

**COMPARATIVE STUDY OF BUPIVACAINE V/S BUPIVACAINE WITH CLONIDINE FOR BRACHIAL PLUXUS BLOCK**

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**ABSTRACT: BACKGROUND:** The prime duty of any anesthesiologist is to relieve pain in the perioperative period. Today regional anesthesia is well established as equal to general anesthesia in effectiveness and patient acceptability. Regional anesthesia is blocking of peripheral nerve conduction in a reversible way using local anesthetic agents. For surgeries on upper extremities, particularly in emergency surgeries, regional anesthesia has many advantages over general anesthesia. The brachial plexus is approached at the level of trunks and the compact arrangement of trunks at the supraclavicular level gives a high success rate with minimum local anesthetic drug volume and a dense and fast onset of the block. To prolong the duration of analgesia various drugs have been studied as adjuvants to the local anesthetics. This study is intended to determine the effects of adding Clonidine to Bupivacaine in brachial plexus blockade by Nerve locator assisted supraclavicular approach, with regard to the onset, intensity and duration of blockade along with its analgesic efficacy. **METHODS:** Forty adult patients of both sexes in the age group of 20-60 years of weight ranging from 50-70kg belonging to ASA I/II category posted for various types of upper limb surgeries the patients were randomly allocated into two groups,. Supraclavicular brachial plexus block was performed via peripheral nerve locator assisted subclavian perivascular technique. Group – B (Bupivacaine alone)–20 patients received 30ml of 0.375%Bupivacaine with 2ml of 0.9% sodium chloride solution. Group–BC (Bupivacaine+Clonidine)–20 patients received 30ml of 0.375%Bupivacaine with Clonidine hydrochloride 100µg (1ml of 150µg diluted with 2ml 0.9% NaCl solution. From that 2ml used for study. (The following parameters are assessed Onset of blockade, Duration of blockade, Intensity of blockade, Sedation, Quality of analgesia, Haemodynamic changes & Complications if any **RESULTS:** Onset time for both motor and sensory block was quicker in the Bupivacaine with clonidine group, Time taken for completion of both motor and sensory blockade was, significantly lesser in clonidine group, There was no difference between the groups in the intensity of blockade., The mean duration of both sensory & motor blockade was significantly prolonged in clonidine group, Sedation was statistically significant with Bupivacaine-clonidine group in the intraoperative period, There was no haemodynamic instability in both the groups in the study period, There was no complication due to the addition of 100µg clonidine to Bupivacaine **CONCLUSION:** clonidine 100µg (in 2ml)when used as an additive to 0.375% Bupivacaine(30ml) solution for Supraclavicular brachial plexus block, quickens the onset of sensory & motor blockade and prolongs the duration of sensory & motor blockade. It also improves the quality of post-operative analgesia with mild intraoperative sedation and decreases the heart rate without any haemodynamic instability. Hence, clonidine can be considered as a safe additive to local anaesthetic solution for brachial plexus blocks.

**KEYWORDS:** Brachial Plexus Block, Bupivacaine, Clonidine, Supraclavicular Approach.

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**INTRODUCTION:** The prime duty of any anaesthesiologist is to relieve pain in the perioperative period. The anaesthesiologist adopts various types of techniques to alleviate pain, like general or regional anaesthesia. Today regional anaesthesia is well established as equal to general anaesthesia in effectiveness & patient acceptability.

Regional anaesthesia is the blocking of peripheral nerve conduction in a reversible way by using local anaesthetic agents thereby one region of the body is made insensitive to pain and is devoid of reflex response to surgical stimuli. In this the CNS is spared, so that the patient is conscious, fully awake during the surgical procedure without recognizing pain.

For surgeries on upper extremities particularly in emergency surgeries regional anaesthesia has many advantages over general anaesthesia. The frequent use of pneumatic tourniquet.<sup>1</sup> to provide a bloodless field during surgery makes individual nerve blocks impractical. Brachial plexus block.<sup>2</sup> is the answer in such a situation. There are different approaches but the ones frequently employed for blocking the brachial plexus.<sup>3</sup> include;

- Supraclavicular approach.
- Infraclavicular approach.
- Axillary approach.
- Interscalene approach.

**Axillary approach.<sup>4</sup> has the lowest incidence of serious complications and can be performed with ease. But there are limitations associated with axillary approach.<sup>5,6</sup> like:**

- It is inadequate for operations on the arm and shoulder.
- It is difficult to block the musculocutaneous nerve predictably with resultant sparing of the radial aspect of forearm and dorsum of hand.
- Tourniquet pain is not well tolerated.
- Also abducting the arm by 90 degrees for giving the block may be painful and even dangerous in traumatic lesions of the upper extremity.

The brachial plexus is approached at the level of trunks and the compact arrangement of trunks at supraclavicular level gives a high success rate with minimum local anaesthetic drug volume and a dense & fast onset of block. Hence the supraclavicular approach is the method of choice for blocking the brachial plexus.<sup>3</sup>

William Steward Halsted first performed brachial plexus block in 1885. In 1911, Kulenkampff and Hirshel described the first percutaneous brachial plexus block by supraclavicular and axillary routes respectively.

Since then several techniques of brachial plexus block have been described with the purpose of improving the efficacy and success rate and minimizing the risk and rate of complications. Of the various techniques.<sup>3</sup> the most widely practiced methods are the classical technique described by Patrick (1940), Vertical plumb bob approach described by Brown, 1<sup>st</sup> rib walk over technique described by Bonica and Moore and the Subclavian perivascular technique described by Winnie and Collins (1964). Of the several local anaesthetic drugs used for brachial plexus block, bupivacaine is used most frequently in our set up as it has a long duration of action varying from 3 – 8 hours.<sup>1,4,7</sup>

To prolong the duration of analgesia various drugs have been studied as adjuvant to the local anaesthetic solution and techniques like the continuous catheter placement in the plexus have evolved. These adjuvant drugs ideally are expected to prolong the analgesic effect without causing any systemic side effects or prolonging motor blockade Nerve locators are now widely seen as useful

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aids in nerve blocks. Its use avoids paraesthesia, decreases the chance of nerve injury and gives high success rate.

Clonidine is a  $\alpha_2$  agonist has an anti-nociceptive effect on a wide dynamic range of neurons and receptors. In animal studies, Clonidine depressed impulse conduction in isolated nerve fibre with some preference for C-fibres. Used as the sole analgesic, it produced analgesia after intrathecal, epidural and intra articular administration. Clonidine can be safely administered as an adjunct to local anaesthetics to increase the duration of analgesia. It produces analgesia by interacting with  $\alpha_2$ -adrenergic receptors. These receptors are located on superficial laminae of spinal cord and brain stem nuclei implicated in pain. So analgesia may be produced at peripheral, spinal and brain stem sites.

This study is intended to determine the effects of adding Clonidine to Bupivacaine in brachial plexus blockade by Nerve locator assisted supraclavicular approach, with regard to the onset, intensity and duration of blockade along with its analgesic efficacy.

**AIM:** The aim of the present study is to evaluate the effect of addition of 100 $\mu$ g of Clonidine to 0.375% Bupivacaine solution in Supraclavicular brachial plexus block with regard to following parameters:

- Onset of blockade.
- Duration of blockade.
- Intensity of blockade.
- Sedation.
- Quality of analgesia.
- Haemodynamic changes &.
- Complications if any.

**METHODOLOGY:** Forty adult patients of both sexes in the age group of 20-60 years of weight ranging from 50-70kg belonging to ASA I/II category posted for various types of upper limb surgeries at the Department of orthopaedics, Mahatma Gandhi Memorial Hospital, formed the study group.

This study was designed as a prospective randomized comparative study. After receiving the institutional ethical committee approval and informed consent, the patients were randomly allocated into two groups. Supraclavicular brachial plexus block was performed via peripheral nerve locator assisted subclavian perivascular technique.

### Groups:

**Group - B** (Bupivacaine alone)–20 patients received 30 ml of 0.375%Bupivacaine with 2 ml of 0.9% sodium chloride solution

**Group - BC** (Bupivacaine + Clonidine)–20 patients received 30ml of 0.375% Bupivacaine with Clonidine hydrochloride 100 $\mu$ g (1ml of 150 $\mu$ g diluted with 2ml 0.9% Nacl solution. From that 2ml used for study.

### Inclusion Criteria:

- ASA PS I & II.
- Age group 20-60 years.
- Surgeries on forearm and hand.

**Exclusion Criteria:**

- Patient refusal.
- Local infection at needle insertion site.
- Coagulopathy.
- Patient on anticoagulants.
- Pneumothorax or previous pneumonectomy on the opposite side.

All patients were preoperatively evaluated for any systemic diseases and investigations done prior to assessment. Procedure was explained in detail and written consent obtained.

The procedure was carried out in the theatre, where facilities for resuscitation was available.

**Intraoperative and Postoperative Monitoring Parameters:**

- Heart rate.
- O<sub>2</sub> Saturation.
- Non-invasive Blood Pressure.
- Electro Cardio Graph.

Initially the pre-procedure parameters were recorded i.e., Heart rate, Systolic BP, Diastolic BP, Mean BP SPO<sub>2</sub> & ECG. These were taken as baseline values before giving the block. Then block was performed. All through the study these parameters were monitored continuously except the NIBP which was recorded intermittently. Postoperatively they were monitored for 24 hours.

Patients were observed vigilantly for the development of various complication.

**Hollmen's scale: Sensory blockade (Grade):**

1. 0 – Normal sensation of pin prick.
2. + - Pin prick felt as sharp pointed but weaker compared with the same area in other extremity.
3. ++ - Pin prick felt as touch with blunt object.
4. +++ - No perception of pin prick.

Onset of blockade means minimum grade 2 and complete blockade means minimum grade 3.

**Motor blockade (Grade): Nerves Studied in the Block;****Sensory:**

- Lateral cutaneous nerve of arm.
- Medial cutaneous nerve of arm.
- Medial cutaneous nerve of forearm.
- Posterior cutaneous nerve of forearm.
- Lateral cutaneous nerve of forearm.
- Median nerve.
- Ulnar nerve.
- Radial nerve.

**Motor:**

- Median nerve.
- Ulnar nerve.
- Radial nerve.
- Musculocutaneous nerve.

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Evaluation was carried for every minute after completion of the injection and the time of onset was noted for both sensory and motor blockade.

Onset of blockade, both sensory and motor is defined as a minimum of grade 2 in Hollmen's scale. Blockade was considered complete when least grade 3 in Hollmen's scale. Only patients included in the study. Sensory and motor scores were at with complete sensory block were Once block was complete, surgery was allowed to proceed.

Duration of sensory blockade was considered as the time interval between the onset of sensory blockade and the onset of paraesthesia (During recovery) while duration of motor block was defined as the time interval between the onset of motor blockade and the recovery of motor block.

**Sedation was assessed using the sedation score described by Culebraset al.<sup>8</sup> where sedation was graded on a scale of 1 to 5 as follows:**

1. Awake and alert.
2. Sedated, responding to verbal stimulus.
3. Sedated, responding to mild physical stimulus.
4. Sedated, responding to moderate or severe physical stimulus.
5. Not arousable.

**Monitoring:** Monitoring during anaesthesia focuses on systemic effects of Clonidine, localanaesthetic toxicity from excessive tissue absorption (Usually 40 – 60 min), ventilation, oxygenation and the consequences of surgical stress such as tourniquet pain or blood loss.

As systemic absorption of clonidine produces maximum haemodynamic effects within 2 hours.<sup>9</sup> these parameters were recorded over the period of 2hours & compared with the baseline values.

Onset, completion of blockade, duration of blockade was assessed as described earlier.

Pain was assessed using a numerical rating pain score scale where 0 represents no pain and 10 means the worst possible pain. (VAS scale – Annexure).

**Statistics & Analysis:** Sample size of 20 per group was adequate for the present study.???????????

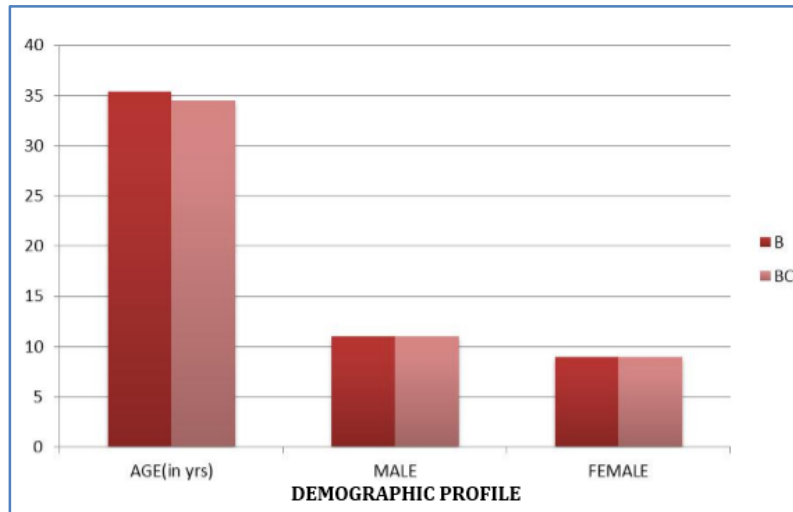
Data like age, weight, onset, completion & duration of blockade were analyzed using students independent t – test.

Data like intensity of blockade, sedation score were analyzed with chi-square test. Data were expressed as Mean  $\pm$  SD. P value < 0.05 was taken as statistically significant.

Mean values of haemodynamic parameters (Heart rate, systolic BP, diastolic BP, mean arterial pressure) over the period of 2 hours (At 10minutes interval) after giving the block were compared with the base line values. Any deviation of more than 30% from the base line values were taken as haemodynamic instability.<sup>10,11</sup>

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### OBSERVATIONS:

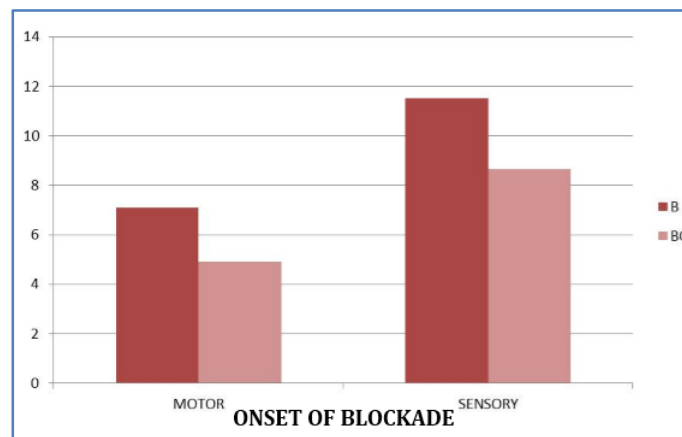


The mean age in B group was 35.35 years  $\pm$ 8.40 SD and in the BC group it was 34.52 years  $\pm$ 10.50 SD. ( $t=0.27$ ,  $p=0.790$ ).

**Sex distribution in each group:** 11 males and 9 females.

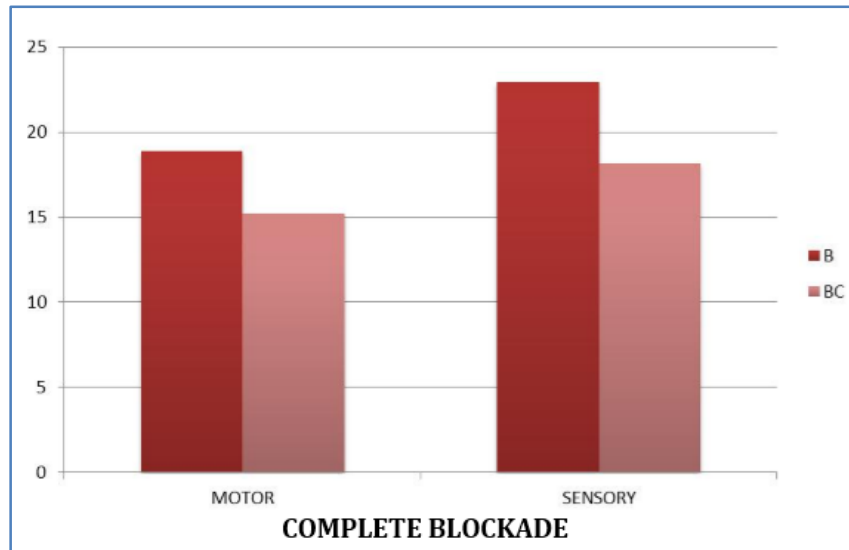
Thus the demographic profile was comparable between the two groups. ( $P$  value= NS).

**The mean duration of surgery was comparable between the two groups:** 88 $\pm$ 10.08 mins in Group B and 92 $\pm$ 9.38 mins in Group BC ( $t=1.30$ ,  $p=0.209$ )



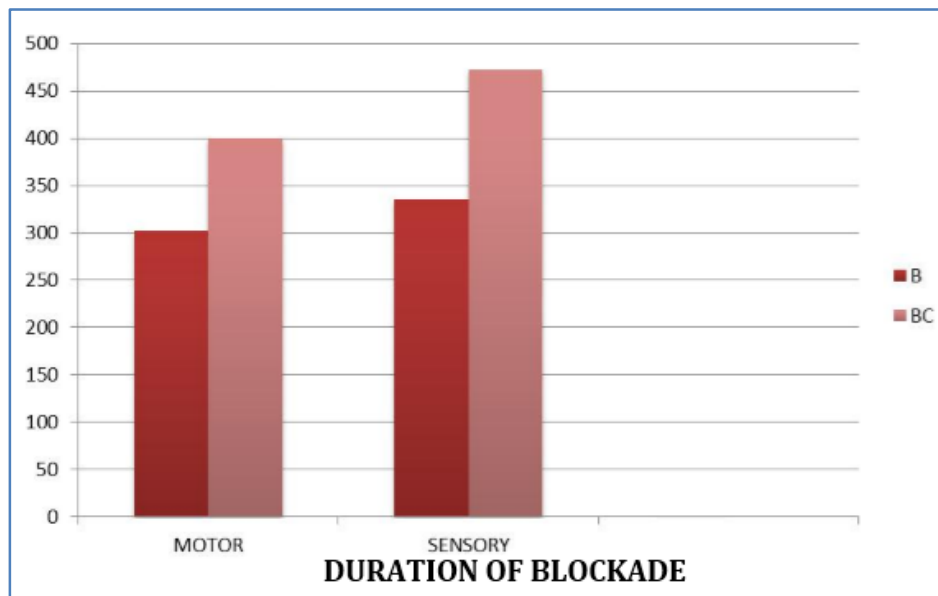
- The mean time of onset of motor block in Group B: 7.10 $\pm$ 0.83 mins Group BC: 4.90 $\pm$ 0.62 mins
- The onset of motor blockade was statistically significant in BC group ( $t=9.52$ ,  $p<0.05$ ) the onset time of sensory block in Group B: 11.5 $\pm$ 2.03 mins Group BC: 8.64 $\pm$ 0.80 mins.
- The onset of sensory blockade was statistically significant in BC group ( $t=6.04$ ,  $p<0.05$ ).
- Motor blockade occurred earlier than sensory blockade in both the groups ( $p<0.05$ )

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The mean time for complete motor block was Group B: 18.9±1.81 mins Group BC: 15.2±1.72 mins, the time for complete motor block was statistically significant in BC group (t=6.72, p<0.05).

The mean time for complete sensory block was Group B: 22.95±2.15 mins Group BC: 18.15±1.71 min. the time for complete sensory block was statistically significant in BC group (t=6.21, p<0.05).



The mean total duration of motor block was Group B: 302.2±17.59 mins Group BC: 400.3±11.12 mins, the mean total duration of motor blockade was statistically significant (t=21.18, p<0.05).

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The mean total duration of sensory blockade was Group B: 335.4±17.07 mins Group BC: 472.3±12.01 mins, the mean total duration of sensory blockade was statistically significant (t=29.3, p<0.05)

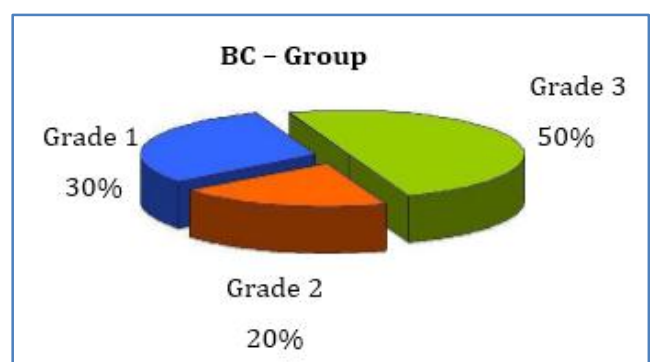
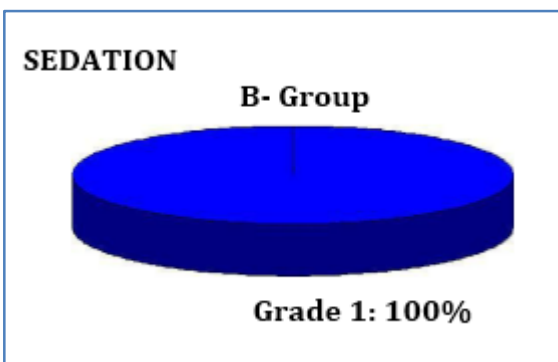
	Grading	Group B	Group BC
MOTOR	4	12(60%)	15(75%)
	3	5(25%)	4(20%)
	2	(10%)	1(5%)
	1	0	0
SENSORY	4	15(75%)	16(80%)
	3	5(25%)	4 (20%)
	2	0	0
	1	0	0
<b>INTENSITY OF BLOCKADE</b>			

**Intensity of Motor blockade:** Group B: 60% of patients had grade 4 motor block while 25% had grade 3 and 10% had grade 2 motor block.

Group BC: 75% patients had grade 4 motor block while 20% had grade 3 and 5% had grade 2 motor block, this was not statistically significant. ( $X^2 = 3.73$ ,  $p = 0.29$ )

**Intensity of Sensory blockade:** Group B: 75% patients had grade 4 sensory block and 25% patients had grade 3 sensory block.

Group BC: 80% patients had grade 4 sensory block and 20% had grade 3 sensory block. This was not statistically significant. ( $X^2 = 0.143$ ,  $p = 0.704$ ).



Sedation scores differed between two groups during intraoperative period (at 30 min) Group B: None of the patients were sedated i.e. all were awake and alert

Group BC: 50% patients were sedated and required mild physical stimulus to awaken, 20% patients sedated and required verbal stimulus to awaken and 30% not sedated.



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No patient in BC group required assistance for airway maintenance due to sedation. Sedation score achieved during the intraoperative period was statistically significant ( $X^2=21.53$ ,  $P<0.001$ ). Sedation score did not differ between the groups during the postoperative period.

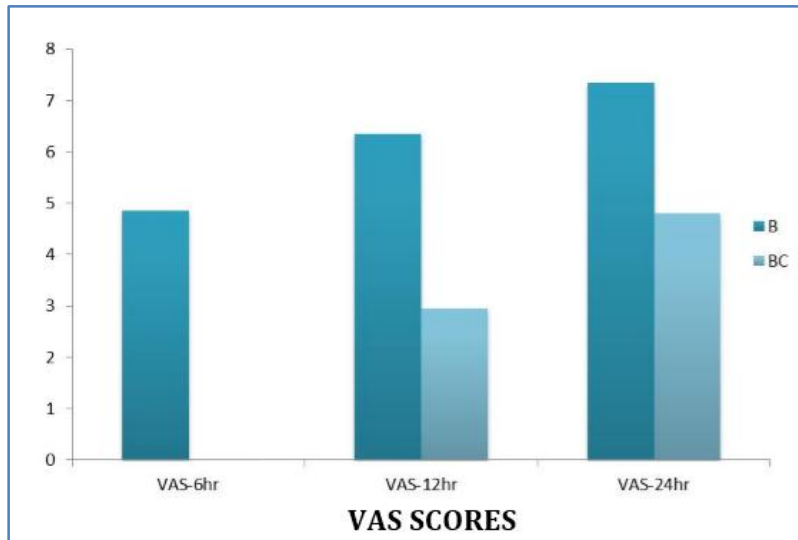
Postoperative pain scores were recorded according to Visual Analog Scale (VAS 0 -10, Annexure 4a) at 6, 12 and 24 hours. Group BC patients recorded a lower mean VAS score than their counterparts. Likewise the rescue analgesic requirement (Inj. Diclofenac sodium 3ml IM) was lower in BC group (4 patients compared to group B (13 patients). Both were statistically significant ( $p<0.05$ )

**Haemodynamic Parameters:** The baseline & first 2 hours haemodynamic parameters observed during the study period for both the groups were tabulated. From these, mean value over the period of 2hrs, mean baseline value, deviation from the baseline (+ indicates increase, - indicates decrease) values were derived.

Heart rate significantly decreased during the intraoperative period when compared to baseline values in clonidine group. Diastolic BP, systolic BP, mean arterial pressure were lower in clonidine group than control group but not significant.

Parameters	Group-B			Group-BC		
	Mean	Base	Deviation	Mean	Base	Deviation
	over 2hr	Line	From	over	Line	From
			baseline	2hr		baseline
Heart Rate	71.01	78.10	-7.03	65.00	80.00	-15.00
Bpm	(±2.27)	(±9.65)	(±8.54)	(±2.29)	(±7.71)	(±7.22)
Systolic BP	118.8	122.30	-3.5	113.74	119.05	-5.31
MmHg	(±4.06)	(±9.10)	(±6.19)	(±2.84)	(±7.33)	(±6.80)
Diastolic BP	77.48	77.90	-0.42	75.03	79.75	-4.72
MmHg	(± 2.68)	(±5.75)	(±4.90)	(±2.20)	(±6.21)	(±4.97)
Mean Arterial	91.25	92.50	-1.25	87.9	92.85	-4.95
Pressure mmHg	(±2.88)	(±6.43)	(±4.78)	(±2.47)	(±6.13)	(±4.84)

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No hemodynamic instability (deviation > 30%) occurred in both group during the study period.

**COMPLICATIONS:** There was one incidence of arterial puncture without formation of hematoma in group-B. Needle was again repositioned, aspirated and drug administered. Block was successful.

**There was no other incidence of;**

- Pneumothorax.
- Neurological deficit.
- Phrenic nerve palsy.
- Horner"s syndrome.
- Excess sedation.
- LA toxicity.

In one patient (In Clonidine group) heart rate went below 50 during intraoperative period and treated with Inj. Atropine 0.6mg i.e. Blood pressure, Oxygen saturation and respiration were monitored and were stable.

**DISCUSSION:** Brachial plexus blockade offers an excellent alternative technique to general anaesthesia in anaesthetising the upper limb for surgical procedures. Various approaches for successful performance of these blocks and for reducing the complications have been described.

The technique chosen in this study was the Nerve locator assisted subclavian perivascular technique. In 1964 subclavian perivascular technique was described by Winnie and it allowed accurate percutaneous localisation of the plexus. He used the concept that there is a constant relationship between the anterior and middle scalene muscles, the plexus and the first rib and that there is an advantage of the continuity of the neurovascular sheath of the brachial plexus. Winnie"s concept that the roots of the plexus were sandwiched between the two scalene muscles and the muscles are always found to be inserted in the 1st rib. Hence he introduced the needle between the two muscles and in the direction of the space between them. Thus by using a single needle technique

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eliciting paraesthesia or vascular pulsation as a guide to confirm the needle placement in the space he injected the anaesthetic solution, which will be confined to the perineural and perivascular area. Hence he was almost certain of a complete and safe block. This technique by Winnie was anatomically precise and conceptually logical.

Elicitation of paraesthesia to confirm the needle position in nerve blocks are now becoming less popular as it has problems in the form of direct neuronal damage by the advancing needle, patient discomfort and failure rates. While using nerve locator as an aid to the nerve blocks, these problems can be avoided. Various studies demonstrated its effective usefulness in peripheral nerve blocks.<sup>12,13,14,15,16</sup>

Bupivacaine hydrochloride was the first local anaesthetic that combined the properties of an acceptable onset, long duration of action and profound conduction blockade.

Various agents like epinephrine, opioids, Ketamine, potassium chloride, verapamil, neostigmine, hyaluronidase and Sodium bicarbonate have been used as adjuvants to local anaesthetics in brachial plexus block to quicken the onset, increase the duration and enhance the quality of block and also to reduce the post-operative analgesic requirements. The results have been mixed and at times associated with side effects.

Clonidine as an additive to local anaesthetics has been studied in the intrathecal, epidural & caudal routes.<sup>17,18,19,20</sup>. It has been proved in these studies that clonidine is as useful additive by way of improved analgesia and with sedation.

Even though clonidine used as an adjuvant in wide range of doses (30-300µgs) with local anaesthetics to demonstrate its effects in various studies, Bernard et al.,<sup>21</sup> in their study clearly concluded that the best dose to use clinically is 60-100µg to limit the  $\alpha_2$  agonist side effects. Hence 100µg dose was chosen in this study.

In this prospective randomised comparative study, 40 patients satisfying the selection criteria underwent brachial plexus block with or without addition of clonidine. Comparison of onset, completion, duration & intensity of blockade, sedation, haemodynamic changes and quality of analgesia between the two groups were observed and statistically analysed.

The onset of sensory and motor blockade was quicker in the clonidine group. This could be due to the synergistic action of clonidine with that of local anaesthetics.

The onset of motor block was found to be faster than the sensory block. This may be attributed to the arrangement of nerve fibres in the trunks as described by Winnie<sup>22</sup>. Motor fibres are located more peripherally than sensory fibres. Hence a local anaesthetic drug will begin to block motor fibers before it arrives at the centrally located sensory fibres.

Duration of sensory block tended to last longer than motor block in the present study. This is in line with the observations made by de Jong et al.,<sup>1</sup> who explained that larger fibres require a higher concentration of local anaesthetic than smaller fibres.

The minimal effective concentration of local anaesthetic for large (Motor) fibers is greater than for small (sensory) fibers. Thus, motor function return before pain perception and duration of motor block is shorter than the sensory block, Time taken to complete the motor & sensory blockade was significantly lesser in Clonidine group.

In this study, during postoperative period pain scores were significantly lower in patients who received clonidine in addition to Bupivacaine. The number of patients who required rescue analgesia was also lower in this group.

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As a  $\alpha_2$ -specific adrenergic agonist, it has been presumed that the block-prolonging effect of clonidine results from a pharmacodynamically mediated mechanism. Clonidine blocks the conduction of C and A gamma fibres and increases potassium conductance in isolated neurons and intensifies conduction block of local anaesthetics. However, the data supporting this assumption is conflicting. For example, consistent with the presumption that clonidine exerts its effects pharmacodynamically, several studies have shown that peak plasma concentrations of local anaesthetics are unaltered when clonidine is added.<sup>23,24</sup> However, data from other studies have shown that clonidine does decrease peak local anaesthetic plasma concentrations to the same extent as epinephrine, a fact that supports a pharmacokinetic mechanism.<sup>25,26,27</sup> Other evidence of a pharmacokinetic mechanism comes from studies showing that clonidine itself (As a sole agent) is incapable of producing nerve block in the absence of co administered local anaesthetics.<sup>28</sup>

Sedation scores were higher in patients in clonidine group compared to control group during the intraoperative period. Even though sedation is one of the side effects of clonidine, it is a desirable one for the surgical procedure during intraoperative period. No patient experienced airway compromise or required airway assistance due to this sedation. Heart rate in clonidine group decreased during the intraoperative period. Both these effects could be due to partial vascular uptake of the drug and its transport to the central nervous system where it acts. At the same time no haemodynamic instability was observed in both the groups.

No complications with regard to the technique or drug was observed except accidental arterial puncture in one and decrease in heart rate (<50) in one of the cases.

**CONCLUSION:** In conclusion, clonidine 100 $\mu$ g (In 2ml) when used as an additive to 0.375% Bupivacaine (30ml) solution for Supraclavicular brachial plexus block, quickens the onset of sensory & motor blockade and prolongs the duration of sensory & motor blockade. It also improves the quality of post-operative analgesia with mild intraoperative sedation and decreases the heart rate without any haemodynamic instability. Hence, clonidine can be considered as a safe additive to local anaesthetic solution for brachial plexus blocks

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