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DEXAMETHASONE VS DEXMEDETOMIDINE AS AN ADJUVANT TO 0.75% ROPIVACAINE ON THE ONSET OF SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK - A RANDOMISED DOUBLE BLIND CONTROLLED TRIAL

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ABSTRACT

OBJECTIVE – The aim of study was to assess the clinical effect of Dexamethasone and Dexmedetomidine as an adjuvant with 0.75% Ropivacaine in onset of supraclavicular brachial plexus block under ultrasonography guidance.

METHOD – A randomised double blinded controlled trial was conducted and patients were allotted with systemic sampling technique in three groups; Group R (Ropivacaine alone), Group R+Dexmed (Ropivacaine and Dexmedetomidine), Group R+Dexa (Ropivacaine and Dexamethasone). Under USG guidance supraclavicular block was given. Hemodynamic parameters including HR, NIBP, SPO2 were recorded also onset and duration of motor and sensory blockade were recorded.

RESULT – Onset of motor and sensory blockade were quicker in Group R+Dexmed (4.8 ± 1.4, 2.9 ± 1 in mins) compared to other two groups but duration of motor and sensory blockade was longer in Group R+Dexa (747.7 ± 87.8, 1025.5 ± 63.9 in mins) compared to other two groups. Hemodynamic parameters remained stable in all groups with slight fall in heart rate in group R+Dexmed.

CONCLUSION – Dexmedetomidine and Dexamethasone both increases duration of motor and sensory blockade and has quicker onset of motor and sensory blockade compared to ropivacaine alone without altering the hemodynamic status of the patient. Also, USG guided supraclavicular block leads to less complications and more accurate block compared to other technique.

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KEY-WORDS – *Dexmedetomidine, Dexamethasone, Ropivacaine, Supraclavicular brachial plexus block.*

INTRODUCTION

General anaesthesia is a technique of choice for many operations, but it is related to physiologic fluctuations that requires active intervention, complex care. Patients with severe co-morbidities are at risk with general anaesthesia. While using regional anesthesia, most of those drawbacks may be overcome.

Nerve blocks are associated with least systemic physiologic changes compare to general anaesthesia. [(1)]

Halstead in 1884 introduced the technique of plexus brachialis block [(2)]; George Hirschel in 1911 performed the primary percutaneous plexus brachialis block through axillary approach. [(3)]

Supraclavicular nerve plexus block is employed to supply anaesthesia and analgesia for surgeries of lower arm, forearm, and hand. D. Kulenlampff in 1911 demonstrated his first supraclavicular block in Germany. [(4)]

Supraclavicular approach is more advantageous over other approaches because it is more easy, reliable, and successful with least amount of side effects. [(5)]

Ropivacaine has superior motor and sensory differentiation. Ropivacaine has minimal cardiotoxicity and neurotoxicity compared to Bupivacaine. The decreased systemic toxicity is healthier when a possible for top concentrations of local agents is employed in peripheral nerve block and epidural anesthesia. [(6)]

The adjuvant drugs are added to peripheral nerve block to extend the duration of analgesia without causing any systemic adverse effects and prolonging motor blockade.

Dexamethasone reduces inflammation and inhibits potassium channel mediated discharge of pain carrying nociceptive C – fibres. [(7)] Perineural injection of steroids is reported to influence post-operative analgesia. [(8)]

Dexmedetomidine promote hyperpolarization of nerve tissues by modifying transmembrane potential and ion conductance at locus coeruleus within the brainstem, greatly reduce the necessity for anaesthesia and analgesia. With Ropivacaine, the duration of block increases in a very dose-dependent manner. [(9)]

Ultrasound guided peripheral block has advantage over any other method as in it shows direct visualization of the target nerve, block needle and applied drugs.

METHODS

A randomised double blind controlled trial was conducted following institutional ethics committee approval wherein total 90 patients having ASA I and II and in the age range of 18-70 years planned for various upper limbs surgeries were classified into three groups 30 patients in each group using systemic sampling technique. Pre-anaesthetic check-up was done and Informed written consent for procedure and future use of data for publication were obtained. On arrival of patient in the operating room standard monitoring were applied.

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Blinding was achieved through the use of equal amount of drugs. Identical coded syringes were kept ready by person not involving in study, for example OT consultant, and were randomly handed over to Anaesthesiologist who was unaware of the identities of the drug. Syringes were labelled as A, B and C according to their content. 3 groups labelled as follow

Group A (Group R)	0.75% Ropivacaine 15ml + 0.9% NS 2ml
Group B (Group R+Dexmed)	0.75% Ropivacaine 15ml + 8 mg Dexamethasone 2ml
Group C (Group R+Dexa)	0.75% Ropivacaine 15ml + 50 mcg Dexmedetomidine 2ml

Technique:

Patient was asked to lying down on supine position with arm slightly flexed and forearm resting at abdomen. One bolster was applied under center of back for proper positioning. After painting and draping of the part, linear ultrasonography probe with frequency of 5-12 MHz was used. After confirmation of brachial plexus under USG guidance needle was inserted using In-plane technique and total of 17 ml of drug injected confirming with ultrasonographic view and with negative aspiration test.

Hemodynamic monitoring was recorded pre-operative, after giving block, after 5, 15, 30, 60 and 120 mins of giving block.

Table 1: Pulse variation with time

	Group A (mean ± SD)	Group B (mean ± SD)	Group C (mean ± SD)
Pre-operative	83.3 ± 14.6	79.4 ± 11.9	78.3 ± 11.1
After giving block	94.2 ± 15.1	94.4 ± 15.3	87.3 ± 11.5
After 5 min	89.6 ± 15.1	91.4 ± 14.3	85.7 ± 10.9
After 15 min	84.4 ± 13.1	88.2 ± 13.7	82.3 ± 10.1
After 30 min	82.7 ± 13.9	84.2 ± 11.9	78.3 ± 10.1
After 60 min	82.8 ± 13.7	81.6 ± 11.2	74.6 ± 10.1
After 120 min	82.4 ± 13.3	81.1 ± 11.3	73.6 ± 9.5

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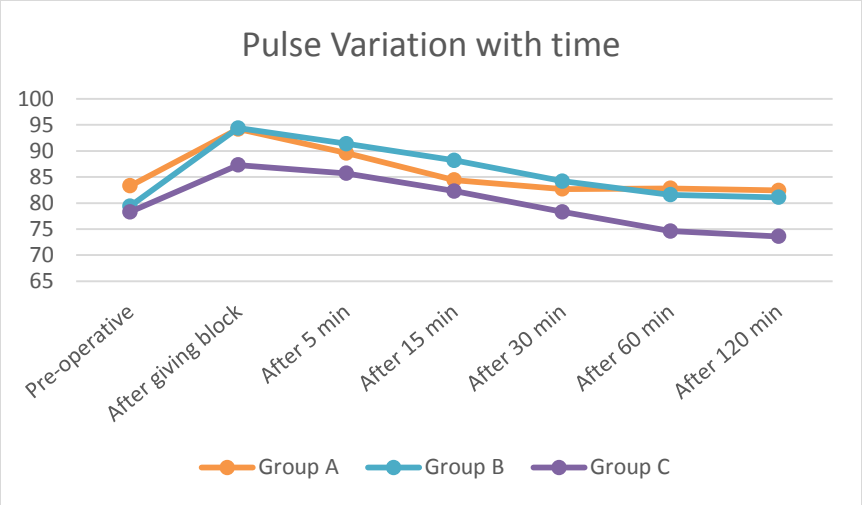

Figure 1: Pulse variation with time

Table 2: Systolic BP variation with time

	Group A (mean ± SD)	Group B (mean ± SD)	Group C (mean ± SD)
Pre-operative	124.6 ± 14.9	120.2 ± 11.1	129.1 ± 10.8
After giving block	133 ± 11.8	130.8 ± 10.4	134.9 ± 9.7
After 5 min	128.5 ± 12.3	130.2 ± 10	132.5 ± 9.1
After 15 min	124.4 ± 11.8	127.8 ± 9.8	129.6 ± 9
After 30 min	121.4 ± 12.7	125.8 ± 9.8	126.8 ± 8.4
After 60 min	120.7 ± 12.3	122.8 ± 9.1	123.7 ± 8.6
After 120 min	121.5 ± 11.7	121.6 ± 9.3	123.1 ± 8.4

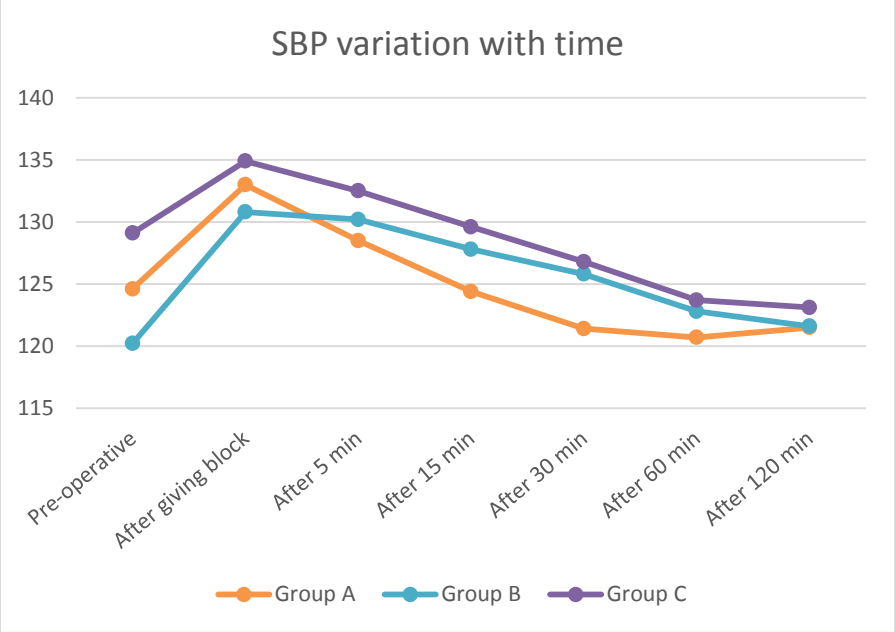

Figure 2: Systolic BP variation with time

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Table 3: Diastolic BP variation with time

	Group A (mean ± SD)	Group B (mean ± SD)	Group C (mean ± SD)
Pre-operative	72.8 ± 9.5	67 ± 5.9	74.6 ± 9.9
After giving block	74.3 ± 8.4	73 ± 5.9	77.2 ± 9.4
After 5 min	73.4 ± 8.6	71.4 ± 5.5	76.2 ± 9.6
After 15 min	71.5 ± 8.3	70.1 ± 5	75 ± 8.8
After 30 min	71.7 ± 7.7	68.4 ± 4.8	73.8 ± 9.3
After 60 min	72.2 ± 8.4	67.7 ± 4.7	72.4 ± 8.4
After 120 min	71.4 ± 8.5	66.9 ± 5.7	71.9 ± 8.6

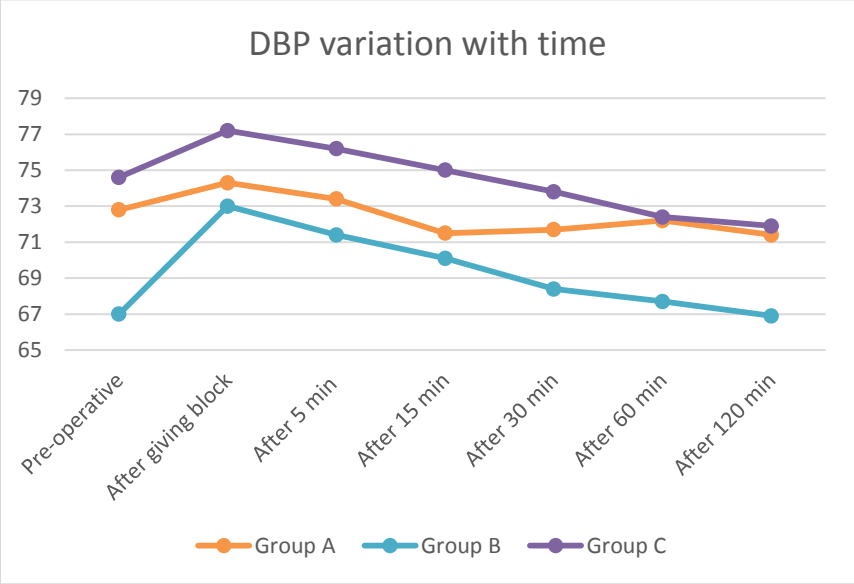

Figure 3: Diastolic Variation with time

Table 1, 2, & 3 shows Heart Rate, Systolic and Diastolic BP variation with time in any of the group is not that significant. After giving block increasing in HR, SBP and DBP is due to anxiety of procedure. In group C there is fall in heart rate around 20% but not it is not that significant drop.

Table 4: Sensory onset in min

Onset within	Group A	Group B	Group C
0-2 min	0	0	5

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2.1-4 min	10	20	18
4.1-6 min	11	9	7
6.1-8 min	7	1	0
8.1-10 min	2	0	0
10.1-12 min	0	0	0

From the Table 4, it is proven that 17% of the patients of Group C had onset of sensory block within 2 minutes whereas no patients in either Group A or Group B had onset of sensory block within 2 minutes. All the patients of Group C had onset of sensory block within 6 minutes, and it took 8 and 10 minutes respectively to have onset of sensory block in Group B and Group A.

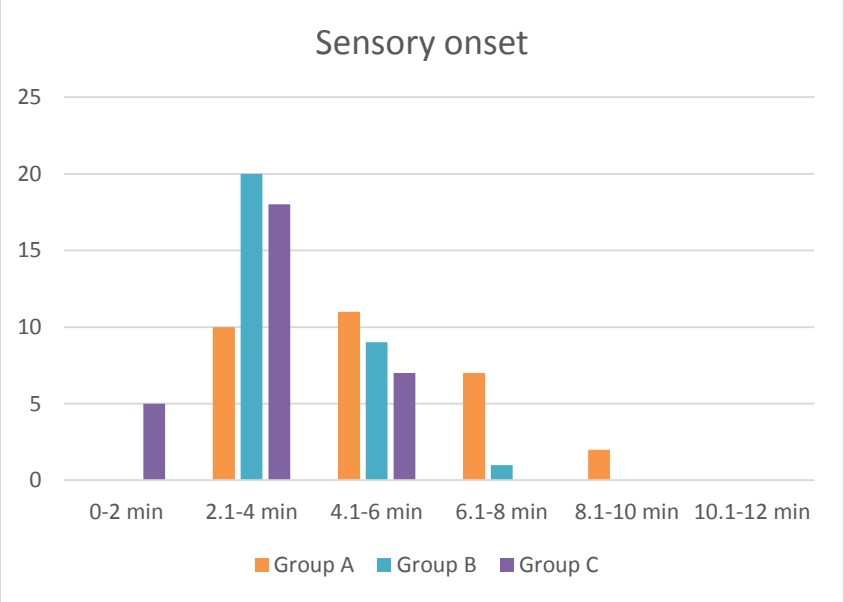

Figure 4: Sensory onset in minute

Table 5: Motor onset in min

Onset within	Group A	Group B	Group C
0-2 min	0	0	1
2.1-4 min	0	1	7
4.1-6 min	5	12	17
6.1-8 min	9	12	5
8.1-10 min	9	5	0
10.1-12 min	7	0	0

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From the Table 5, 27% of the patients of Group C had onset of motor block within 4 minutes whereas no patients in either Group A or Group B had onset on motor block within 4 minutes. All the patients of Group C had onset of motor block within 8 minutes, and it took 10 and 12 minutes respectively to have onset of motor block in Group B and Group A.

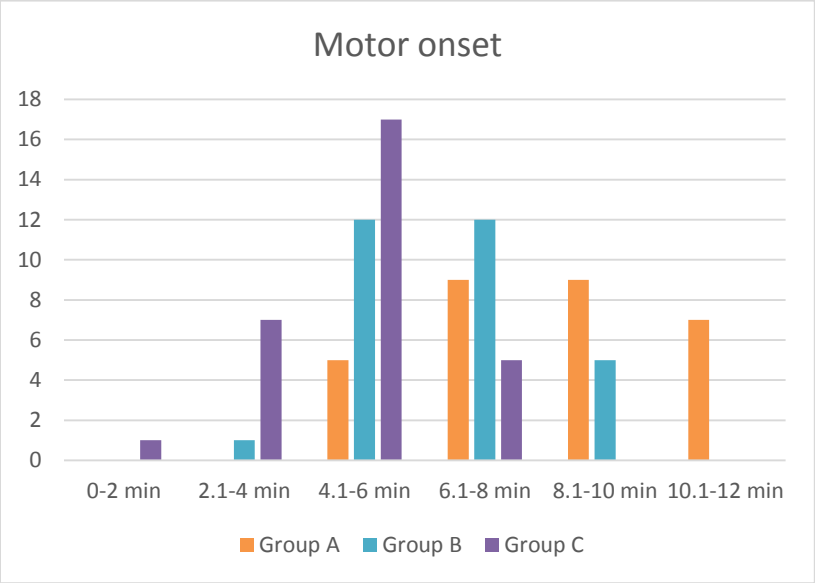

Figure 5: Motor onset in minute

Table 6: Mean sensory and motor onset in Group A and B

	Group A (mean ± SD)	Group B (mean ± SD)	P value
Sensory onset (min)	5 ± 1.6	3.6 ± 1	0.0001
Motor onset (min)	8.1 ± 2	6.3 ± 1.3	0.0001

The mean onset time of sensory block was faster in Group B (3.6 ± 1 mins) compared to Group A (5 ± 1.6 mins), which was statistically significant. (p= 0.0001).
The onset of motor block was faster in Group B (6.3 ± 1.3 mins) compared to Group A (8.1 ± 2 mins), which was statistically significant. (p=0.0001)

Table 7: Mean sensory and motor onset in Group A and C

	Group A (mean ± SD)	Group C (mean ± SD)	P value
Sensory onset (min)	5 ± 1.6	2.9 ± 1	<0.0001
Motor onset (min)	8.1 ± 2	4.8 ± 1.4	<0.0001

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The mean onset time of sensory block was faster in Group C (2.9 ± 1 mins) compared to Group A (5 ± 1.6 mins), which was statistically significant. (p=0.0001)
The onset of motor block was faster in Group C (4.8 ± 1.4 min) compared to Group A (8.1 ± 2 min), which was statistically significant. (p = 0.0001)
Table 8: Mean sensory and motor onset in Group B and C

	Group B (mean ± SD)	Group C (mean ± SD)	P value
Sensory onset (min)	3.6 ± 1	2.9 ± 1	0.0088
Motor onset (min)	6.3 ± 1.3	4.8 ± 1.4	0.0001

The onset of sensory block was faster in Group C (2.9 ± 1 mins) compared to Group B (3.6 ± 1 mins), which was statistically significant. (p = 0.0088). The onset of motor block was faster in Group C (4.8 ± 1.4 mins) compared to Group B (6.3 ± 1.3 mins), which was statistically significant. (p = 0.0001)

Table 9: Motor block duration

Motor block (in min)	Group A	Group B	Group C
200-300	7	0	0
301-400	14	0	0
401-500	8	0	7
501-600	1	0	16
601-700	0	11	6
701-800	0	11	1
801-900	0	6	0
901-1000	0	2	0

From the Table 9, it is evident that 27% of the patients of Group B had duration of motor block more than 800 minutes whereas no patients in either Group A or Group C had duration of motor block more than 800 minutes. All patients of Group B had duration of motor block in excess of 600 minutes whereas only 23% of the patients of Group C & no patients of Group A had duration of motor block in excess of 600 minutes.

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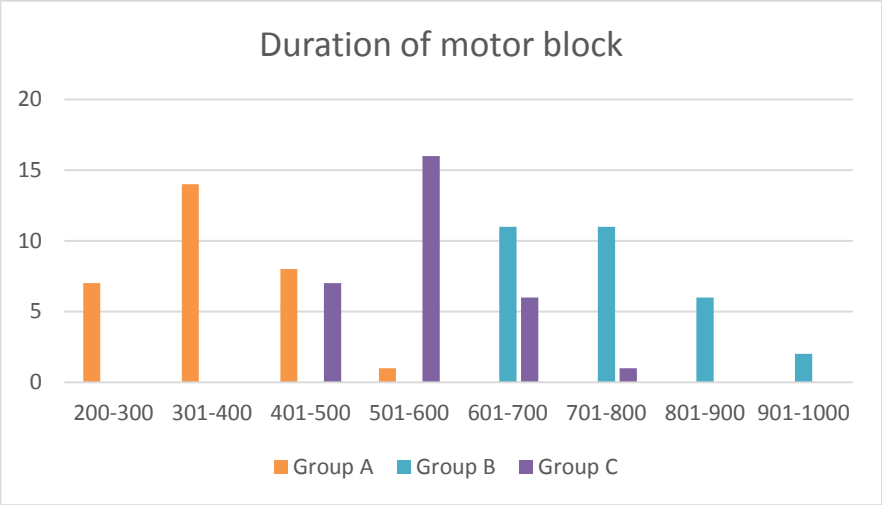

Figure 6: Duration of Motor block

Table 10: Duration of analgesia

Analgesia (in min)	Group A	Group B	Group C
300-400	4	0	0
401-500	15	0	0
501-600	8	0	0
601-700	2	0	12
701-800	1	0	13
801-900	0	1	4
901-1000	0	10	1
1001-1100	0	16	0
1101-1200	0	3	0

From the Table 10, 63% of the patients of Group B had duration of analgesia more than 1000 minutes whereas no patients in either Group A or Group C had duration of analgesia more than 1000 minutes. All except one patient (97%) of Group B had duration of motor block more than 900 minutes whereas only 4% of the patients of Group C & no patients of Group A had duration of analgesia more than 900 minutes.

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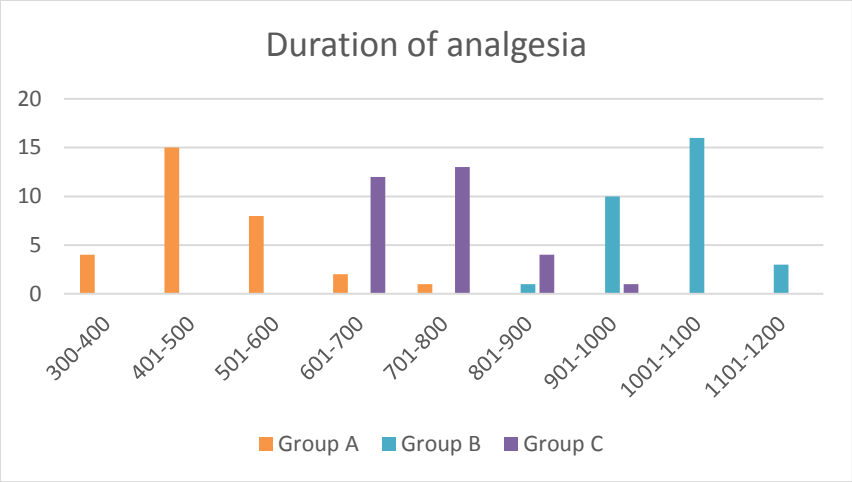

Figure 7: Duration of Analgesia

Table 11: Duration of motor block and duration of analgesia in Group A and B

	Group A (mean ± SD)	Group B (mean ± SD)	p value
Motor block (min)	357.9 ± 73.1	747.7 ± 87.8	<0.0001
Analgesia (min)	491 ± 78.4	1025.5 ± 63.9	<0.0001

The duration of motor block was longer in Group B (747.7 ± 87.8 mins) compared to Group A (357.9 ± 73.1 mins), which was statistically significant. (p = 0.0001).

The duration of analgesia was longer in Group B (1025.5 ± 63.9 mins) compared to Group A (491 ± 78.4 mins), which was statistically significant. (p = 0.0001)

Table 12: Duration of motor block and duration of analgesia in Group A and C

	Group A (mean ± SD)	Group C (mean ± SD)	p value
Motor block (min)	357.9 ± 73.1	553.7 ± 71.2	<0.0001
Analgesia (min)	491 ± 78.4	736.2 ± 76.4	<0.0001

The duration of motor block was longer in Group C (553.7 ± 71.2 mins) compared to Group A (357.9 ± 73.1 mins), which was statistically significant. (p = 0.0001).

The duration of analgesia was longer in Group C (736.2 ± 76.4 mins) compared to Group A (491 ± 78.4 mins), which was statistically significant. (p = 0.0001)

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Table 13: Duration of motor block and duration of analgesia in Group B and C

	Group B (mean ± SD)	Group C (mean ± SD)	p value
Motor block (min)	747.7 ± 87.8	553.7 ± 71.2	<0.0001
Analgesia (min)	1025.5 ± 63.9	736.2 ± 76.4	<0.0001

The duration of motor block was longer in Group B (747.7 ± 87.8 mins) compared to Group C (553.7 ± 71.2 mins), which was statistically significant. (p = 0.0001). The duration of analgesia was longer in Group B (1025.5 ± 63.9 mins) compared to Group C (736.2 ± 76.4 mins), which was statistically significant. (p = 0.0001)

Table 14:

	Group A	Group B	Group C
Hematoma	Nil	Nil	Nil
Horner's syndrome	Nil	Nil	Nil
Nausea and Vomiting	Nil	Nil	Nil
Pneumothorax	Nil	Nil	Nil
Hypotension	Nil	Nil	Nil
Bradycardia	Nil	Nil	Nil
LAST	Nil	Nil	Nil

Complication and adverse effects

As illustrated in Table 14, no complications or adverse effects were noted in either of the patients among all three groups.

DISCUSSION

We have studied three groups & compared Dexamethasone and Dexmedetomidine as adjuvants with Ropivacaine in our study by using Inj. Ropivacaine 0.75% (Group A), Inj. Ropivacaine 0.75% with 8 mg Dexamethasone (Group B) and Inj. Ropivacaine 0.75% with 50 mcg Dexmedetomidine (Group C) in supraclavicular brachial plexus block using ultrasonography guidance in upper limb surgeries.

Hemodynamic parameters remained stable in the perioperative period in all the 3 groups.

In our study, we observed that mean onset of sensory block was 5 ± 1.6 min in Group A, 3.6 ± 1 min in Group B & 2.9 ± 1 min in Group C. The mean of motor onset was 8.1 ± 2 min in Group A, 6.3 ± 1.3 min in Group B & 4.8 ± 1.4 min in Group C.

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Kumkum Gupta et al [10] in their study observed the onset of sensory and motor block was 2.57 ± 1.5 min and 3.10 ± 4.3 min with Ropivacaine.

Santosh Kumar et al [11] in a similar study observed the mean time of onset of sensory and motor block with Ropivacaine was 3.62 ± 0.79 min and 5.23 ± 0.69 min respectively and observed the mean time of sensory and motor block with Ropivacaine & Dexamethasone was 3.35 ± 0.86 min and 4.92 ± 0.81 min, respectively.

Harshvardhana [12] in his study observed the mean time for onset of sensory and motor block was 2.59 ± 2.2 min and 4.12 ± 1.6 min respectively with Ropivacaine and Dexmedetomidine.

However, in a study, Rohit Aravindakshan Kooloth et al [5] in their study observed the time of mean onset of the sensory and motor block was 10.73 ± 3.11 min and 14.33 ± 4.92 min with Ropivacaine alone.

Don Sebastian et al [13] in their study, observed the onset of sensory block in patients receiving Ropivacaine and Dexmedetomidine was 9.27 ± 1.68 min whereas it was 2.9 ± 1 min in our study.

We observed much faster onset of sensory and motor block with each of the groups. The reason may be due to difference in the technique used for the localization of brachial plexus. They have used elicitation of paraesthesia or electric nerve-stimulator technique for localization of nerve plexus. The likely explanation for faster onset for sensory as well as for motor blockade in our study could be that ultrasound can determine the size, depth and exact location of the nerve plexus bundles and its neighboring structures so the drug can be deposited exactly at the site of plexus.

In our study, we observed that mean duration of motor block was 357.9 ± 73.1 min in group A, 747.7 ± 87.8 min in group B and 553.7 ± 71.2 min in group C. The mean duration of analgesia was 491 ± 78.4 min in group A, 1025.5 ± 63.9 min in group B and 736.2 ± 76.4 min in group C.

Kumkum Gupta et al [10] observed the duration of motor block and analgesia with Ropivacaine 485.12 ± 30 min & 736.53 ± 47 min, respectively.

In a study conducted by Rohit Aravindakshan Kooloth et al [5], they observed the mean duration of sensory block was 480.43 ± 55.26 min with Ropivacaine alone.

Santosh Kumar et al [11] in their study, observed the duration of motor block & duration of analgesia was 465.62 ± 54.29 min & 557 ± 58.99 min respectively with Ropivacaine. They observed the duration of motor block & duration of analgesia was 1091 ± 106.74 min and 1179.4 ± 108.60 min respectively with Ropivacaine & Dexamethasone group. These observations are like our study.

The mechanism of analgesia induced by corticosteroids is not fully understood. This effect is suspected to be mediated by their anti-inflammatory or immunosuppressive effects. [14] steroids bind to intracellular receptors and modulate nuclear transcription. Honorio et al [15] discovered that steroids injection leads to analgesia by blocking transmission in nociceptive small c-fibers and inhibiting ectopic neuronal discharge. According to Attardi et al [16] steroids alter the function of potassium channels in the excitable cells, and this might be the probable mechanism of action by Dexamethasone for the prolongation of blockade in our study.

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Don Sebastian et al [13] in a similar study observed the mean duration of motor block and analgesia was 600.83 ± 46.722 min & 720.83 ± 44.16 min with Dexmedetomidine and Ropivacaine.

In a study which was conducted by Suneet Kathuria et al [17], they observed that duration of motor blockade & analgesia was 387.85 ± 129.3 min and 536.75 ± 251.19 min respectively with Ropivacaine. The duration of motor block and analgesia was and 754.60 ± 180.50 min & 967.55 ± 310.50 min respectively with Ropivacaine and Dexmedetomidine.

Harshvardhana [12] in his study observed the duration of motor block and analgesia was 363.11 ± 54.2 min & 414.32 ± 14.2 min with Ropivacaine and Dexmedetomidine.

All these observations are consistent with our studies. Dexmedetomidine provides anti-nociception through non-spinal mechanisms by activation of α2a receptors, inhibition of the conduction of nerve signals through C and Aδ fibers and the local release of encephalin, thus prolonging the effect of Ropivacaine in our study.

Complications:

All patients were monitored for complications during the intraoperative period. The observations and particulars of each patient were recorded in the proforma enclosed. No complications or significant adverse effects were observed in all the study groups.

Thus, when Dexamethasone and Dexmedetomidine used as adjuvants with Ropivacaine in brachial plexus block, both have faster onset of sensory and motor block, longer duration of analgesia and longer duration of motor blockade compared to Ropivacaine alone.

Limitations:

In our study we noticed that adding dexamethasone to 0.75% ropivacaine sometimes led to precipitation of the solution. Later, this drug mixture was discarded, and new preparations were made.

Trevor et al [18] in his study noticed the same thing where he mixed dexamethasone to ropivacaine and led to precipitation of ropivacaine.

CONCLUSION

From this study, it can be concluded that

1. Onset of sensory and onset of motor block is faster with both the drugs, Dexamethasone and Dexmedetomidine when added to Ropivacaine as compared to Ropivacaine alone. Although onset of sensory and motor blockade is faster with Dexmedetomidine compared to using Dexamethasone.
2. The use of ultrasonographic guidance not only improves success rate but it necessarily reduces complications like accidental arterial puncture, pneumothorax, horner's syndrome while performing block and the faster onset of sensory and motor blocks are achieved.
3. Duration of motor block and duration of analgesia are prolonged by both the drugs, Dexamethasone and Dexmedetomidine using with Ropivacaine as compared to Ropivacaine

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alone. Duration of motor block and analgesia is moderately prolonged with Dexmedetomidine and even more prolonged with using Dexamethasone.

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ABBREVIATIONS

α - Alpha
ASA- American society of Anaesthesiologist
BP- Blood pressure
cm- Centimeter
DBP- Diastolic blood pressure
et al- et alia
gm- Grams
HR- Heart rate
Kg- Kilograms
L- Litres
LA- Local Anaesthetic
MAP- Mean arterial pressure
ml- Mililitres
mg- Miligrams
min- Minutes
NIBP – non-invasive blood pressure
NS- Normal saline
OT- Operation theatre
PNB- Peripheral Nerve Block
SBP- Systolic blood pressure
SCBP- Supraclavicular brachial plexus
SD- Standard deviation
Spo2- Oxygen saturation
USG- Ultrasonography