European Journal of Molecular & Clinical Medicine (EJMCM)
ISSN: 2515-8260 Volume 09, Issue 02, 2022

Original research article

A Prospective Study on Upper Limb Supraclavicular Brachial Plexus Block: Dexmedetomidine with Ropivacaine and Dexamethasone with Ropivacaine and Ropivacaine Alone

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Abstract

Introduction:

Pain is defined as "As unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage". Pain is an inevitable consequence of surgery. Surgical intervention done to reduce human suffering is associated with pain and distress to patients. Severe pain causes increased stress response to surgery, seen as a cascade of endocrine, metabolic and inflammatory events that may contribute to organ dysfunction, morbidity, increased hospital stay and mortality.

Material and Methods:

The present study from May 2020 to March 2022 was conducted on 60 cases prospectively in patients admitted to the, Department of anaesthesia ,Dr. N.D. Desai FMSR, Dharmasinh Desai University, College Road, Nadiad, Gujrat, undergoing elective upper limb surgery. The inclusion and exclusion criteria, 60 ASA physical status I or II patients of either sex, aged 18-60 yrs were randomly allocated in to 3 groups of 20 each.

Group I: Patients receiving 0.5% Ropivacaine (30ml) + Dexmedetomidine 50mcg (diluted to 2 ml).

Group II: Patients receiving 0.5% Ropivacaine (30ml) + Dexamethasone 8mg (2ml).

Group III: Patients receiving 0.5% Ropivacaine (30ml) + saline (2ml).

Under strict aseptic precautions, patients were given Ultrasound guided Supraclavicular brachial plexus block with any one of the study drugs .

Results:

Demographic data(age ,sex distribution ,weight) and surgical characteristics (duration of surgery and type of surgery) were similar in all the 3 groups.

ONSET OF SENSORY AND MOTOR BLOCKADE : The mean time for onset of sensory block in group I was 7.45±1.10 min and in group II was 10.15 ± 1.14 min and group III was 12.45±2.76 . The mean time for onset of motor block in group I was 10.60 ± 1.05 min and in group II was 14.95 ± 0.83 min and and group III was 16.05 ± 1.96.

The onset of sensory and motor block was significantly early in Dexmedetomidine group (group I) i.e, 7.45±1.10 min followed by dexamethasone group (group II) as compared to plain Ropivacaine group (group III).
DURATION OF SENSORY AND MOTOR BLOCKADE: The total duration of sensory block in group I was 768±25.52 min and in group II was 909±22.10 min and in group III was 450±27.74 min. The duration of motor block in group I is 717.50±22.09 min and in group II was 878±19.47 min and in group III was 420±23.17 min.
There is significant difference in the total duration of sensory and motor block between the three groups. (P <0.001).The duration sensory and motor blockade is longest in Dexamethasone group followed by Dexmedetomidine group as compared to the control group Ropivacaine alone.
Conclusion:
We conclude that although both Dexmedetomidine and Dexamethasone are better adjuvants to Ropivacaine as compared to Ropivacaine alone in Supraclavicular Brachial block , Dexamethasone is a better choice in terms of prolonging the duration of sensory and motor blockade and duration of analgesia, followed by Dexmedetomidine than Ropivacaine alone.
Keywords: Brachail plexus; Ropivacaine; Dexamethasone; Dexmedetomidine, ASA (American Society of Anesthesia)

Introduction

Fundamental to modern neural blockade is the concept that, pain is a sensory warning conveyed by specific nerve fibre and is amenable for modulation or interruption anywhere in the nerve's pathway.[1] As unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage .Pain is an inevitable consequence of surgery. Surgical intervention done to reduce human suffering is associated with pain and distress to patients. Severe pain causes increased stress response to surgery, seen as a cascade of endocrine, metabolic and inflammatory events that may contribute to organ dysfunction, morbidity, increased hospital stay and mortality. Pain in the post operative period often causes the patient to remain immobile, increasing vulnerability to deep venous thrombosis, pulmonary atelectasis, which may contribute to postoperative hypoxemia.[2] In most human studies done earlier the local anesthetics useful for brachial plexus block involved combinations with Bupivacaine or Levobupivacaine. Now due to unique pharmacologic properties and fewer side effects like less cardiac and central nervous system toxic ,less lipophilic than other long acting local anesthetics like Bupivacaine, Ropivacaine is being preferred by an increasing number of anesthesiologists for peripheral nerve blocks[3] .Peripheral nerve block as an anesthetic technique plays an important role in modern regional anaesthesia compared with general and systemic analgesia .This type of block mainly avoids the untoward effects of general anaesthesia like the upper airway instrumentation and mainly helps in achieving ideal operating conditions by producing muscular relaxation, maintaining stable intraoperative hemodynamic condition and sympathetic block which reduces postoperative pain, vasospasm and edema , excellent pain control, and shortened stay in post anesthetic care unit and reduced side effects[4] .Dexmedetomidine, a selective α2- adrenoceptor agonist, has been used as an adjuvant during animal and human studies have shown safety and efficacy of adding to local anesthetics in various regional anesthetic procedures, such as subarachnoid, epidural, and caudal Injections[5,6.].The key to successful regional anaesthesia is deposition of local anesthetic accurately around the nerve structures . In the past,peripheral nerve stimulator or by eliciting paraesthesia ,both of which relied on surface landmark, were used . However these landmark

techniques have limitations , variations in anatomy and nerve physiology ,as well as equipment accuracy have an effect on success rate and complications . The use of Ultrasound imaging in regional Anesthesia is rapidly becoming an area of increasing interest[7]. The mechanism of the analgesic actions of α2 agonists has not been fully elucidated and is probably multifactorial .It acts by activation of alpha 2A receptors ,inhibition of conduction of nerve signals through C & A-delta fibres and local release of encephalin.A number of supraspinal and spinal sites modulate the transmission of nociceptive signals in the CNS. Peripheral α2 adrenoceptors may also mediate the antinociception.[8]α2agonist by acting at any of these sites reduce nociceptive transmission, leading to analgesia. The activation of inwardly rectifying G1-protein-gated potassium channels resulting in membrane hyperpolarization and decreasing the firing rate of excitable cells in the CNS is considered to be a significant mechanism of the inhibitory neuronal action of α2-adrenoceptor agonists.[9]Hence Dexmedetomidine is used as one oof the adjuvant to Ropivacaine in our study.

Material and Methods

The present study from May 2020 to March 2022 was conducted on 60 cases prospectively in patients admitted to the, Department of anaesthesia ,Dr. N.D. Desai FMSR, Dharmasinh Desai University, College Road, Nadiad, Gujrat, undergoing elective upper limb surgery. The inclusion and exclusion criteria, 60 ASA physical status I or II patients of either sex, aged 18-60 yrs were randomly allocated in to 3 groups of 20 each.

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Methodology

The present study from May 2020 to March 2022 was conducted on 60 cases prospectively in patients admitted to the, Department of anaesthesia ,Dr. N.D. Desai FMSR, Dharmasinh Desai University, College Road, Nadiad, Gujrat, undergoing elective upper limb surgery. After institutional ethical committee approval and obtaining informed written consent from the patients, those satisfying the inclusion and exclusion criteria from (18 Months),60 ASA(American Society of Anesthesia) physical status I or II patients of either sex, aged 18-60 yrs scheduled for upper limb surgeries under supraclavicular brachial plexus block were included in this study.

Inclusion criteria

Patients belonging to age group 18-60 years with ASA grade I and grade II undergoing elective operative procedure for upper limb surgeries (i.e. elbow, forearm and hand surgeries.)

Exclusion criteria

1. Patients' refusal.
2. Patients with history of bleeding disorders.
3. Patients with local infection at the site of block.
4. Patients with pre-existing peripheral neuropathy
5. Patients with hepatic or renal disease
6. Patients with Hypertension and heart blocks
7. Patients with known allergy to local anaesthetics ,and any of the study drugs
8. ASA grade III and IV patients.

Statistical Analysis:
Data were entered in MS-Excel and analyzed in SPSS V22. Descriptive statistics were represented with percentages; Mean with SD depends on nature of the data. Chi-square test, ANOVA, Post hoc tests – Dunnetts, Tuckey test were applied to find significance. P<0.05 was considered as statistically significant

Results

Demographic Parameter:

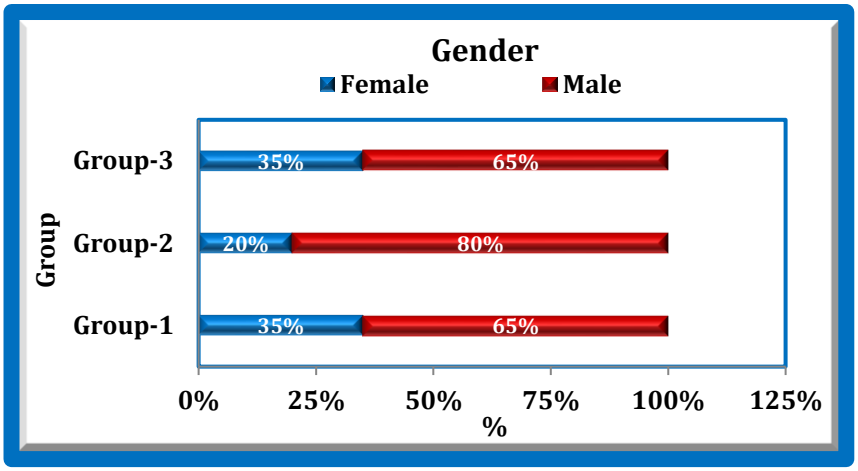
Table 1: Age distribution of the study groups:

Variable	Group	N	Minimum	Maximum	Mean	SD	P-value
Age	I	20	20	60	39.65	15.48	0.33
	II	20	20	58	38.65	12.81	
	III	20	20	60	44.80	13.26	

As shown in Table 1 , all the 3 groups , Group I , Group II and Group III are Age matched. Most of the patients age in all the 3 groups ranged between 35-45yrs. The average Age was 39.65±15.48 in Group I and 38.65±12.81 in group II and 44.80±13.26 in Group II

Table 2 : Sex distribution of the study groups:

Sex	Group					
	I		II		III	
	Count	%	Count	%	Count	%
Female	7	35.0%	4	20.0%	7	35.0%
Male	13	65.0%	16	80.0%	13	65.0%
Total	20	100.0%	20	100.0%	20	100.0%
P=0.49						



As shown in Table 2, all the 3 groups, Group I, Group II and Group III are gender matched. All 3 groups had predominantly Male population.

BLOCK CHARACTERISTICS

Table 3 : Onset of sensory block of the study groups:

Variable	Group	N	Minimum	Maximum	Mean	SD	P-value
SOT(IN MIN)	1	20	5	9	7.45	1.10	<0.001
	2	20	8	12	10.15	1.14	
	3	20	8	18	12.45	2.76	

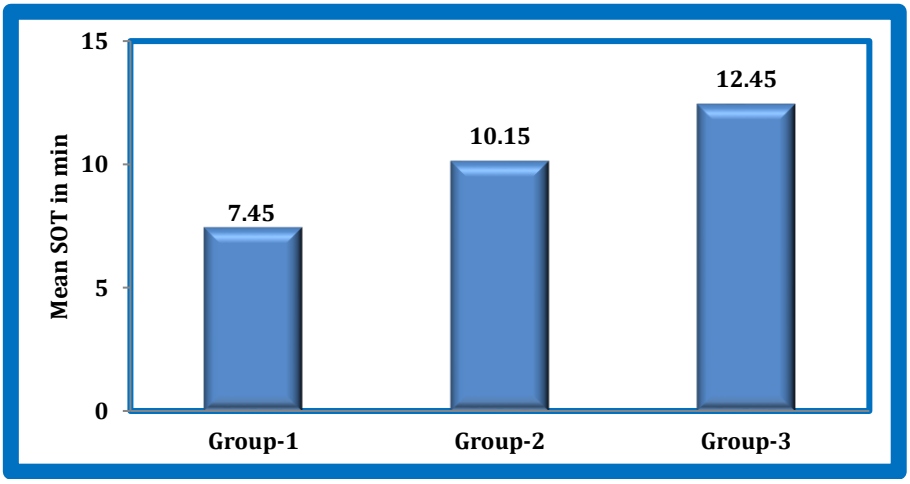


Table 3 shows: The mean time for onset of sensory block in group 1was 7.45±1.10 min and in group 2 was 10.15± 1.14 min and group 3 was 12.45±2.76 .The statistical analysis by students unpaired‘ test showed that there is significant difference in onset time of sensory block between the three groups. (P < 0.001). The onset of sensory block was significantly early in dexmedetomidine group (group 1) i.e, 7.45±1.10 min as compared to dexamethasone group (group 2) and plain ropivacaine group(group 3).

Table 4 : ONSET OF MOTOR BLOCK OF THE STUDY GROUPS:

Variable	Group	N	Minimum	Maximum	Mean	SD	P-value
MOT(IN MIN)	1	20	9	12	10.60	1.05	<0.001
	2	20	14	16	14.95	0.83	
	3	20	12	20	16.05	1.96	

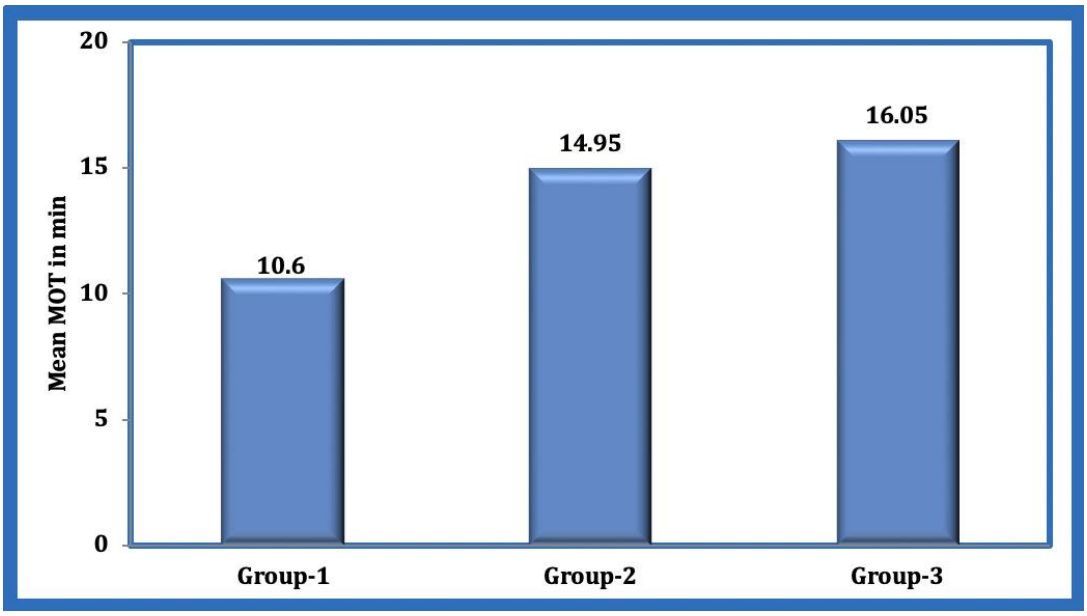


Table 4: The mean time for onset of motor block in group 1 was 10.60 ± 1.05 min and in group 2 was 14.95 ± 0.83 min and n group 3 was 16.05 ± 1.96. The statistical analysis by student‘s unpaired‘ test showed that there is significant difference in onset time of motor block between the three groups.(P = <0.001)

Table 5 : DURATION OFSENSORY BLOCK

Variable	Group	N	Minimum	Maximum	Mean	SD	P-value
DOSB	1	20	700	810	768.00	25.52	<0.001
	2	20	875	960	909.00	22.10	
	3	20	400	480	450.25	27.74	

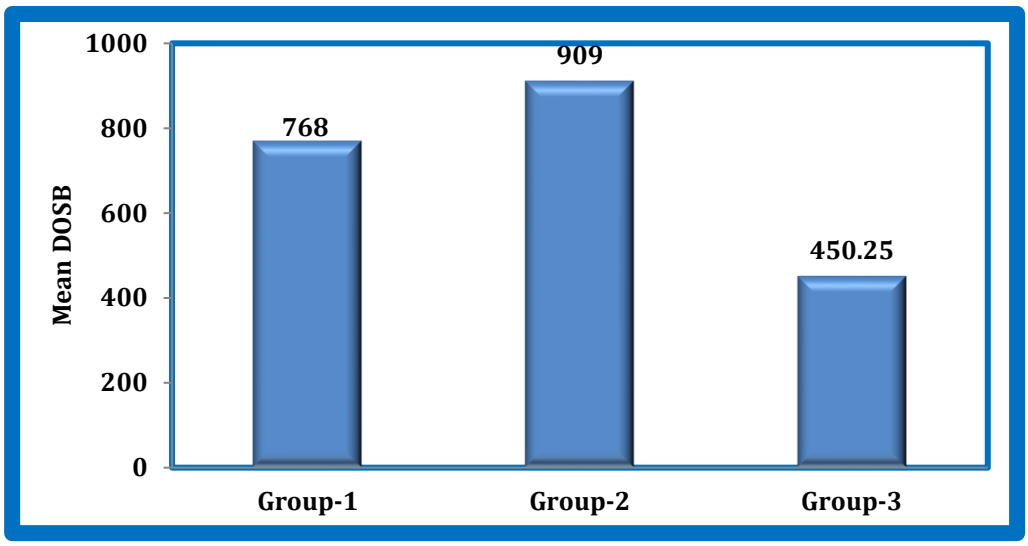


Table 5: The total duration of sensory block in group 1 was 768±25.52 min and in group 2 was 909±22.10 min and in group 3 was 450±27.74 min. There is significant difference in the total duration of sensory block between the three groups. (P <0.001)

Table 6: DURATION OF MOTOR BLOCK

Variable	Group	N	Minimum	Maximum	Mean	SD	P-value
DOMB	1	20	670	750	717.50	22.09	<0.001
	2	20	840	915	878.50	19.74	
	3	20	360	460	420.00	23.17	

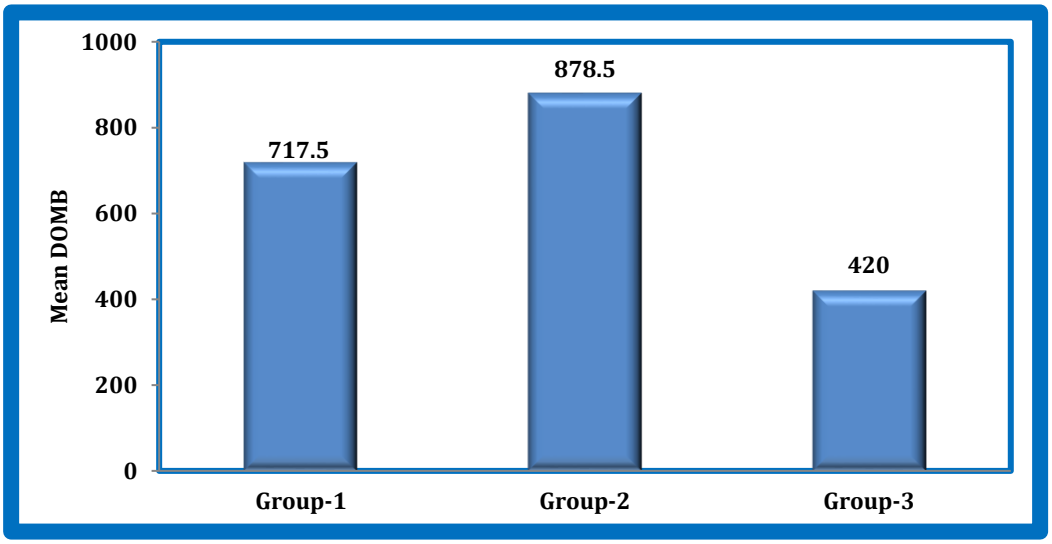


Table 6: The duration of motor block in group 1 is 717.50±22.09 min and in group 2 was 878±19.47 min and in group 3 was 420±23.17 min. There is significant difference in the total duration of motor block between the three groups. (P <0.001)

Table 7:TOTAL DURATION OF ANALGESIA(DOA)

Variable	Group	N	Minimum	Maximum	Mean	SD	P-value
DOA (in mins)	1	20	800	870	822.00	20.42	<0.001
	2	20	960	1040	1004.50	25.49	
	3	20	420	560	498.50	35.43	

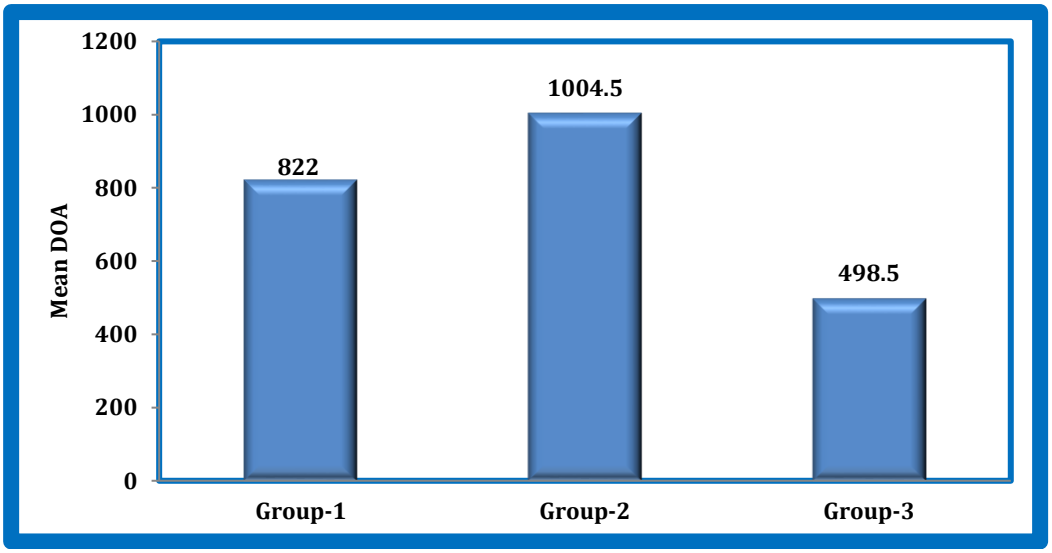


Table 7: The time for first rescue analgesia was given when VAS score was 3 and above. The total duration Analgesia in 1 group was 822±20.42 min and in group 2 was 1004±25.49 min and group 3 was 498 ±35.43. There was significant difference in the total duration of Analgesia between the three groups. (P <0.001).

Table 8 : COMPLICATIONS

COMPLICATIONS						
	Group-1		Group-2		Group-3	
	Count	%	Count	%	Count	%
NIL	20	100.0%	20	100.0%	20	100.0%

Table 8: None of the patients in any of the three groups experienced any complications. None of the patients had failure of block.

DISCUSSION

Brachial plexus block is an easy and relatively safe procedure for upper limb surgeries. Various approaches like Supraclavicular, interscalene, infraclavicular and axillary have been used for blocking the brachial plexus. Supraclavicular approach to Brachial plexus block is associated

with rapid onset and reliable anesthesia. Hence it is one of the most popular techniques used for upper limb blocks. Currently available local anaesthetics can provide analgesia for limited period of time when used as single injection. To extend the analgesia period beyond the operating rooms, various methods have been tried with the aim of prolonging the local anaesthetic action, like continuous infusion of local anaesthetics via indwelling catheters , use of combination of anaesthetics increasing the volume of LA ,addition of different adjuvants in local anaesthetics.[10]

Of various LA s ,Lignocaine and Bupivacaine are the most frequently used ,however there are limitations like shorter duration of action(Lignocaine) and increased incidence of Cardiotoxicity (Bupivacaine) .To overcome these limitations newer LA like Ropivacaine has been introduced which is 10-30 percent less cardiotoxic and less CNS toxic than Bupivacaine with enhanced tendency to block sensory fibres more readily than motor fibres. Hence we choose to use Ropivacaine in our study . Increasing the volume (dose) of LAs may prolong the duration of analgesia, but may also increase the risk of LA systemic toxicity. Therefore LA with less toxic effects is preferred. Although continuous catheter-based nerve blocks can extend postoperative analgesia, their placement requires additional time, cost and skill. While a novel sustained-release encapsulated (liposomal) preparation of bupivacaine is presently undergoing investigation in phase III trials[11], a variety of perineural adjuvants, including Buprenorphine, Fentanyl[12], Tramadol,Clonidine, Dexmedetomidine ,Dexamethasone, Magnesium, and Midazolam,[13] have been used to prolong the duration of analgesia of nerve blocks with varying degrees of success. Dexamethasone is a steroid with potent anti inflammatory agent with potency of 25- 30 times of hydrocortisone. Steroids have nerve block prolonging effects. Mechanism of action is not clear ,but it is suggested from a number of studies that they block the nociceptive impulse transmission along unmyelinated C fibres . They also have an action on potassium channels causing hyperpolarization and blocking nerve conduction. The block effect may be due to its local action and not a systemic one [14] .Dexmedetomidine, an α2 Adrenoreceptor agonist, was first proposed as an adjuvant capable of prolonging duration of sensory and motor block produced by nerve blocks by Memis, and colleagues[15] In another study by Brummett CM et al Observed that ,perineural Dexmedetomidine added to Ropivacaine for sciatic nerve block in rats prolonged the duration of analgesia by blocking the hyperpolarization-activated cation current ,which prevents the nerve from returning from hyperpolarized to resting membrane potential for subsequent firing [16]. Dexmedetomidine is a highly selective a_2 Agonist. Highest densities of alpha2 receptors have been located in the locus cereleus. The hypnotic and sedative effects of alpha 2 adrenoceptor activation have been attributed to this site in the CNS. It is also the site of origin of the descending medullospinal noradrenergic pathway, known to be an important modulator of nociceptive neurotransmission. Proposed mechanism of action of Dexmedetomidine in peripheral block is via centrally mediated analgesia, α2 Adrenoreceptor mediated vasoconstriction, attenuation of inflammatory response and direct action on peripheral nerves .Dexmedetomidine enhances activity dependent hyperpolarisation by repetitive stimulation of Na/k pump causing slowing or blockage of conduction**.** Presynaptic

activation of a2 adrenoceptor in central nervous system inhibits the release of norepinephrine, terminating the propagation of pain signals and their postsynaptic activation inhibits sympathetic activity, thereby decreasing the heart rate and blood pressure in higher doses [17] .Our finidngs in group II are comparable with the study by Feroz Ahmad Dar, Dr. Neelofaret al [18] ·Naveen Kumar et al in their Comparative study between 0.25% Bupivacaine with 8 M.G Dexamethasone and 0.25% Bupivacaine with 50µg Dexmedetomidine as an adjuvant for brachial plexus Block concluded that Duration of motor block and sensory block and the total duration of analgesia is significantly prolonged in Dexamethasone group compared to Dexmedetomidine group [19].The main limitation of our study was that it was not possible for us to evaluate neurologic complications caused by Dexmedetomidine or Dexamethasone. It is possible, however, for our patients to self-report any untoward reaction that can mimic late-onset neuropathy, but for future investigation, it will be advisable to establish continuous follow-up using survey questionnaires and periodic checking for a longer period.

Conclusion

In the Present study comparing either Dexmedetomidine or Dexamethasone as adjuvant to Ropivacaine with Ropivacaine alone in Ultrasound guided supraclavicular brachial plexus block, we found that both Dexmedetomidine and Dexamethasone are effective as adjuvants ,in hastening the onset of sensory and motor block, in prolonging the duration of sensory and motor block and duration of analgesia ,however Dexamethasone as adjuvant is a better choice and has following advantages .It prolongs the duration of sensory and motor blockade to greater extent .It Prolongs the duration of analgesia (Pain scores in the post operative period are significantly low for longer period of time).It is Cost effective.

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