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A Comparative Study of Bupivacaine with Dexamethasone and Bupivacaine Alone Under Ultrasound Guided Supraclavicular Brachial Plexus Block for Post-Operative Analgesic Efficacy in Below Mid-Arm Orthopaedic Surgeries

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ABSTRACT

Aim: comparing analgesic efficacy of dexamethasone as an adjuvant with bupivacaine under ultrasound guided supraclavicular brachial plexus block in patients undergoing below mid arm orthopedic surgeries.

Method: This prospective study comprised 60 patients in compliance with ASA physical study of class 1 and 2 provided for below mid arm orthopedic surgeries in patients attending preanesthetic checkup clinic of Nalanda Medical College and Hospital.

Results: One common regional nerve block method used in upper limb procedures is supraclavicular brachial plexus block. For brachial plexus block, local anaesthetics alone offer favorable operating conditions, but the duration of postoperative analgesia is shorter. To extend the duration of sensory block (analgesia), a variety of medications have been used in conjunction with local anaesthetics in brachial plexus block. Local anaesthetic & glucocorticoid perineural injection have been shown to affect the length & onset of sensory & motor block. In this regard, we chose to conduct a randomized, double-blind clinical trial to assess the impact of dexamethasone added to 0.25% bupivacaine in supraclavicular brachial plexus block on the length & commencement of sensory & motor block as well as the need for post-operative rescue analgesics. The study was carried out at Nalanda Medical College & Hospital's Department of Anaesthesiology. Two equal groups (groups A & B) of sixty adult patients with ASA grades I or II were assigned at random. They had a supraclavicular brachial plexus block & underwent a variety of orthopaedic procedures on their elbow, forearm, or hand. In groups A (dexamethasone group) & B (control group), supraclavicular brachial plexus block was carried out using 38 mL 0.25% bupivacaine with 2 mL dexamethasone & 38 mL 0.25% bupivacaine plus 2 mL 0.9% normal saline, respectively. Postoperative rescue analgesic requirement, duration of sensory & motor block, & onset time was compared between the two groups. The two groups' demographic characteristics & surgical time did not differ statistically significantly. Both groups saw identical onset times for sensory (dexamethasone group: 18.26 ± 1.25 min versus 18.70 ± 1.26 min) & motor block (dexamethasone group: 19.96 ± 1.28 min versus control group: 20.26 ± 1.28 min). The dexamethasone group experienced a significantly longer duration of sensory block (1091.11 ± 107.42 min versus 605.37 ± 58.60 min in the control group) & motor block (846.67 ± 102.09 min in the dexamethasone group versus 544.07 ± 55.40 min in the control group) than the control group (p value < 0.001). In the first 24 hours following surgery, patients in the dexamethasone group needed a

considerably lower number of injections of diclofenac sodium than patients in the control group (p value < 0.001).
Conclusion: In supraclavicular brachial plexus block, we find that adding 8 mg dexamethasone to bupivacaine 0.25% solution prolongs the duration of sensory & motor blockade & decreases the need for a rescue analgesic in the postoperative period, but it has no effect on when sensory & motor blockade first occurs. The ideal dosage of dexamethasone for chronic brachial plexus block & the precise mechanism underlying this action require more research.

Keywords*: Dexamethasone adjuvant, Bupivacaine, Supraclavicular brachial plexus block, Postoperative analgesia, Ultrasound-guided regional anesthesia.*

INTRODUCTION

"Pain is a perfect misery, the worst of all evils; excessively overturns all patience."

Given that pain is as old as mankind itself—possibly even older—Milton's grievance in Paradise Lost is certainly one that people have heard throughout history. One could argue that suffering is a necessary component of all conscious life. Pain is a very complicated feeling that is hard to describe & equally hard to quantify accurately & objectively. According to the International Association for the Study of Pain, pain is "an unpleasant sensory& emotional experience linked toactual or potential tissue damage or described in terms of such damage."

Millions of people worldwide have surgery each year, & providing the best care possible for these patients depends on efficient pain management. The prevention of pain is actually the main goal of anaesthesia. Regional nerve block reduces the stress involved in tracheal intubation & laryngoscopy & helps prevent the negative effects of anaesthetic medications used in general anaesthesia. Patients with cardio-respiratory comorbidities benefit most from lowering the stress response & using fewer anaesthetic medications.[1]

Dr. Carl Koller is credited with creating regional anaesthesia when he applied a cocaine solution for topical corneal anaesthetic to patients having eye surgery in 1884. With the development of localized anaesthetics to reduce pain during surgery, a new era in medicine began. The famous surgeon Halstead proved the next year, in 1885, that injecting a cocaine solution around nerve pathways could totally eradicate pain & other feelings from the targeted area, close to what is now Bellevue Hospital in New York City.

One popular regional nerve block method for perioperative anaesthesia & analgesia in upper extremity procedures is brachial plexus block. For procedures below the shoulder joint, the supraclavicular approach is thought to be the most straightforward & dependable technique, despite the fact that there are other methods to the brachial plexus block.Although they offer a shorter duration of postoperative analgesia, local anaesthetics alone for supraclavicular brachial plexus block provide effective operational circumstances. Numerous adjuvants, including opioids, clonidine, neostigmine, & midazolam, have been added to local anaesthetics in brachial plexus block in an attempt to produce a faster, denser, & longer block; however, the findings have been either conflicting or linked to adverse consequences. [2].

Steroids are well known for their strong analgesic & anti-inflammatory effects. They reduce inflammation by blocking phospholipase A2. It has been demonstrated that local administration of methylprednisolone inhibits transmission in nociceptive C-fibers while leaving myelinated A-beta fibers unaffected. [3]. The fact that the impact is reversible indicates that steroids have a direct influence on the membrane. Furthermore, ectopic neuronal discharge can be suppressed by corticosteroids. [4.]

It has been documented that the onset & duration of sensory & motor blocks are impacted by the combination of local anaesthetics & glucocorticoid perineural injection.[2, 5, 7] In brachial plexus block, dexamethasone, a very strong & specific glucocorticoid, has been investigated as an adjuvant to local anaesthetic combinations. Using 8 mg of dexamethasone, several investigations have demonstrated varying effects on the onset but longer duration of motor block & analgesia[1, 2, 5, 6, 8-13.]

Given this, the current study intends "to assess the impact of 8 mg of dexamethasone as an adjuvant to 0.25% bupivacaine in supraclavicular brachial plexus block, with a particular focus on the length & start time of both motor & sensory blocks." nociceptive C-fibers while leaving myelinated A-beta fibers unaffected. [3]. The fact that the impact is reversible indicates that steroids have a direct influence on the membrane. Furthermore, ectopic neuronal discharge can be suppressed by corticosteroids. [4.]

MATERIALS AND METHOD:

STUDY AREA: Postoperative analgesia with bupivacaine and dexamethasone in ultrasound guided supraclavicular

brachial plexus block.

STUDY POPULATION: "This prospective study comprised 60 patients in compliance with ASA physical study of class 1 and 2 provided for below mid arm orthopedic surgeries in patients attending preanesthetic checkup clinic of Nalanda Medical College and Hospital, meeting the following inclusion and exclusion criteria"-

Inclusion Criteria:
1. "Adult patients of either sex, aged 18 – 60 years.
2. ASA physical status I or II
3. Posted for elective orthopedic surgeries of elbow, forearm& hand under supraclavicular brachial plexus block".

Exclusion Criteria:
1. Patient refusal
2. ASA physical status III and more
3. Patients with history of peptic ulcer disease, diabetes mellitus, hepatic or renal failure.
4. Patients with history of significant neurological, psychiatric, neuromuscular and cardiovascular disease.
5. Patients receiving psychotropic drugs, chronic analgesic therapy.
6. Pregnancy.
7. Known hypersensitivity to any of the given drugs
8. Patients allergic to local anesthetics.
9. Infection at the site of infection.

STUDY PERIOD: It was started, after getting permission from institutional ethics committee & approval from March 2023 to April 2025.

SAMPLE SIZE: The primary outcome, the duration of sensory analgesia, was used to calculate the sample size. For supraclavicular brachial plexus block, Hickey R et al. (1992) showed that 40 mL of 0.25% bupivacaine produced an analgesic duration of 11.6 hours on average, with a standard deviation of 3.2 (11.6 ± 3.2). In order to demonstrate that the duration of analgesia (sensory block) would be increased by 20% by adding 8 mg of dexamethasone to 38 mL of 0.25% bupivacaine, we determined that 27 patients per group would be required to generate a statistically significant difference between the groups with $\alpha = 0.05$ & 80% power. We enrolled 30 patients in each group to account for any patient dropouts.

SAMPLE DESIGN: Using the lottery approach, patients were assigned at random to either group A or group B.
Group A (n=30): 2 mL of dexamethasone (8 mg) & 28 mL of 0.25% bupivacaine were used to achieve a supraclavicular brachial plexus block. Group B (n=30): 2 mL of 0.9% normal saline & 28 mL of 0.25% bupivacaine were used for the supraclavicular brachial plexus block.

The research design is a double-blind, randomised, prospective study.

Characteristics to be examined:
Patient demographics, including age, sex, height, weight, & ASA status.
1. The length of the procedure.
2. Features of the block:
- Sensory block onset time;
- Motor block onset time;
- Sensory block duration;
- Motor block duration.
3. The amount of intramuscular diclofenac sodium injection needed for post-operative rescue pain management within the first 24 hours.
4. Seizures, bradycardia (heart rate < 60 beats per minute), hypotension (down in mean arterial pressure > 20% of baseline), dysrhythmia, Horner's syndrome, clinically severe pneumothorax, & other complications are all common.
5. Assess the haemodynamic effects of adjuvant with bupivacaine.

STUDY AIDS
- A written form of informed consent.
- 20 cc disposable syringe, IV fluid, transfusion set, & IV cannula.

Among the medications used for cardiac resuscitation finished, & then every 30 minutes until the end of the procedure for the first twelve hours, & then every hour until the block had disappeared entirely.

Each nerve's sensory blockage was measured by pinprick & graded on a 3-point scale, where 2 denoted normal sensibility & 1 denoted lack of pinprick sensation. 0 indicates a lack of light touch sensitivity. Thumb abduction & wrist extension (radial nerve), thumb adduction & hand ulnar deviation (ulnar nerve), elbow flexion in supination (musculocutaneous), & thumb opposition & wrist flexion (median nerve) were used to test motor block. The results were recorded on a 3-point scale, with 2 denoting normal movement, 1 are Bupivacaine 0.25%, Inj. Dexamethasone sodium phosphate (4 mg/mL), & Inj. Diclofenac sodium (rescue analgesic).

- An ultrasound device
- Anaesthetic workstation;
- Emergency medication and resuscitation cart;
- Stimuplex® A needle: a short, bevelled, insulated, 2- inch, 22-gauge needle, and Stimuplex® Dig RC nerve stimulator.
- The analogue visual scale.
- A multichannel monitor that tracks peripheral oxygen saturation (SpO2), non-invasive blood pressure (NIBP), heart rate, respiration rate, & electrocardiography (ECG).

STUDY TECHNIQUES:
Patients undergoing elective orthopaedic surgeries of the elbow, forearm, & hand at Nalanda Medical College & Hospital's pre-anaesthesia checkup clinic were evaluated for study eligibility based on inclusion & exclusion criteria after receiving approval from the Institutional Ethics Committee. Following a thorough description of the study's methodology & anticipated results in their native tongue, all willing participants provided written informed permission.

Preoperative examination: Every patient had a comprehensive preoperative examination the day before surgery, which included counselling & a follow-up anaesthetic assessment. The following topics were covered in the evaluation:

A thorough medical history was obtained from each patient, with particular attention paid to symptoms like dyspnoea, asthma attacks, bleeding disorders, drug allergies, past surgeries & anaesthesia experiences, seizures or episodes of unconsciousness, inherited neurological disorders, addiction, long-term medication use, & any previous hospital stays.

ASSESSMENT OF SENSORY & MOTOR BLOCKADE
The sensory blockade of the radial, median, musculocutaneous, medial cutaneous nerve of the arm & forearm, & ulnar nerves (C5-T1 dermatomes) as well as the motor blockade of the radial, median, musculocutaneous, & ulnar nerves were evaluated every two minutes until the local anaesthetic (bupivacaine ± dexamethasone) injection was paresis, & 0 denoting absent movement.

The time between the conclusion of the local anaesthetic injection & the loss of pinprick feeling in every nerve distribution was referred to as the "onset time of sensory block." The time interval between the conclusion of the local anaesthetic injection & paresis (motor score = 1) in every nerve distribution was used to determine the onset time of motor blockage.

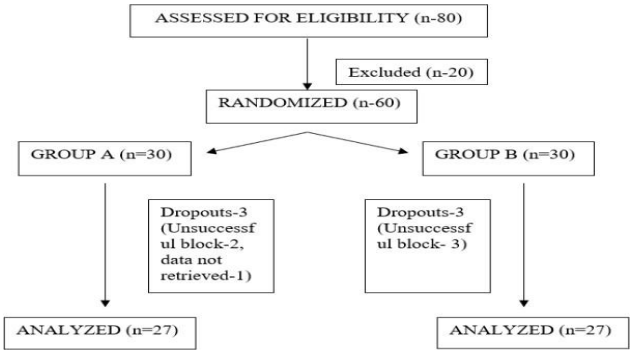
The amount of time between the start of sensory block & the first postoperative pain was known as the duration of sensory block. The time between the start of motor block & full recovery of motor functions was referred to as the duration of motor block. The anaesthesiologist who evaluated the motor & sensory blockage was blind to the medication & group assignment.

Within 30 minutes of receiving a local anaesthetic injection, muscle paresis & loss of pinprick sensation in each of the radial, ulnar, median, & musculocutaneous nerve distributions were deemed to be indicators of a successful block. Ineffective block patients were not allowed to participate in the trial. Surgery started if the block was deemed sufficient after 30 minutes.

Every patient was monitored for side effects such plan, or anaesthesia. Following initial randomization, six patients were deemed dropouts & were not statistically analyzed (five patients had unsuccessful brachial plexus blocks, & one patient's data was not fully recovered). For the final analysis, the data from the remaining 54 patients was evaluated.

seizures, hypotension, bradycardia, dysrhythmia, Horner's syndrome, & clinically significant pneumothorax, which could be brought on by the local anaesthetic itself or the block technique

RESULTS: -
Between March 2023 & April 2025, 80 patients were first evaluated for trial eligibility; 60 of these patients were randomly assigned to receive research medications. Twenty patients were excluded from this trial due to their refusal, a change in the surgical



Consort diagram of the study"

"Table 1: Demographic parameters &duration of surgery"

Test done: Independent samples t-test, #Chi-square test.

Demographic data	Group A	Group B	P value
Age (years)	30.30 ± 10.37	31.04 ± 10.56	0.796
Sex- M/F	17/10	16/11	0.780#
Height (cm)	161.48 ± 5.56	160.70 ± 5.59	0.611
Weight (kg)	61.19 ± 5.12	60.67 ± 5.41	0.719
ASA status- I/II	20/7	18/9	0.551#
Duration of surgery (minute)	118.67 ± 17.45	119.56 ± 18.50	0.857

Regarding the patients' age, height, weight, & length of surgery, Table 1 demonstrates that there is no statistically significant difference between the groups (Independent samples t-test; p >0.05). With regard to sex & ASA status, it also demonstrates that there is no statistically significant difference between the groups (Chi-square test; p >0.05). Therefore, both groups were similar in terms of the length of operation

"Table 2: Onset time of sensory & motor block"

Test done: Independent samples t-test.

Onset time	Group A (mean ± SD)	Group B (mean ± SD)	P value
Onset time of sensory block (minute)	18.26 ± 1.25	18.70 ± 1.26	0.201
Onset time of motor block (minute)	19.96 ± 1.28	20.26 ± 1.28	0.402

"Table 3: Duration of sensory & motor block"

Test done: Independent samples t-test.

Duration of block	Group A (mean ± SD)	Group B (mean ± SD)	P value
Duration of sensory block (minute)	1091.11± 107.42	605.37 ± 58.60	**0.000**
Duration of motor block (minute)	846.67 ± 102.09	544.07 ± 55.40	**0.000**

Table 3 demonstrates that group A (dexamethasone group) had sensory & motor blockage for a considerably longer period of time than group B (control group). There is a statistically significant difference in block durations between the two groups (p value < 0.001).

"Table 4: Post-operative rescue analgesic requirement (Number of intramuscular diclofenac sodium injection) in first 24 hours"

Test done: Chi- square test.

Group	No. of injection diclofenac in first 24 hours of postoperative period			p value
	1	2	3	
Group A	25	2	0	0.000
Group B	0	24	3	

"Table 5: Incidence of Horner's syndrome"

Test done Chi- square test.

Group	Horner's syndrome		P value
	No	Yes	
Group A	15	12	0.783
Group B	16	11	

Postoperative Pain Assessment (VAS Scores)

Notable trends in postoperative pain perception emerged when comparing VAS scores between the group receiving Bupivacaine alone and the group receiving Bupivacaine combined with Dexamethasone across multiple time intervals. At the initial time point (0 minutes), both groups reported identical mean pain scores (2.53 ± 0.78 vs. 2.53 ± 0.82), with a p-value of 1.000, indicating no difference in baseline pain levels. In the early postoperative phase (10 to 30 minutes), both groups exhibited a rapid decrease in VAS scores, with no statistically significant differences observed ($p > 0.05$), indicating comparable early analgesic effects From the 12th hour postoperatively onward, clear differences in pain perception began to appear between the two groups. The group receiving dexamethasone exhibited a significantly lower VAS score at 12 hours (1.97 ± 0.77) compared to the bupivacaine-only group (2.63 ± 0.77), with a p- value of 0.001. This pattern persisted at later time points: at 16 hours (1.77 ± 0.77 vs. 2.63 ± 0.77; $p = 0.0005$), 20 hours (1.57 ± 0.63 vs. 2.73 ± 0.83; $p = 0.0007$), and 24 hours (0.73 ± 0.52 vs. 2.70 ± 0.75; $p = 0.0004$). These consistent findings highlight those patients in the dexamethasone group experienced significantly reduced pain during the later postoperative period, suggesting a prolonged analgesic effect attributable to the addition of dexamethasone. and 24 hours (0.73 ± 0.52 vs. 2.70 ± 0.75; $p = 0.0004$).

These consistent findings highlight those patients in the dexamethasone group experienced significantly reduced pain during the later postoperative period, suggesting a prolonged analgesic effect attributable to the addition of dexamethasone.

HAEMODYNAMIC PARAMETERS SYSTOLIC BLOOD PRESSURE (SBP):

Systolic blood pressure (SBP) measurements were compared between the Bupivacaine-alone group and the group receiving Bupivacaine with Dexamethasone at multiple postoperative time points, revealing no statistically significant differences throughout the 24-hour monitoring period. At baseline (0 minutes), the mean SBP was 113.13 ± 10.44 mmHg in the Bupivacaine group and 110.60 ± 10.76 mmHg in the combination group, with a p-value of 0.359, indicating no significant difference.

Similarly, during the early postoperative period (10, 20, and 30 minutes), SBP readings remained comparable between the two groups.

In the later postoperative phase (4, 8, 12, 16, 20, and 24 hours), no significant differences in SBP were observed. For example, at 4 hours, SBP measured 124.57 ± 9.59 mmHg in the Bupivacaine group versus 122.57 ± 10.75 mmHg in the combination group ($p = 0.450$). At 24 hours, the values were nearly identical—125.36 ± 11.4 mmHg and 125.80 ± 10.74 mmHg, respectively ($p = 0.880$).

DIASTOLIC BLOOD PRESSURE:
There were no statistically significant differences in diastolic blood pressure (DBP) between the Bupivacaine Alone group and the Bupivacaine with Dexamethasone group at any time during the observation period. At baseline (0 minutes), the mean DBP was 80.43 ± 4.69 mmHg in the Bupivacaine group and 79 ± 5.15 mmHg in the Dexamethasone group, with a p-value of 0.265. Over the subsequent 30 minutes, both groups showed minor variations in DBP: 73.50–76.03 mmHg in the Bupivacaine group and 76.00–77 mmHg in the Dexamethasone group. Throughout this interval, all p-values remained above 0.05, indicating no statistically significant differences, although a trend toward significance was observed at the 30-minute mark (p = 0.076).

Between 4 and 24 hours after administration, diastolic blood pressure (DBP) remained relatively stable and comparable in both groups.

In the Bupivacaine group, DBP ranged from 75.33 ± 5.10 to 77.00 ± 5.49 mmHg, while the Dexamethasone group consistently maintained DBP around 77.00 ± 5.15 mmHg. None of the differences observed during this period were statistically significant, with all p-values exceeding 0.2

Heart Rate (HR): A comparison of heart rate (HR) between the two groups—those receiving Bupivacaine alone and those receiving Bupivacaine combined with Dexamethasone—at various postoperative time points showed no statistically significant differences at any interval.

At baseline (0 minutes), the mean HR was 97.60 ± 6.81 bpm in the Bupivacaine group and 98.26 ± 6.40 bpm in the Dexamethasone group (p = 0.697). At 10 minutes, the HR values were 98.30 ± 6.97 bpm and 97.60 ± 5.99 bpm, respectively (p = 0.696). At 20 minutes, HR was 98.80 ± 7.26 bpm

Respiratory Rate (RR):
The respiratory rate (RR) of patients in both the Bupivacaine alone group and the Dexamethasone with Bupivacaine group was monitored at multiple postoperative time points. At baseline (0 minutes), the RR in the Dexamethasone group was significantly higher (11.97 ± 0.67) compared to the Bupivacaine group (11.40 ± 1.04), with a statistically significant p-value of 0.015.

However, at all subsequent time points—10, 20, and 30 minutes, as well as at 4, 8, 12, 16, 20, and 24 hours—there were no statistically significant differences between the two groups (all p-values > 0.05). Overall, respiratory rates remained relatively stable and comparable between groups throughout the postoperative period

DISCUSSION
Pain is an inherent part of human life. Despite notable improvements in perioperative pain control, a significant number of patients still endure inadequate analgesia. When surgical pain is not appropriately addressed, it can contribute to the development of chronic pain syndromes.

Every surgical patient is susceptible to perioperative pain, which can adversely affect both physical health & psychological well-being. For many, the fear of experiencing pain after surgery may surpass concerns about the surgery itself. Hence, it is the ethical responsibility of perioperative care providers—including anaesthesiologists & surgeons—to ensure effective postoperative analgesia. This not only improves patient outcomes but also mitigates the body's adverse physiological responses to pain.

Regional nerve blocks serve as a reliable technique for achieving surgical anaesthesia & postoperative pain relief. These blocks also help avoid the stress responses associated with laryngoscopy & tracheal intubation, along

with minimizing the side effects of general anaesthesia. Among the various options available, the supraclavicular brachial plexus block is a frequently employed regional technique for perioperative anaesthesia & analgesia in upper limb surgeries.

Although local anaesthetics alone provide adequate operative conditions during a supraclavicular block, the resultant analgesia is often short-lived. To address this limitation, a wide range of adjuvants such as opioids, clonidine, neostigmine, & midazolam have been tested in combination with local anaesthetics. Nevertheless, outcomes with these agents have been inconsistent & occasionally associated with side effects.

Glucocorticoids, recognized for their potent analgesic & anti-inflammatoryactions, have been used as adjuvants in peripheral nerve blocks. When administered perineurally with local anaesthetics, these agents can influence both the onset & the duration of sensory & motor blockades.

This randomized, double-blinded clinical study evaluates the efficacy of 8 mg dexamethasone as an adjuvant to 38 mL of 0.25% bupivacaine in supraclavicular brachial plexus blocks, focusing on sensory & motor block onset & duration, & the requirement for diclofenac sodium as rescue analgesia postoperatively. Group A (dexamethasone group) received 38 mL of 0.25% bupivacaine with 2 mL dexamethasone (8 mg), while Group B (control group) was administered 38 mL of 0.25% bupivacaine with 2 mL of 0.9% saline.

Demographic characteristics & surgical durations were comparable between groups. The onset of sensory block was similar in both groups (18.26 ± 1.25 min in the dexamethasone group vs. 18.70 ± 1.26 min in the control group; $p = 0.201$), as was the onset of motor block (19.96 ± 1.28 min vs. 20.26 ± 1.28 min; $p = 0.402$), consistent with findings by Parrington SJ et al.[11] & Movafegh A et al.[9].

However, contrary to our findings, Golwala MP et al.[2] & Yadav RK et al.[8] reported a significantly quicker onset of sensory & motor block with dexamethasone. These discrepancies could stem from differences in assessment methods, higher doses of anaesthetic, or the addition of agents like epinephrine.

In our trial, the dexamethasone group demonstrated a significantly prolonged sensory block duration (1091.11 ± 107.42 min) compared to the control group (605.37 ± 58.60 min; $p < 0.001$).

Similarly, motor block duration was notably extended in the dexamethasone group (846.67 ± 102.09 min) relative to controls (544.07 ± 55.40 min; $p < 0.001$). These observations are in line with previous studies by Movafegh A et al.[9], Shrestha BR et al.[1], Vieira PA et al.[10], & Tandoc MN et al.[13].

In our study, patients in the dexamethasone group experienced an average sensory block duration of 18.18 hours & a motor block duration of 14.1 hours. Tandoc MN et al.[13] found median durations of sensory & motor block to be 24.28 hours & 25.2 to 39.2 hours, respectively, when dexamethasone was combined with bupivacaine. Vieira PA et al.[10] reported similar findings, possibly due to the inclusion of adjuncts like epinephrine or clonidine & a higher concentration (0.5%) of bupivacaine.

The mean motor block onset & duration in our control group are consistent with those reported by Tawfic TA et al.[46], while the sensory block onset & duration align with Hickey R et al.[47]. Additionally, patients in the dexamethasone group required significantly fewer diclofenac injections within the first 24 hours postoperatively ($p < 0.001$), likely due to the extended sensory blockade. This aligns with results from Tandoc MN et al.[13] & Vieira PA et al.[10].

The incidence of Horner's syndrome was statistically similar in both groups (12 cases in the dexamethasone group vs. 11 in the control group; $p = 0.783$). The overall incidence of Horner's syndrome in our study (42.6%) corresponds with data from Hickey R et al.[48] & Yang CW et al.[49]. We used 38 mL of 0.25% bupivacaine (95 mg total), which falls within the recommended dose of 2 mg/kg & volume range (30–50 mL) for brachial plexus blocks[16]. The 8 mg dexamethasone dose was chosen based on previous studies indicating its safe perineural use & its established efficacy in managing postoperative nausea[12].

The precise mechanism through which dexamethasone prolongs nerve block remains unclear, but it is believed to exert a local rather than systemic effect[44]. Possible mechanisms include activation of glucocorticoid receptors on nociceptive C fibers[3] & enhancement of potassium channel activity in excitable cells[37],[38].

Although concerns have been raised regarding the neurotoxicity of perineural steroids, textbooks on regional anaesthesia & pain medicine describe the safe use of dexamethasone at doses ranging from 4 to 12 mg via intravenous, perineural, & epidural routes[11]. Reports of neurotoxicity have typically involved steroid preparations containing benzyl alcohol, polyethylene glycol, or particulate matter[51]. Dexamethasone sodium phosphate is a non-particulate formulation free of these substances. Compared to other corticosteroids such as hydrocortisone & triamcinolone, dexamethasone caused minimal or no nerve damage in animal studies involving extrafascicular or intrafascicular administration. Further in vitro & in vivo research confirms that locally applied corticosteroids do not result in lasting changes to nerve structure, function, or electrical properties[52],[45].

Lastly, the block failure rate in our study was 8.3%, which is consistent with prior studies that utilized nerve stimulator-guided supraclavicular brachial plexus block techniques[50],[53].

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