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ORIGINAL RESEARCH

Comparative Evaluation Of Dexmedetomidine Versus Fentanyl As Adjuvant With Bupivacaine In USG Guided Brachial Plexus Block In Supraclavic Upper Limb Surgeries

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ABSTRACT

Background: brachial plexus block is a common technique instead of general anaesthesia. This type of anaesthesia primarily assists in achieving the best possible operating conditions by causing muscular relaxation, maintaining a stable intraoperative hemodynamic condition, and inducing sympathetic block, which lessens postoperative discomfort, vasospasm, and edoema. Aim & Objective:1. To compare the duration of post operative analgesia 2. To compare the onset & duration of sensory and motor block, hemodynamic changes and adverse effects. Methods: Study design: Randomized comparative study. Study setting: Department of Anaesthesia, Kamineni Institute of Medical Sciences, Sreepuram Narketpally, India. Study duration: From January 2021 to July 2022 (1.5 year). Study population: All patients undergoing upper limb surgeries (below shoulder) under brachial plexus block by supraclavicular approach. Sample size: 105. Results: Age distribution across groups was found statistically significant (p=0.033). This infers that age has a significant impact in causing the variation in results across various groups. mean duration of sensory block measured by return of pin prick sensation was 11.537 hours, 7.81 hours and 10.048 hours in groups A, B and C respectively. p-value was statistically significant (<0.001). mean duration of motor blockade was 9.784 hours, 7.05 hours and 8.774 hours in groups A, B and C respectively. p-value was statistically significant (<0.001). mean duration of effective analgesia (VAS>4) was 14.221 hours, 9.583 hours and 12.299 hours in groups A, B and C respectively. p-value was statistically significant (<0.001). mean duration of complete analgesia (VAS>0) was 11.537 hours, 7.81 hours and 10.048 hours in groups A, B and C respectively. p-value was statistically significant (<0.001). Conclusion: dexmedetomidine is a better option than fentanyl when used for supraclavicular block techniques along with bupivacaine and lignocaine.

Key words: Dexmedetomidine, fentanyl, supraclavicular block, hemodynamic changes

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INTRODUCTION

For procedures on the upper limbs, brachial plexus block is a common technique instead of general anaesthesia. This type of anaesthesia primarily assists in achieving the best possible operating conditions by causing muscular relaxation, maintaining a stable intraoperative hemodynamic condition, and inducing sympathetic block, which lessens postoperative discomfort, vasospasm, and edoema.[1]

The available literature has also shown that this type of block mainly avoids the untoward effects of general anesthesia including upper airway instrumentation and thus prevents the consequences of it. It has also been shown that it is attractive due to its effectiveness in terms of cost and performance, margin of safety, along with good postoperative analgesia.[2] There are many approaches[3] followed to achieve this block like:

- ❖ Interscalene approach
- ❖ Supraclavicular approach
- ❖ Infraclavicular approach
- ❖ Parascalene approach
- ❖ Axillary approach

However supraclavicular block is a consistent and easiest method for anesthesia and post operative pain management.[4]

The classical approach using paresthesia technique being a blind technique may be associated with higher failure rate and injury to the nerves and vascular structures. The application of ultrasound technique for exact localization of nerves/plexus has revolutionized the regional anesthesia field where in ultrasound probes with suitable frequencies have been successfully tried. Ultrasound for supraclavicular brachial plexus block has improved the success rate of block with excellent localization as well as improved safety margin.[5]

LOCAL ANESTHETICS

These are the drugs that block the conduction of impulses in the electrically excitable tissues. Local anesthetics provide anesthesia and analgesia by blocking the transmission of pain sensation along the nerve fibres.[6] They are classified[7] into:

1. Aminoamide group (lignocaine, ropivacaine, bupivacaine, levobupivacaine etc)
2. Amino ester group (cocaine, chloroprocaine, procaine, tetracaine)

Bupivacaine is the commonly used local anaesthetic agent as it has a longer duration of action varying from 3 to 8 hours. However, it has limiting factors like delayed onset, patchy or incomplete analgesia. To minimize these drawbacks, various adjuvants like Morphine, Fentanyl, Neostigmine, Opioids, Hyaluronidase, Midazolam, Clonidine, Dexamethasone are added to local anesthetic agents.[8]

Adjuvants are added to local anesthetic agents to

- ❖ Prolong the duration of anesthesia and analgesia
- ❖ Improves quality of block
- ❖ Reduces the dose requirement
- ❖ Reduces the incidence of toxic effects[8]

There has always been a search for adjuvant in regional nerve block with the drugs that prolong the duration of analgesia but with lesser adverse effects. The search for the ideal additive continues and leads us to try the novel α2 adrenergic agent dexmedetomidine and an opioid fentanyl.[8]

Dexmedetomidine, a centrally acting α2 receptor agonist, is widely used for anesthesia, analgesia and monitored anesthesia care, has also been used as an adjunct to local anesthetics for brachial plexus block. Addition of fentanyl to local anesthetics is known to significantly improve duration of sensory and motor block in brachial plexus blocks.[8]

Dexmedetomidine and fentanyl are two such adjuvant drugs that have been used in combination with bupivacaine to enhance the analgesic efficacy of the drugs and that facilitate early achievement and prolongation of block. A number of studies have evaluated the efficacy of both the drugs, either independently or in combination with other adjuvants.[9]
There are limited studies comparing the use of bupivacaine with fentanyl to bupivacaine with dexmedetomidine.
Considering the low side effect and excellent postoperative analgesic efficacy of two drugs, it is essential to carry out a comparative evaluation of two drugs for their adjuvant use with bupivacaine in supraclavicular block among patients undergoing upper limb surgeries.

Aim & Objective:

1. To compare the duration of post operative analgesia
2. To compare the onset & duration of sensory and motor block, hemodynamic changes and adverse effects.

MATERIAL AND METHODS

Study design: Randomized comparative study.
Study setting: Department of Anaesthesia, Kamineni Institute of Medical Sciences, Sreepuram Narketpally, India.
Study duration: From January 2021 to July 2022 (1.5 year)
Study population: All patients undergoing upper limb surgeries (below shoulder) under brachial plexus block by supraclavicular approach.
Sample size: 105.

INCLUSION CRITERIA:

➢ ASA I, II
➢ Age 18 to 65
➢ Unilateral upper limb (below shoulder) surgeries
➢ Both sexes

EXCLUSION CRITERIA:

➢ Patient Refusal
➢ Hypertensive Patients
➢ Suspected coagulopathy
➢ Infection at the site of block
➢ History of respiratory, cardiac, hepatic or renal failure
➢ Patients with medical complications like severe anemia, shock, septicemia.
➢ Allergy to local anesthetics and study drug
➢ Pregnant women

Sample size and sample technique -
Sample size - Total 105 patients (35 patients each group).
Sampling technique - Random selection of patient. (simple random sampling)

ANESTHETIC TECHNIQUE

After shifting to the operation theatre, monitors connected and baseline pulse rate, blood pressure, respiratory rate and SpO2 were recorded. IV line was established with 18-Guage cannula in non-operated arm and infusion of Ringer's lactate solution was started.
Position: The patient was placed in a supine position and the head was turned to the opposite side.
Premedication: Inj. Midazolam 0.05mg/kg body weight + Inj. Fortwin 0.5 mg/kg body weight.

Scanning Technique

Placed the ultrasound probe over the supraclavicular fossa, aiming caudad, scanning at different angles to obtain the best image of the subclavian artery, brachial plexus, and first rib. Located the pulsatile, hypoechoic subclavian artery sitting on the hyperechoic line of the first rib or pleura. Taken care not to mistake the carotid artery for the subclavian. Confirmed by scanning medially or laterally along the clavicle, as well as cranially up the interscalene groove where we can follow the brachial plexus and associated vessels proximally. The subclavian vein was located medial to the artery. The brachial plexus lies lateral to the subclavian artery and superior to the first rib. After injecting a small amount of 1% lidocaine to anesthetise the skin, short bevel needle inserted along the longitudinal axis of the ultrasound probe (in-plane needle approach). Needle inserted lateral to the probe aiming medially. Advanced the needle toward the junction of the subclavian artery and first rib.

This area, which is inferomedial to the plexus, posterolateral to the subclavian artery, and superior to the first rib, is commonly referred to as ‘‘the corner pocket.’’ Half of the local anesthetic was injected here in small 5-mL portions with repeated aspiration to reduce the risk of intravascular injection. The local anesthetic hydrodissection ‘‘floats’’ the plexus superficially. The needle was then redirected toward the superficial aspect of the plexus or middle of the cluster and the remaining local
anesthetic was injected there.

All patients were monitored before starting until at least 1 hour after completion of the procedure using NIBP, SpO2 and ECG monitoring. Baseline values were taken just few minutes prior to block.

DURATION OF BLOCKADE

Sensory block: Time interval between first loss of sensation of cold/hot and the complete resolution of anesthesia on all nerves.

Motor block: Time interval between the first feeling of heaviness/reduction in movement and recovery of complete motor function. The block was considered incomplete when any of the dermatome did not have analgesia even after 30 minutes of drug injection. When more than 1 nerve remained unaffected, it was considered a failed block. In this case general anesthesia was given intra operatively. Patients who required general anesthesia or supplemental analgesia were excluded from the study.

DURATION OF ANALGESIA

It was recorded as per numeric rating scale of 0 to 10. The numeric rating scale was recorded post operatively every 30 minutes till the score of 5. The rescue analgesia was given in the form of Inj. Diclofenac sodium 75mg intravenously in 100 ml Normal Saline drip at the Numeric Rating Scale of 5 and the time of administration was noted.

RESULT AND OBSERVATIONS

In the present study, mean ASA grade of subjects in group B was 1.2$\pm$0.4, mean ASA grade of subjects in group A was 1.25$\pm$0.44 years and mean ASA grade of subjects in group C was 1.2$\pm$0.4. p-value was not statistically significant (p=0.805).

Table 1: Statistics of age (years) in study population

One Way ANOVA					
		N	**Mean**	**Std. Deviation**	**p**
Age (years)	GROUP B	35	39.714	13.196	0.033
	GROUP A	35	32.428	10.519	
	GROUP C	35	33.057	14.150	

In the present study, mean age of subjects in group A was 32.42±10.51 years, mean age of subjects in group B was 39.71±13.19 years and mean age of subjects in group C was 33.05±14.15 years. Age distribution across groups was found statistically significant (p=0.033). This infers that age has a significant impact in causing the variation in results across various groups.

Table 2: Statistics of "Duration of sensory block in hours (return of pin prick sensation)" in study population at various stages

One Way ANOVA					
		N	Mean	Std. Deviation	P
Duration of sensory block (return of pin prick sensation)	GROUP B	35	7.810	0.399	<0.001
	GROUP A	35	11.537	0.760	
	GROUP C	35	10.048	1.862	

In the present study, mean duration of sensory block measured by return of pin prick sensation was 11.537 hours, 7.81 hours and 10.048 hours in groups A, B and C respectively. p-value was statistically significant (<0.001).

Table 3: Statistics of "Duration of motor blockade (hours)" in study population at various stages

One Way ANOVA					
		N	Mean	Std. Deviation	p
Duration of motor blockade	GROUP B	35	7.050	0.339	<0.001
	GROUP A	35	9.784	0.597	
	GROUP C	35	8.774	1.513	

In the present study, mean duration of motor blockade was 9.784 hours, 7.05 hours and 8.774 hours in groups A, B and C respectively. p-value was statistically significant (<0.001).

Table 4: Statistics of "Time for full sensory recovery (hours)" in study population at various stages

One Way ANOVA					
		N	Mean	Std. Deviation	p
Time for full sensory recovery	GROUP B	35	9.547	0.532	<0.001
	GROUP A	35	14.066	0.993	
	GROUP C	35	12.192	2.148	

In the present study, mean time for full sensory recovery was 14.066 hours, 9.547 hours and 12.192 hours in groups A, B and C respectively. p-value was statistically significant (<0.001).

Table 5: Statistics of "Time for full motor recovery (hours)" in study population at various stages

One Way ANOVA					
		N	Mean	Std. Deviation	p
Time for full motor recovery	GROUP B	35	8.266	1.529	<0.001
	GROUP A	35	11.057	0.663	
	GROUP C	35	10.226	1.539	

In the present study, mean time for full motor recovery was 11.057 hours, 8.266 hours and 10.226 hours in groups A, B and C respectively. p-value was statistically significant (<0.001).

Table 6: Statistics of "Duration of complete analgesia in hours (VAS>0)" in study population at various stages

One Way ANOVA					
		N	Mean	Std. Deviation	p
Duration of complete analgesia (VAS>0)	GROUP B	35	7.810	0.399	<0.001
	GROUP A	35	11.537	0.760	
	GROUP C	35	10.048	1.862	

In the present study, mean duration of complete analgesia (VAS>0) was 11.537 hours, 7.81 hours and 10.048 hours in groups A, B and C respectively. p-value was statistically significant (<0.001).

DISCUSSION

Peripheral blocks, such as the supraclavicular brachial plexus block, which delivers efficient anaesthetic, are frequently used during surgeries on the upper limb.[2,3] Research is still being done to find effective adjuvants for regional nerve blocks, including drugs that lengthen the duration of analgesia yet have fewer adverse effects.[10] With varied degrees of efficacy, medications such opioids, naloxone, clonidine, midazolam, dexmedetomidine, epinephrine, and most recently dexamethasone have been used with local anaesthetics for this purpose.[11] Dexmedetomidine is a potent α2 adrenoceptor agonist that has sedative and analgesic, peri-operative sympatholytic, and cardiovascular stabilising effects. It is roughly eight times more selective towards the 2 adrenoceptor than clonidine. These results lead to sufficient opioid-sparing effects and a decrease in the need for inhalational anaesthetics. When combined with local anaesthetic, dexmedetomidine has also been shown to lengthen the time that certain blocks last and give post-operative analgesia.[10]

In the present study, mean time for full sensory recovery was 14.066 hours, 9.547 hours and 12.192 hours in groups A, B and C respectively. p-value was statistically significant (<0.001). This signifies that dexmedetomidine is better than patients in other 2 groups in achieving faster sensory recovery. In the present study, mean time for full motor recovery was 11.057 hours, 8.266 hours and 10.226 hours in groups A, B and C respectively. p-value was statistically significant (<0.001).

This signifies that dexmedetomidine is better than patients in other 2 groups in achieving faster motor recovery. In the present study, mean duration of complete analgesia (VAS>0) was 11.537 hours, 7.81 hours and 10.048 hours in groups A, B and C respectively. p-value was statistically significant (<0.001). This signifies that dexmedetomidine is better than patients in other 2 groups in achieving longer duration of analgesia.

This longer duration may be explained by the hyperpolarization effect of the α2 receptor agonist, which causes a reduction in the firing of excitable cells in the central nervous system. Another mechanism could be the decrease in calcium conductance into the cells, which prevents the release of neurotransmitters, neuron firing, and the transmission of signals to neighbouring cells.[12]

Similar results were obtained by studies done by Hamed MA et al [13], Nallam SR et al [14] where they used 100 μg dose of dexmedetomidine, Nazir N et al [15]. Contrastingly, Chavan SG et al [16] found that the mean duration of analgesia is extended if fentanyl is added to local anesthetics, without increasing the side effects.

In the present study, mean duration of effective analgesia (VAS>4) was 14.221 hours, 9.583 hours and 12.299 hours in groups A, B and C respectively. p-value was statistically

significant (<0.001). This signifies that dexmedetomidine is better than patients in other groups in achieving better analgesia. Sane S et al [17] concluded that dexmedetomidine reduced postoperative pain significantly with the use of bupivacaine for supraclavicular blocks.

In the present study, mean "time to first pain medication (VAS>5)" was 14.432 hours, 9.775 hours and 12.490 hours in groups A, B and C respectively. p-value was statistically significant (<0.001). This signifies that requirement of rescue analgesia was delayed in dexmedetomidine group. Reddy B et al [18] proposed that when dexmedetomidine is added as adjunct to levobupivacaine in supraclavicular BPB, duration of analgesia is more prolonged when used perineurally than intravenously.

Duration and Onset of action

In the present study, mean duration of sensory block measured by return of pin prick sensation was 11.537 hours, 7.81 hours and 10.048 hours in groups A, B and C respectively. p-value was statistically significant (<0.001). It indicates that addition of dexmedetomidine or fentanyl prolongs the duration of block. Clinical observation showed that patients who were given dexmedetomidine had comparatively more increased duration of sensory block. Reddy B et al [18] proposed that when dexmedetomidine is added as adjunct to levobupivacaine in supraclavicular BPB, onset of sensory blockade is faster and duration of sensory blockade is more prolonged when used perineurally than intravenously.

BIBLIOGRAPHY

1. Benítez D, Torres LM. Anesthesia for arthroscopic shoulder surgery. In Modern arthroscopy 2011 Dec 9 (p. 49).
2. Saraswat V. Effects of anaesthesia techniques and drugs on pulmonary function. Indian J Anaesth 2015; 59(9):557–64.
3. Yang CW, Kwon HU, Cho C-K, Jung SM, Kang P-S, Park E-S et al. A comparison of infraclavicular and supraclavicular approaches to the brachial plexus using neurostimulation. Korean J Anesthesiol 2010; 58(3):260–6.
4. Baloda R, Bhupal JPS, Kumar P, Gandhi GS. Supraclavicular Brachial Plexus Block With or Without Dexamethasone as an Adjuvant to 0.5% Levobupivacaine: A Comparative Study. J Clin Diagn Res 2016; 10(6):UC09-12.
5. Honnannavar KA, Mudakanagoudar MS. Comparison between Conventional and Ultrasound- Guided Supraclavicular Brachial Plexus Block in Upper Limb Surgeries. Anesth Essays Res 2017; 11(2):467–71.
6. Taylor A, McLeod G. Basic pharmacology of local anaesthetics. BJA Educ 2020; 20(2):34– 41.
7. Covino BG. Pharmacodynamic and pharmacokinetic aspects of local anesthetics. InAnnales Chirurgiae et Gynaecologiae 1984 Jan 1 (Vol. 73, No. 3, pp. 118-122).
8. Swain A, Nag DS, Sahu S, Samaddar DP. Adjuvants to local anesthetics: Current understanding and future trends. World J Clin Cases 2017; 5(8):307–23.
9. Farooq N, Singh RB, Sarkar A, Rasheed MA, Choubey S. To Evaluate the Efficacy of Fentanyl and Dexmedetomidine as Adjuvant to Ropivacaine in Brachial Plexus Block: A Double-blind, Prospective, Randomized Study. Anesth Essays Res 2017; 11(3):730–9.
10. Swami SS, Keniya VM, Ladi SD, Rao R. Comparison of dexmedetomidine and clonidine (α2 agonist drugs) as an adjuvant to local anaesthesia in supraclavicular brachial plexus block: A randomised double-blind prospective study. Indian journal of anaesthesia. 2012 May;56(3):243.
11. Lashgarinia M, Naghibi K, Honarmand A, Safavi M, Khazaei M. Effect of ketamine as an adjuvant in ultrasound-guided supraclavicular brachial plexus block: A double-blind

randomized clinical trial study. Advanced Biomedical Research. 2014;3.

12. Kaygusuz K, Kol IO, Duger C, Gursoy S, Ozturk H, Kayacan U, Aydin R, Mimaroglu C. Effects of adding dexmedetomidine to levobupivacaine in axillary brachial plexus block. Current therapeutic research. 2012 Jun 1;73(3):103-11.
13. Hamed MA, Ghaber S, Reda A. Dexmedetomidine and Fentanyl as an Adjunct to Bupivacaine 0.5% in Supraclavicular Nerve Block: A Randomized Controlled Study. Anesth Essays Res 2018; 12(2):475–9.
14. Nallam SR, Chiruvella S, Karanam S. Supraclavicular brachial plexus block: Comparison of varying doses of dexmedetomidine combined with levobupivacaine: A double-blind randomised trial. Indian J Anaesth 2017; 61(3):256–61.
15. Nazir N, Jain S. A Randomized Controlled Trial Study on the Effect of Adding Dexmedetomidine to Bupivacaine in Supraclavicular Block Using Ultrasound Guidance. Ethiop J Health Sci 2016; 26(6):561–6.
16. Chavan SG, Koshire AR, Panbude P. Effect of addition of fentanyl to local anesthetic in brachial plexus block on duration of analgesia. Anesth Essays Res 2011; 5(1):39–42.
17. Sane S, Shokouhi S, Golabi P, Rezaeian M, Kazemi Haki B. The Effect of Dexmedetomidine in Combination with Bupivacaine on Sensory and Motor Block Time and Pain Score in Supraclavicular Block. Pain research & management 2021; 2021:8858312.
18. Reddy B, Gaude Y, Vaidya S, Kini G, Budania L, Eeshwar MV. Effect of dexmedetomidine on characteristics of ultrasound-guided supraclavicular brachial plexus block with levobupivacaine-A prospective double-blind randomized controlled trial. Journal of anaesthesiology, clinical pharmacology 2021; 37(3):371.