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Original Research Article

Comparative Analysis between Dexamethasone and Tramadol as an admixture to Bupivacaine in Supraclavicular Brachial Plexus Block

Milan Mehta[1], Ketan Modi[2], Balraj B. Joshi[3], Nikita Mevada[4], Mitul Hareshkumar Chaudhary[5]

[1]Professor, Department of Anesthesiology, Banas Medical College and Research Institute, Palanpur, Gujarat

[2]Associate Professor, Department of Anesthesiology, Banas Medical College and Research Institute, Palanpur, Gujarat

[3]Assistant Professor, Department of Anesthesiology, Banas Medical College and Research Institute, Palanpur, Gujarat

[4]Senior Resident, Department of Anesthesiology, Banas Medical College and Research Institute, Palanpur, Gujarat

[5]Junior Resident, Department of Medicine, Banas Medical College and Research Institute, Palanpur, Gujarat

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Corresponding Author: Dr. Nikita Mevada

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Abstract:

Background and Aim: There is a list of additives for supraclavicular block that can help enhance the onset, intensity, and duration of the block, which can also be beneficial for postoperative pain relief. Our study sought to compare the effectiveness of Tramadol and Dexamethasone when combined with Bupivacaine in Supraclavicular Brachial Plexus block. We examined various factors including the onset and duration of sensory and motor blockade, haemodynamic variables, and the time to first rescue analgesia within the first 24 hours after surgery.

Material and Methods: A study was conducted on 105 patients who were scheduled for elective upper limb surgeries under brachial plexus block. These patients were randomly divided into three groups, with 35 patients in each group. The study involved three groups: one receiving Bupivacaine with Tramadol, another receiving Bupivacaine with Dexamethasone, and a third group receiving Bupivacaine alone. The study recorded the time when the sensory and motor block started and how long it lasted. Hemodynamic variables were measured from the beginning of the study until the first use of a rescue analgesic.

Results: The study did not find any statistically significant differences in the age, gender, and body weight of patients in the three groups. The heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure of patients in all three groups were found to be similar at all the observation periods following the initial measurements.

Conclusion: In this study, it was found that the combination of Dexamethasone at a specific drug dose was more effective than Tramadol. These findings provide valuable insights into the comparative effectiveness of these two combinations. Additionally, it is recommended to conduct further studies on different drug-dose combinations to confirm the results of the current study and identify the ideal and most efficient dosage of local anaesthetic and adjuvants.

Keywords: Brachial Plexus Block, Dexamethasone, Supraclavicular Block, Tramadol.

Introduction

Regional anaesthesia is often preferred over general anaesthesia for upper extremity surgeries due to its lower complication rates and ability to provide effective postoperative pain relief. Brachial Plexus block is a highly beneficial option instead of general anaesthesia for a range of upper limb procedures. It also serves as a valuable pain relief method for certain major elective and emergency surgeries. It offers a higher level of pain relief and prevents the typical adverse effects linked to general anaesthesia, like postoperative nausea and vomiting. It has the versatility to be administered as either a one-time injection or as a continuous infusion for pain relief. [1] In patients with significant comorbidities such as severe respiratory and cardiovascular diseases, morbid obesity, and

potential airway difficulties, it can be incredibly beneficial. Having a good understanding of the Brachial Plexus anatomy is crucial for successfully administering a Brachial Plexus block.

This technique effectively blocks the entire upper limb, extending from the proximal region to the mid-arm level. Conventional anaesthetics commonly employed for blocks typically provide temporary pain relief that usually lasts less than 6 hours. Several adjuvants have been utilised in an effort to extend analgesia, including epinephrine, midazolam, clonidine, fentanyl, buprenorphine, ketamine, and more. [2,3] An opioid called tramadol is frequently used as an additive. [4] While it is not commonly linked to hemodynamic instability, it does have a high occurrence of nausea and vomiting, particularly when administered intravenously (IV) or orally. [5] Dexamethasone is a glucocorticoid with a long duration of action. It possesses properties that can reduce inflammation and alleviate pain.

Dexamethasone has been found to have a significant impact on the duration of analgesia. This is because the steroids block the transmission of nociceptive impulses along the myelinated C-fibers, resulting in prolonged nerve block effects. According to a recent review6, Tramadol was found to have the ability to increase serotonin release in the spinal cord, while also blocking the reuptake of norepinephrine in the central nervous system. Additionally, it acts as a weak agonist for μ- and κ-opioid receptors, and has been found to inhibit voltage gated sodium channels in laboratory studies, independent of its effects on opioid receptors. Our objective was to compare the effectiveness of Tramadol and Dexamethasone when combined with Bupivacaine in Supraclavicular Brachial Plexus block. We assessed various factors including the speed at which sensory and motor blockade occurred, the duration of sensory and motor blockade, changes in haemodynamic variables, and the time it took for the first rescue analgesia to be administered within the first 24 hours after surgery.

Material and Methods

A prospective, interventional, and randomised study was conducted at our tertiary care centre over a period of 12 months. Having received approval from the Institutional Ethical Committee, a total of 180 patients in ASA grade I & II, aged between 18-65 years, who were scheduled for upper limb procedures A total of 180 orthopaedic surgeries performed under Supraclavicular Brachial Plexus block were divided into three groups, each consisting of 60 surgeries. Group I was administered 28 ml of 0.5% bupivacaine and 100 mg tramadol (50mg/ml). Group II was administered 28 ml of 0.5% bupivacaine and 8 mg of dexamethasone (4mg/ml). Group III was administered 28 ml of 0.5% bupivacaine along with 2 ml of 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.[7]This scale consists of the following scores.

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: $n = (Z\alpha + Z\beta)^2 (\sigma 1^2 + \sigma 2^2) / d^2$, Sample size comes out to be n = 60 each group.

Statistical analysis

The data was compiled and entered into a spread sheet computer programme (Microsoft Excel 2007) and then exported to the data editor page of SPSS version 15 (SPSS Inc., Chicago, Illinois, USA).

The quantitative variables were described using either means and standard deviations or median and interquartile range, depending on their distribution. The qualitative variables were displayed as counts and percentages. Confidence level and level of significance were set at 95% and 5% respectively for all tests.

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. ($p>0.05$) (Table 1 and 2)

Table 1: Intergroup Comparison of Time of Sensory and Motor Onset among Stud Population

Group	No	Mean±SD	P value
Time of Sensory onset			
Group I	60	11.50±2.10	0.01*
Group II	60	8.80±1.74	
Group III	60	19.23±4.78	
Time of Motor onset			
Group I	60	22.48±3.54	0.02*
Group II	60	14.56±3.85	
Group III	60	27.69±4.22	

*** indicate statistically significance at p≤0.05**

Table 2: Intergroup Comparison of Duration of Sensory and Motor Block among Study Population

Group	No	Mean±SD	P value
Duration of Sensory block			
Group I	60	380.25±57.53	0.003*
Group II	60	426.18±41.67	
Group III	60	301.19±55.47	
Duration of Motor block			
Group I	60	321.68±48.67	0.05*
Group II	60	368.47±35.23	
Group III	60	275.36±67.50	

*** indicate statistically significance at p≤0.05**

Discussion

This regional nerve block, known as supraclavicular brachial plexus block, is commonly used to administer anaesthesia and pain relief for surgeries on the upper extremity, specifically the elbow and below.

Local anesthetics currently on the market offer temporary pain relief when administered as a single injection. While plain bupivacaine does offer improved operating conditions, it is important to note that the duration of analgesia is typically not sustained beyond 4 to 6 hours. Ensuring the relief of suffering is a top priority for an anesthesiologist. Every method of postoperative pain relief must fulfill three fundamental criteria. It needs to be efficient, secure, and practical. As previously discussed, researchers have explored different additives to local anesthetics in order to prolong the pain relief after surgery.

In a recent study, Shrestha et al. [6] examined the effectiveness of local anesthetic with and without dexamethasone in supraclavicular brachial plexus block for pain relief. It has been found that the inclusion of dexamethasone in brachial plexus block can significantly increase the duration of pain relief when compared to using only a local anesthetic. Several studies have shown that the inclusion of dexamethasone with different local anesthetics can effectively increase the duration of sensory and motor block, as well as the duration of pain relief, when used for brachial plexus blockade in any form, such as interscalene or supraclavicular. [8-13] In a meta-analysis of randomized trials, Choi et al [14] discovered that the administration of dexamethasone with local anaesthetic can extend the duration of a brachial plexus block when delivered through perineural administration.

Group II experienced a significantly earlier time of sensory onset compared to Group I and Group III. The statistical analysis revealed significant differences between the groups, with Group II showing a later sensory onset compared to Group I, and Group III showing the latest sensory onset of all. In Group II, the time of motor onset was found to be significantly earlier compared to Group I and Group III. The difference in time of motor onset between the groups was found to be statistically significant, with Group II showing a shorter time compared to Group I and Group III. The duration of sensory block was longest among patients in Group II, followed by Group I, and shortest among patients in Group III. The statistical analysis revealed that there were significant differences in the duration of sensory block between the groups. Specifically, Group II had the longest duration, followed by Group I, and then Group III. The duration of motor block was longest among patients in Group II, followed by Group I, and shortest among patients in Group III. The statistical analysis revealed significant differences between the groups, with Group II showing the longest duration of motor block, followed by Group I and then Group III. The time at which the first dose of analgesia was required varied among the different patient groups. Patients in Group III needed it the earliest, followed by those in Group I, and lastly,

patients in Group II. In a recent study by Kapral et al [15], the researchers investigated the effects of adding tramadol to mepivacaine on the duration of an axillary brachial plexus blockade. The results showed a significant prolongation of both sensory and motor block in the group that received tramadol. In a similar vein, Robaux et al [16] and Chattopadhyay et al [17] discovered that the duration of analgesia is significantly extended when tramadol is added to the local anesthetic, compared to when the local anesthetic is used alone. The addition of steroids to local anesthetics has been found to greatly increase the duration of pain relief. Steroids are highly effective at reducing inflammation and suppressing the immune system. Dexamethasone is the preferred steroid due to its highly potent anti-inflammatory property, which has been widely used for this purpose. This substance is significantly more potent than hydrocortisone and does not have any mineralocorticoid activity. It was discovered to be a safer option with no potential side effects. It is worth noting that Dexamethasone has been found to have a positive effect in reducing postoperative nausea and vomiting. The analgesic and antiemetic actions of dexamethasone may be attributed to its anti-inflammatory properties. The exact cause of the pain relief brought about by corticosteroids remains a topic of on-going research and investigation. It is believed that this effect is influenced by their ability to reduce inflammation or suppress the immune system. As per the conventional theory of steroid action, steroids attach to receptors inside cells and regulate the process of nuclear transcription. It is possible that corticosteroids can have a localized impact on the nerve, and it seems that the effect of dexamethasone may be connected to this action. It is highly unlikely to experience any negative effects from a single dose of dexamethasone, as previous research has shown that its short-term use for 24 hours is considered safe and has minimal risks. [18]

Several adjuvants, such as Epinephrine, Clonidine, Opioids, Ketamine, and Midazolam, have had limited success. [19,20] Glucocorticoids have been found to extend nerve blockade more than corticosteroids, depending on their anti-inflammatory potency. This effect can be reduced by using the corticosteroid antagonist Cortexolone. [21] Recent studies have been investigating the use of the glucocorticoid Dexamethasone as an adjuvant to local anaesthesia in regional anaesthesia. Recent studies have shown that the addition of Dexamethasone to perineural local anaesthetic injections can extend the duration of peripheral nerve block analgesia. [22,23]

All three groups were statistically matched. Throughout the study period, the haemodynamic stability of all three groups remained consistent and comparable. Throughout the study period, the sensory block scores were consistently higher in both the Tramadol and Dexamethasone groups compared to the Control group. This difference was observed from 5 minutes to 30 minutes, as well as from 240 minutes to 480 minutes. When examining the sensory block scores of the two study groups, it was discovered that Dexamethasone had significantly higher scores compared to the Tramadol group at various time intervals. This indicates that the quality of the sensory block was superior in the Dexamethasone group for the majority of the study duration. In terms of onset time, the Dexamethasone group had the shortest mean time for sensory block onset, followed by the Tramadol group, while the Control group had the longest onset time. These findings indicate that the Dexamethasone group reduced the onset time by 10 minutes compared to the Control group, and by 2.94 minutes compared to the Tramadol group. In contrast, the Tramadol group was able to decrease the onset time by 7.06 minutes in comparison to the Control group. The duration of sensory blockade varied between the Control group and the Dexamethasone group, with the Control group having the shortest duration and the Dexamethasone group having the longest duration. It is worth noting that Dexamethasone significantly increased the duration of the block by 125.50 and 44.20 minutes compared to the control and Tramadol group, respectively. In comparison to the control group, the Tramadol group significantly extended the duration of the block by 82.10 minutes. According to the study, both Tramadol and Dexamethasone were found to decrease the time it takes for the sensory block to occur, while also prolonging its duration. In a study conducted by Taluqdar et al [24], they discovered that the inclusion of Dexamethasone with Bupivacaine not only decreased the time it took for the block to take effect, but also extended the duration of the sensory block. The time it took for the motor block to set in followed a similar pattern as the sensory block, with the highest value observed in the Control group, followed by Tramadol, and the lowest in the Dexamethasone group. The results indicate that the Dexamethasone group experienced the earliest motor block, followed by the Tramadol group, and finally the control group. In terms of the duration of motor block, the Control group had the shortest duration, followed by the Tramadol group. In a study conducted by Yadav and Saini [25], similar to our own, it was found that the onset time for sensory block in the Tramadol group was longer compared to the Dexamethasone group. This difference was found to be statistically significant.

It is worth noting that the studies consistently demonstrated that Dexamethasone has a faster and longer duration of action compared to Tramadol.

However, accurately determining the onset time of these differences requires careful consideration of the appropriate dose combinations.

In terms of the mean time for the first rescue analgesic need, it was found to be highest in the Dexamethasone group compared to the Tramadol and Control groups. This difference was statistically significant. Dexmethasone significantly increased the duration of the analgesic effect by 235.50 minutes compared to Tramadol and 420 minutes compared to the Control group. Tramadol, on the other hand, extended the analgesic effect by 185.50 minutes compared to the Control group. In a study conducted by Shrestha et al [6], they discovered a notable difference in the analgesic effect between the Dexamethasone and Tramadol groups, with duration of 575 minutes. Similarly, Yadav and Saini25 reported a similar difference of 569 minutes, while Raj et al [7] found the difference to be 481 minutes. No potential side effects, such as nausea, vomiting, headache, or shivering, were observed in any of the patients across the three groups in the present study.

There are a few limitations to consider in our study. Firstly, it may not be applicable to patients who meet the exclusion criteria. Additionally, since the supraclavicular block is administered blindly using the paresthesia technique, patient cooperation is necessary and there is a possibility of block failure. For the prevention of block failure, there are newer techniques available such as peripheral nerve stimulator or ultrasonography guidance. Additionally, premedication with ondansetron was administered as an injection. However, it is important to note that the effects of the study drugs on nausea and vomiting could not be assessed until the effects of ondansetron had subsided.

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.

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