus block: A prospective, double-blinded and randomized controlled study. *Saudi J Anaesth* 2014; 8(suppl 1):S72–7
9. Fritsch G, Danningier T, Allerberger K, Tsodikov A, Felder TK, Kapeller M, Gerner P, Brummett CM: Dexmedetomidine added to ropivacaine extends the duration of interscalene brachial plexus blocks for elective shoulder surgery when compared with ropivacaine alone: A single-center, prospective, triple-blind, randomized controlled trial. *Reg Anesth Pain Med* 2014; 39:37–47
10. Marhofer D, Kettner SC, Marhofer P, Pils S, Weber M, Zeitlinger M: Dexmedetomidine as an adjuvant to ropivacaine prolongs peripheral nerve block: A volunteer study. *Br J Anaesth* 2013; 110:438–42
11. Rutkowska K, Knapik P, Misiolek H: The effect of dexmedetomidine sedation on brachial plexus block in patients with end-stage renal disease. *Eur J Anaesthesiol* 2009; 26:851–5
12. Borgate A, Schäppi B, Biasca N, Gerber C: Patient-controlled analgesia after major shoulder surgery: Patient-controlled interscalene analgesia versus patient-controlled analgesia. *Anesthesiology* 1997; 87:1343–7
13. Abdallah FW, Halpern SH, Aoyama K, Brull R: Will the real benefits of single-shot interscalene block please stand up? A systematic review and meta-analysis. *Anesth Analg* 2015; 120:1114–29
14. Fredrickson MJ, Krishnan S, Chen CY: Postoperative analgesia for shoulder surgery: A critical appraisal and review of current techniques. *Anaesthesia* 2010; 65:608–24
15. Klein SM, Greengrass RA, Steele SM, D'Ercole FJ, Speer KP, Gleason DH, et al. A comparison of 0.5% bupivacaine, 0.5% ropivacaine and 0.75% ropivacaine for interscalene brachial plexus block. *Anesth Analg*. 1998 Dec;87(6):1316-9. [PubMed]