Original Research Article

Perineural Dexamethasone Prolongs the Duration of Analgesia in Supraclavicular Brachial Plexus Block With Ropivacaine: A Comparative Study

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Abstract

Introduction: The analgesia provided by single shot brachial block is of limited duration and hence many perineural adjuvants have been tried to improve block characteristics. We evaluated the effects of adding dexamethasone to ropivacaine on onset and duration of sensory and motor block. **Study design**: A Prospective, Comparative, Randomized study conducted on 80 patients in a tertiary care centre for duration of 8 months. **Materials and Method:** Eighty patients aged18-60years, ASA physicalstatus I-II weighing 50-80kg scheduled for surgeries under supraclavicular block were randomised into two groups. Group R(n=40) received 0.5%ropivacaine28ml with 2mlnormal saline and group RD received 0.5%ropivacaine28ml with 2ml(8mg)dexamethasone. Primary outcome was duration of analgesia which is the time interval between onset of sensory block and first rescue analgesia (VAS >5). Secondary outcomes were onset and duration of sensory and motor blockade. **Statistical analysis:** Chisquare and independent t test were used as test of significance for qualitative and quantitative data respectively. **Results:** Demographic data were similar in both groups. Mean Duration of analgesia in Group R was 530.3 ± 107.58 min and in Group RD was 887.63 ± 228.56 min ($p<0.001$).Mean duration of sensory and motor block in Group R was 499.83 ± 113.1min and 499.98 ± 103.38min respectively and in Group RD 856.05 ± 229.36min and 812.3 ± 225.23min respectively ($p<0.001$). Duration of analgesia, duration of sensory and motor blockade were prolonged in group RD than groupR. **Conclusion:** Perineural dexamethasone in supraclavicular block with 0.5%ropivacaine prolongs the duration of analgesia and block duration but has no effect on onset of block.

Keywords: Perineural dexamethasone, Ropivacaine , Supraclavicular brachial plexus block, Duration of analgesia.

Introduction

"DIVINE IS THE TASK TO RELEIVE PAIN"

HIPPOCRATES

Brachial plexus regional anaesthesia is being used worldwide by anaesthesiologists for upper limb surgeries since 1884 when William Stewart Halsted and Richard John Hall first reported the use of cocaine to block upper extremity nerves[1]. Supraclavicular brachial plexus block is preferred for any upper extremity surgeries not involving shoulder since it is reliable, highly successful and a safe procedure where local anaesthetic is injected at the level of distal trunks of brachial plexus. It was first performed by Kulenkampff in Germany in 1911 on himself[2]. After a few months, Hirschelpropagated a method for brachial plexus block with an axillary approach. Kulenkampff and Persky published a long paper of their experiences in 1928, without any majorcomplications. Regional anaesthetic techniques are now used as a principal method of anaesthesia for upperlimb surgeries because the overall complications associated with general anaesthesia are reduced[3] hence very useful in patients with co- morbidities. The analgesia provided by single shot brachial block is of limited duration and hence many perineural adjuvants (epinephrine, clonidine, midazolam, ketamine and opioids) have been tried to improve block characteristics but met with limited success and a number of side effects like respiratory depression, hypotension, bradycardia, pruritis and sedation[4]. The ideal adjuvant with favourable profile remained undiscovered.

In the meantime various studies showed that dexamethasone prolongs the nerve blockade that is extending the duration of analgesia with minimal side effects[4,5,6]. Most common local anaesthetic (LA) used for this purpose is bupivacaine, a long acting amide LA which has better quality of motor block[7]. But the problem is with its high central nervous system (CNS) and cardio toxicity and if unintended IV injection it leads to cardiac arrest which is very difficult to resuscitate resulting in high number of deaths . Therefore ropivacaine (pure S enantiomer) , a long acting amide L A which had better safety profile that is less cardiac as well as CNS toxic effects was tried[8,21,22]. We conducted this study to compare the effects of dexamethasone with ropivacaine on the characteristics of supraclavicular brachial plexus block.

Materials and Methods

A Prospective, Comparative ,Randomized study which was carried out at McGANN Teaching District Hospital under auspices of Department of Anesthesiology, Shimoga Institute Of Medical Sciences, Shimoga from September 2019 to May 2020 for a period of 8 months after clearance by institutional ethical committee. Eighty patients aged between 18 to 60 years of either sex and ASA physical status I & II weighing between 50 – 80 kg who was posted for elective upper limb surgeries were included in the study after

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obtaining informed written consent. The exclusion criteria included Patients with known hypersensitivity to study drugs, who do not give consent , Infection at the site of block, Patients with known coagulopathy or patient on anticoagulant therapy, Pregnant and lactating females, Morbid obesity (BMI >40), Patients with severe systemic disorder , Patients with injury to any of the nerves of upper limb, Patients having distorted anatomy of the neck and Patients with systemic use of corticosteroids for 2 weeks and chronic opioid use

The Sample size(35 patients in each group) was calculated based on previous literature[7]taking standard deviation as 1.88 and 1.81 and mean difference of 1.24 with 80% power of study and 5% alpha error. Considering 10% dropouts (change in technique or cancellation on table) 40 patients (total 80) were included in the study.

Preoperative evaluation of the patient was done on the day before surgery. After explaining the procedure, written and informed consent was obtained and advised overnight fasting and patients were premedicated with tablet Alprazolam 0.5 mg the night before the surgery.On arrival of patients to operating room, intravenous line with 18G was secured on non-operating hand and an infusion of Ringer lactate started. Patients were randomized into two groups of 40 each by computer generated random table and blinding by sealed envelope method, receiving one of the following for supraclavicular brachial plexus block:

- ✓ Group R(n= 40)- Ropivacaine(0.5%) 28ml + 2ml Normal Saline
- ✓ Group RD (n=40)- Ropivacaine(0.5%) 28ml with 8mg(2ml) dexamethasone

Baseline heart rate, non-invasive blood pressure, pulse haemoglobin oxygen saturation (SPO2), were recorded using multi-parameter monitor, before starting the procedure

- Under aseptic precautions with patient in supine position and head turned away from the site of blockade, nerve stimulator needle inserted 2cm above the midclavicular point just lateral to subclavian artery pulsation which was directed caudal and medially.The positive electrode of the nerve stimulator was connected to an ECG electrode which was placed on the chest of the patient. The negative electrode connected to needle. The intensity of stimulating current was set initially to 1mA with impulse duration of 0.1ms.Motor response to the stimulation was observed by identifying contraction of brachioradials and index, middle finger when current was gradually reduced to <0.5mA to get muscle contraction which was considered as evidence of proper needle position. The study drug was then injected in 3ml increments after negative aspiration, with repeat aspirations every 3ml and frequent communication with the patient. During injection patients were observed for toxicity of the drug and any other immediate complication of the block.

Assessment was done every 1 minute till 30min for the onset of sensory and motor blockade till the complete achievement of motor and sensory block. At the end of 30minutes if there were no signs of sensory and motor block, the block was considered as failed block and patients were excluded from the study.

Assessment of sensory blockade: tested by pin prick test using hypodermic needle on 3 point scale

2= normal sensation of pinprick.

1 = Sensation to pinprick is less than the prick in same dermatome of opposite limb.

0 = loss of sensation to pinprick.

Assessment of motor blockade: LOVETT RATING SCALE[9]

6- Normal muscular force

5- Slightly reduced muscular force

4- Pronounced reduction of muscularforce

3- Slightly impaired mobility

2- Pronounced mobility impairment

1-Almost complete paralysis

0-Complete paralysis

- **Primary outcome** was the duration of analgesia which is the time interval between onset of sensory block and first rescue analgesia (VAS >5) of injection Diclofenac 75mg was given and study concluded at that point.
- **Secondary outcomes** were onset and duration of sensory and motor blockade.
- **Onset of sensory blockade:** It is the time taken from the completion of injection of study drug till the patient does not feel the pin prick sensation in any of C5 to T1 dermatomes. (score -0)
- **Onset of motor blockade:** Is defined as time taken from the completion of injection of study drug till the patient develops first loss of motor power in any of the dermatomes C_5-T_1 (LOVETT RATING SCALE - 0)
- **Duration of sensory blockade:** It is the time from the onset of sensory blockade to complete recovery of sensation in all dermatomes.
- **Duration of motor blockade:** It is the time from the onset of motor blockade to complete recovery of motor power(LOVETT RATING SCALE -6)

Statistical analysis

- Data was entered into Microsoft excel data sheet and was analyzed using SPSS 22 version software. Categorical data was represented in the form of Frequencies and proportions. Chi-square test was used as test of significance for qualitative data.
- Continuous data was represented as mean and standard deviation. Independent t test was used as test of significance to identify the mean difference between two quantitative variables.
- Graphical representation of data: MS Excel and MS word was used to obtain various types of graphs such as bar diagram and line diagram.
- p value (Probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests.
- Statistical software: MS Excel, SPSS version 22 (IBM SPSS Statistics, Somers NY, USA) was used to analyze data.

Results

Table 1: Mean Age Comparison between two groups

	Group				p value
	Group R		Group RD		
	Mean	SD	Mean	SD	
Age	35.37	12.8	34.21	11.74	0.667

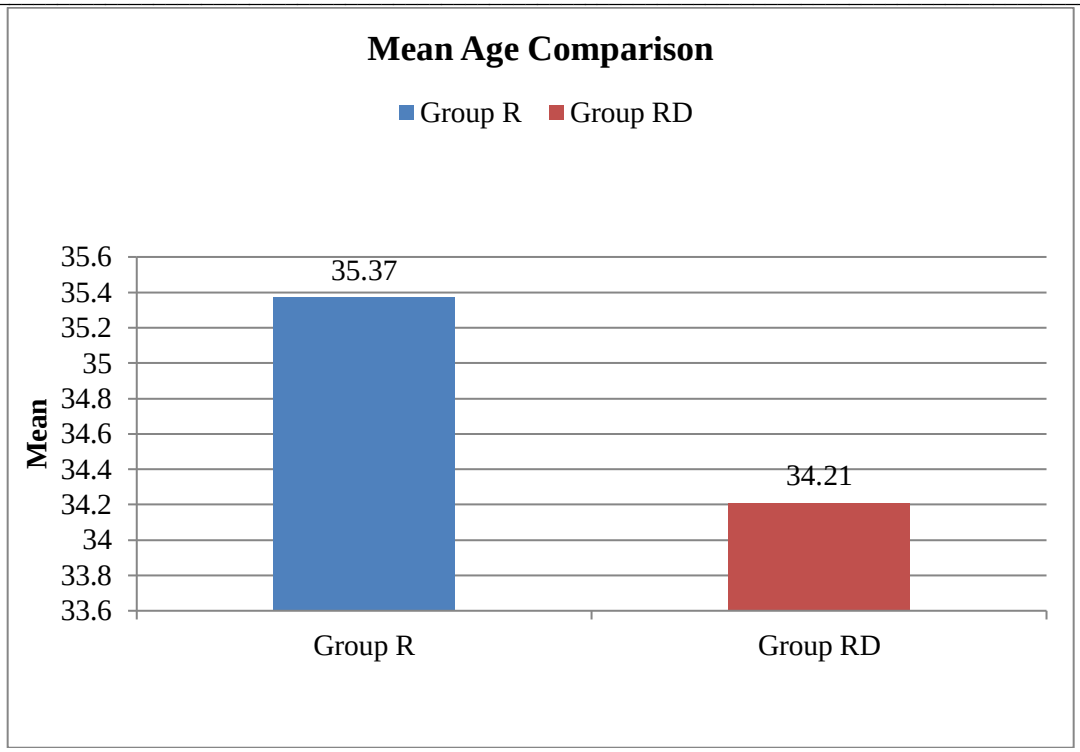

Figure1: Bar Diagram Showing Mean Age Comparison between two groups

Table 2: Sex Distribution between two groups

		Group			
		Group R		Group RD	
		Count	%	Count	%
Sex	Female	6	14.63%	6	13.95%
	Male	35	85.37%	37	86.05%

$\chi 2$ = 0.008, df = 1, p = 0.929

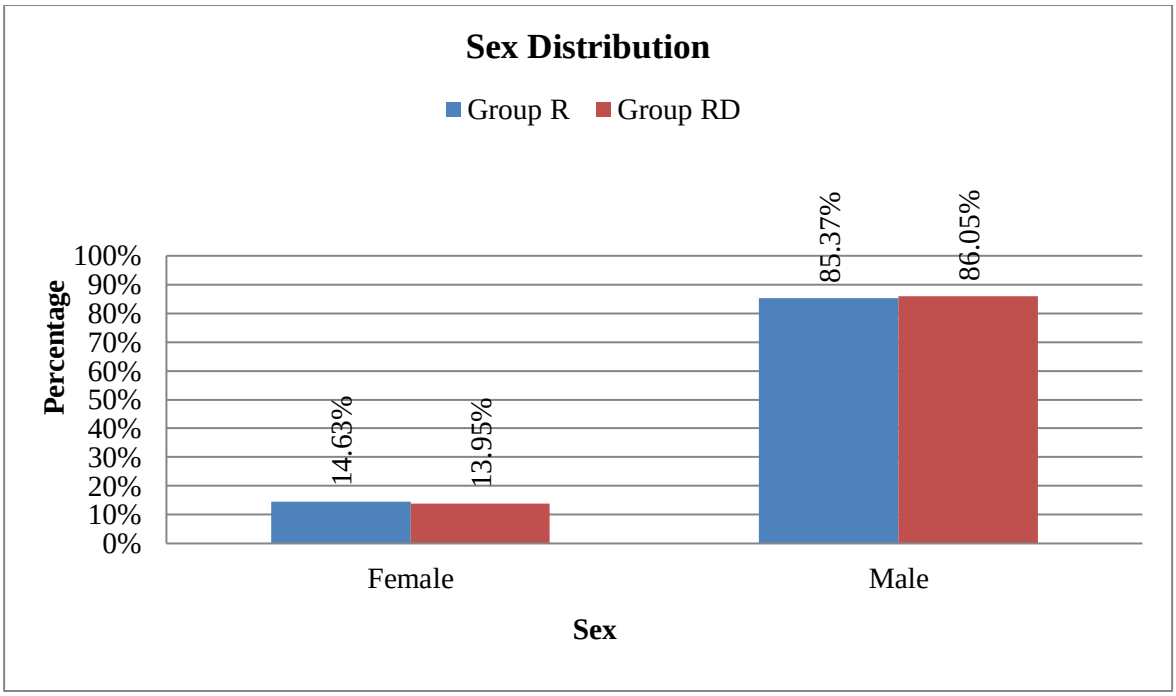

Figure 2: Bar Diagram Showing Sex Distribution between two groups

Table 3: ASA Distribution between two groups

		Group			
		Group R		Group RD	
		Count	%	Count	%
ASA	ASA 1	22	53.66%	20	46.51%
	ASA 2	19	46.34%	23	53.49%

$\chi 2 = 0.429$, df = 1, p = 0.513

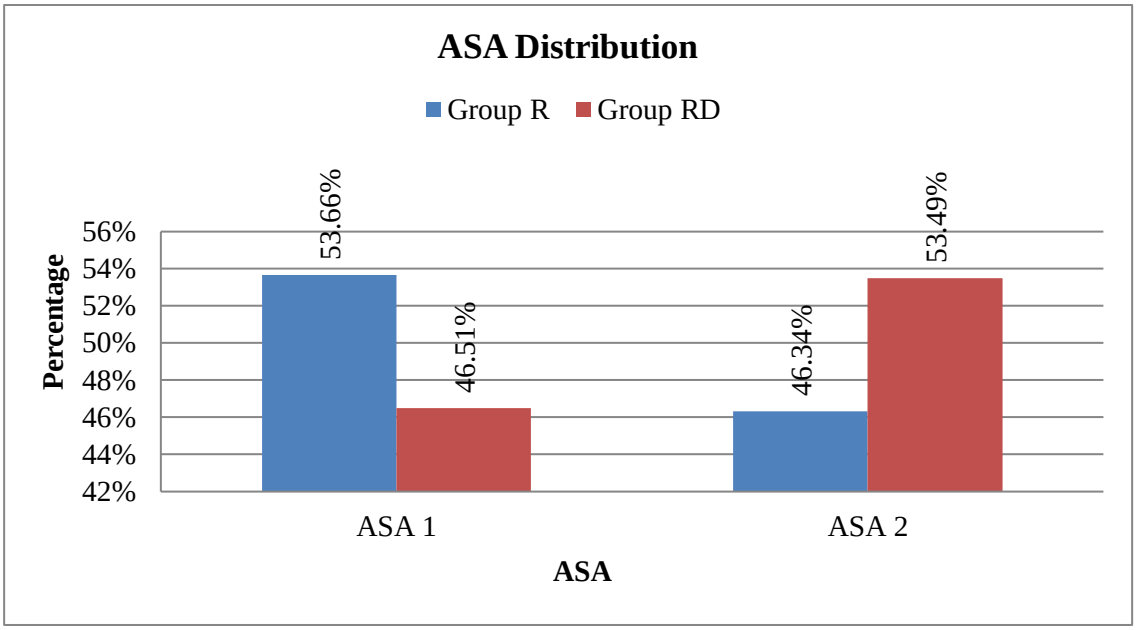

Figure 3: Bar Diagram Showing ASA Distribution between two group

Table 4: Mean Weight Comparison between two groups

	Group				p value
	Group R		Group RD		
	Mean	SD	Mean	SD	
Weight in kgs	61.56	8.16	60.53	7.3	0.545

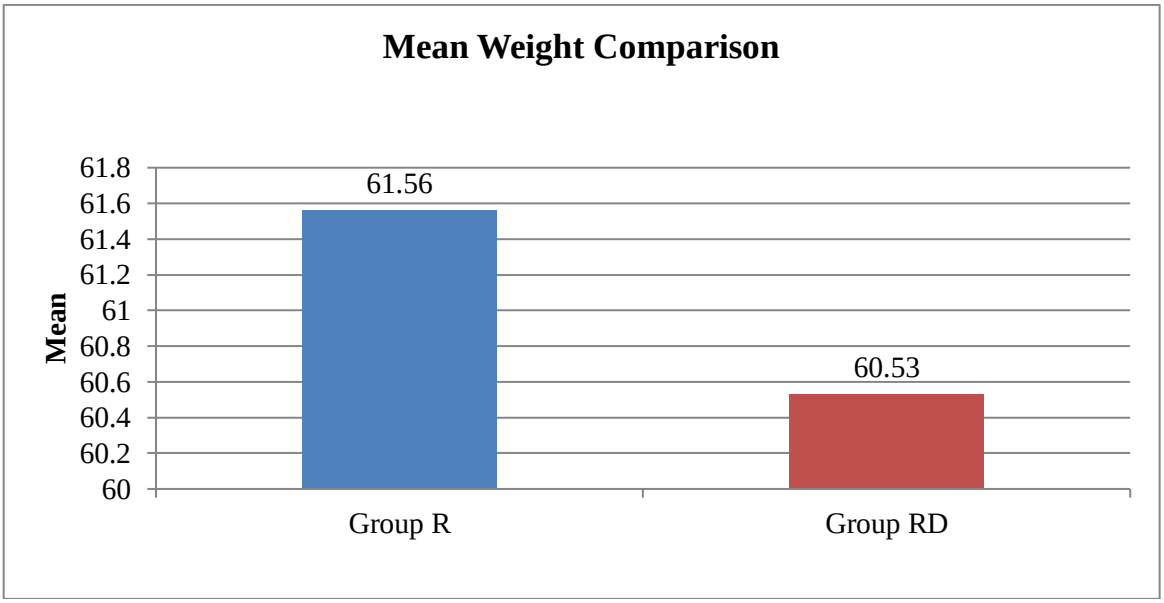

Figure 4: Bar Diagram Showing Mean Weight Comparison between two groups

There were no statistically significant differences in the demographic profile of patients in either group in terms of age, body weights, or male/female (M/F) ratio

Table 5: Mean Duration of surgery in minutes Comparison between two groups were similar

	Group				p value
	Group R		Group RD		
	Mean	SD	Mean	SD	
Duration of surgery in mins	103.25	31.14	109.27	28.25	0.365

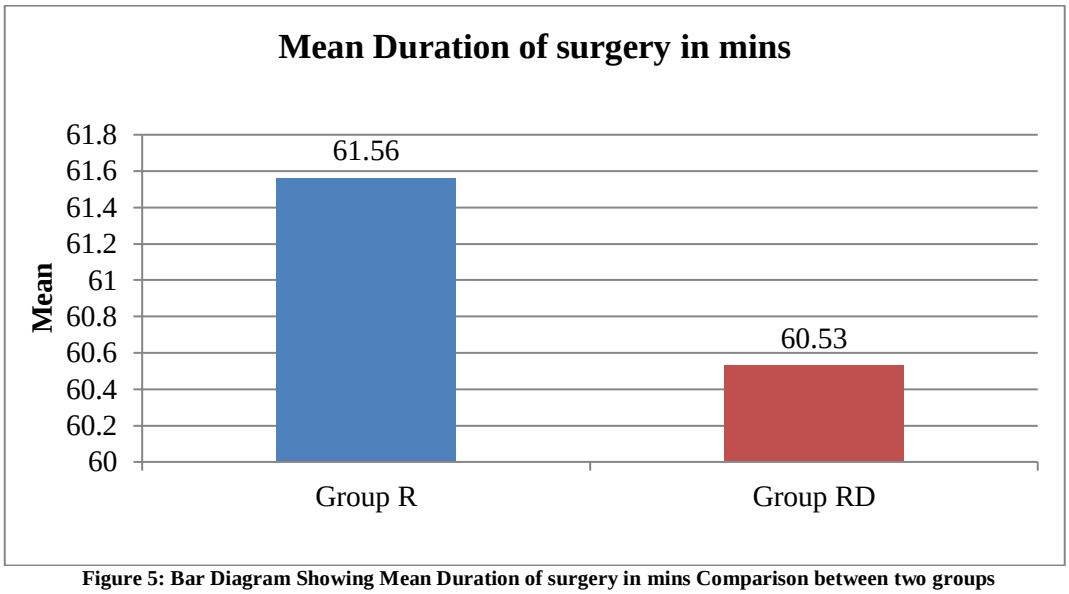

Figure 5: Bar Diagram Showing Mean Duration of surgery in mins Comparison between two groups

Table 6: Mean Onset of Sensory and Motor Block in Secs Comparison between two groups

	Group				p value
	Group R		Group RD		
	Mean	SD	Mean	SD	
Onset of sensory block in secs	162.38	63.99	175	96.23	0.488
Onset of motor block in secs	210.13	84.74	223.41	122.71	0.573

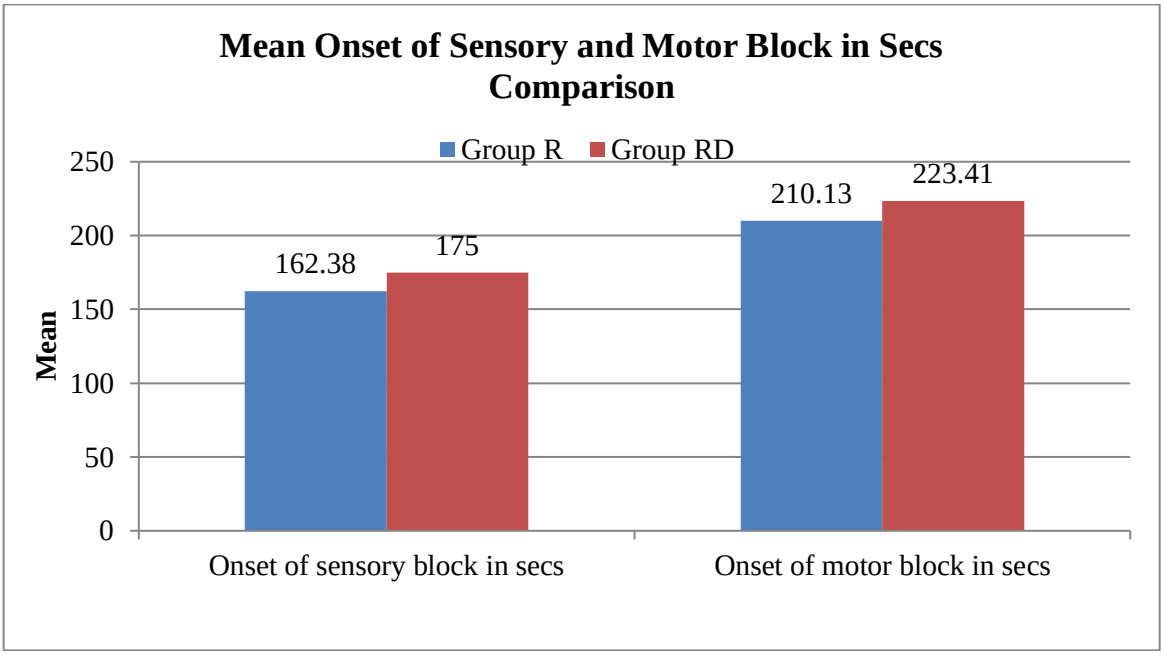

Figure 6: Bar Diagram Showing Mean Onset of Sensory and Motor Block in Secs Comparison between two groups

Onset of sensory block in Group R was 162.38 ± 63.99 secs and in Group RD was 175 ± 96.23. There was no significant difference in mean Onset of sensory block between two groups. Onset of motor block in Group R was 210.13 ± 84.74 secs and in Group RD was 223.41 ± 122.71. There was no significant difference in mean Onset of motor block between two groups.

Table 7: Mean Total duration of Sensory, motor block and Duration of analgesia in mins Comparison between two groups

	Group				p value
	Group R		Group RD		
	Mean	SD	Mean	SD	
Total duration of sensory block in Mins	499.83	113.1	856.05	229.36	< 0.001*
Duration of analgesia in mins	530.3	107.58	887.63	228.56	< 0.001*
Total duration of motor block in mins	449.98	103.38	812.3	225.23	< 0.001*

Mean Total duration of sensory block in Group R was 499.83 ± 113.1 min and in Group RD was 856.05 ± 229.36 min. There was significant difference in Total duration of sensory block between two groups. Mean Duration of analgesia in Group R was 530.3 ± 107.58 min and in Group RD was 887.63 ± 228.56 min. There was significant difference in Duration of analgesia between two groups.

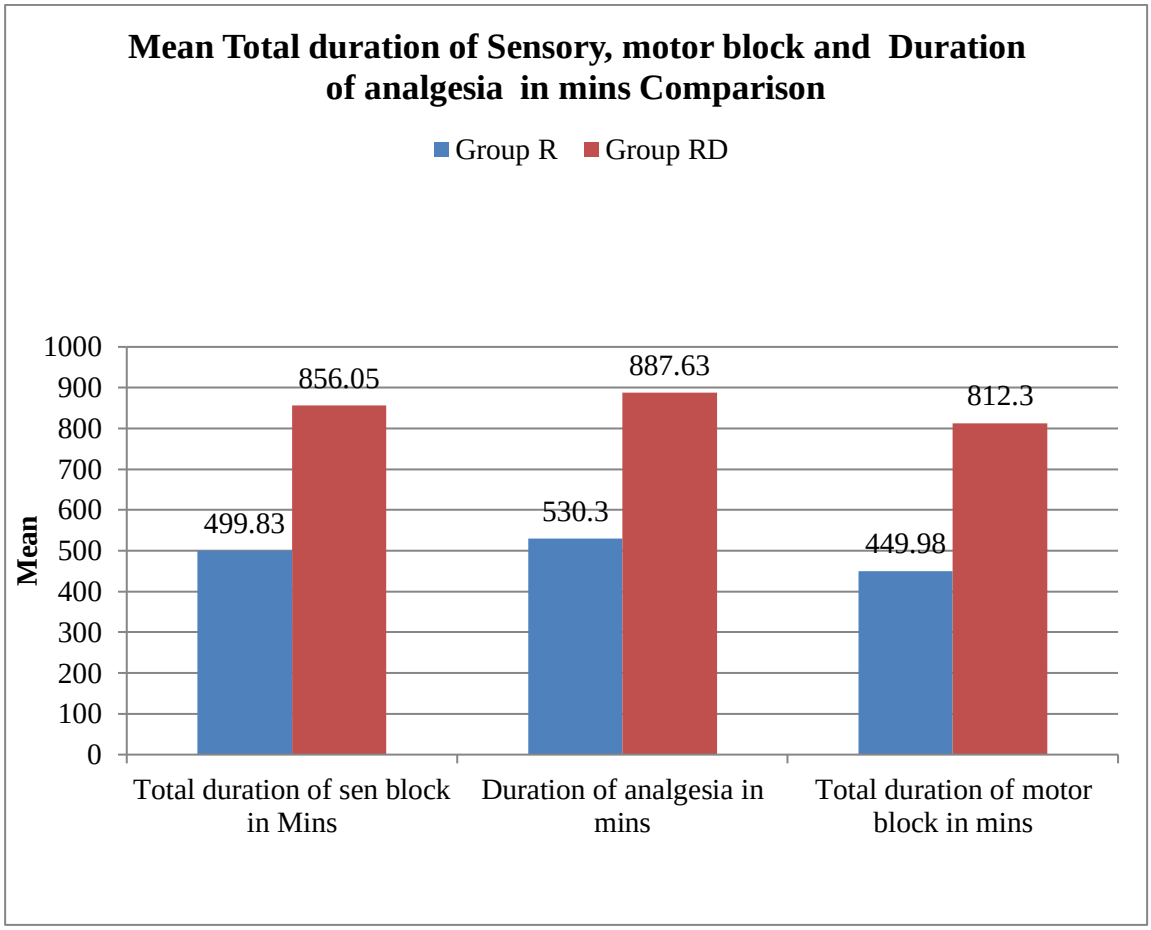

Figure 7: Bar Diagram Showing Mean Total duration of Sensory, motor block and Duration of analgesia in mins Comparison between two groups

Table 8: Mean Heart Rate Comparison between two groups

	Group				p value
	Group R		Group RD		
	Mean	SD	Mean	SD	
HR Basal	74.18	8.86	74.5	9.93	0.878
HR Post Block	73.48	9.79	72.6	10.19	0.696

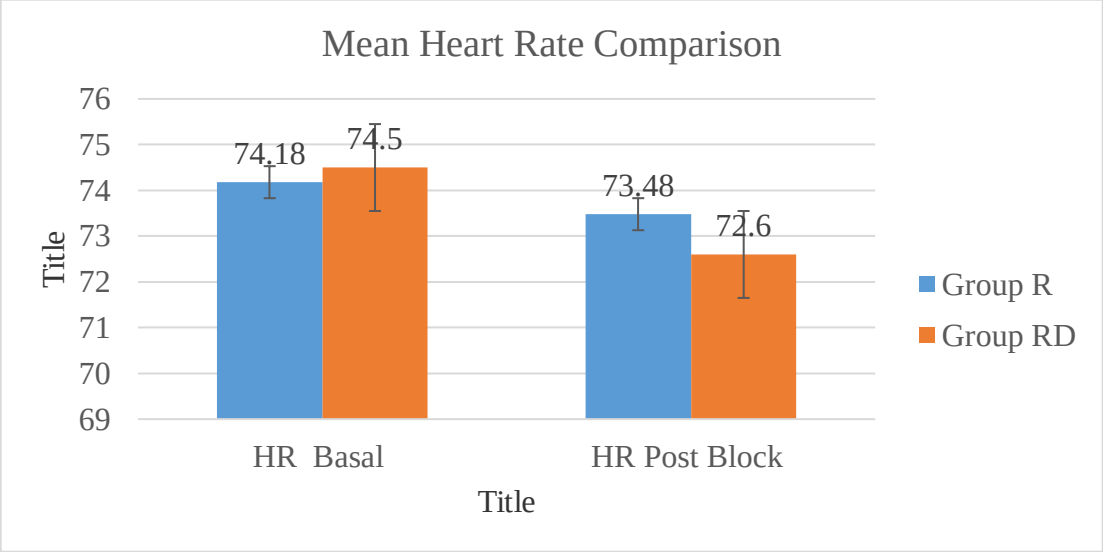

Figure 8: Bar Diagram Showing Mean Heart Rate Comparison between two groups

Table 9: Mean MAP Comparison between two groups

	Group				p value
	Group R		Group RD		
	Mean	SD	Mean	SD	
MAP Basal	79.5	7.43	82.3	6.6	0.079
MAP Post Block	80.08	9.02	79.7	14.28	0.889

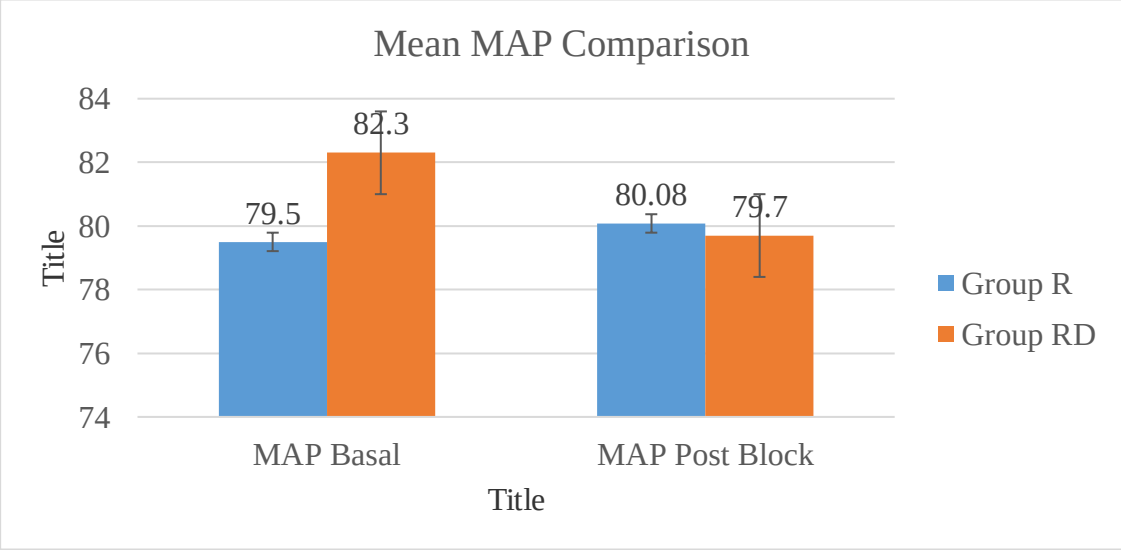

Figure 9: Bar diagram showing Mean MAP Comparison between two groups

In the study there was no significant difference in mean MAP and mean heart rate at basal and post block between two groups

Discussion

Supraclavicular brachial plexus block offers excellent anaesthesia for upper limb surgeries and since it has many advantages over general anaesthesia like good patient satisfaction, acceptability, awake patient, early mobilisation, good muscle relation, less postoperative complications like nausea vomiting and other complications associated with GA can be avoided and a very good analgesia but the duration of analgesia is limited[5]. In a study conducted by Sakae et al[10]., concluded that perineural 4mg dexamethasone is more effective than intravenous in extending the duration of analgesia of ropivacaine. Also many studies in the literature[5,6,11] have used 8mg dexamethasone with clinical benefits without any side effects.

The exact mechanism of action of dexamethasone to increase the duration of analgesia remains undiscovered but there is two proposed mechanisms for this beneficial action. One mechanism is by direct blockade of transmission in nociceptive C-fibers, reducing the release of neuronal discharge and upregulation of potassium channels. The other mechanism is that by causing vasoconstriction via glucocorticoid receptor mediated nuclear transcription modulation[13-20].

Venkatesh RR et al[1] in their study showed that increasing the concentration of ropivacaine from 0.5% to 0.75% failed to improve onset as well duration of sensory and motor block. The spread of local anaesthetic to nerve plexus depends on the volume of the anaesthetic

injected and good anaesthesia is obtained with 25-40ml of drug volume according to the literature. Various authors have used different volumes of Ropivacaine for brachial plexus block. Kaur A et al[7]., and Kumar S[5] et al have used 30ml of drug in their study. We chose 28ml of Ropivacaine 0.5% made to 30ml. In studies conducted by and Kumar S et al[5]., and Jadon A et al[6]., there was no statistically significant difference between the onset and time taken for maximum sensory and motor blockade among Ropivacaine group and Ropivacaine with Dexamethasone group which stands in line with our study. In a similar study conducted by Dar FA[11] et al , there was significantly early onset of sensory and motor block in dexamethasone and ropivacaine group (p=<0.05) compared to ropivacaine group which did not co-relate with our study the authors postulated that the early onset of action might be because of synergism of dexamethasone with local anaesthetics . Also Sakae TM[10] et al in his study showed that the onset of sensory block was significantly reduced in perineural dexamethasone(11.6±3.03 min) group compared to IV dexamethasone group (13.86±5.28 min) with p value of <0.05. They have used modified bromage scale for motor block but in our study we have used Lovett Rating scale, probably hence the difference in the results.

In the studies conducted by Dar FA et al[11]., Kumar S et al[5]., and Sakae TM et al[10] highly significant difference in the duration of Motor and Sensory blockade between Ropivacaine and Ropivacaine with Dexamethasone group for brachial plexus block which co relates with our study.Dar FA et al[11]., Bindal D et al[12] andJadon A et al[6]., the duration of analgesia between ropivacaine alone and ropivacaine with dexamethasone was highly statistically significant and our study consistent with previous studies with respect to the duration of analgesia.

Conclusion

Addition of Dexamethasone 8 mg to 0.5% Ropivacaine 28ml for supraclavicular brachial plexus block using PNS prolongs the duration of sensory block, motor block and duration of analgesia. However we did not find any difference in the time taken for onset of sensory and motor blockade and hemodynamic changes by adding Dexamethasone to Ropivacaine. No complications were reported in either of the groups**.**

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