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A comparative study of the efficacy between 0.5% bupivacaine and 0.5% bupivacaine-dexamethasone 8mg combination in supraclavicular brachial plexus block

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Abstract---Background: Initially the concept of pain was emotional rather than a sensory modality. The word pain is acquired from the Greek word poine which means “penalty”.¹ The International Association for the Study of Pain (IASP) described pain as “an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage”.² Peripheral nerve blocks have become a popular anaesthetic option in the perioperative management of patients because nerve blocks provide better postoperative analgesia than does general anaesthesia, while avoiding the cardiopulmonary and central nervous system effects of general anaesthesia. Peripheral nerve block is a technique which uses local anaesthetic to be deposited around a target nerve and block the conduction of action potential thus not allowing pain signals to be transmitted to the pain centre in the brain. Materials & methods: A prospective randomised single blinded study was conducted at Vinayaka Missions Kirupananda Variyar Medical College & Hospitals, Salem from December 2019 to May 2021. A total of 60 Adult patients of both gender undergoing upper limb elective surgeries under brachial plexus block were allocated in two groups I & II and each group comprises 30 patients were selected for the purpose of the study. Results: The association of age group between both the groups

was found to be statistically insignificant with mean age of 43.1 ± 12.4 years of age in Group 1 and 43.3 ± 11.9 years of age in Group 2. The mean time of onset of sensory block in group I was 16.47 mins & in Group II was 10.57 mins. This was found to be clinically highly significant with $P < 0.0001$. The duration of Sensory Block between both the study and control group was found to be statistically insignificant whereas the duration of Motor blockade was found to be statistically significant along with the no of RA given in 24 hours which was also found to be statistically significant. The difference of pulse rate between both the groups at various intervals was found to be statistically insignificant. The Oxygen saturation between both the group was found to be statistically insignificant till 60 minutes of the procedure and it was found to be statistically significant after 2 hours till the end of the study. Conclusion: We conclude that adding dexamethasone to the local anaesthetic provides rapid onset of both sensory and motor blockade, and prolongs the motor blockade and analgesia duration.

Keywords---Bupivacaine, Dexamethasone, Supraclavicular, Brachialplexus Block, Comparative study.

Introduction

Peripheral nerve blocks have evolved over the years in providing pain relief either as analgesia or anaesthesia. The difference between analgesia or anaesthesia with peripheral nerve block is the dosage of the drug, where a higher dose is needed for the latter. Brachial Plexus blocks are generally used for upper limb surgeries. Various approaches are used to block Brachial Plexus and choice depends on the site of surgery. Supraclavicular block is often referred as “Spinal of the Arm” as it provides anaesthesia for the entire upper limb distal to shoulder since nerves are tightly packed in a bundle.³ Bupivacaine is a long acting local anaesthetic which is used often to provide good operative conditions and postoperative analgesia. But it has a delayed onset of action. To overcome these adjuvants like Dexamethasone, Clonidine, Neostigmine, Opioids are added to Bupivacaine to improve the quality of the block. Dexamethasone as a steroid reduces the inflammation and also shown analgesic effects.^{4,5} Since very minimal studies are have been done on the analgesic efficacy of Dexamethasone we decided to study the onset and duration of sensory and motor blockade, postoperative analgesia, hemodynamic effects using Dexamethasone when added as adjuvant to bupivacaine (0.5%) for brachial plexus block by supraclavicular approach.

Objectives of the study

To evaluate the efficacy of adding Dexamethasone (8mg) to 0.5% Bupivacaine in Supraclavicular Brachial Plexus block for upper limb surgeries.

Materials and Methods

A prospective randomised single blinded study was conducted at Vinayaka Missions Kirupananda Variyar Medical College & Hospitals, Salem from December 2019 to May 2021. A total of 60 Adult patients of both gender undergoing upper limb elective surgeries under brachial plexus block were allocated in two groups I & II and each group comprises 30 patients were selected for the purpose of the study.

Inclusion Criteria:

- ASA grade I and II
- Patients aged between 18 to 60 years
- Patients from whom consent was obtained

Exclusion Criteria:

- Patient refusal
- Patients with infection at the puncture site
- Patients with known allergy to local anaesthetic drug ASA grade III and

IV patients

- Patients with coagulation disorder
- Pregnant patients
- Patients with severe anemia, hypovolemia, septicaemia
- Patients with documented neuromuscular disorders Patients with a history of peptic ulcer disease, diabetes mellitus, hepatic or renal failure & seizures.

Drugs received by two groups are:

- Group I : 30 patients receive 30ml Bupivacaine 0.5%
- Group II : 30 patients receive a mixture of 28ml of Bupivacaine 0.5% and + 2ml Dexamethasone (8mg).

Patients were fasted adequately overnight prior to the day of surgery. On arrival of the patient to the preanesthetic room, intravenous access was gained with 18G iv cannula and the patient was premeditated with Midazolam. The patients were elaborated about the significance of co-operation during the procedure and were also informed that they would perceive a different sensation like pins & needle and warmth sensation on the limb to be blocked. ECG leads, NIBP and Pulse Oximeter were applied to the patient and monitored constantly throughout the entire procedure.

With all aseptic precautions subclavian artery pulsations were felt at a point 1.5 to 2.0 cm posterior and cephalad to midpoint of clavicle. Local anaesthetic was injected into the skin cephalo-posterior to the pulsations. A 22 gauge, short beveled needle is inserted at the point parallel to head and neck in a caudal position and little medial & posterior direction until either by eliciting paraesthesia or on encountering the first rib. If the rib is felt by the needle, it should be moved over the first rib until paraesthesia is elicited in the arm or hand. After eliciting paraesthesia and negative aspiration for blood, the needle should be kept in the same position and the medication under study was injected slowly by ruling out the intravascular injection intermittently. Intercostobrachial nerve and medial cutaneous nerve are blocked separately at the axilla anterior to the axillary artery by subcutaneous infiltration of local anaesthetic to ensure

complete regional anaesthesia of the upper extremity. The onset of anaesthesia was evaluated by the pin prick with a 23-gauge needle. The time of onset sensory block is from the time injection to complete loss of pin prick sensation in C2 and T2 dermatomes. The time of complete sensory blockade was noted. Vital parameters: The pulse rate, blood pressure, O₂ saturation were monitored every 15min till 1hr, 2nd hourly till 6 hrs and 6th hourly till 24hrs.

Onset of motor blockade was described as the time from when injection of drug to complete the motor block. Duration of motor blockade was considered as the time interval between the complete motor blockade and onset of regression of motor blockade. Onset of sensory block was described as the time from when the injection of drug and complete loss of cold perception of the hand. Duration of sensory blockade was considered as the time interval between the complete sensory blockade and the onset of regression of sensory blockade – first pain to pin prick. The data thus obtained was compiled and analysed using Statistical Package for Social services. (SPSS vs 18). Quantitative data was analysed by using the student's t' test. Chi – Square test was used for analysing the qualitative data. A p value of < 0.05 was seen as significant statistically.

Results

A total of 30 study subjects were enrolled in each group by computer generated randomized number.

Table 1: Age group of the study subjects

Social Profile		Group 1	Group 2	P value
Age Group	<30 years	6(20%)	4(13.3%)	0.966
	31-40 years	6(20%)	7(23.3%)	
	41-50 years	7(23.3%)	9(30%)	
	>51 years	11(36.7%)	10(33.3%)	

The association of age group between both the groups was found to be statistically insignificant with mean age of 43.1±12.4 years of age in Group 1 and 43.3±11.9 years of age in Group 2.

Table 2: Distribution of Onset of Sensory, Motor block between the study groups

	Group 1	Group 2	P value
Onset of sensory block in Minutes	16.47 ± 1.008	10.57 ± 1.04	T= 22.31 P <0.001
Onset of motor block in Minutes	9.33 ± 1.15	5.87 ± 0.81	T=13.41 P<0.001

The onset of sensory and motor blockade between both the groups was found to be statistically significant.

Table 3: Distribution of Duration of Sensory, Motor block between the study groups

	Group 1	Group 2	P value
Duration of sensory block in hours	5.20 $\pm$ 2.59	5.95 $\pm$ 0.89	T= -1.49 P <0.145
Duration of motor block in hours	1.97 $\pm$ 0.64	4.24 $\pm$ 0.70	T=13.03 P<0.001
No of RA in 24hrs	2.87 $\pm$ 0.57	1.73 $\pm$ 0.58	T=7.60 P<0.001

The duration of Sensory Block between both the study and control group was found to be statistically insignificant. whereas the duration of Motor blockade was found to be statistically significant along with the no of RA given in 24 hours which was also found to be statistically significant.

Table 4 : Distribution of Pulse Rate among study subjects between the study groups

	Group 1	Group 2	P value
0 min	78 $\pm$ 6.28	80 $\pm$ 6.28	T= -1.27 P =0.20
5 min	78 $\pm$ 5.86	80 $\pm$ 5.46	T= -1.52 P =0.13
15 min	78 $\pm$ 5.26	79 $\pm$ 4.26	T= -1.15 P =0.25
30 min	78 $\pm$ 5.93	80 $\pm$ 5.51	T= -1.26 P =0.21
60 min	77 $\pm$ 4.26	79 $\pm$ 6.09	T= -1.54 P =0.12
2hr	78 $\pm$ 5.10	79 $\pm$ 5.83	T= -1.34 P =0.18
6 hrs	78 $\pm$ 5.59	79 $\pm$ 5.65	T= -0.11 P =0.90
12 hrs	78 $\pm$ 4.84	79 $\pm$ 5.61	T= -0.18 P =0.24
24 hrs	79 $\pm$ 6.19	80 $\pm$ 4.37	T= -0.43 P =0.66

The difference of pulse rate between both the groups at various intervals was found to be statistically insignificant.

Table 4: Distribution of Systolic Blood Pressure among study subjects between the study groups

	Group 1	Group 2	P value
0 min	116 $\pm$ 7.77	120 $\pm$ 9.81	T= -1.8. P =0.07
5 min	116 $\pm$ 7.39	120 $\pm$ 7.92	T= -1.887 P =0.06
15 min	116 $\pm$ 5.95	118 $\pm$ 6.53	T= -1.11 P =0.26
30 min	116 $\pm$ 7.91	120 $\pm$ 7.56	T= -1.58 P =0.11
60 min	115 $\pm$ 7.87	120 $\pm$ 9.01	T= -1.63 P =0.10
2hr	115 $\pm$ 8.42	120 $\pm$ 7.83	T= -2.79 P =0.007
6 hrs	115 $\pm$ 5.61	121 $\pm$ 8.03	T= -3.59 P =0.0007
12 hrs	115 $\pm$ 6.97	121 $\pm$ 7.17	T= -3.19 P =0.002
24 hrs	115 $\pm$ 6.59	121 $\pm$ 8.24	T= -3.27 P =0.001

The systolic blood pressure between both the group was found to be statistically insignificant till 60 minutes of the procedure and it was found to be statistically significant after 2 hours till the end of the study.

Table 5: Distribution of Oxygen Saturation among study subjects between the study groups

	Group 1	Group 2	P value
0 min	98.3± 0.47	98.47 ± 0.57	T= -1.23 P =0.22
5 min	98.50± 0.51	98.57 ± 0.50	T= -0.50 P =0.61
15 min	98.43± 0.57	98.63 ± 0.56	T= -1.37 P =0.17
30 min	98.50± 0.57	98.43± 0.50	T= -0.47 P =0.63
60 min	98.53± 0.57	98.5± 0.57	T= 0.22 P =0.82
2hr	98.37± 0.61	98.43 ± 0.50	T= -2.7 P =0.007
6 hrs	115 ± 5.61	121 ± 8.03	T= -3.59 P =0.0007
12 hrs	115 ± 6.97	121 ± 7.17	T= -3.19 P =0.002
24 hrs	115 ± 6.59	121 ± 8.24	T= -3.27 P =0.001

The Oxygen saturation between both the group was found to be statistically insignificant till 60 minutes of the procedure and it was found to be statistically significant after 2 hours till the end of the study.

Discussion

Supraclavicular approach of brachial plexus block is a common technique of peripheral nerve block used for providing anesthesia for upper limb surgeries. By providing regional anesthesia, the complications pertaining to the general anesthesia are avoided. And it is also effective in the means of performance, margin of safety and cost.

One of the common complaints among the patients undergoing upper limb surgeries is post-op pain. Often nerve blocks provided using single shot method fail to yield extended analgesia in the post op period. Hence additives are added to the local anesthetics as a solution to overcome this issue. To improve the block quality and to prolong the duration of analgesia numerous additives have been used along with local anesthetic.

Dexamethasone, a glucocorticoid, appeared to be a formidable steroid when combined with bupivacaine for peripheral nerve blocks. It significantly prolongs the analgesic effects without a lot of side effects. It has been proven in lots of studies to be an effective analgesic. Yet, there are not enough studies to assess the potency of Bupivacaine alone and when steroids like dexamethasone are added to it. So this study has been carried out to evaluate its efficacy.^{6,7} In our study the demographic variables like, gender, age and ASA status were comparable and no significant difference occurred between them in both the groups.

In our study, the mean time of onset of sensory block in group I was 16.47 mins & in Group II was 10.57 mins. This was found to be clinically highly significant with $P < 0.0001$. The results of our study are similar to the results of a study conducted by Dar et al.² Huynh et al. (2013)⁸ conducted a metaanalysis of RCTs in which they looked at 12 studies in which dexamethasone was administered to a local anaesthetic. By weighted mean difference, they found that the period of onset of sensory block was drastically decreased from 10 minutes (control group).

The mean time for the onset of motor block in Group 1 was 9.3 minutes and 5.87 minutes in Group 2. El Baradei and El Shmaa⁹ found that the onset time for motor block with bupivacaine and dexamethasone was 11.4 3.6 minutes in a research. This is consistent with the outcomes of our research.

Similar findings were found in a randomised research by Vieira et al. (2008)¹⁰, who looked at the influence of dexamethasone on analgesia with 0.5 percent bupivacaine, epinephrine, and clonidine. When compared to the control, the median sensory block length was 1457 against 833 minutes (P 0.0001), while the median motor block duration was 1374 versus 827 minutes (P 0.0001). These findings, although comparable to ours, are somewhat higher. This discrepancy might be attributed to epinephrine's additional vasoconstrictive effects, as well as the addition of clonidine. The mean duration of sensory and motor block among the study group in our study showed it significant for motor block and not significant for sensory block. This finding matched that of Choi et al.¹¹, who performed a metaanalysis of RCTs that comprised nine studies and 801 patients. Dexamethasone extended the analgesic duration of a long-acting local anaesthetic from 730 to 1306 minutes, while motor block was extended from 664 to 1102 minutes, all without any side effects. The modest discrepancies in outcomes between our trials might be attributable to the use of different dexamethasone concentrations, such as 4–10 mg, while we utilised 8 mg for all patients in Group 2.

In their investigation, Biradar et al.¹² found that dexamethasone prolonged the effect of lignocaine for both sensory and motor blocking. This is consistent with our results, which showed that bupivacaine's activity was prolonged. Dexamethasone causes vasoconstriction, stops ectopic neuronal discharges, and prevents inflammatory mediators from being released. The fact that dexamethasone enhances the activity of inhibitory potassium channels on nociceptive neurons accounts for the longer duration of sensory and motor blocking and analgesia reported in the dexamethasone group. Heart rate, systolic blood pressure, and diastolic blood pressure were all steady in both groups in our research. This was comparable to the findings of ElBaradei and Elshmaa's research.⁹

Conclusion

We infer that adding dexamethasone to the local anaesthetic provides rapid onset of both sensory and motor blockade, and prolongs the motor blockade and analgesia duration. The use of a number of rescue analgesics were also less in post-op 24hrs in our study groups. The hemodynamic parameters were within ideal limits in control and study groups and no side effects were reported with our study.

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