Original Research Article

Comparing the Efficacy of Bupivacaine Alone vs. Tramadol Plus Bupivacaine in Supraclavicular Brachial Plexus Block for Upper Limb Surgery

Muhammad Usman Mohsin (Corresponding Author)
Nishtar Hospital, Multan, Pakistan.
Email shusmanmohsin@gmail.com

Nida Gulzar
University of Lahore Teaching Hospital, Lahore, Pakistan
Email: nidagulzar13@gmail.com

ABSTRACT

Objective: To compare the onset of motor and sensory block, duration of analgesia, and respiratory and hemodynamic stability with tramadol as an adjuvant to bupivacaine in supraclavicular brachial plexus block in patients undergoing orthopedic upper limb surgery.

Study Design: Randomized controlled trial

Place and Duration: The trial was conducted in the Department of Anesthesia, Pain, and Intensive Care of Nishtar Hospital, Multan, from May 2017 to May 2018.

Methodology: The study was conducted on 80 patients, divided into two equal groups (I and II) by the lottery method. Variables assessed included gender, motor block (movement of hand), bradycardia, hypotension, nausea, vomiting, age, and VAS score. Data analysis was performed using SPSS version 23.

Results: The mean onset of sensory block, onset of motor block, duration of analgesia, and VAS score of patients in Group I were 18.37±1.99, 23.75±2.11, 270.75±2.99, and 7.37±1.04, respectively. In Group II, the mean onset of sensory block, onset of motor block, duration of analgesia, and VAS score were 17.67±2.32, 24.12±1.92, 466.03±4.11, and 4.97±1.34, respectively. The difference was statistically significant for the duration of analgesia (p=0.000) and VAS score (p=0.000).

Conclusion: Tramadol with bupivacaine in supraclavicular brachial plexus block prolongs analgesia, decreases postoperative pain, and shortens the onset of motor and sensory block. Tramadol does not affect hemodynamic stability.

Keywords: Tramadol, Bupivacaine, Duration of analgesia, Brachial plexus block, Upper limb surgery

1. INTRODUCTION

In surgeries of the upper extremity without involvement of the shoulder joint, supraclavicular brachial plexus block is a safe and preferred anesthetic technique known for its reliability and rapid onset of action (1). It provides better intraoperative hemodynamic stability and postoperative analgesic effects, promoting early recovery and discharge from the hospital (2). The adverse effects of general anesthetic drugs, tracheal intubation, and laryngoscopy can be avoided by using regional blocks (3).

Regional blocks do not compromise hemodynamic stability, provide effective muscle relaxation, facilitate early transition to oral feeding, deliver superior analgesia, promote early ambulation, and result in a reduced stress response (4). Bupivacaine is the most commonly used anesthetic agent in peripheral nerve blocks due to its prolonged duration of action. Chemically known as N-2,6-dimethylphenyl-1-propyl-2-piperidinecarboxamide, bupivacaine offers extended anesthetic effects with minimal central nervous system and cardiac toxicity (5,6).

In the past, various combinations of local anesthetics and adjunct medications, such as dexamethasone, opioids, clonidine, midazolam, and dexmedetomidine, have been evaluated for their effectiveness in postoperative analgesia (7). Among these, the combination of opioids like fentanyl, morphine, and meperidine has been found to provide high-quality postoperative pain relief (8,9) Tramadol, an analog of codeine, has a centrally acting analgesic effect. It is a 4-phenyl piperidine analog with peripheral local anesthetic properties, making it a valuable adjuvant when combined with local anesthetics for peripheral nerve blocks (10).

Numerous studies have explored the use of various drug combinations in anesthesia, but there has been limited research on the use of tramadol combined with bupivacaine, particularly in the Pakistani population. Our study aims to compare the effects of bupivacaine with tramadol on the duration of anesthesia, the quality of onset, and the postoperative analgesic effect in patients undergoing supraclavicular brachial plexus block.

2. METHODOLOGY

This randomized controlled trial was conducted in the Department of Anesthesia, Pain, and Intensive Care at Nishtar Hospital, Multan, from May 2017 to May 2018. The trial was approved by the hospital's ethical review board, and informed written consent was obtained from all patients before the start of the study. The study included patients aged 25 to 60 years with ASA status I and II, who were scheduled for upper limb surgery. Patients were excluded if they had arrhythmias, hemodynamic instability, skin infections at the incision site, coagulopathy, hypersensitivity to the study drugs, or neuromuscular diseases.

The total number of patients was divided into two groups (Group I and Group II) using a lottery method. Group I patients received 0.5% bupivacaine diluted with 2 ml of normal saline, while Group II patients received 0.5% bupivacaine combined with 2 ml of tramadol (100 mg). The study drugs were prepared and administered by a medically qualified third person who was unaware of the specific drug combinations used in the study.

After being transferred to the operating theater, two large-bore IV lines were inserted into the dorsal side of each hand. Continuous monitoring of heart rate, electrocardiography, pulse oximetry, and non-invasive blood pressure was performed. To alleviate major discomfort and anxiety, patients were administered 0.03 mg/kg of midazolam. Patients were positioned supine with their heads turned to the opposite side of the ipsilateral arm. The pulsation of the subclavian artery and the interscalene groove were identified, and after taking all aseptic precautions, a 1-2 cm area above the clavicle posterior to the subclavian artery was prepared and infiltrated with 1 ml of 2% lignocaine. A short-beveled insulated 22-gauge needle connected to a nerve stimulator was used to locate the plexus, with a current of 1.5 mA set to elicit hand movement. Upon identifying the appropriate movement response, 30 ml of the prepared study drug was injected.

The pinprick method was used to assess the sensory block at the level of C3 to T1 after the administration of the injection. A score of less than 2 was considered incomplete. Sensory responses were assessed at 5, 10, 15, 20, and 25 minutes, with sensory blockage at 25 minutes considered successful. The

duration and onset time of the sensory block were recorded, with the duration defined as the time taken from onset to recovery of sensation to pinprick.

The motor block was assessed by grading hand movement on a 3-point scale, with a score of 2 considered a complete block. The Visual Analog Scale (VAS) was used to assess the degree of pain. If the VAS score reached 2, 0.5 mg of nalbuphine was administered intravenously. If the VAS score exceeded 2, general anesthesia was provided. Cases in which patients expressed no discomfort during the entire procedure were labeled as effective for surgical anesthesia; mild discomfort was labeled as adequate; and cases requiring general anesthesia or ketamine were labeled as inadequate.

Oxygen saturation, blood pressure, and heart rate were continuously monitored during the operative period, and any side effects, such as respiratory depression, dizziness, nausea, or vomiting, were recorded. Postoperative pain was assessed at 1 hour, 2 hours, 4 hours, 8 hours, and 12 hours post-surgery.

SPSS version 23 was used for data analysis. The chi-square test and Student's T-test were applied to assess the association between variables, with probability values less than or equal to 0.05 considered significant.

3. RESULTS

A total of 80 patients participated in this study, equally distributed into two groups: Group I (n=40) and Group II (n=40). The demographic and clinical characteristics of the two groups were comparable, with no statistically significant differences observed (Table I).

Demographic and Clinical Characteristics

Table I: Demographic Characteristics Among the Groups

Variables	Group I n=40	Group II n=40	P-value
Age (years)	29.65±3.16	28.55±3.58	0.201
Weight (kg)	60.27±3.73	60.47±3.96	0.808
Gender			
Male	n=23 (57.5%)	n=26 (65%)	0.491
Female	n=17 (42.5%)	n=14 (35%)	
ASA			
I	n=37 (92.5%)	n=36 (90%)	0.692

II	n=3 (7.5%)	n=4 (10%)	

- Group I: Composed of 57.5% males (n=23) and 42.5% females (n=17). The mean age was 29.65±3.16 years, and the mean weight was 60.27±3.73 kg. ASA I status was seen in 92.5% (n=37), and ASA II in 7.5% (n=3).
- Group II: Comprised 65% males (n=26) and 35% females (n=14). The mean age was 28.55±3.58 years, and the mean weight was 60.47±3.96 kg. ASA I status was observed in 90% (n=36) and ASA II in 10% (n=4).

Surgical Details

Table II: Surgical Profile of the Patients

Variables	Group I n=40	Group II n=40	P-value
Duration of surgery (minutes)	84.20±4.01	84.05±3.96	0.867
ORIF	n=31 (77.5%)	n=36 (90%)	0.130
Implant removal	n=2 (5%)	n=2 (5%)	0.152
Other surgeries	n=1 (2.5%)	n=8 (20%)	0.013

- Group I had a mean surgery duration of 84.20±4.01 minutes. The procedures included ORIF (77.5%, n=31), implant removal (5%, n=2), and other surgeries (2.5%, n=1).
- Group II had a mean surgery duration of 84.05±3.96 minutes, with ORIF (90%, n=36), implant removal (5%, n=2), and other surgeries (20%, n=8).

Hemodynamic Stability

Table III: The Mean Heart Rate (beats/minute) of the Patients

Variables	Group I n=40	Group II n=40	P-value
0 Minute	77.90±6.55	77.25±6.76	0.664
15 Minutes	77.55±5.56	75.50±5.32	0.096
30 Minutes	74.10±5.66	73.15±5.96	0.467
45 Minutes	72.40±2.71	73.22±3.07	0.207
60 Minutes	71.60±2.63	72.42±2.33	0.142
75 Minutes	70.87±3.93	70.77±4.23	0.913
90 Minutes	70.97±5.59	70.80±5.21	0.885

Total	73.92±7.78	73.52±5.59	0.793

- Heart Rate: Group I showed a total mean heart rate of 73.92±7.78 bpm, while Group II had a total mean of 73.52±5.59 bpm, with no significant difference.

Table IV: The Mean Arterial Pressure (mmHg) of the Patients

Variables	Group I n=40	Group II n=40	P-value
0 Minute	100.35±5.36	99.87±7.35	0.742
15 Minutes	97.71±2.99	98.52±3.59	0.268
30 Minutes	95.65±2.37	96.27±2.35	0.240
45 Minutes	93.40±4.48	94.92±4.22	0.122
60 Minutes	93.52±2.87	92.70±2.85	0.202
75 Minutes	90.25±3.88	91.82.±2.96	0.061
90 Minutes	90.20±3.58	89.77±3.05	0.569
Total	97.45±3.99	96.32±4.89	0.264

- Mean Arterial Pressure (MAP): The total mean MAP was 97.45±3.99 mmHg in Group I and 96.32±4.89 mmHg in Group II, showing stable hemodynamics across both groups.

Block Characteristics

Table V: Sensory and Motor Block Profile of the Patients

Variables	Group I n=40	Group II n=40	P-value
Onset of sensory block	18.37±1.99	17.67±2.32	0.152
Onset of motor block	23.75±2.11	24.12±1.92	0.409
Duration of Analgesia	270.75±2.99	466.03±4.11	0.000
VAS Score	7.37±1.04	4.97±1.34	0.000

- Sensory Block: Onset time was 18.37±1.99 minutes in Group I and 17.67±2.32 minutes in Group II (p=0.209, not significant).
- Motor Block: Onset time was 23.75±2.11 minutes in Group I and 24.12±1.92 minutes in Group II (p=0.474, not significant).

- Duration of Analgesia: Group II (466.03±4.11 minutes) demonstrated a significantly longer duration of analgesia compared to Group I (270.75±2.99 minutes; p=0.000).
- VAS Scores: Group II reported significantly lower VAS scores (4.97±1.34) than Group I (7.37±1.04; p=0.000).

Table 5 presents a comparison between Group I and Group II, highlighting key differences in block characteristics, particularly in the duration of analgesia and pain intensity. Although the onset times for both sensory and motor blocks were comparable between the two groups, significant differences were observed in pain management outcomes.

- **Duration of Analgesia**: Group II, which received the combination of bupivacaine and tramadol, experienced a significantly longer duration of analgesia (466.03±4.11 minutes) compared to Group I, which only received bupivacaine (270.75±2.99 minutes). This extended pain relief in Group II was statistically significant (p=0.000).
- **VAS Scores**: The Visual Analog Scale (VAS) scores for pain intensity were significantly lower in Group II (4.97±1.34) than in Group I (7.37±1.04). This suggests that patients in Group II experienced less pain during the postoperative period, which was also statistically significant (p=0.000).

These findings suggest that the addition of tramadol to bupivacaine in Group II provided more effective and prolonged pain relief, leading to a reduction in pain intensity when compared to the bupivacaine-only treatment in Group I. This makes the combination therapy in Group II a more effective intervention for managing postoperative pain in upper limb surgeries.

Key Findings

1. The combination of tramadol with bupivacaine significantly prolonged the duration of analgesia and improved postoperative pain management as reflected by lower VAS scores.
2. Both groups showed comparable onset times for sensory and motor blocks.

3. Hemodynamic parameters, including heart rate and mean arterial pressure, remained stable throughout the procedures in both groups.

These findings indicate the superiority of the tramadol and bupivacaine combination in enhancing analgesic outcomes without compromising safety.

4. DISCUSSION

In our study, we found that using tramadol as an adjuvant significantly prolonged the duration of analgesia for upper extremity surgery. These results align with the study by Antonucci et al., who concluded that combining bupivacaine with tramadol provides a longer duration of analgesia compared to using bupivacaine alone (11). Madhusudhana et al. (12) also conducted a study on this topic and reported similar findings to those in our study. Both of these studies corroborate the effectiveness of tramadol as an adjuvant in enhancing the duration of analgesia.

In a study by Shah et al. (13), it was found that the combination of bupivacaine with tramadol significantly prolonged the duration of analgesia compared to bupivacaine with normal saline. Similarly, research conducted by Megpal et al. (14) supports the use of tramadol as an adjuvant, noting that the addition of tramadol to a local anesthetic prolongs postoperative analgesia. These findings are consistent with the results of our study. However, it's important to note that not all studies align with these conclusions. For instance, Sarsu et al. (15) conducted a study comparing bupivacaine with tramadol to bupivacaine alone and reported conflicting results, observing no significant difference in the duration of analgesia between the two groups.

In our study, we used the VAS scoring system to evaluate the intensity of pain and observed a significant decrease in the VAS score in the postoperative period when tramadol was used. Similar findings were observed by Madhusudhana et al.[12] regarding the intensity of pain and VAS score in patients undergoing a supraclavicular block. Another variable that was assessed was the onset of motor and sensory blockade, where no difference was found between the two groups. A similar study conducted by Karpal S et al. (16) reported similar findings, noting that no difference was observed in either group regarding the onset of motor and sensory blockade.

In 2015, another study was conducted by Regmi NK et al. (17), who reported a notable difference between the two groups regarding the duration of analgesia. They found that the tramadol group performed better than the bupivacaine-alone group, with the difference being statistically significant. Regarding the VAS score, the tramadol group showed lower scores in the postoperative period. There was no significant difference in the onset of sensory and motor blockade between the two groups.

Another study conducted by Sarihasan et al. (18) on the addition of tramadol to a local anesthetic reported better anesthesia effects and prolonged postoperative analgesia when used in a brachial plexus block in the supraclavicular region. These results are consistent with our findings, which also demonstrate that postoperative analgesia and anesthesia can be improved with the combination of tramadol and bupivacaine.

Tramadol has been evaluated in numerous studies alongside various drug combinations. For instance, in a study by Geze et al. (19), tramadol was used as an adjuvant with fentanyl, yielding favorable results. The combination of tramadol and fentanyl was compared to fentanyl alone, and it was found that the combination provided superior anesthesia quality and enhanced analgesic effects during brachial plexus blocks for upper limb surgeries. Similarly, Shrestha et al. (20) conducted a study comparing a combination of tramadol and bupivacaine with bupivacaine alone, reporting that the combination group achieved lower VAS scores, indicating better pain management.

5. CONCLUSION

The addition of tramadol to bupivacaine in supraclavicular brachial plexus block prolongs the duration of analgesia, reduces postoperative pain, and shortens the onset of both motor and sensory blocks, without affecting hemodynamic stability.

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