ISSN: 0975-3583, 0976-2833 VOL15, ISSUE4, 2024

Original Research Article

A Comparative Study Between 0.25% Ropivacaine with Dexmedetomidine and 0.25% Ropivacaine with Clonidine as adjuvants in Ultrasound Guided Supraclavicular Brachial Plexus Block

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ABSTRACT:

INTRODUCTION: Various studies have investigated the role of different drugs as adjuncts to SBPB to prolong the duration and quality of analgesia without producing any major adverse effects. We conducted a study to compare the novel alpha 2 agonists (clonidine and dexmedetomidine) with respect to onset, duration of block and postoperative analgesia when added as adjuvants to the local anaesthetic 0.25% ropivacaine.

MATERIALS AND METHOD: A total of 60 patients, confirming to inclusion criteria, undergoing elective upper limb surgeries under SBPB, were enrolled for the study, over a period of 2 years. Sensory block was evaluated by Hollmen scale and findings were recorded at an interval of every 2 min from time-0 till complete sensory block was achieved i.e Hollmen Score = 4 . Onset Time of Sensory Block, Time for complete sensory block and total duration of sensory block were recorded. Motor block was evaluated by using Bromage Scale for upper extremity and findings were again recorded at an interval of every 2 min from time-0 till complete loss of motor power was achieved i.e BS =3. Onset Time of Motor Block, Time for complete motor block and total duration of motor block were recorded. Level of sedation was assessed at an interval of every 20 min from Time-0 till the end of surgery using the 5 point sedation scale. Postoperatively, sensory block and motor block and post-operative pain (by Visual Analogue Scale) were assessed. VAS was recorded at an interval of every 1hour till the score ≥ 4.

RESULTS: The onset of sensory block was significantly faster and the onset of motor block was significantly early in Dexmedetomidine group compared to Clonidine group and the duration of sensory and motor block were significantly longer in the Dexmedetomidine group. Duration of analgesia was significantly more in Dexmedetomidine group compared to Clonidine group.

CONCLUSION: Addition of 1 µg/kg of dexmedetomidine in contrast to addition of 1 µg/kg of clonidine as an adjuvant to 0.25% Ropivaciane in a volume of 20 ml, for Supraclavicular

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Brachial Plexus Block in arm and forearm surgeries shortens the onset time and prolongs the duration of sensory block, motor block and analgesia without producing any clinically significant side effects.

Key words: Supraclavicular block, Dexmedetomidine, Clonidine

1. INTRODUCTION:

Regional anaesthetic techniques are as successful as general anaesthesia in alleviating pain during various surgical procedures. The role of peripheral nerve block (PNB) has expanded from the operating suite into the arena of postoperative and chronic pain management. PNB are achieved by injecting local anaesthetic solution around a nerve root to produce anaesthesia in the distribution of that nerve without any distortion of the surgical anatomy [1]. There are many advantages of a single shot PNB like rapid onset, predictable and dense anaesthesia, a relatively simpler technique, good muscle relaxation and adequate post operative analgesia. It also means early ambulation, early oral intake, avoiding intubation and its complications with lesser systemic side effects and fewer postoperative side effects [2]. Among the various PNB, Brachial Plexus Block (BPB) is one of the most common practiced blocks, as it offers almost complete anaesthesia and analgesia and an excellent operative field for surgeries of the upper extremities. The various local anaesthetics used in Supraclavicular block are quite effective but the duration of analgesia is a major limiting factor. There has always been a search for adjuvants which can be added to the local anaesthetics in peripheral nerve block to improve the duration and quality of analgesia but without producing any major adverse effects. Various studies have investigated several adjuncts, including opioids [3], clonidine [4], neostigmine [5], hyaluronidase [6] and dexamethasone [7]. Since their synthesis, Alpha-2 adrenergic receptor agonists have been studied for their sedative, analgesic, perioperative sympatholytic and cardiovascular stabilizing effects with concomitant reduced anaesthetic requirements. They have been used intrathecally, epidurally or as part of peripheral nerve blocks either alone or in conjunction with local anaesthetics in an attempt to prolong the duration of analgesia and to improve the quality of the block [8-9]. Clonidine, the older drug is a selective α-2 adrenergic agonist with some α-1 agonist property. In clinical studies, the addition of clonidine to local anaesthetic solutions has shown reduction in the onset time of the block and a more efficient peripheral nerve block with longer post operative analgesia. The effect of clonidine is dose related between 0.1 and 0.5 µg/kg. Clonidine possibly enhances or amplifies the sodium channel blockade action of local anaesthetics by opening up the potassium channels resulting in membrane hyperpolarisation, a state in which the cell is unresponsive to excitatory input [10]. Dexmedetomidine, the newer drug, is a potent α2 adrenoceptor agonist, and about eight-times more selective towards the α2 adrenoceptor than clonidine. In previous clinical studies, administration of intravenous dexmedetomidine has shown to produce significant opioid sparing effects as well as a decrease in inhalational anaesthetic requirements [11]. In humans, it has been used in various strengths as an adjunct to local anaesthetics to prolong the duration of block and post-operative analgesia in various peripheral blocks [12-13]. Very few studies have compared dexmedetomidine with clonidine with respect to duration of block and post-operative analgesia especially as an adjuvant to Ropivacaine 0.25%. This current study was designed to test the hypothesis that dexmedetomidine when added as an adjuvant to the more diluted 0.25% Ropivacaine in ultrasound guided supraclavicular brachial plexus block enhanced the onset and duration of sensory and motor block and duration of analgesia as compared with

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clonidine without causing any major hemodynamic instability or any other systemic side effects.

2. MATERIALS AND METHODOLOGY

The present study was conducted in conducted in the Department of Anaesthesiology, Shyam Shah Medical College & associated Sanjay Gandhi Memorial and Gandhi Memorial Hospitals, Rewa (M.P.) from January 2023 to December 2023 (12 Months) after approval by institutional ethics committee. A total of 60 patients undergoing elective upper limb surgeries were included in the study. The purpose and entire anaesthetic procedure were explained in detail to them and written informed consent was taken from all the patients. Patients with age more than 18 years of either sexes, Body weight of 50 kg and above, ASA physical status I and II were included in the study. Patients who were unwilling for the procedure, in ASA physical status III and above, having neurological lesions in the upper limb to be operated upon, with diabetic neuropathy, psychiatric patients, patients with history of allergy to local anaesthetics, with infection / swelling at proposed site of injection, or patient on alpha blockers or beta blockers or with bleeding disorders or patients on anticoagulants, or with any contraindication for peripheral nerve block were excluded from the study. All patients underwent routine pre-anaesthetic evaluation. After taking detailed history and clinical examination, routine and specialised investigations as per patient and case requirement were done. The patients were randomly divided into two groups of 30 each. Block was administered using the following combination of drugs Group 1: Ropivacaine 0.25% (19 ml) + Dexmedetomidine 1 µg/kg to make 20 ml Group 2: Ropivacaine 0.25% (19 ml) + Clonidine1 µg/kg to make 20 ml All the patients were given Tablet Alprazolam 0.25 mg orally the night before surgery. All selected cases were advised to remain nil orally for fluids and solids as well, at least 6 six hours prior to the time of performing the block. All patients were explained the Visual analogue scale (VAS) on 0-10 where 0 denoted no pain and 10 denoted worst pain. On arrival in the operation theatre, each patient's baseline heart rate, non invasive blood pressure and oxygen saturation were recorded and noted and then these were recorded every five minutes till end of the surgery. An IV canula was secured in the non affected limb and appropriate IV fluid was started. All patients received supraclavicular brachial plexus block under Ultrasound Guidance by an experienced anaesthesiologist who was blinded to the grouping. The bunch of grape appearance on Ultrasound was noted and then the test drug combination (which had been loaded in a sterile syringe by another anaesthesiologist blinded to the study) was given after negative aspiration using a 22 G, 50mm, Stimuplex, Braun needle. A total of 20 ml of solution containing 19 ml of 0.25% Ropivacaine with either 1 microgram per kg clonidine or dexmedetomidine in 1 ml was injected to get a classical doughnut appearance on USG. After the completion of injection the needle was withdrawn completely and antiseptic pressure dressing was applied at the site of puncture. Once total volume as planned according to study was injected, the time was noted and this was recorded as Time 0. Intra-operative Monitoring PR, SBP, DBP, MAP, RR and SpO2 were recorded at time 0 and thereafter at an interval of every 5 minutes (mins) from Time-0 for the initial 60 mins and thereafter at an interval of every 10 mins till the end of surgery. Sensory block was evaluated by Hollmen scale. and findings were recorded at an interval of every 2 min from time-0 till complete sensory block was achieved i.e. Hollmen Score = 4.

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Hollmen Scale:
Score 1 = Normal sensation of pinprick.
Score 2 = Pin prick felt as sharp pointed but weaker compared with same area in the other upper limb.
Score 3 = Pin prick recognized as touch with blunt object.
Score 4 = No perception of pin prick.

Onset Time of Sensory Block (OTSB) was taken as the time interval in minutes from time-0 till sensory block started appearing i.e. Hollmen score = 2. Time for Complete Sensory Block (TCSB) was taken as the duration of time in minutes from time 0 till complete sensory block was achieved i.e Hollmen Score=4. Thereafter effect of block was tested every 30 minutes. Total Duration of Sensory Block (TDSB) was taken as the duration of time in minutes from the TCSB till the time when patient came back to Hollmen score 1. Motor block was evaluated by using Bromage Scale (BS) [14] for upper extremity and findings were recorded at an interval of every 2 min from time-0 till complete loss of motor power was achieved i.e. BS Score=3.

Bromage scale for upper extremity:
0: Able to raise the extended arm to 90° for full 2 seconds.
1: Able to flex the elbow and move the fingers but unable to raise the extended arm.
2: Unable to flex the elbow but able to move the fingers.
3: Unable to move the arm, elbow and fingers.

Onset Time of Motor Block (OTMB) was taken as the time interval in minutes from time-0 till motor block started appearing i.e BS score ≥ 2. Time for Complete Motor Block (TCMB) was taken as the duration of time in minutes from time-0 till complete motor block was achieved i.e. BS score=3. Thereafter effect of block was tested every 30 minutes. Total Duration of Motor Block (TDMB) was taken as the duration of time in minutes from the TCMB till the time when BS score < 3 in the postoperative period. Adequacy of block was evaluated by Allis clamp test before handing over the patient to surgeon. The test was done by asking the patient whether they felt any discomfort when pressure was applied with the Allis clamp at the area of the surgical field. The reading was recorded as follows: a) Complete (Total comfort to patient) b) Inadequate (Discomfort: Requiring supplementation) Block was considered as a failure if complete sensory and motor block was not achieved even after 45 minutes. Failed blocks were converted to GA and recorded. The ECG was constantly monitored in the display screen and only the significant changes (if any) from the base line was recorded under the heading of intraoperative complications. Level of sedation was assessed at an interval of every 10 min from Time-0 till the end of surgery using the 5 point sedation scale. The scoring was recorded as follows: 1= Awake and alert. 2= Sedated but responding to verbal stimulus. 3= Sedated, responding to mild physical stimulus 4= Sedated, responding to moderate or strong physical stimulus 5= Not arousable Duration of surgery and type of surgical procedure done was recorded. Following intra-operative and post operative complications were looked for - inadequacy of block, any reaction at injection site like haematoma, persistent bradycardia, persistent hypotension, oversedation- sedation score >4, any respiratory distress, fall in respiratory rate to < 90%, pruritus, any symptoms or signs of local anaesthetic toxicity, any significant ECG changes and Horner's syndrome. Intra-operative medication given (if any) for sedation or management of complications were also noted and recorded.

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After the completion of the surgery patient was shifted to post operative recovery ward without prescribing any analgesics in any form. Patient was monitored till the complete recession of sensory as well as motor block occurred and till the time patient did not demand any analgesic or VAS Score was recorded as ≥ 2. On reaching that point of time, study was stopped and for breakthrough pain relief patient was given systemic analgesic Inj Diclofenec Sodium 75mg IM or as per individual requirement. Parameters recorded in the post operative period were PR, SBP, DBP, MAP and RR were recorded at an interval of every 30 minutes. Sensory block was evaluated and recorded by Hollmen scale at an interval of every 30 minutes till the time when it fell to 1 or patient complained of pain in the post operative period. Pain was assessed by Visual Analogue Scale (VAS). VAS was recorded and assesed at an interval of every 30 minutes till the score ≥ 2. Motor Block was evaluated and recorded at an interval of every 30 minutes till the time when BS score was < 3 in the postoperative period. Time of first dose of post–operative systemic analgesic was on the basis of VAS score ≥ 2 or on demand made by the patient (whichever was early) and was noted for use as Analgesia time. Post operatively CXR was done after six hours from Time-0 or early if patient showed any clinical evidence of pneumothorax and finding was recorded. Any complication / complaint (if any) as mentioned above were recorded with their respective management. All the collected data was entered in Microsoft Excel sheet. It was then transferred to SPSS ver. 17 software for statistical analysis. All the Quantitative data was presented as mean and standard deviation and compared using student's ttest. Qualitative data was presented as frequency and percentage and analysed using chi-square test. P-value of < 0.05 was considered as significant.

3. RESULTS

About 63% of subjects were male while 37% were females. No significant difference was observed between the groups on the basis of gender distribution (p-value = 0.59). Two third of subjects were ASA grade I while rest one third were grade II. No difference was observed between groups (p-value = 0.1). Mean age and weight of subjects of group 1 and 2 was 35.4 years, 56.5 Kg and 36.5 years and 56.9 Kg respectively. The difference was statistically non significant (p=0.67 for age and p=0.53 for weight).

TABLE-1: Sensory block characteristics.

Variable	Group	Number	Mean	SD	p-value
OTSB	1	30	9.7	1.5	<0.05
	2	30	12.9	1.4	
CTSB	1	30	15.6	1.6	<0.05
	2	30	20.6	1.5	
TDSB	1	30	690.0	87.4	<0.05
	2	30	336.7	33.5	

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The onset of sensory block was significantly faster in Dexmedetomidine group compared to Clonidine group (9.7 vs. 12.9 minutes). Also the duration of sensory block was significantly longer (690 vs 336 minutes) in the Dexmedetomidine group.

TABLE-2: Motor block characteristics.

Variable	Group	Number	Mean	SD	p-value
OTMB	1	30	15.7	1.7	<0.05
	2	30	20.4	2.0	
CTMB	1	30	19.9	1.7	<0.05
	2	30	24.4	1.5	
TDMB	1	30	503.1	40.4	<0.05
	2	30	351.0	28.8	

The onset of motor block was significantly early in Dexmedetomidine group compared to Clonidine group (15.7 vs. 20.4 minutes), and the duration of block was also significantly longer (503.1 vs 351 minutes) in the dexmedetomidine group.

TABLE-3: Duration of Surgery and Analgesia.

Variable	Group	Number	Mean	SD	p-value
Duration of Analgesia (In Min.)	1	30	721.3	88.3	<0.05
	2	30	534.0	30.7	
Duration of Surgery (In Min.)	1	30	95.1	3.7	0.2
	2	30	93.7	4.9	

Duration of analgesia was significantly more in Dexmedetomidine group compared to Clonidine group (721.3 vs. 534 minutes), while the duration of surgery was almost similar (95.1 vs 93.7 minutes).

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TABLE-4: Comparison of variation in Sedation Score.

Sedation Score	Group	Number	Mean	SD	p-value
0 Min	1	30	2		NA
	2	30	2		
10 Min	1	30	2		NA
	2	30	2		
20 Min	1	30	2		NA
	2	30	2		
30 Min	1	30	2		NA
	2	30	2		
40 Min	1	30	2		NA
	2	30	2		
50 Min	1	30	2		0.05
	2	30	2.2	0.407	
60 Min	1	30	2		0.05
	2	30	2.2	0.407	
90 Min	1	30	2		0.05
	2	30	2.57	0.504	
120 Min	1	30	2		0.05
	2	30	2.2	0.407	
150 Min	1	30	2		NA
	2	30	2		

Above table shows the variation in Intra-op Sedation Score among both groups. There was a statistically significant difference in sedation scores in the Clonidine group at 50, 60, 90 and 120 minutes. However clinically all the patients were arousable and responding to verbal stimuli.

The haemodynamic parameters were comparable in both groups. No cases of clinically significant bradycardia and hypotension were noticed in any of the groups. The Respiratory rate, Oxygen saturation was comparable in both the groups and did not show any fall. No side effects requiring any intervention were noticed in either group. No patients in the study demonstrated any signs or symptoms of local anaesthetic drug toxicity.

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4. DISCUSSION

Supraclavicular Brachial plexus block is a very common PNB used for providing anaesthesia for upper limb surgeries of the arm and the forearm. The use of Ultrasound has made the procedure safer, as smaller amounts of local anaesthetic can be given with more accurate needle placement thus avoiding injury to arteries, veins and other adjacent structures. The ultrasound can also be used to ensure that the local anaesthetic spread is in the correct tissue plane and therefore decreases the chances of pneumothorax, arterial puncture and direct nerve damage [15-16]. Then the limiting factor in the more widespread use of this block is the duration of action of the local anaesthetics available which means either use of perineural catheters for longer surgeries or addition of adjuvants which prolong the duration of motor and sensory block and analgesia A few groups have compared the effects of the alpha 2 agonists clonidine and dexmedetomidine with bupivacaine [17] and with 0.75% Ropivacaine [18]. We wanted to compare the two drugs as adjuvants to a weaker solution of 0.25% Ropivacaine delivered more precisely near the brachial plexus roots with the help of ultrasound guidance. The aim was to study and compare the two groups with regard to onset time of sensory and motor blocks, the total duration of sensory and motor block and analgesia, significant hemodynamic changes, effect on sedation level and the complications produced if any. Our study found that the onset of sensory block was significantly faster in the dexmedetomidine group (Gp1) when compared to the clonidine group (Gp2) (9.7 vs 12.9 mins). Also, the total duration of sensory block was also significantly longer in Gp1 (690mins vs 336 mins). Similar observation was noted in a study by Swami SS et al. [17] who studied the effect of adding clonidine 1 µg/kg and dexmedetomidine 1 µg/kg to bupivacaine 0.25% (35 cc) with duration of sensory blocks with dexmedetomidine of 413.97±87.13mins versus 227.00±48.36 mins in the clonidine group. In 2013, a prospective, double-blinded, controlled volunteer study was carried out by Marhofer D et al [19] to investigate the effects of dexmedetomidine as an adjuvant to ropivacaine in peripheral nerve block. Ultrasound-guided ulnar nerve block (UNB) was performed in three different groups using 3 ml ropivacaine 0.75%, 3 ml ropivacaine 0.75% plus 20 µg dexmedetomidine, or 3 ml ropivacaine 0.75% plus systemic 20 µg dexmedetomidine. They noticed that sensory onset time of UNB was not different between the study groups, but the duration of sensory block was prolonged in the ropivacaine with dexmeditomidine group. In our study the onset of motor block was also significantly early in dexmedetomidine group (15.7 vs. 20.4 minutes). Also, the duration of block was significantly longer in Gp1 (503.1 vs 351 minutes). Harshvardhan HS in his study comparing the effects of adding Clonidine and Dexmeditomidine to 0.75% Ropivacaine for supraclavicular nerve blocks also found a significantally faster onset time and duration of motor block with the addition of dexmeditomidine [18]. Our study however showed a slightly longer onset time for both sensory and motor blocks in both groups as compared to studies by Harshvardhan [18]. This could be because we used a weaker concentration of 0.25% Ropivacine as compared to 0.75% used in Harshvardhan's study. In our study, duration of analgesia was also found to be significantly greater in dexmedetomidine group (721.3 vs. 534 minutes). This is similar to findings from the study by Harshvardhan HS [18] and Swamy SS et al [17]. In 2012, Gandhi R et al [20] conducted a study to compare the postoperative analgesic efficacy and safety of dexmedetomidine for brachial plexus blockade along with bupivacaine. They observed that dexmedetomidine group had prolonged postoperative analgesia. The mechanism of this analgesic action is not very clear. Probabaly peripherally α2 agonists produce analgesia by reducing the release of norepinephrine and also causing inhibitory effects on the nerve fibre action potentials which is receptor independent. Central

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analgesia and sedation by these drugs is caused by the inhibition of release of Substance P in the nociceptive pathway at the level of the dorsal root neurons and by activating the α2 receptors in the locus cerulus [20].The locus ceruleus is also the site of origin for the descending medullospinal noradrenergic pathway, known to be an important modulator of nociceptive neurotransmission [21]. Dexmedetomidine and clonidine are both α2 adrenergic agonists. It is possible that they work in a similar manner and may indicate a class effect. However, the novel α2 agonist dexmedetomidine has eight times higher selectivity to α2 adrenoceptors [21]. Level of sedation was assessed at an interval of every 20 min from Time-0 till the end of surgery using the 5 point sedation scale. In our study, intraoperatively all patients were comfortable. Only in clonidine group some patients were observed to have sedation score >2 at 50 and 90 minutes. This was statistically significant. However, clinically all the patients were arousable and responding to verbal stimuli. This effect may be because some amount of systemic absorption of the drug may occur even when these drugs are administered to block peripheral nerves [21]. No patients in either study group had any hemodynamic instability, bradycardia or significant hypotension. None of the patients developed any serious complications due to block procedure (pneumothorax, large hematoma, Horners syndrome, prolonged nerve palsy, nausea, vomiting or dry mouth). In a study conducted by Singh S et al, the effects of clonidine (150 µg) added to bupivacaine was compared with bupivacaine alone on supraclavicular brachial plexus block. No side-effects were observed in both the clonidine and the control group throughout the study period [22].

LIMITATIONS OF THE STUDY

The present study's limitations include small sample size and a single-centric design.

5. CONCLUSION:

To conclude, from our study, of a comparison of adding 1 µg/kg of dexmedetomidine versus adding1 µg/kg of clonidine as an adjuvant to 0.25% Ropivaciane in a volume of 20 ml for Supraclavicular Brachial Plexus Block in arm and forearm surgeries, we found that the addition of dexmedetomidine shortens the onset time and prolongs the duration of Sensory block, Motor block and Analgesia as compared to clonidine without producing any clinically significant side effects.

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