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Comparison of 2mg vs 6mg Dosage in Upper Limb Surgery: Impact on Block Onset and Post-Operative Analgesia Duration

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ABSTRACT

Background- Regional nerve blocks are crucial for intraoperative and postoperative pain management, reducing complications linked to general anesthesia. The purpose of this study is to compare the effects of dexamethasone dosages of 2mg & 6mg on sensory & motor block completion periods as well as post-operative analgesic duration in infraclavicular blocks for upper-limb procedures.

Methods- Infraclavicular brachial plexus block guided by USG was administered to 34 ASA-I and II patients, with 17 patients in each group. 25 ml of 0.5% levobupivacaine and 2 mg dexamethasone were administered to Group A. For the block, Group B received 25 ml of 0.5% levobupivacaine combined with 6 mg dexamethasone. The analysis did not include three of the unsuccessful blocks. After the brachial plexus block, vital parameters were recorded every at 0, 120,150,180, 210 and 240 mins. Postoperatively vitals were recorded at 12 hours, 24 hours and 36 hours. The patient was monitored until the motor and sensory block had regressed completely.

Results- The study found that demographic variables and hemodynamic parameters were non-significant in both groups. The mean duration of motor block in group A (2mg) was 1069.38 minutes, significantly lower than group B (6mg) with 1294.07 minutes. Additionally, the mean duration of analgesia in group A (2mg) was 1117.19 minutes, significantly shorter than group B (6mg) with 1418.13 minutes.

Conclusion- The study suggests that a 2mg dosage of dexamethasone when combined with 0.5% levobupivacaine, may be a more effective option for infraclavicular brachial plexus

blocks due to its ability to provide effective analgesia.

Key-words- Dexamethasone, Infraclavicular blocks, Nerve block, Post-operative analgesia, Sensory block, Upper limb surgeries.

INTRODUCTION

Regional nerve blocks, also known as nerve blocks, can be used to improve general anesthesia by delivering intraoperative & postoperative analgesia while reducing the complications associated with general anesthesia. For upper-limb surgeries, a brachial plexus nerve block with local anesthetic can be used instead of general anesthesia [1].

Ultrasound-guided nerve blocks have become a fundamental feature of regional anesthesia nerve fibers, and they can be modulated or interrupted at any point along the neural pathway. Post-operative pain is a big concern that is not well addressed. The benefits of managing postoperative pain effectively include increased pain management, early mobilization, a lower risk of complications such as deep vein thrombosis and pulmonary atelectasis, prompt or early release, and improved clinical outcomes [1].

The infraclavicular block is safer and more effective than other techniques [2]. When applied correctly, it minimizes issues and yields an excellent block [3]. The local anesthetic (LA) is applied and the nerves are located using ultrasound equipment. This treatment can also be performed using a gadget known as a nerve stimulator. Performing the block under ultrasound guidance resulted in superior sensory and motor blockade [4].

The short duration of action, the delayed onset of the local anesthetic agent, and the brief duration of post-operative analgesia are the three primary problems that have restricted the use of regional anesthesia techniques. Eventually, short- and long-acting local anesthetic medications were mixed to provide a longer half-life and a faster onset. However, this led to anesthetic toxicity locally. To prolong the duration of the neural blockade during blocks, adjuvants such as alpha-2 agonists (clonidine, dexamedetomidine), opioids (fentanyl, tramadol), steroids (dexamethasone), and other medications are used in combination with local anesthetics [2].

Prior studies have shown that perineural dexamethasone, when added to regional analgesia as an adjuvant, significantly shortened the duration of analgesia, increased the time until the patient's first analgesic request, and had no negative side effects [3]. Most likely, dexamethasone acts by directly affecting glucocorticoid receptors and inhibitory potassium channels, which reduces nociceptive C-fiber activity. Reduced absorption of local anesthetic

due to a local vasoconstrictive impact is suggested by some authors [5]. Furthermore, other studies have added different doses of dexamethasone to LA, ranging from 4 mg to 10 mg; nonetheless, an ideal dosage schedule is yet unknown. There was also a case report which showed delayed motor regression which lasted up to 24 hours. As such several investigators have attempted to compare the effects of high-dose and low-dose dexamethasone on the duration of analgesia during peripheral nerve blocks with decidedly mixed results. Very few studies are available with Levobupivacaine as a local anaesthetic.

Delayed sensory and motor block completion following surgery can have significant implications for pain management and patient outcomes. Studies have shown that patients experiencing delayed recovery of sensory and motor function may face challenges such as inconsistent motor blocks, prolonged recovery times, and potential complications like nerve injuries [6-8]. These delays can lead to extended periods of non-weight-bearing, irregular courses of anesthesia, and even the need for specialist treatments from peripheral nerve injury services [9]. Furthermore, delayed sensory or motor block resolution can result in unexpected complications, such as extensive spinal blocks, which may require immediate interventions like vasopressor support and oxygen therapy to stabilize vital signs [10]. Recognizing and addressing these delays promptly is crucial to ensuring optimal pain control, preventing long-term complications, and improving overall patient outcomes post-surgery.

This study was conducted with the null hypothesis that administering 6mg & 2mg of dexamethasone had no clinical difference in terms of onset time, duration of motor, sensory block, & post-operative analgesia.

MATERIALS AND METHODS

This prospective randomized single-blind study was conducted at Vydehi Institute of Medical Sciences and Research Centre, Bangalore from January 2017 to June 2019.

Inclusion criteria- The study comprised patients who were listed for upper limb surgeries below the mid-humerus, between the ages of 18 and 70 (males and females), and who had an ASA classification of I or II.

Exclusion criteria- The study excluded patients who refused nerve block, those who had a history of significant cardiovascular, pulmonary, renal, hepatic, or peripheral vascular disease, those who were on sedative medications and perioperative IV steroids, those who were pregnant or lactating, those who had nerve injury from trauma, and those who were contraindicated for brachial plexus block due to severe lung disease, contralateral

diaphragmatic paralysis, pre-existing neuropathy in the surgical limb, injection site infection, coagulopathy, pregnancy or lactation, and those who had failed block.

Methodology

Pre-anesthetic Evaluation- Each patient underwent a comprehensive pre-anesthetic evaluation, which encompassed various aspects. Vital parameters such as blood pressure, pulse rate, oxygen saturation levels, and weight were meticulously assessed to gauge the patient's baseline health status. Detailed information regarding any significant present and past medical or surgical history was obtained to ensure a thorough understanding of the patient's overall health background. A physical examination, including a local assessment relevant to the upcoming procedure, was conducted to identify any potential risk factors or contraindications. Routine investigations like complete blood count (CBC), urine analysis, bleeding time (BT), clotting time (CT), & random blood sugar (RBS) were performed to assess the patient's physiological status comprehensively. Additionally, further investigations such as renal function tests (RFT), chest X-ray, and electrocardiogram (ECG) were carried out when deemed necessary based on individual patient needs. To maximize their perioperative care, patients were also given Tablet of Alprazolam 0.5 mg and Ranitidine 150 mg orally the night before the planned operation as part of the pre-operative medicine regimen.

Procedure- Patients undergoing upper limb surgeries who meet preoperative criteria were shifted to the operating room (OT) on the day of surgery. They were premedicated with Fentanyl 50mcg and underwent a block procedure at least 30 minutes before surgery under ultrasound guidance. Patients were split into two groups: Group A received 0.5% levobupivacaine 25 ml and 2 mg of dexamethasone 4 mg/ml (0.5 ml), while Group B received 0.5% levobupivacaine 25 ml and 6 mg of dexamethasone 4 mg/ml (1.5 ml). Brachial plexus blockade was administered by an experienced anaesthesiologist. Patients had their sensory and motor block evaluated every 5 minutes for 30 minutes. A successful block was achieved when at least two out of four nerve territories were effectively blocked. If inadequate blockade was noted, the case was converted to general anesthesia.

The interval between a local anesthetic injection and the elimination of the pinprick reaction is known as the period of onset for sensory blocking. Up to 30 minutes after injection, it was assessed in four different nerve regions every five minutes. The block was deemed unsuccessful if anesthesia was lacking in two or more peripheral nerve distributions. The

inability to flex or extend joints is referred to as a successful motor block.

The assessment of sensory and motor blocks involves a pinprick test to determine the degree of pain felt. Thumb opposition, thumb adduction, thumb abduction, and elbow flexion were used to identify the motor block. Both blocks were assessed at different intervals, and patients were monitored until pain onset.

Statistical analysis- The research employed both descriptive and inferential statistical analysis, with categorical measurements expressed as numbers (%) and mean ± SD for the outcomes. Samples were assumed to be random, cases to be independent, and dependent variables to be normally distributed. The Chi-square/Fisher Exact test, the Student t-test, and Leven's test for homogeneity of variance were utilized to analyze the qualitative data. Microsoft Word and Excel were used to create graphs, tables, and other visual aids, while SPSS 22.0 and the R environment version 3.2.2 were utilized for data analysis.

Ethical approval- The institutional ethical review committee granted ethical clearance. Written and informed consent was obtained from each subject.

RESULTS

In comparing the clinical variables between Group A and Group B, several key findings emerge (Table 1). The mean age was 35.94 years in Group A and 33.00 years in Group B, with a total mean age of 34.52 years (p=0.505). Height was slightly higher in Group B (170.87 cm) compared to Group A (165.81 cm), with a total mean height of 168.26 cm (p=0.051). Weight showed a similar trend, with Group B having a slightly lower weight (66.40 kg) compared to Group A (68.19 kg), resulting in a total mean weight of 67.32 kg (p=0.484). There was a significant difference in the two groups' Body Mass Index (BMI), with Group A having a higher BMI (24.78 kg/m^2) than Group B (22.87 kg/m^2). As a result, the two groups' total mean BMI was 23.85 kg/m^2 (p=0.040). There was no significant difference in the onset of sensory block or motor block across the groups (p-values of 0.134 and 0.059, respectively). Likewise, there was no statistically significant difference in the length of the surgery between the two groups (p-value = 0.816).

Table 1: Comparison of clinical variables in two groups of patients.

Variables	Group A	Group B	Total	p-value
Age in years	35.94±12.04	33.00±12.16	34.52±11.99	0.505
Height (cm)	165.81±7.39	170.87±6.36	168.26±7.26	0.051+
Weight (kg)	68.19±6.74	66.40±7.31	67.32±6.96	0.484
BMI (kg/m^2)	24.78±1.54	22.87±3.18	23.85±2.62	0.040*
Onset of Sensory Block (mins)	21.56±4.37	24.67±6.67	23.06±5.73	0.134
Onset of Motor Block (mins)	31.88±7.27	37.33±8.21	34.52±8.10	0.059+
Duration of surgery(mins)	124.06±32.57	128.47±66.95	126.19±51.25	0.816

*+: Suggestive significance (p-value: 0.05<p<0.10); *: Moderately significant (p-value: 0.01<p ≤ 0.05)*

In the comparison between Group A and Group B of patients studied, it is observed that in Group A, 81.3% were classified as ASA 1, 18.8% as ASA 2, and none as ASA 3. In contrast, Group B had 73.3% classified as ASA 1, 20% as ASA 2, and 6.7% as ASA 3. The total distribution shows that out of the total of 31 patients studied, 77.4% were ASA 1, 19.4% were ASA 2, and only 3.2% were ASA 3. The statistical analysis using the Fisher Exact Test yielded a p-value of 0.820, indicating that there is no significant difference in the distribution of ASA classifications between the two groups of patients (Table 2).

Table 2: ASA distribution in two groups of patients.

ASA	Group A	Group B	Total	p-value
1	13 (81.3%)	11 (73.3%)	24 (77.4%)	0.82*
2	3 (18.8%)	3 (20%)	6 (19.4%)	
3	0 (0%)	1 (6.7%)	1 (3.2%)	
Total	16 (100%)	15 (100%)	31 (100%)	

**Fisher Exact Test*

The data presented in Fig. 1 (A) compares the pulse rates (beats per minute) between two groups of patients, Group A and Group B, at various time intervals ranging from 0 minutes to 2160 minutes. The mean pulse rates for both groups fluctuate over time but generally remain within a close range. At 0 minutes, Group A had a slightly higher mean pulse rate compared to Group B (83.00 bpm vs. 76.13 bpm), with a p-value of 0.067 suggesting a trend towards significance. However, as time progressed, the differences in pulse rates between the two

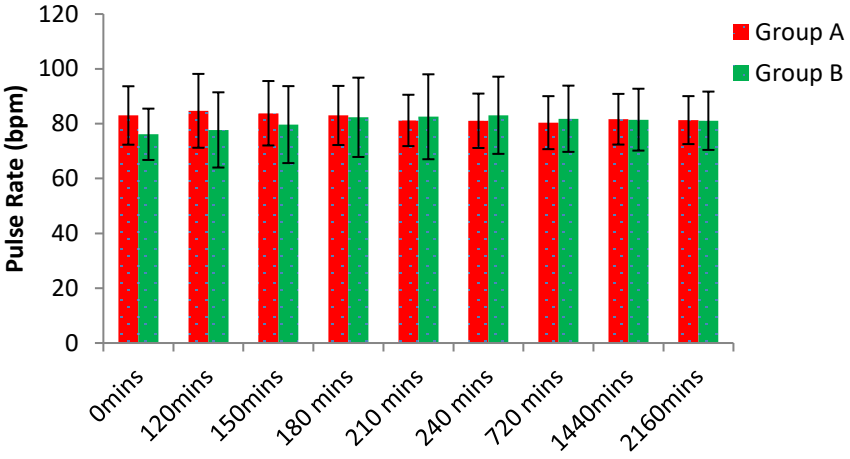
groups became less pronounced and were not statistically significant at later time points (120 mins to 2160 mins). Overall, the data indicated that there was no significant difference in pulse rates between Group A and Group B over the observed period.

Systolic blood pressure (SBP) readings over a range of time intervals in two patient groups are compared in Fig. 1 (B). At every time point, Group A continuously had somewhat lower SBP values than Group B, but the differences were not statistically significant ($p>0.05$), except in the first minute when the p-value was 0.098. This meant that during the designated periods, there was no discernible variation in SBP between the two groups.

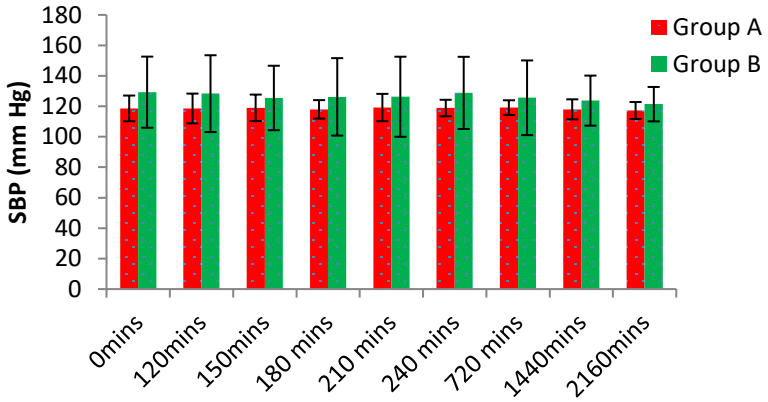
Group A exhibited a slight decrease in diastolic blood pressure (DBP) from 78.75 mm Hg at 0 minutes to 78.13 mm Hg at 1440 minutes, with fluctuations throughout the time points. In contrast, Group B showed a more significant increase in DBP from 83.40 mm Hg at 0 minutes to 81.93 mm Hg at 2160 minutes, with notable spikes at certain time intervals. The statistical analysis revealed significant differences between the two groups at various time points, notably at 120 minutes ($p=0.003$), suggesting divergent trends in DBP over the observation period (Fig. 1 C).

In the comparison of MAP (mean arterial pressure) between Group A and Group B over various time points, fluctuations in MAP values were observed (Fig. 1 (D)). Group A and Group B showed different mean MAPs at 0 minutes, although the difference was not statistically significant ($p=0.093$). Nonetheless, Group B continuously displayed considerably greater mean MAP values than Group A at 120 minutes, 150 minutes, and 240 minutes ($p=0.021$, $p=0.142$, and $p=0.113$, respectively). Interestingly, there were no statistically significant variations in the mean MAP values between the two groups at 180, 210, 720, 1440, and 2160 minutes ($p=0.372$, $p=0.542$, $p=0.229$, $p=0.246$, and $p=0.418$, respectively). All things considered, these results indicated that there were differences in MAP between the two groups at various stages during the research period.

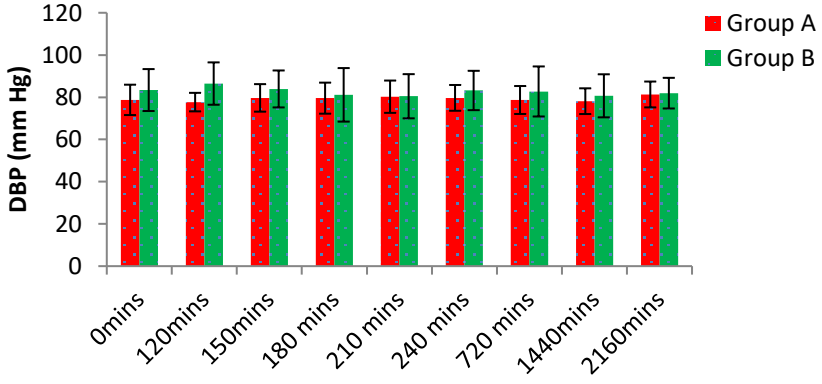
The mean SpO2% values for each group at various time points were recorded, showing fluctuations over time (Fig. 1 (e)). Group A generally exhibited higher SpO2% levels compared to Group B at most time intervals, with statistically significant differences observed at 120 mins, 150 mins, 180 mins, 240 mins, 720 mins, and 1440 mins. However, there was no significant difference between the two groups at 210 mins and 2160 mins. These findings suggest that there may be variations in oxygen saturation levels between the two groups of patients over time, indicating potential differences in respiratory function or response to treatment.


Pulse Rate (bpm)
120
100
80
60
40
20
0
Group A
Group B
0mins
120mins
150mins
180 mins
210 mins
240 mins
720 mins
1440mins
2160mins

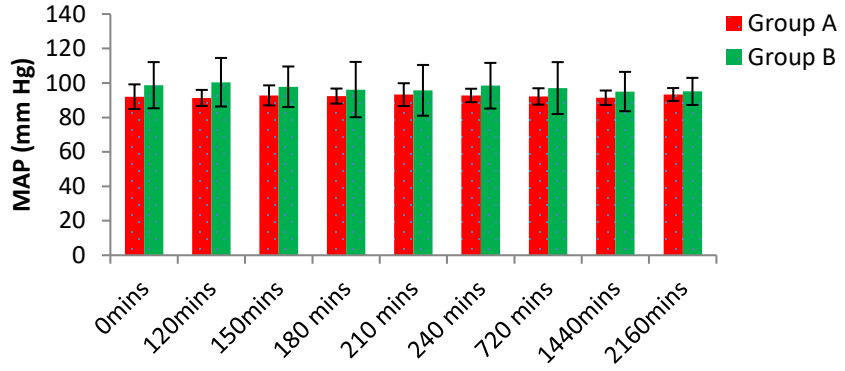
(A)


SBP (mm Hg)
180
160
140
120
100
80
60
40
20
0
Group A
Group B
0mins
120mins
150mins
180 mins
210 mins
240 mins
720 mins
1440mins
2160mins

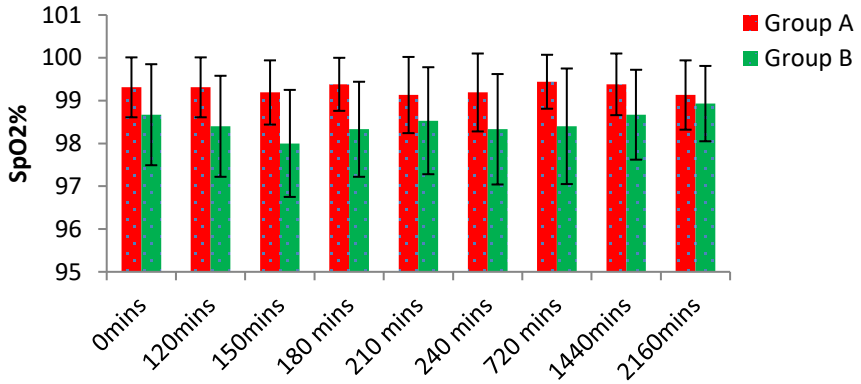
(B)


DBP (mm Hg)
120
100
80
60
40
20
0
Group A
Group B
0mins
120mins
150mins
180 mins
210 mins
240 mins
720 mins
1440mins
2160mins

(C)



(D)



(E)

Fig. 1: Comparison of two groups of patients studied for (A) Pulse Rate (bpm), (B) SBP (mm Hg), (C) DBP (mm Hg), (D) MAP (mm Hg) and (E) SpO_2%.

Table 3 illustrates the significant difference in the length of motor block and analgesia between Group B (6 mg dexamethasone) and Group A (2 mg dexamethasone) in patients undergoing upper limb surgeries. With a mean duration of 1069.38 minutes, Group B's motor block was determined to be significantly longer than Group A's. The statistical analysis revealed a p-value of 0.004, indicating a highly significant difference in the motor block length between the two groups. Group B reported analgesia for a much longer period (1418.13 minutes) than did Group A (mean duration: 1117.19 minutes), according to the study.

Table 3: Comparison of duration of motor block & analgesia in 2 groups of patients.

	Group A	**Group B**	**Total**	**p-value**
Duration of motor block (mins)	1069.38±159.98	1294.07±237.21	1178.10±228.22	0.004**
Duration of analgesia (mins)	1117.19±158.68	1418.13±313.86	1262.81±286.24	0.002**

***: Strongly significant (p≤ 0.01)*

DISCUSSION

Numerous research offers insightful comparisons between the effects of varying dosages on post-operative analgesic duration, time to sensory and motor block completion, and both. According to a study on brachial plexus block, 4 mg of dexamethasone produced a sensory block that lasted noticeably longer (1080 minutes) than 2 mg (840 minutes) [11]. Additionally, a study that employed dexmedetomidine as an adjuvant to bupivacaine in spinal anesthesia found that while dexmedetomidine generated a longer-lasting postoperative analgesia, clonidine caused a speedier start of sensory block [12]. Moreover, compared to dexamethasone, dexmedetomidine demonstrated an earlier onset of action, sustained blockage, and longer post-operative analgesia in an axillary block for forearm and hand procedures [13]. These findings collectively suggest that higher dosages of dexamethasone and dexmedetomidine can lead to prolonged sensory block duration and enhanced post-operative analgesia.

The infraclavicular approach for brachial plexus block provides an appropriate anesthetic for upper limb surgery below the mid-humerus. With just one puncture, this technique can cover every sensory area in the distal part of the upper limb by concurrently anesthetizing the ulnar, radial, median, axillary, and musculocutaneous nerves. This tactic has recently attracted increased attention [14].

These methods work quite well for perioperative pain management following upper limb surgery. Compared to general anesthesia, an infraclavicular block is better for upper limb surgeries because it provides better post-operative analgesia, sympathetic block, and fewer side effects like stellate ganglion block, pneumothorax, and phrenic nerve injury [15]. In addition to successfully blocking the ulnar portion of the medial cord and the intercostobrachial nerve, this technique lessens the discomfort related to tourniquets [16,17].

In this investigation, two groups receiving varying doses of dexamethasone had their motor block onset investigated. The average time for the onset of motor block in Group A was 30.17±6.02 minutes following the administration of 2 mg of dexamethasone. Group B

recorded a mean onset of motor block of 32.97±8.12 minutes following 6 mg of dexamethasone administration. The statistical analysis showed a p-value of 0.121, which meant that there was no significant difference between the two groups. However in the trial by Knezevic *et al.* [18], dexamethasone (6 mg) was administered to 1022 patients who had peripheral nerve blocks. Comparing this study's results to ours, we found that the onset of both motor and sensory blockages occurred later than expected. The sensory block onset had a standardized mean difference (SMD) of -0.49 (95% CI: -0.89, -0.09, p = 0.02), indicating a significant delay in sensory block onset with the higher dose of dexamethasone. Similarly, the motor block onset had an SMD of -0.56 (95% CI: -1.13, 0.00, p = 0.05), showing a trend towards delayed motor block onset with the higher dose.

In the current study, the mean duration of analgesia was 1743.59±231.39 minutes for group B (6 mg) and 1310.16±151.34 minutes for group A (2 mg). A p-value of less than 0.001 indicated statistical significance between the two groups. 150 patients undergoing upper limb procedures underwent USG-guided infraclavicular brachial plexus block with either IV dexamethasone or 6 mg dexamethasone in a related study by Leurcharusmee *et al.* [19]. The group receiving 6mg dexamethasone had a longer duration of analgesia compared to the IV counterpart, with mean durations of 22.1±8.5 hours and 18.6±6.7 hours, respectively (p-value = 0.014). Furthermore, a study by Choi *et al.* [20] looked at the brachial plexus block treatment of dexamethasone as an additive. It was discovered that the use of dexamethasone increased the duration of analgesia from 730 minutes to 1306 minutes for long-acting local anesthetics and from 134 minutes to 343 minutes for intermediate local anesthetics.

In a study comparing groups A (2 mg) and B (6 mg), it was discovered that group A's mean block duration was 1069.38 minutes, significantly shorter than group B's 1294.07 minutes (p-value <0.001), indicating statistical significance between the two groups. The results of this investigation are consistent with a related study by Persec *et al.* [21], in which patients having upper limb surgery were given distinct therapies. The trial's subjects were divided into two groups: one received 25 ml of 0.5% levobupivacaine together with 4 ml of dexamethasone, while the other received the same amount of 0.5% levobupivacaine along with 1 ml of saline. The results showed that the dexamethasone group's duration of sensory and motor blockade was noticeably longer than that of the saline group. To be more precise, group 1's motor blockade lasted 1,200 minutes, whereas group 2's sensory blockade lasted 600 minutes and group 1's 1,260 minutes. Moreover, studies by Choi *et al.* [20] demonstrated that the duration of motor block for long-acting local anesthetics was prolonged when dexamethasone was

added to brachial plexus blocks. With a mean difference of 438 minutes and a 95% confidence interval spanning from 89 to 786 minutes, the mean time increased from 664 to 1102 minutes.

LIMITATIONS

Certain limitations of the study in question should be taken into account when interpreting the findings. The fact that the study was not carried out in a double-blind manner is one of the noted shortcomings. An additional constraint noted in the research is the lack of measurement of sensory block duration through multiple neurologic assessments.

CONCLUSION

In conclusion, our study suggests that when considering dexamethasone as an adjunct to 0.5% levobupivacaine in infraclavicular brachial plexus blocks, a dosage of 2mg may be a better choice due to its ability to provide effective analgesia without leading to prolonged motor blockade or the need for additional rescue analgesia. Further research is needed to investigate the potential of utilizing dexamethasone in combination with novel analgesic agents to improve the overall efficacy of regional nerve blocks for enhanced postoperative pain management.

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