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Original Research Article

Assessment of the Clinical Profile of Alpha two Agonists Dexmedetomidine and Clonidine as An Adjuvant to Ropivacaine in Supraclavicular Brachial Plexus Block: A Comparative Study

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Abstract

Aim: The aim of the present study was to compare the clinical profile of Alpha two agonists Dexmedetomidine and Clonidine as an adjuvant to Ropivacaine in supraclavicular brachial plexus block with respect to sensory and motor blockade, level of sedation and duration of analgesia.

Methods: The present study was conducted in the Department of Anaesthesiology for the period of one year. The study was carried out in 50 adult patients admitted in the department of Orthopaedics, with age in the range of 18-60 years, ASA Grade I and II posted for elective upper limb surgeries under Supraclavicular brachial plexus block. They were included in the study only after obtaining a written informed consent.

Results: The mean onset time of sensory block was achieved significantly earlier in group D (4.97 ± 1.67 minutes) than in group C (8.64 ± 2.36 minutes) (p=0.000). The mean (SD) time for complete sensory block in Group D (12.0 ± 2.07 minutes) was earlier as compared to Group C (17.13 ±5.97 minutes) (p=0.000). The mean total duration sensory block in Group D (718.32 ± 52.78 minutes) was significantly prolonged as compared to Group C (464.66± 56.64 minutes) (p=0.000). The mean time for total duration of analgesia in Group D (736.00 ± 56.84 minutes) was prolonged as compared to Group C (516.00 ± 52.78 minutes) (p=0.000). The mean (±SD) onset time of motor block in Group C (Clonidine) was 15.35 (± 5.40) minutes and in Group D (Dexmedetomidine) was 9.81 (± 4.26) minutes which was statistically significant (p=0.000). The mean time for complete motor block in Group D (16.94 ± 3.97 minutes) was earlier as compared to Group C (25.45 ± 8.02 minutes) (p=0.000). The mean (± SD) total duration of motor block in Group C (Clonidine) was 428.12 (± 50.95) minutes and in Group D (Dexmedetomidine) was 610.40 (± 52.48) minutes which was statistically significant (p=0.000).

Conclusion: We concluded that Dexmedetomidine is a better adjuvant to Ropivacaine for supraclavicular brachial plexus block when compared to Clonidine as it provides earlier onset of sensory and motor blockade, prolongs the duration of sensorimotor blockade and postoperative analgesia with stable vitals and minimal side effects.

Keywords: Dexmedetomidine, Clonidine, Ropivacaine, Supraclavicular brachial plexus block, Upper limb surgeries

Introduction

Supraclavicular brachial plexus block is a common regional anesthetic technique used to provide anesthesia and analgesia for upper extremity surgery at our institution. α-2 adrenoreceptor agonists have been the focus of interest for their sedative, analgesic, and perioperative sympatholytic and cardiovascular stabilizing effects with reduced anesthetic requirements. Clonidine, an imidazoline, α-2 adrenoreceptor agonist, has been extensively studied as an adjuvant to local anesthetic in peripheral nerve blocks. [1-5] Dexmedetomidine is also α-2 adrenoreceptor agonist and its selectivity to α-2 adrenoreceptor is 8 times greater than clonidine. [6] The anesthetic and analgesic requirements get reduced to a huge extent by the use of these two adjuvants because of their analgesic properties and augmentation of local anesthetic effects.

Peripheral nerve blocks have assumed a prominent role in modern anaesthesia practice as they provide ideal operative conditions and excellent post operative analgesia without any sedation or systemic side effects. [7] Various adjutants with local anaesthetics are being studied and used for prolongation of intra and post operative analgesia in brachial plexus block for upper limb surgeries. [8]

Ropivacaine is a newer amide local anaesthetic with a high pKa and low lipid solubility has gained popularity as it is less cardio toxic and has a significantly higher threshold for central nervous system toxicity than bupivacaine. [9] Recently, alpha 2 agonists have been studied as adjutants to local anaesthetics in regional anaesthetic techniques for their efficacy to enhance the quality and duration of analgesia with fewer side effects. [10] Among two alpha 2 agonists, Clonidine and Dexmedetomidine, Clonidine is very well known and studied. But Dexmedetomidine is newly emerging and highly selective but not studied much especially in brachial plexus block.

The aim of the present study was to compare the clinical profile of Alpha two agonists Dexmedetomidine and Clonidine as an adjuvant to Ropivacaine in supraclavicular brachial plexus block with respect to sensory and motor blockade, level of sedation and duration of analgesia.

Materials and Methods

The present study was conducted in the Department of Anaesthesiology at BMIMS Pawapuri, Nalanda, Bihar, India for the period of one year. The study was carried out in 50 adult patients admitted in the department of Orthopaedics, with age in the range of 18-60 years, ASA Grade I and II posted for elective upper limb surgeries under Supraclavicular brachial plexus block. They were included in the study only after obtaining a written informed consent.

Inclusion Criteria

1. Age between 18 years - 60 years of either sex.

2. Body weight between 50 kg - 80 kg.

3. ASA physical status 1 and 2.

4. Patients to be posted for upper limb surgeries involving forearm.

5. Patients willing to undergo surgeries under regional anaesthesia.

Patients who had contraindications to peripheral nerve block like bleeding diathesis, local infection and patients on anticoagulants, patients with neurological lesions in the upper limb, diabetic neuropathy, psychiatric illness and neurological disease, cardiovascular diseases like arrhythmias, ischaemic heart disease and valvular heart disease, Liver, Respiratory, Kidney and Endocrine diseases and hemodynamically unstable patients were excluded from the study. Detailed pre-anaesthetic evaluation of the patients was performed by an anaesthesiologist a day before the surgery. Preliminary Investigations in the form of Complete blood count, Random blood sugar. Bleeding time, Clotting time, Coagulation profile, Liver function tests, Kidney function tests, Electrocardiography (ECG), Chest x ray postero- anterior (PA) view were noted.All patients were kept nil by mouth for 8 hrs. All patients were given overnight sedation in the form of Tab. Alprazolam 0.5 mg orally a day prior to surgery. In operation theatre, multipara monitoring device with ECG, pulse rate, non-invasive blood pressure, SpO2 was attached to the patient and baseline parameters were noted. Ringer lactate was started after establishing intravenous line with 18 G cannula in unaffected limb, before the block. Thereafter, intravenous fluids were calculated and given as per body weight and operative loss. Patients also received Inj. Ranitidine 50 mg and Inj. Ondansetron 4 mg IV slowly as a premedication. Patients were randomly divided into two groups of 25 each.

Group C: 29 ml of 0.5 % Ropivacaine with Clonidine 1 mcg/kg (total volume 30 ml).

Group D: 29 ml of 0.5 % Ropivacaine with Dexmedetomidine 1 mcg/kg (total volume 30 ml).

Positioning of the patient: Patients were placed in supine position with head turned away from the side where block was performed. A pillow was placed below the shoulder to make landmarks prominent. The arm to be anaesthetized was adducted and hand should be extended along the side. By asking the patient to raise his head slightly, the lateral border of sternocleidomastoid was palpated. Palpating fingers then rolled over the belly of anterior scalene muscle into interscalene groove where mark was made 1.5 to 2.0 cm posterior to the midpoint of clavicle.Palpation of the subclavian artery at this site confirmed the landmark.

Technique: Under all aseptic precautions, the skin wheal was raised with 1ml of 2% Lignocaine. A nerve stimulator (Organon, Ireland) with 22G, 50 mm long stimulating needle (stimuplex, Germany) was used to locate the brachial plexus. The stimulating needle was connected with the Nerve stimulator, with the current output set at 1.0 mA and repeat twitch mode selected by the assistant under the guidance of an expert anaesthesiologist. A 22G stimuplex needle was inserted 1.5-2 cm posterior to the midpoint of clavicle. The needle was advanced caudal, slightly medial, and posterior direction until a motor response was elicited. A twitch of the upper trunk (shoulder) was considered as the evidence of the needle approaching the brachial plexus. Wrist flexion and extension of the fingers was taken as acceptable responses to nerve stimulator and the current was gradually reduced to 0.5 mA, whereby maintaining the visible twitches. The total volume of the anaesthetic solution was injected at an incremental dose of 5 ml each, preceded by negative aspiration of blood in each group. Time of injection was considered as Time -0.

Intra operatively all patients were monitored for Heart rate, Blood pressure (systolic, diastolic and

mean), Respiratory rate, SpO2, Sensory block : onset and duration by Hollmen Scale, Motor block: onset, duration and density of motor block using Bromage scale for upper extremity, Visual analogue scale score for pain assessment, Sedation score using Five point sedation scale. Intraoperatively and postoperatively, bradycardia (heart rate<60 beats per minute) was to be treated with 0.6 mg injection Atropine and hypotension (systolic blood pressure falling more than 20% basal value or less than 80 mmHg) with 3-6 mg injection Mephentermine as bolus along with necessary fluid replacement. Respiratory depression (SpO2 <90% or respiratory rate < 10 breaths per minute) if any, was treated by administering 100% O2 with face mask or ventilation with IPPV accordingly.

Assessment of Sensory Block: Sensory block was evaluated by Hollmen scale[22] 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 Hollmen Scale[22]:

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 (Time of injection of local anaesthetic) 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 time-0 till the time when patient came back to Hollmen score 1.

Assessment of Motor Block: Motor block was evaluated by using Bromage Scale (BS)22 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 extremity22:

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 (Time of local anaesthetic injection) till motor block started appearing i.e. BS score ≥1.

Time for Complete Motor Block (TCMB): was taken as the duration of time in minutes from time-0 (Time of local anaesthetic injection) 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 time-0 (Time of local anaesthetic injection) till the time when BS score 0 with complete recovery of motor functions in the postoperative period.

ADEQUACY OF BLOCK: 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 applied with the Allis clamp at the area of the surgical field. The reading was recorded as follows:

a. Complete block (Total comfort to patient)

b. Inadequate block (Discomfort: Requiring supplementation)

These patients were supplemented with intravenous fentanyl (1 mcg/kg) and midazolam (0.02mg/kg). Surgery was allowed to proceed when there was complete block or patient did not complain of pain at the surgical site by Allis clamp test after supplementation, in case of inadequate effect. 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 these patients were excluded from the study. Haemodynamic changes: pulse rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure were monitored.

Level of Sedation: Level of sedation was assessed using Five Point Sedation scale22. Level of sedation was assessed at an interval of every 30 min from Time-0 till the end of surgery using the 5-point sedation scale22. 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 Complete Analgesia: Duration of post-operative analgesia was taken till the time patient asked for rescue analgesia i.e. VAS ≥4. Pain was

assessed by Visual Analogue Scale (VAS). VAS was recorded and assesed at an interval of every 30 minutes till the score ≥4.Time of first dose of post–operative systemic analgesic was on the basis of VAS score ≥ 4 and was noted for use as duration of analgesia.

Visual analogue scale18:Visual analogue scale consists of a 10 cm line, marked at 1 cm each. The patie patients a mark on the line that represents the intensity of pain he or she experienced. Mark "0" represents no pain and mark "10" represents worst possible pain. The numbers marked by the patient was taken as units of pain intensity.

0 = no pain

10= maximum pain

Duration of surgery and type of surgical procedure done was recorded. Intra-operative and post- operative complications were looked for like inadequacy of block, any reaction at injection site like haematoma, persistent bradycardia, persistent hypotension, over-sedation score >4, any respiratory distress, pneumothorax, fall in respiratory rate to <10 per min, fall in SpO2 to < 90%, dryness of mouth, nausea, vomiting, local haematoma, 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 was noted and recorded. Nausea and/or vomiting were treated with intravenous Ondensetron 4 mg slowly. After the completion of the surgery patients were shifted to post-operative recovery ward without prescribing any analgesics in any form. Patients were 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 ≥ 4. For pain relief, patients were given systemic analgesic Inj. Diclofenac Sodium 1.5mg/kg (75mg) IV slowly or as per individual requirement. Subsequently analgesia was given with injection Diclofenac sodium 1.5mg/kg I.V. slowly BD along with injection Ranitidine hydrochloride 50mg twice daily. Parameters along with vitals were recorded in the post operative period every 6 hourly till 24 hrs after the block. 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 and treated accordingly.

Statistical Analysis: Data were collected, tabulated, coded then analysed using SPSS computer software version 20.0 and Microsoft word and Excel have been used to generate graphs and tables.

Results

Table 1: Sensory and motor characteristics

Sensory Characteristics	**Group C**	**Group D**	**P Value**
Onset time	8.64 ± 2.36 minutes	4.96 ± 1.64 minutes	0.000
Complete sensory block	17.13 ±5.97 minutes	12.0 ± 2.07 minutes	0.000
Total duration sensory block	464.66± 56.64 minutes	718.32 ± 52.78 minutes	0.000
Total duration of analgesia	516.00 ± 52.78 minutes	736.00 ± 56.84 minutes	0.000
Motor characteristics			
Onset time	15.35 ± 5.40 minutes	9.81 ± 4.26 minutes	0.000
Complete sensory block	25.45 ± 8.02 minutes	16.94 ± 3.97 minutes	0.000
Total duration sensory block	428.12± 50.95 minutes	610.40 ± 52.48 minutes	0.000

The mean onset time of sensory block was achieved significantly earlier in group D (4.97 ± 1.67 minutes) than in group C (8.64 ± 2.36 minutes) (p=0.000). The mean (SD) time for complete sensory block in Group D (12.0 ± 2.07 minutes) was earlier as compared to Group C (17.13 ±5.97 minutes) (p=0.000). The mean total duration sensory block in Group D (718.32 ± 52.78 minutes) was significantly prolonged as compared to Group C (464.66± 56.64 minutes) (p=0.000). The mean time for total duration of analgesia in Group D (736.00 ± 56.84 minutes) was prolonged as compared to Group C (516.00 ± 52.78 minutes) (p=0.000). The mean (±SD) onset time of motor block in Group C (Clonidine) was 15.35 (± 5.40) minutes and in Group D (Dexmedetomidine) was 9.81 (± 4.26) minutes which was statistically significant (p=0.000). The mean time for complete motor block in Group D (16.94 ± 3.97 minutes) was earlier as compared to Group C (25.45 ± 8.02 minutes) (p=0.000). The mean (± SD) total duration of motor block in Group C (Clonidine) was 428.12 (± 50.95) minutes and in Group D (Dexmedetomidine) was 610.40 (± 52.48) minutes which was statistically significant (p=0.000).

Table 2: Comparison of the mean (±sd) pain score (visual analogue scale) in the two

Group	Basal	30 min	60 min	90 min	120 min	150 min	180 min	6 hrs	12 hrs	18 hrs	24 hrs
Group C	3.67± 1.23	0.07± 0.23	0.00± 0.00	0.00± 0.00	0.00± 0.00	0.00± 0.00	0.00± 0.00	0.93± 0.83	2.08± 0.36	1.36± 0.82	1.42± 0.78
Group D	3.84± 1.32	0.07± 0.23	0.00± 0.00	0.00± 0.00	0.00± 0.00	0.00± 0.00	0.00± 0.00	0.00± 0.00	2.10± 0.61	1.40± 0.77	1.20± 0.85
P Value	0.618	1.000						0.000	0.820	0.750	0.314

The pain scores were noted at periodic intervals till 24 Hrs postoperatively. The mean (SD) VAS Scores in Dexmedetomidine group were significantly lower than Clonidine group at 6 Hrs. while the mean VAS scores in Clonidine group and Dexmedetomidine group were comparable at various time intervals in rest of the perioperative period.

Table 3: Comparison of the mean (±sd) sedation score

Group	Basal	30 min	60 min	90 min	120 min	150 min	180 min	6 hrs	12 hrs	18 hrs	24 hrs
Group C	1.00± 0.00	1.23± 0.43	1.72± 0.07	1.95± 0.46	1.78± 0.58	1.82± 0.54	1.22± 0.42	1.04± 0.18	1.00± 0.00	1.00± 0.00	1.00± 0.00
Group D	1.00± 0.00	1.17± 0.36	1.93± 0.04	2.00± 0.00	1.87± 0.52	1.83± 0.58	1.40± 0.64	1.13± 0.34	1.00± 0.00	1.00± 0.00	1.00± 0.00
P Value		0.756	0.000	0.450	0.480	0.830	0.175	0.18			

The mean sedation scores were comparable between two groups at various time intervals.

Table 4: Perioperative complications

Side effects	Group C	Group D
Hypotension	0	0
Bradycardia	0	0
Nausea	1	0
Vomiting	0	0
Horner's syndrome	0	0
Pneumothorax	0	0
Dry mouth	0	1
Local Hematoma	0	0

The hypotension and bradycardia was not observed in any patients of either group. No major alterations were observed in both the groups. Dry mouth was observed in 1 patient in Group D (Dexmedetomidine). Nausea was observed in 1 patient in Group C (Clonidine).

Discussion

There are many advantages of a single shot peripheral nerve block 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. Among the various peripheral nerve blocks, Brachial Plexus Block is one of the most commonly 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 along with toxicity. Ropivacaine is a pure S[-] enantiomer, unlike bupivacaine which is a racemic mixture, developed for the purpose of reducing potential cardiovascular and central nervous system toxicity and improving relative sensory and motor block profiles. [11]

An increasing demand for regional anesthesia from patients and surgeons both matches the fact that regional anesthesia can provide superior pain management and improves patient outcome. Supraclavicular brachial plexus block is a very effective procedure of anaesthesia for various upper limb surgeries due to its effectiveness in terms of cost and performance, margin of safety and good postoperative analgesia. Over the period of years, there is advent of various sophisticated techniques in anaesthesia. The mean onset time of sensory block was achieved significantly earlier in group D (4.97 ± 1.67 minutes) than in group C (8.64 ± 2.36 minutes) (p=0.000). The mean (SD) time for

complete sensory block in Group D (12.0 ± 2.07 minutes) was earlier as compared to Group C (17.13 ±5.97 minutes) (p=0.000). The mean total duration sensory block in Group D (718.32 ± 52.78 minutes) was significantly prolonged as compared to Group C (464.66± 56.64 minutes) (p=0.000). The mean time for total duration of analgesia in Group D (736.00 ± 56.84 minutes) was prolonged as compared to Group C (516.00 ± 52.78 minutes) (p=0.000). Bafna Usha, Sharma Gaurav et al (2015) [12] conducted a study to compare Clonidine (2µg/kg) and Dexmedetomidine (1µg/kg) as an adjuvant to 0.5% Ropivacaine in supraclavicular brachial plexus block. They found that mean (±SD) onset of sensory block in Control group was 12.2(±3.1) minutes, in Clonidine group was 10.7(± 4.0) minutes and in Dexmedetomidine group was 4.9(±1.08) minutes. Onset time of sensory block was earlier in Dexmedetomidine group than Control group and Clonidine group. It was found to be statistically significant when Dexmedetomidine group was compared to Clonidine group and Control group. (p<0.0001). More Preeti, Basavaraja et al (2015) [13] conducted a study to compare Clonidine(1µg/kg) and Dexmedetomidine(1µg/kg) used as an adjuvant to 0.25% Bupivacaine in supraclavicular brachial plexus block. They found that onset of sensory block in Clonidine group was 11.07(± 2.14) minutes and in Dexmedetomidine group was 9.17(±1.26) minutes. Onset time of sensory block was earlier in Dexmedetomidine group than Clonidine group which was statistically significant. (p< 0.05). Kirubahar R et al (2016) [14] found that the mean (±SD) onset of motor block in Clonidine group was 13.1(±1.42) minutes and in Dexmedetomidine group was 9.63(±0.89) minutes. The mean onset time of motor block was earlier in Dexmedetomidine group than Clonidine group which was statistically significant (p <0.001).

The mean (±SD) onset time of motor block in Group C (Clonidine) was 15.35 (± 5.40) minutes and in Group D (Dexmedetomidine) was 9.81 (± 4.26) minutes which was statistically significant (p=0.000). The mean time for complete motor block in Group D (16.94 ± 3.97 minutes) was earlier as compared to Group C (25.45 ± 8.02 minutes) (p=0.000). The mean (± SD) total duration of motor block in Group C (Clonidine) was 428.12 (± 50.95) minutes and in Group D (Dexmedetomidine) was 610.40 (± 52.48) minutes which was statistically significant (p=0.000). Agarwal Sandhya et al (2014) [15] found that, the mean (±SD) time for complete motor block in Control group was 22.7(±2.8) minutes and in Dexmedetomidine group was 16.3(±1.7) minutes. The mean time for complete motor block was significantly earlier in Dexmedetomidine group than Control group (p<0.001). Sebastian Don et al (2015) [16] found that, the mean (±SD) total duration of motor block in Clonidine group was 424.33 (±44.65) minutes and in Dexmedetomidine group was 600.83 (±46.722) minutes. The mean total duration of motor block was significantly prolonged in Dexmedetomidine group than Clonidine group (p <0.01).

The pain scores were noted at periodic intervals till 24 Hrs postoperatively. The mean (SD) VAS Scores in Dexmedetomidine group were significantly lower than Clonidine group at 6 Hrs. while the mean VAS scores in Clonidine group and Dexmedetomidine group were comparable at various time intervals in rest of the perioperative period. The mean sedation scores were comparable between two groups at various time intervals. The hypotension and bradycardia was not observed in any patients of either group. No major alterations were observed in both the groups. Dry mouth was observed in 1 patient in Group D (Dexmedetomidine). Nausea was observed in 1 patient in Group C (Clonidine). More Preeti et al (2015)[13] found that, patients in both the groups suffered nausea and vomiting (5 patients in Dexmedetomidine group and 2 patients in Clonidine group). Dryness of mouth was observed in 1 patient in Dexmedetomidine group and blurring of vision was observed in 1 patient in Clonidine group. JinjilKavitha et al (2015) [17] observed no complications in Clonidine group and Dexmedetomidine group. None of the patients developed any serious complications due to block procedure (pneumothorax, large haematoma, Horners syndrome, prolonged nerve palsy, nausea, vomiting or dry mouth).

Conclusion

We concluded that Dexmedetomidine is a better adjuvant to Ropivacaine for supraclavicular brachial plexus block when compared to Clonidine as it provides earlier onset of sensory and motor blockade, prolongs the duration of sensorimotor blockade and postoperative analgesia with stable vitals and minimal side effects.

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