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Original Research Article

A Comparative Study of the Effect of Addition of Tramadol or Dexmedetomidine as an Adjunct to Local Anaesthetic Ropivacaine for Supra Clavicular Brachial Plexus Block in Upper Extremity Surgery

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Conflict of interest: Nil

Abstract:

Background: Regional Anaesthesia is a safe alternative to General Anaesthesia. The block achieves ideal operating conditions. Bupivacaine is most commonly used but cardiac and CNS toxicity is seen with that so we used Ropivacaine. Plain Local Anaesthetic is short lived so different adjuvants are added to achieve quick, dense and prolonged block. So, this study was carried out to evaluate the effect of dexmedetomidine or tramadol as an adjunct to local anaesthetic ropivacaine in brachial plexus block through supraclavicular route in upper limb surgeries.

Methods: A total of 104 patients aged 18-60 years, American Society of Anaesthesiologists (ASA) physical status I or II, of either sex, planned for unilateral upper extremity surgery were included. The patients were randomly divided into two equal groups. Group D received ropivacaine+dexmedetomidine and Group T received ropivacaine+tramadol. Effect was observed and compared intraoperatively and post operatively.

Result: The onset and duration of sensory and motor block is significantly rapid and prolonged in the D group as compared to T group. Duration of analgesia and time of rescue analgesia is significantly prolonged in Group D compared to Group T.

Conclusion: Dexmedetomidine as an adjunct to Ropivacaine produces an early onset and more prolonged duration of sensory and motor blockade as compared to Tramadol. Hence, Dexmedetomidine seems to be a better adjuvant to Ropivacaine in supra-clavicular brachial plexus block than Tramadol.

Keywords: Supraclavicular Brachial Plexus Block, Ropivacaine, Tramadol, Dexmedetomidine.

Introduction

Regional anaesthesia is a safe alternative to general anaesthesia. Improvements in outcomes such as quality of analgesia, early rehabilitation and patient satisfaction have been observed. Advances in ultrasound guided regional anaesthesia and introduction of newer longer acting local anaesthetics have given clinicians an opportunity to apply novel approaches to block peripheral nerves with ease.[1] Brachial plexus blocks are amongst the most commonly performed peripheral neural blocks for upper extremity owing to their high success rate and their ability to provide prolonged post-operative pain relief. Brachial plexus block is a versatile and reliable regional anaesthesia technique. Since the introduction of 1st brachial plexus block using cocaine by Halstead (1884) the technique of brachial plexus block has evolved from classical blind technique to use of nerve stimulator and ultrasound guidance for supraclavicular brachial plexus block. The block achieves ideal operating conditions by producing complete muscular relaxation maintaining stable intraoperative haemodynamic parameters and the associated sympathetic block. The sympathetic block decreases post-operative pain, vasospasm and oedema. The Supraclavicular approach to brachial plexus blockade was introduced in clinical practice in Germany by Kulenkampff in 1911. Ropivacaine has better safety profile compared to Bupivacaine as it has less cardiac depression and central nervous system toxicity; potential clinical advantage during neural blockade when large volumes are used so, we chose Ropivacaine in our study. Effect of simple anesthetic solution i.e. Plain local anaesthetic is short lived and often lasting only for 6-8 hours. So nowadays different drugs have been used as Adjuvant with local anesthetics in brachial plexus block to achieve quick, dense and prolonged block. Drugs like epinephrine,

clonidine, dexmedetomidine, dexamethasone, butorphanol, buprenorphine are commonly used along with local anesthetics for this purpose.

Dexmedetomidine: A newer alpha 2 adrenoreceptor agonist is currently in focus for sedative, anxiolytics & analgesic property. Pre and intra op IV dexmedetomidine has shown to prolong the duration of sensory block with local anaesthesia during peripheral nerve block.[2]

Tramadol has an opioid action mediated by u receptor and a non-opioid action mediated by alpha 2 adrenergic and serotoninergic activities. We carried out this study to evaluate the effects of dexmedetomidine tramadol as an adjunct to local anaesthetic ropivacaine brachial plexus block through supraclavicular route in upper limb surgeries in terms of onset and duration of sensory and motor blockade and duration of analgesia.[3]

Methods:

After obtaining approval from institutional ethical committee, written informed consent was taken. Study was conducted during 1 year duration in 2022. Total 104 patients of 18-60 years were randomly allocated into 2 equal groups (n= 52 in each group) using computer generated random number, the allocation ratio was 1:1.Patients having American society of Anaesthesiologist (ASA) physical status up to grade II of both the genders undergoing upper limb surgery were included in study. This was a prospective randomized controlled study of interventional type. This study was carried out at Civil Hospital Ahmedabad after obtaining Institutional approval and written informed consent of patients.

According to the drug administered the patients were randomly allocated into 2 groups and patient information was not known to investigator.

Group T: Tramadol 100mg + Ropivacaine 0.5% 30ml.

Group D: Dexmedetomidine 1µg/kg + Ropivacaine 0.5% 30ml.

Pre-Operative preparation:

- All the patients underwent a pre anaesthetic check-up before surgery and all the routine and specific investigations were noted.
- The patients were kept electively nil per oral for 6 hours before surgery.
- On the day of surgery written informed valid consent was taken and prior to operation patients was explained about the procedure.
- Standard monitors like ECG, NIBP, and pulse oximeters were applied and patient's baseline parameters like pulse, blood pressure, respiratory rate, SpO2 were recorded.
- Intravenous line was secured in all the patients and intravenous fluid was started.

Pre-Medication: to all pts

- Inj. Midazolam 2 mg I.V. slowly
- Inj. Ondansetron 4mg I.V

Technique:

For performing brachial plexus blockade through supraclavicular approach we used Classical technique (Kulenkampff's).

After placing the patient in a dorsal recumbent position with head turned away from the site of injection with strict aseptic and antiseptic precautions, midclavicular point, external jugular vein and subclavian artery pulsation were identified.

About 2 cm above the midclavicular point just lateral to subclavian artery pulsation, a 22gauge 1.5inch hypodermic needle attached with 2 ml saline-filled syringe was introduced and directed caudal and medially until paraesthesia or motor response was elicited or the first rib was encountered.

After the brachial plexus block was located, the drug was injected and before every incremental dose, negative aspiration for blood was performed to avoid any intravascular placement.

During the conduct of block and thereafter, the patient was observed vigilantly for any complications of the block and for the toxicity of the drugs injected.

Prevention of Deleterious Effects:

Following precautions were be taken during conduct of the block-

1. Repeated aspiration before injection to prevent intravascular spread.

2. Injection stopped immediately if early signs of toxicity appeared.

Parameters to Be Observed:

All the following parameters were observed at 5 minutes interval for 15minute, then15 minute interval for 30 minutes, then 30minute interval for 60 minutes, then 1 hourly interval for 2 hour, then 2 hourly interval for 12 hours and then at 16 hours.

A) Sensory Blockade:

Sensory block onset was assessed every 2 min by atraumatic pinprick test in the areas innervated by radial, ulnar, and median nerves and compared with the same stimulation on the contralateral hand.

Sensory blockade was graded as"

- Grade 0: No loss of sensation to pinprick
- Grade 1: Analgesia (patient feel touch but no pain on pinprick)

- Grade 2: Anaesthesia (patient even not feel touch sensation on pinprick)

Onset time was defined as time taken from drug injection to complete ablation of sensation. (Sensory score 2).

Duration of sensory block was defined as time from onset of block to complete return of sensation. (Sensory score 0).

B) Motor Blockade:

By asking the patient to elevate the arm while keeping elbow straight (superior trunk) and at hand by grip strength (middle and inferior trunk), which was graded as follows:

Motor block was evaluated by Modified Bromage Scale for upper extremities on a 3 point scale.

- Grade 0: No weakness -normal motor function with full flexion and extension of elbow, wrist and fingers
- Grade 1: Paresis (decreased movements with an inability to perform activities-able to move the fingers only)
- Grade 2: Paralysis (complete motor block with inability to move the fingers)

Onset time was defined as the time taken from drug injection to complete motor block (motor grade score 2)

Duration of motor blockade was defined as the time taken from complete motor blockade to restoration of movements of the forearm (grade 0)

C) Hemodynamic Parameters:

Intra-operative Pulse, Blood pressure, Respiratory rate, Spo2 were recorded at a regular interval in proforma.

D) Intra op complications:

Patients were observed for any systemic side effects like bradycardia, hypotension, Nausea, Vomiting, Pruritus, any respiratory distress, fall in respiratory rate <10 per min, fall in spo2 <90%, any significant ECG changes, Horner's syndrome etc.

E) Post op analgesia:

Intensity of postoperative pain was evaluated using a **VAS Score** (visual analogue scale) with grade 0 (no pain) to 10 (worst pain).

Pain scores were noted post-operatively at 30 mins, 60 min, and then 2 hourly intervals till 18 hours and 24 hours.

Time was noted when the patient regained a VAS score of 4. Analgesia was considered satisfactory if the score is 3 or less. If VAS score is more than 4, analgesia was judged unsatisfactory and Rescue Analgesia was administered in the form of inj. Diclofenac sodium 2 mg/kg I.V. The evaluation was stopped and time for need of first analgesia was noted. Both groups were compared for duration of analgesia.

Duration of postoperative analgesia = Time from onset of sensory blockade to time when patient VAS score > 4 (four).

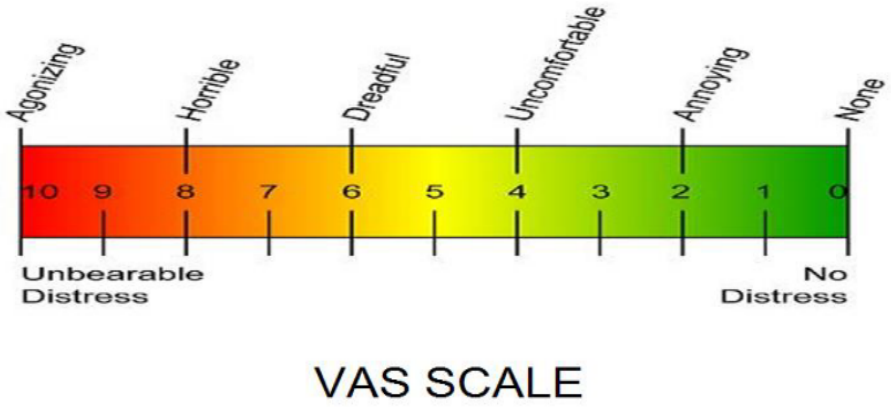

Figure 1: VAS Scale

F) Post op Complications:

- Patients were observed for any complications like
  - Local: Haematoma / Infection/ Neuropathy
  - Systemic: Neurotoxicity/ cardiotoxicity/ pneumothorax
  - Miscellaneous
- Tourniquet inflation and deflation time and duration of surgery were noted.

Result

The observations made were tabulated and analyzed using appropriate statistical tools.

Table 1: Demographic Data

Variables	Group D	Group T	p Value
Age in years	37.65 ± 13.38	33.17 ± 11.34	0.06
Weight in Kg	65.83 ± 6.12	66.31 ± 7.06	0.71
Sex Ratio (M:F)	44:8	36:16	0.18

It shows patients' distribution according to mean age and mean weight with standard deviation and sex incidence of patients in both groups with no significant difference. There is no significant difference in type of surgery and duration of surgery between two groups.

Table 2: Mean Onset time for Sensory and Motor block (in mins)

Parameters	Group D	Group T	p Value
Onset of Sensory Block (min)	9.04 ± 1.86	13.60 ± 1.47	<0.0001
Onset of Motor Block (min)	13.82 ± 2.41	15.14 ± 1.13	<0.0001

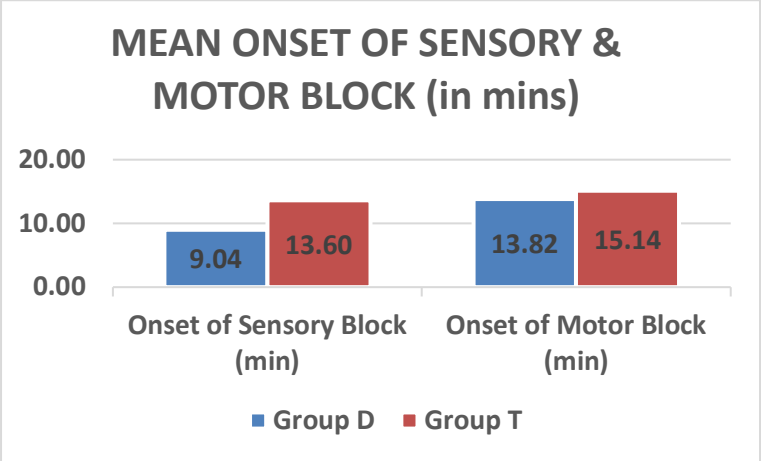

Figure 2: MEAN ONSET OF SENSORY & MOTOR BLOCK (in mins)

The table shows the mean duration of onset of sensory and motor block. The mean duration of the sensory block onset was 9.04 ± 1.86 mins in group D while it was 13.60 ± 1.47 mins with group T and the difference was statistically significant ($p<0.05$). The mean duration of the motor block onset was 13.82 mins in group D and 15.14 mins in group T and the difference was statistically significant ($p<0.05$).

Table 3: Mean Duration of Sensory and Motor block (in mins)

Parameters	Group D	Group T	p Value
Duration of Sensory Block (min)	623.56 ± 45.15	555.19 ± 68.44	<0.0001
Duration of Motor Block (min)	554.81 ± 45.91	489.04 ± 55.14	<0.0001

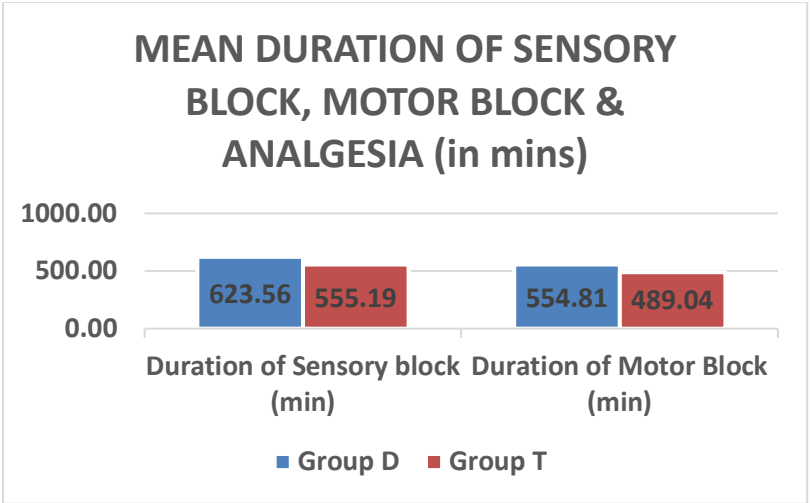

Figure 3: MEAN DURATION OF SENSORY BLOCK, MOTOR BLOCK & ANALGESIA (in mins)

The table shows the mean duration of sensory and motor block per hour at a different time interval. The mean duration of sensory block was 623.56 ± 45.15 mins in group D, while it was 555.19 ± 68.44 mins with group T and the difference was statistically significant (p<0.05). The mean duration of motor block in group D was 554.81 ± 45.91 mins, and 489.04 ± 55.14 mins in group T, and the difference was statistically significant (p<0.05).

Table 4: Mean Duration of post-operative analgesia (in mins)

Parameters	Group D	Group T	p Value
Duration of analgesia (min)	936.25 ± 47.63	730.00 ± 56.12	<0.0001

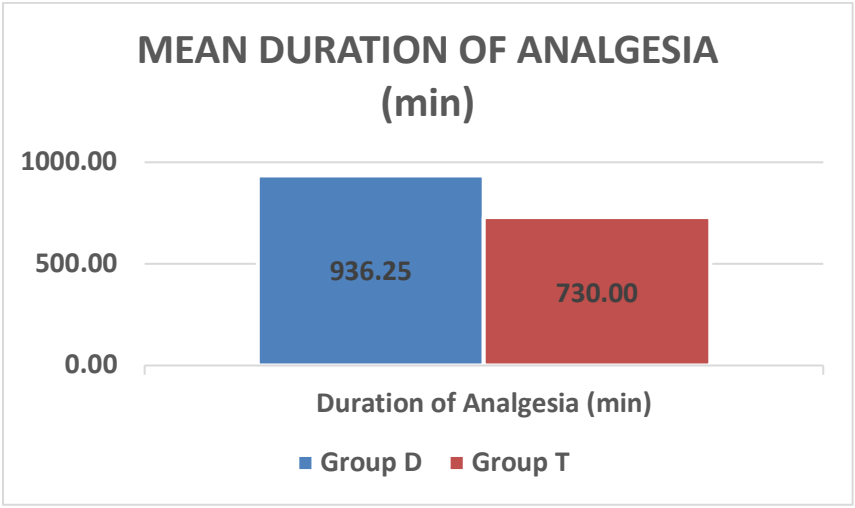

Figure 4: MEAN DURATION OF ANALGESIA (min)

The table shows the mean duration of analgesia between Dexmedetomidine and Tramadol group. Mean Duration of Analgesia was longer in group D as compared to group T and it was statistically significant (P-value <0.05).

Table 5: Mean Time of Rescue Analgesia

Parameters	Group D	Group T	p Value
Time for 1st rescue analgesia (min)	725.77 ± 37.95	617.88 ± 60.53	<0.0001

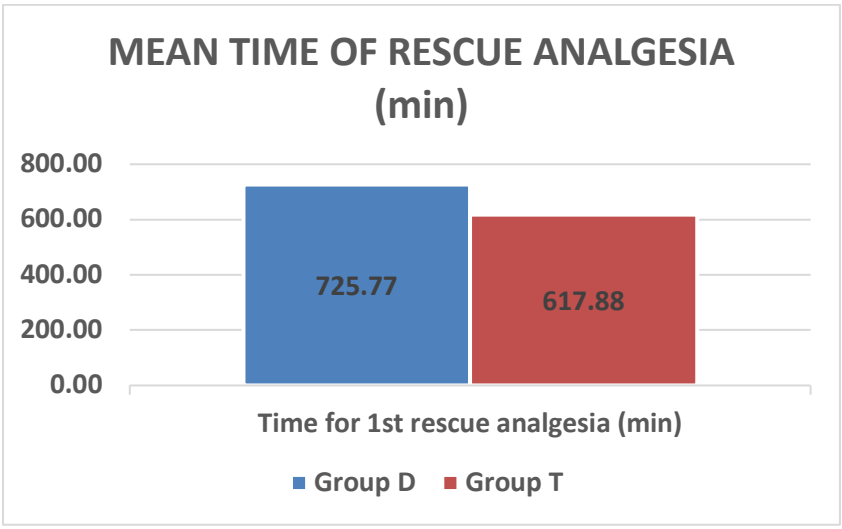

Figure 5: MEAN TIME OF RESCUE ANALGESIA (min)

Time of 1st rescue analgesia was calculated from end of the local anesthetic administration to time when VAS score was greater than 4. Duration of Rescue Analgesia was longer in group D as compared to group T and it was statistically significant (P-value <0.05).

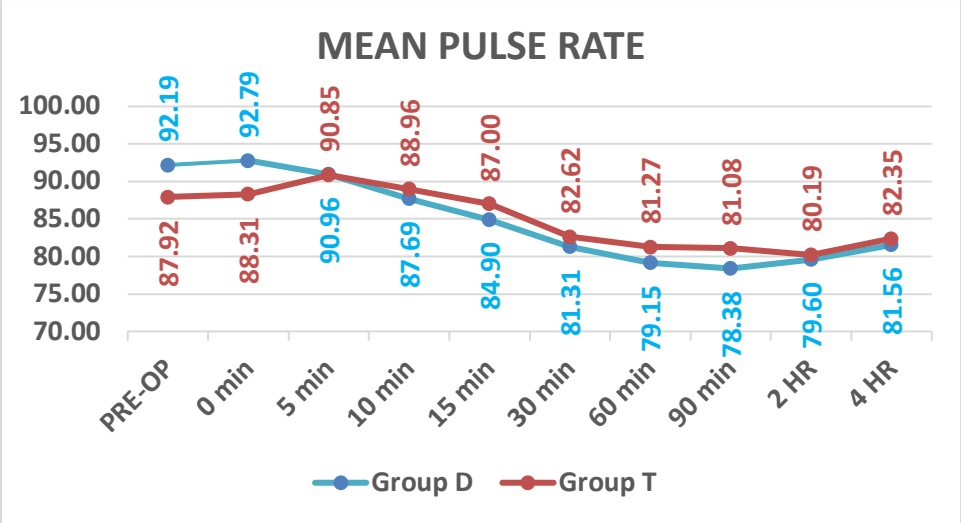

Figure 6: MEAN PULSE RATE

The image5 shows the mean heart rate at a different time interval in perioperative period in both the groups and the difference was statistically not significant (p>0.05).

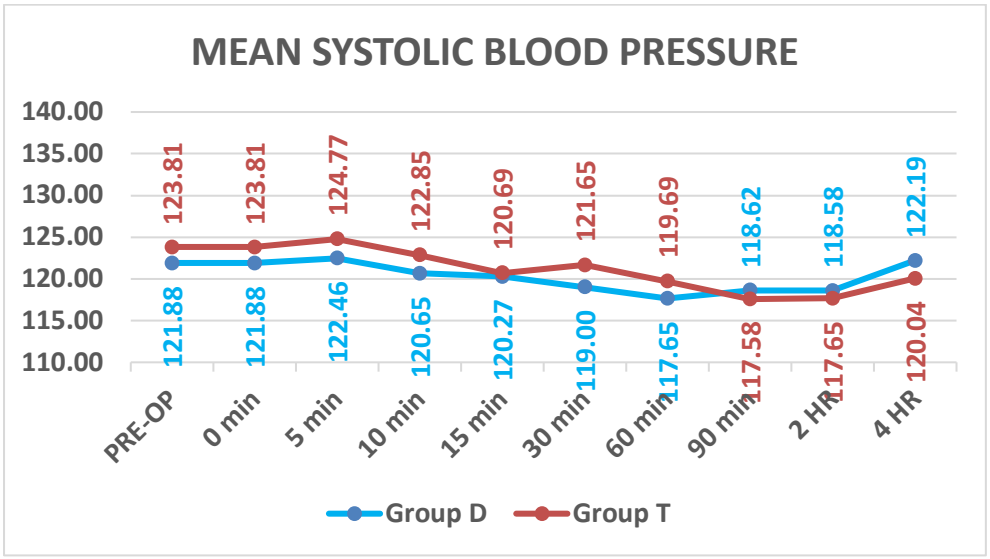

Figure 7: MEAN SYSTOLIC BLOOD PRESSURE

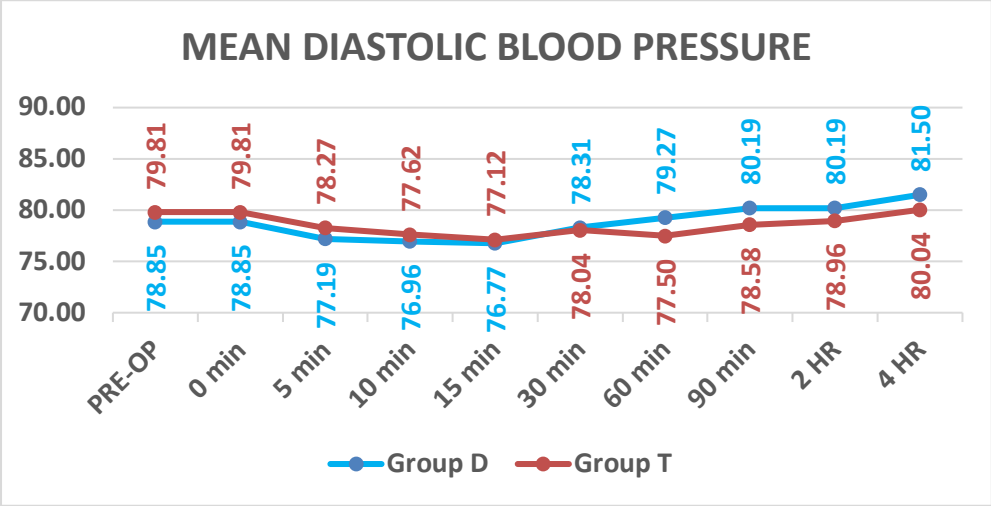

Figure 8: MEAN DIASTOLIC BLOOD PRESSURE

The Figure 7&8 shows the mean systolic and diastolic blood pressure at a different time interval in perioperative period in both the groups and the difference was statistically not significant (p>0.05).

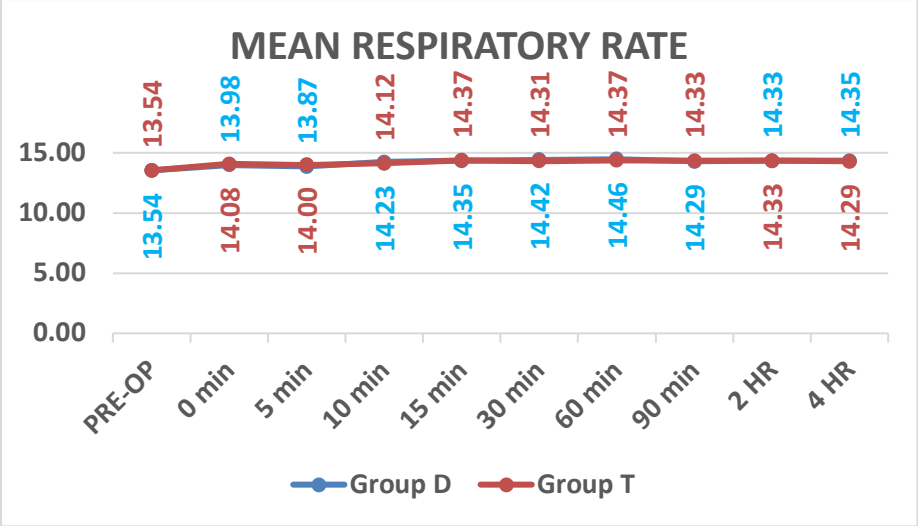

Figure 9: MEAN RESPIRATORY RATE

The Figure 9 shows the mean respiratory rate at a different time interval in perioperative period in both the groups and the difference was statistically not significant (p>0.05).

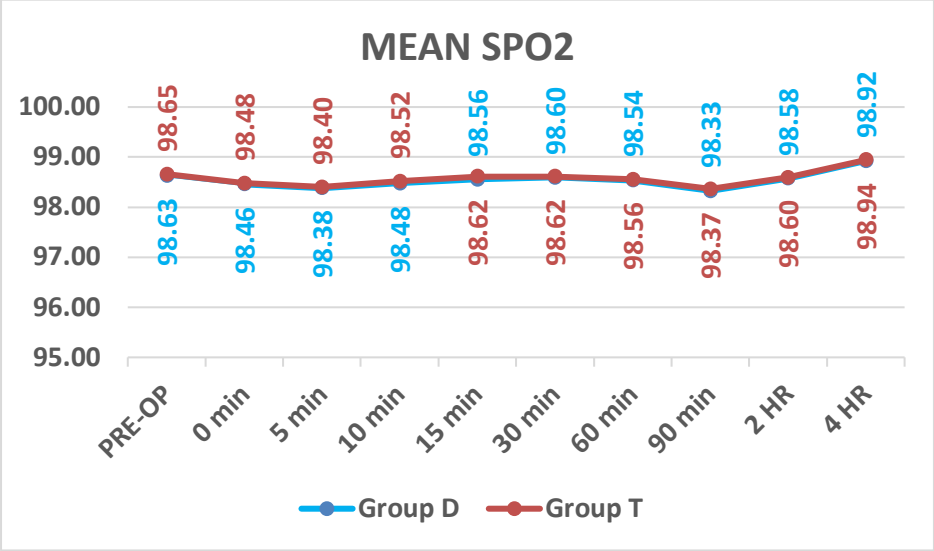

Figure 10: MEAN SPO2

The Figure shows the mean SpO2 at a different time interval in perioperative period in both the groups and the difference was statistically not significant (p>0.05).

In both the groups during surgery and post-operative period no patient developed any complication.

Discussion:

Technique: It is a simple, safe, and effective anesthesia technique having distinct advantages over general and intravenous regional anesthesia. There are different approaches to block the brachial plexus. We had selected the supraclavicular process because it is performed at the trunk level where the plexus is presented most compactly. This anatomic compactness is responsible for rapid onset, complete and reliable anesthesia. Another advantage is that it can be performed with the patient's arm in any position to provide excellent anaesthesia for elbow, forearm, and hand surgery.

Drugs: Ropivacaine is a long - acting regional anaesthetic that is structurally related to bupivacaine. It is a pure S (-) enantiomer, unlike bupivacaine. It developed for the purpose of reducing potential toxicity and improving relative sensory and motor block profiles. Ropivacaine has lower lipid solubility and have produced less central nervous sys-

tem and cardiac toxicity than bupivacaine for which it is gaining popularity over bupivacaine for peripheral neural blockade when large volumes of local anesthetic are required. Ropivacaine is also used in the chronic pain management.

Ropivacaine is as effective as bupivacaine and levobupivacaine when used in peripheral nerve blocks.

Ropivacaine is considered as an important option for regional anaesthesia, postoperative pain management and labour analgesia due to the following reasons:

- Efficacy
- Lower propensity for motor block.
- Reduced potential for central nervous system toxicity and cardio toxicity.

Dexmedetomidine via presynaptic and post synaptic activation of α2 adrenoceptor in the CNS can produce analgesia, sedation and anxiolysis. At the spinal cord level it cause inhibition of the firing of nociceptive neurons and inhibition of release of substance P.

Tramadol is known to produce antinociception and to enhance the effect of local anaesthetic. Tramadol produces this effect by its dual mechanism of action. Firstly, it stimulates μ receptor and to lesser extent δ and κ - opioid receptors. Secondly it activates spinal inhibition of pain by decreasing the reuptake of norepinephrine and serotonin (non-opioid mechanism) in peripheral nerve blocks.

Several studies have demonstrated the advantage of using tramadol hydrochloride through various routes for analgesia. Hence an attempt has been made to assess the efficacy of tramadol (2mg/kg) as an adjuvant to bupivacaine (0.25%) in brachial plexus block (supraclavicular approach) in terms of onset time, duration of analgesia, hemodynamic variables and rescue analgesic requirements in the first 24 hours.

Demographic Data: All patients in our study were demographically similar in both groups. There were no statistically significant intergroup variations regarding age, body weight, and gender distribution.

Onset of Action: In our study we found that the onset of sensory and motor block was significantly faster in patients of Group D who received a combination of dexmedetomidine and ropivacaine than in Group T who received a combination of tramadol and ropivacaine. Onset of motor block (group D, 13.82 ± 2.41 min; group T, 15.14 ± 1.13 min). Onset of sensory block (group D 9.04 ± 1.86 min; group T 13.60 ± 1.47 min).[4,5]

Duration of Motor and Sensory Block:

In our study mean duration of motor block was prolonged when dexmedetomidine was added to ropivacaine. (Group D, 554.81 ± 45.91 mins; Group T, 489.04 ± 55.14 mins) and the mean duration of sensory block was also significantly higher ($P < 0.05$) in group D than in group T. (Group D, 623.56 ± 45.15 mins; Group T, 555.19 ± 68.44 mins).[5]

Rescue Analgesia and Duration of Analgesia: In our study, the number of patients who required rescue analgesia was also significantly lower in patients in Group D. Also, the duration of analgesia in post-operative period is longer in (Group D 936.25 ± 47.63 mins as compared to Group T, 730.0 ± 56.12 mins).[15,16]

Haemodynamic Parameters: In this study there was no significant change in the haemodynamic parameters between the groups.[6,13]

Side Effects: No significant side effects like Nausea, Vomiting, Hypotension, Bradycardia, Local haematoma, Pneumothorax, Surgical emphysema or Nerve injury were observed in any of the two groups. Due to less side effects like respiratory depression Dexmedetomidine and Tramadol act as a better adjuvant for supraclavicular brachial plexus block.[8,12]

Conclusion

From overall analysis, it can be concluded that Dexmedetomidine as an adjunct to Ropivacaine produces an early onset and more prolonged duration of sensory and motor blockade as compared to Tramadol. Hence, Dexmedetomidine seems to be a better adjuvant to Ropivacaine in supra-clavicular brachial plexus block than Tramadol. However still further studies are required.

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