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Original Research Article

Comparative study between tramadol and dexamethasone as an adjuvant to bupivacaine in supraclavicular brachial plexus block

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ABSTRACT

Background: Brachial plexus block is widely used as an efficient and cost effective alternative to general anesthesia for upper limb surgeries. A variety of adjuvants to local anesthetics have been used and compared, however, drugs which prolong the duration of anaesthesia and analgesia are being constantly studied for patient satisfaction and cost effectiveness.

Materials and Methods: Prospective, Interventional, Randomised study was conducted over 105 patients scheduled for elective upper limb surgeries under brachial plexus block, who were randomly allocated into three groups of 35 patients each. Group I- Bupivacaine with Tramadol, Group II- Bupivacaine with Dexamethasone and Group III- Bupivacaine alone. The time of onset and duration of sensory and motor block was noted. Hemodynamic variables were measured from baseline until the use of first rescue analgesic. The statistical analysis was done using SPSS (Statistical Package for Social Sciences) version 15.0 statistical analysis software.

Results: Onset of sensory and motor blockade was significantly earlier in Group II (9±1.83 min) and (14.14±3.53min) as compared to Group I (11.94 ±2.59min) and (22.86±3.70min) and Group III(19±5.26min) and (27.14±4.07min). The requirement of first rescue analgesic was significantly earlier in Group III patients (211.43±23.25 min) followed by Group I (397±20.15 min) and last in Group II (632.43±23.15 min).

Conclusion: Bupivacaine with Dexamethasone provided an early onset of sensory and motor blockade with maximum duration of blockade requiring rescue analgesic at a much later time period compared to Bupivacaine with Tramadol and Bupivacaine alone when used in supraclavicular brachial plexus block.

1. Introduction

Brachial Plexus block is an excellent alternative to general anaesthesia for a wide variety of upper limb procedures and a useful analgesic component for some of the other more major elective and emergency surgeries. It provides a superior quality of analgesia and avoids the common side-effects associated with general anaesthesia such as postoperative nausea and vomiting. It can be used as a single shot injection or as a continuous infusion for analgesia. [1]

It can be extremely useful in patients with significant co-morbidities such as severe respiratory and cardiovascular diseases, morbid obesity and those with potential airway difficulties.

Adequate knowledge of the anatomy of the Brachial Plexus is essential to perform a Brachial Plexus block. Supraclavicular technique blocks the entire upper limb proximally till mid arm level. Bupivacaine, owing to its long duration of action and a favourable ratio of sensory to motor neural block, is frequently the drug of choice. Drugs like Morphine, Pethidine, Clonidine, Dexmedetomidine, Butorphanol, and Midazolam are commonly used along

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with local anaesthetics to hasten the onset and prolong the duration of the block.

Dexamethasone significantly prolongs the duration of analgesia as the steroids via blocking the nociceptive impulse transmission along the myelinated C-fibres have nerve block prolonging effects. In a recent review,[2] Tramadol was described to stimulate serotonin release intrathecally, while inhibiting norepinephrine reuptake centrally. It is also a weak μ- and κ-opioid receptor agonist, and also blocks voltage gated sodium channels in vitro in a fashion that is not opioid receptor related.

In this study, we aimed to compare the efficacy of Tramadol and Dexamethasone as an admixture to Bupivacaine in Supraclavicular Brachial Plexus block in terms of onset of sensory and motor blockade, duration of sensory and motor blockade, haemodynamic variables and time to first rescue analgesia in postoperative 24 hours.

2. Materials and Methods

Prospective, interventional and randomized study was conducted in our tertiary care centre over 18 months. After obtaining approval from the Institutional Ethical Committee, 105 patients in ASA grade I & II aged between 18-65 years, scheduled for upper limb Orthopaedic surgeries under Supraclavicular Brachial Plexus block were randomly allocated into 3 groups of 35 each. Group I – received 28 ml of 0.5% bupivacaine and 100 mg tramadol (50mg/ml). Group II – received 28 ml of 0.5% bupivacaine and 8 mg dexamethasone (4mg/ml). Group III – received 28 ml of 0.5% bupivacaine and 2 ml normal saline.

Sensory block is graded as:

1. Grade 0: Sharp pin felt
2. Grade 1: Analgesia, dull sensation felt
3. Grade 2: Anaesthesia, no sensation felt

Motor block was assessed by modified Bromage scale.[3] This scale consists of the following scores:(Table 1)

Table 1:

Grade	Criteria	Degree of block
0	Able the raise the extended arm to 90^o for a full 2 seconds	Nil (0%)
1	Able to flex the elbow and move the fingers but unable to raise the extended arm	Partial (33%)
2	Unable to flex the elbow but able to move the fingers	Almost Complete (66%)
3	Unable to move the arm, elbow or fingers	Complete (100%)

The rescue analgesia in the form of inj. Diclofenac sodium 75mg i.m. was administered at the Visual Analogue Scale (VAS) score of >4. Adverse effects like nausea, vomiting, hypotension, bradycardia, respiratory distress, if present, were noted.

The sample size was calculated based on findings of Shreshtha et al (2007)[4] using the formula: $n = (Z\alpha + Z\beta)^2 (\sigma 1^2 + \sigma 2^2) / d^2$, where, $\sigma 1 = 72.81$, $\sigma 2 = 194.51$, d = mean ($\sigma 1$, $\sigma 2$) α = type I error (5%), β = type II error (10%), Power of study = 90% and Data loss = 10%.

Sample size comes out to be n = 35 each group.

2.1. Statistical tools employed

The statistical analysis was done using SPSS (Statistical Package for Social Sciences) Version 15.0 Statistical Analysis Software. The values were represented in number (%) and Mean ± SD. Analysis of Variance (ANOVA) test was used to compare within group and between group variances amongst the study groups. Paired "t" test used to compare the change in a parameter at two different time intervals. Chi-square test, Kruskall Wallis H test and Mann Whitney U test were also used.

3. Results

Difference in age, gender and body weight of patients in above three groups was not found to be statistically significant. Heart rate, Systolic BP, Diastolic BP, Mean arterial pressure of patients in all three groups were found to be comparable at all the periods of observation after baseline. ($p>0.05$)

4. Discussion

Time of sensory onset was significantly earlier in Group II (9.00±1.83 min) as compared to Group I (11.94±2.59 min) and Group III (19.00±5.26 min).(Table 2) All the between group differences were found to be statistically significant indicating time of sensory onset as Group II < Group I < Group III.

Time of motor onset was significantly earlier in Group II (14.14±3.53 min) as compared to Group I (22.86±3.70 min) and Group III (27.14±4.07 min).(Table 2) Between Group difference in time of motor onset was found to be statistically significant indicating the time of motor onset as Group II < Group I < Group III.

Mean duration of sensory block among Group II patients (425.71±42.38 minutes) was maximum, followed by that of Group I (381.14±58.10 min) and minimum duration of sensory block was among Group III (300.00±54.45 min).(Table 3) All the between group differences were statistically significant indicating duration of sensory block among groups as Group II > Group I > Group III.

Mean duration of motor block among Group II patients (369.43±36.78 minutes) was maximum, followed by that of Group I (322.57±47.24 min) and minimum duration of motor block was among Group III (274.29±68.70 min).(Table 3) All the between group differences were

Table 2: Intergroup comparison of time of sensory and motor onset among study population

Group	No.	Min.	Max.	Median	Mean	S.D.
Time of Sensory onset						
Group I	35	8	18	10	11.94	2.59
Group II	35	5	12	10	9.00	1.83
Group III	35	10	30	20	19.00	5.36
Total	105	5	30	10	13.31	5.49
					F=73.552; P<0.001	
Time of Motor onset						
Group I	35	15	30	20	22.86	3.70
Group II	35	10	20	15	14.14	3.53
Group III	35	20	30	30	27.14	4.07
Total	105	10	30	20	21.38	6.60
					F=17.236; P<0.001	

Table 3: Intergroup comparison of duration of sensory and motor block among study population

Group	No.	Min.	Max.	Median	Mean	S.D.
Duration of Sensory block						
Group I	35	300	540	380	381.14	58.10
Group II	35	360	490	420	425.71	42.38
Group III	35	180	420	300	300.00	54.45
Total	105	180	540	360	368.95	73.44
					F=52.431; p<0.001	
Duration of Motor block						
Group I	35	240	420	300	322.57	47.24
Group II	35	300	420	360	369.43	36.78
Group III	35	180	360	300	274.29	68.70
Total	105	180	420	340	322.10	65.10
					F=28.619;P<0.001	

Table 4: Intergroup comparison of time to first analgesic dose (mins) required by study population

Group	No.	Min.	Max.	Median	Mean	S.D.
Group I	35	360	435	400	397.00	20.15
Group II	35	600	675	630	632.43	23.15
Group III	35	180	260	210	211.43	23.25
Total	105	180	675	400	413.62	174.49
					F=3152.869; p<0.001	

statistically significant indicating duration of motor block as Group II > Group I > Group III.

Time of requirement of first dose of analgesia was earliest among patients of Group III (211.43±23.25 minutes) followed by that of Group I (397.00±20.15 min) and last among Group II (632.43±23.15 min).(Table 4)

Anaesthesia and analgesia for surgeries of the upper extremity is commonly provided using Brachial Plexus block, which is a suitable alternative and a valuable addition to general anaesthesia. By using this technique, patient satisfaction is improved and there is less cognitive impairment compared to general anaesthesia. To prolong the analgesic effect of Brachial Plexus block, various strategies are used such as placement of continuous catheters and use of adjuvant drugs. A number of adjuvants including Epinephrine, Clonidine,[5,6] Opioids,[7,8] Ketamine,[9,10] and Midazolam[11] have met with limited success. As compared to corticosteroids, glucocorticoids have been shown to prolong nerve blockade in proportion to their rank-order anti-inflammatory potency, an effect that can be mitigated by the corticosteroid antagonist Cortexolone.[12] Thus, recent researches have focused on the addition of the glucocorticoid Dexamethasone as a local anaesthetic adjuvant in regional anaesthesia. In some recent studies, it has been indicated that Dexamethasone added to perineural local anaesthetic injections, augment the duration of peripheral nerve block analgesia.[13,14]

Statistically, all the three groups were matched. In the present study, haemodynamically, all the three groups remained stable and comparable throughout the study period. As far as sensory block scores were concerned, they were significantly higher in both Tramadol and Dexamethasone groups as compared to Control group throughout the study period starting from 5 min to 30 min

and from 240 min to 480 min intervals. On comparing the sensory block scores between the two study groups, they were found to be significantly higher in Dexamethasone as compared to Tramadol group at 10 min, 15 min and from 300 to 420 min intervals, thus showing that quality of sensory block was better in Dexamethasone group as compared to Tramadol group for most of the study duration. With respect to onset time, mean time taken for onset of sensory block was minimum in Dexamethasone group (9.00+1.83 min) followed by Tramadol group (11.94+2.59min) and was maximum in Control group (19.00+5.26 min). Thus, showing that as compared to Control group, Dexamethasone group shortened the onset time by 10 minutes and as compared to Tramadol group, Dexamethasone shortened the onset time by 2.94 minutes. On the other hand, Tramadol group reduced the onset time by 7.06 minutes compared to the Control group. In contrast, duration of sensory blockade was minimum in Control group (300±54.45 min) and maximum in Dexamethasone group (425.71+42.38 min). Thus emphasizing that when compared to control and Tramadol group, Dexamethasone prolonged the block duration by 125.71 and 44.57 minutes respectively. However, as compared to control group, Tramadol group prolonged the block time by 81.14 minutes. The findings thus suggest that both Tramadol as well as Dexamethasone helped to reduce the onset time for sensory block while at the same time both helped to prolong the sensory block duration. Contrary to the present study, Shaikh et al[15] did not find a significant change in sensory block onset time when Dexamethasone was added to Bupivacaine in Supraclavicular Brachial Plexus block. However, similar to our study, they found the duration of sensory block to be longer in Dexamethasone group as compared to control group. The reason for this difference could be the difference in dosages of drugs used in two studies. Taluqdar et al,[16] in their study similar to our study, found that addition of Dexamethasone to Bupivacaine helped not only to reduce the onset time but also helped to prolong the duration of sensory block. Time taken for onset of motor block also showed a similar trend as observed for sensory block with maximum value for Control (27.14±14.07 min) followed by Tramadol (22.86±3.70 min) and minimum for Dexamethasone (14.14±3.53). Thus showing that Dexamethasone group achieved the motor block earliest followed by Tramadol and finally control group. With respect to duration of motor block, it was minimum in Control group (274.29±68.70 min) followed by Tramadol group (322.57±47.24 min). With respect to difference in onset time and duration of sensory block between Tramadol and Dexamethasone group, Yadav and Saini,[17] similar to our study, found the onset time for sensory block in Tramadol group to be longer (18.20±1.47 min) as compared to Dexamethasone group (14.83±2.61 min) and the difference thus, to be significant statistically. However, they did not compare the duration of sensory block between the two groups.

On evaluating the comparative studies between Dexamethasone and Tramadol motor block onset time was found to be significantly lower in Dexamethasone group(14.14 ±3.53 min) as compared to Tramadol group (22.86±3.70 min) and longest in the control group (27.14±14.07 min) while mean duration of motor block was significantly longer in Dexamethasone (369.43±36.78 min) as compared to Tramadol group (322.57±47.24 min) and shortest in the control group (274.29±47.24 min).

These findings were also supported by almost all the researchers who compared them in various drug-dose combinations. Shrestha et al[4] reported the mean motor block onset and duration times as 13.93 and 202.93 minutes in Tramadol group as compared to 12.90 and 393.03 minutes respectively in Dexamethasone group and reported a significant difference between two groups with respect to the duration of motor block. Shah et al.[18] in their study reported the mean motor block onset and duration times as 13.07 and 356.1 minutes in Tramadol group and 12.93 and 513.17 minutes in Dexamethasone groups and also found the difference to be significant for duration of block only. Both these studies used 2 ml/kg of 0.5% Bupivacaine. However, in the present study, we used a fixed dose of 28 ml 0.5% Bupivacaine and found the difference to be significant for both onset time as well as duration of the block.

In effect, although almost all the studies showed that dynamics and duration of action of Dexamethasone was faster and longer as compared to Tramadol, however, the reflection of these differences at onset time requires a skillful selection of dose combinations.

With respect to mean time for first rescue analgesic need, it was maximum in Dexamethasone group (632.43±23.15 min) as compared to Tramadol (397±20.15 min) and Control group (211.43±23.25 min). Statistically, this difference was significant. Thus Dexmethasone prolonged the analgesic effect by 235.43 min as compared to Tramadol and 421 min as compared to Control group while Tramadol prolonged the analgesic effect by 185.57 minutes as compared to the Control group. Shrestha et al[4] in their study found the difference in analgesic effect between Dexamethasone and Tramadol group to be 575 min, Yadav and Saini[16] reported this difference to be 569 minutes while Raj et al[3] reported this difference to be 481 min.

In the present study, no potential side effects such as nausea, vomiting, headache or shivering were noted in any of the patients in either of the three groups. In different studies reviewed by us too, no mention of such side effects has been made thus showing that at the given dosages, both the drugs were almost side effect free.

5. Conclusion

The findings of the present study showed that of the two combinations, Dexamethasone, in given drug-dose combination was more effective than Tramadol. Further, studies at variable drug-dose combinations are recommended to validate the findings of present study and also to determine the optimum and the most effective dose of local anaesthetic and adjuvants.

6. Source of Funding

None.

7. Conflict of Interest

None.

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