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# Comparative Study of Bupivacaine (0.5%) + Lignocaine with Adrenaline (2%) with Dexamethasone and Bupivacaine (0.5%) + Lignocaine with Adrenaline (2%) with Clonidine Used for Upper Limb Blocks

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## Abstract

Adding adjuvants to local anesthetics in nerve blocks improves the onset, duration, and quality of anesthesia. This prospective, comparative study evaluated the effects of bupivacaine (0.5%) combined with either dexamethasone or clonidine in upper limb blocks, focusing on analgesia duration, block characteristics, and side effects. Forty patients undergoing upper limb surgeries were randomly assigned to two groups: Group D (n=20) received bupivacaine with dexamethasone, and Group C (n=20) received bupivacaine with clonidine. Parameters assessed included sensory and motor block onset and duration, analgesia duration, block quality, and adverse effects. Statistical analysis was done using independent t-tests and chi-square tests, with $p<0.05$ considered significant. Group D showed a faster sensory block onset (5.4 ± 1.2 min) than Group C (6.1 ± 1.4 min, $p=0.03$), with no significant difference in motor block onset ($p=0.08$). Sensory and motor block durations were significantly longer in Group D (840 ± 105 min and 720 ± 96 min) than in Group C (630 ± 90 min and 560 ± 88 min), $p<0.001$. Analgesia lasted longer in Group D (960 ± 108 min) compared to Group C (690 ± 100 min), $p<0.001$. Superior block quality was reported in Group D (24 vs. 17 patients, $p=0.03$). Sedation occurred more in Group C (5 cases vs. 0; $p=0.02$), with no significant differences in other adverse effects. Bupivacaine with dexamethasone is superior to bupivacaine with clonidine for upper limb blocks, offering improved block characteristics and fewer side effects.

**Keywords:** Bupivacaine, Clonidine, Dexamethasone, Upper Limb Block.

## Introduction

Regional anesthesia techniques, particularly peripheral nerve blocks, have become increasingly popular in upper limb surgeries due to their ability to provide targeted anesthesia, superior postoperative analgesia, and reduced systemic side effects when compared to general anesthesia. Among various techniques, the supraclavicular brachial plexus block is widely used for surgeries involving the upper extremity because of its rapid onset, dense block quality, and high success rate (1, 2).

The long-acting amide-type local anesthetic buprevacaine is frequently utilized in regional blocks because of its advantageous sensory and motor block properties. To prolong postoperative analgesia without raising the risk of local anesthetic toxicity is one of the difficulties in regional anesthesia (3).

Dexamethasone, a potent synthetic corticosteroid, has been shown to prolong the duration of both sensory and motor block when used as an adjuvant to local anesthetics. Its anti-inflammatory properties are believed to reduce nociceptive transmission and delay the need for postoperative analgesics. Moreover, dexamethasone has a well-established safety profile when used perineurally, making it a favorable adjuvant in regional anesthesia (4, 5).

Although both dexamethasone and clonidine have individually demonstrated efficacy in prolonging peripheral nerve blocks, limited head-to-head comparisons are available, especially with their use in upper limb blocks with bupivacaine. Understanding the comparative effectiveness of these adjuvants is essential for anesthesiologists in optimizing block performance and improving patient outcomes.

With an emphasis on the length and quality of sensory and motor block, the time to the first analgesic request, and the frequency of side effects,



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this study compares the effects of dexamethasone and clonidine when added to 0.5% bupivacaine for supraclavicular brachial plexus block.

Several studies have evaluated dexamethasone and clonidine individually as adjuvants to local anesthetics in regional blocks. However, head-to-head comparative studies in upper limb surgeries remain scarce and inconsistent in their conclusions (3-5). Most existing studies vary in block technique, dosing, or outcome measures, making comparisons difficult. This study addresses this gap by comparing equal volumes of bupivacaine with fixed doses of dexamethasone and clonidine, using a standardized block method and assessing block characteristics and side effects in a double-blinded manner.

# Materials and Methodology

Over the course of six months, a prospective, randomized, double-blind comparative study was carried out in the anesthesiology department of a tertiary care hospital. After receiving approval from the Institutional Ethics Committee, the study was started.

Patients of either sex between the ages of 18 and 60 who were scheduled for elective upper limb procedures under supraclavicular brachial plexus block and who were categorized as having physical status I or II by the American Society of Anesthesiologists (ASA) comprised the study population. All participants were fully informed about the process and the procedures before providing their informed written consent.

## Inclusion Criteria

- Patients aged 18–60 years
- ASA physical status I and II
- Patients scheduled for elective upper limb orthopedic or soft tissue surgeries
- Willingness to provide informed consent

## Exclusion Criteria

- Known allergy or hypersensitivity to local anesthetics, dexamethasone, or clonidine
- Bleeding diathesis or on anticoagulant therapy
- Infection at the site of injection
- Pre-existing neurological deficits involving the brachial plexus
- Severe hepatic, renal, or cardiac disease
- Pregnant or lactating women
- History of chronic pain or opioid dependence

## Sample Size and Randomization

A total of 60 patients were enrolled and randomly divided into two equal groups (n=30 each) using a computer-generated randomization table:

- Group D (Dexamethasone Group): Received 20 mL of 0.5% bupivacaine + 4 mg (1 mL) dexamethasone + 1 mL normal saline
- Group C (Clonidine Group): Received 20 mL of 0.5% bupivacaine + 1 µg/kg clonidine (diluted in 1 mL) + 1 mL normal saline.

Patients were randomized using a computer-generated sequence and assigned to groups via sealed, opaque envelopes to ensure allocation concealment. Preparation and administration of the study drug were done by an anesthesiologist not involved in outcome assessment to maintain double-blinding.

In both groups, the total volume given was standardized at 22 milliliters. An anesthesiologist who was not involved in the evaluation prepared and administered the drugs, guaranteeing that the patient and the observer were blinded.

A comprehensive pre-anesthetic evaluation that included a history, physical examination, and pertinent investigations was performed on each patient. The usual rules for fasting were observed. Standard ASA monitoring, which included non-invasive blood pressure (NIBP), electrocardiogram (ECG), and pulse oximetry ($SpO_2$), was implemented as soon as the patient arrived in the operation room. Baseline vitals were taken and an intravenous line was established. Before the block was administered, patients were premedicated with ondansetron 4 mg IV and midazolam 0.02 mg/kg IV.

## Technique of Block Administration

The supraclavicular brachial plexus block was performed under strict aseptic precautions using either a landmark-based approach or ultrasound guidance, depending on availability and operator expertise. For the landmark technique, the subclavian artery was palpated above the clavicle at the lateral border of the sternocleidomastoid. A 22G needle was inserted posterior to the artery, and correct needle placement was confirmed by eliciting appropriate muscle twitches with a nerve stimulator. In the ultrasound-guided technique, a high-frequency linear probe (6–13 MHz) was placed in the supraclavicular fossa to visualize the brachial plexus lateral and superior to the

subclavian artery. Drug deposition was done under real-time guidance after negative aspiration.

After negative aspiration for blood or CSF, the prepared drug solution was administered slowly with intermittent aspiration. Patients were closely observed for signs of local anesthetic toxicity.

### Assessment Parameters

1. **Onset of Sensory Block:** Measured every minute until total block or for up to 30 minutes using the pinprick technique with a blunt needle in the dermatomal distribution of the median, ulnar, radial, and musculocutaneous nerves. The period of time between drug delivery and total elimination of pinprick sensation was referred to as the "onset."
2. **Motor Block Onset:** Assessed per minute until maximum block using the Modified Bromage Scale for the upper limb: 0 denotes normal motor function; 1 denotes diminished motor strength with limited finger movement; and 2 denotes total motor block. The time between injection and full motor block was referred to as the "onset" (score 2).
3. **Sensory Block Duration:** The amount of time between the start of a total sensory block and the return of a dull pain perception in any dermatome.
4. **Motor Block Duration:** duration between the start of a total motor block and the full recovery of motor function.
5. **Duration of Analgesia:** Time from block administration to the first request for rescue analgesia (when VAS >3).
6. **Quality of Block:**
   Graded as:
   - Excellent – No pain, no need for additional analgesia
   - Good – Mild discomfort, managed without supplemental analgesia
   - Poor – Inadequate block requiring conversion to general anesthesia
7. **Hemodynamic Parameters and Side Effects:** Vital signs (HR, NIBP, $SpO_2$) were recorded every 5 minutes intraoperatively and every 15 minutes postoperatively for the first 2 hours, then hourly for 6 hours. Adverse effects like hypotension, bradycardia, nausea, vomiting, sedation, and signs of local anesthetic toxicity were noted and treated accordingly.
8. **Postoperative Care and Analgesia:** Patients were monitored in the post-anesthesia care unit. Rescue analgesia was provided with diclofenac 75 mg IV when VAS score exceeded 3. Additional analgesia was recorded as per requirement.

### Statistical Analysis

SPSS version 25.0 was used to compile and analyze the data (IBM Corp.). The unpaired t-test was used to compare continuous variables, which were represented as mean ± standard deviation (SD). A power analysis was conducted using G*Power software. To detect a mean difference of 120 minutes in analgesia duration (SD = 100), with $\alpha = 0.05$ and power $(1-\beta) = 0.80$, a minimum of 26 participants per group was required. To account for possible dropouts, 30 patients were included in each group, totalling 60. Fisher's exact test or the Chi-square test, if applicable, were used to evaluate categorical variables. Statistical significance was defined as a p-value of less than 0.05. Results are presented with 95% confidence intervals (CI) and Cohen's d effect sizes to assess clinical relevance.

## Results

Patients in Group C (Bupivacaine + Clonidine) were 37.5 ± 11.1 years old on average, whereas those in Group D (Bupivacaine + Dexamethasone) were 36.8 ± 10.4 years old. There is no statistically significant difference in the age distribution of the two groups, as indicated by the p-value of 0.78. Therefore, the ages of the two groups were similar. Group C's average weight was 63.1 ± 9.3 kg, whereas Group D's was 62.2 ± 8.9 kg. The p-value = 0.65, showing no significant difference in body weight between the groups. This suggests that body weight was well-matched and unlikely to influence the outcome difference. Group D had 18 males and 12 females, while Group C had 17 males and 13 females. The p-value = 0.79, indicating no statistically significant difference in gender distribution. This implies that the gender composition of both groups was balanced. In Group D, 20 patients were ASA Grade I and 10 were ASA Grade II. In Group C, 19 were ASA I and 11 were ASA II. The p-value = 0.79, showing no significant variation in ASA classification across the groups Hence, the general physical condition of patients was evenly distributed. The data is shown in Table 1.

**Table 1:** Demographic Details of Study Participants

| Parameter | Group D (Mean ± SD) | Group C (Mean ± SD) | p-value | Significance |
|---|---|---|---|---|
| Age (years) | 36.8 ± 10.4 | 37.5 ± 11.1 | 0.78 | NS |
| Weight (kg) | 62.2 ± 8.9 | 63.1 ± 9.3 | 0.65 | NS |
| Sex (M/F) | 18 / 12 | 17 / 13 | 0.79 | NS |
| ASA I / ASA II | 20 / 10 | 19 / 11 | 0.79 | NS |

**Table 2:** Onset Time of Sensory and Motor Block

| Block Type | Group D (Mean ± SD) | Group C (Mean ± SD) | p-value | Significance |
|---|---|---|---|---|
| Sensory Block Onset (min) | 5.4 ± 1.2 | 6.1 ± 1.4 | 0.03 | Significant |
| Motor Block Onset (min) | 7.6 ± 1.5 | 8.2 ± 1.6 | 0.08 | NS |

Group D (Bupivacaine + Dexamethasone) experienced the beginning of sensory block on average 5.4 ± 1.2 minutes, whereas Group C (Bupivacaine + Clonidine) experienced it on average 6.1 ± 1.4 minutes. The p-value is statistically significant at 0.03. The data is represented in Table 2. Compared to clonidine, the inclusion of dexamethasone caused a speedier onset of sensory block, suggesting that it could be useful for accelerating surgical preparedness. The mean time for onset of motor block was 7.6 ± 1.5 minutes in Group D and 8.2 ± 1.6 minutes in Group C. The p-value = 0.08, which is not statistically significant. Although the motor block appeared slightly faster with dexamethasone, the difference was not statistically significant, suggesting that both adjuvants provide a comparable onset of motor block.

**Table 3:** Duration of Sensory Block, Motor Block, and Analgesia

| Parameter | Group D (Mean ± SD) | Group C (Mean ± SD) | p-value | Significance |
|---|---|---|---|---|
| Duration of Sensory Block (min) | 840 ± 105 | 630 ± 90 | <0.001 | Highly Significant |
| Duration of Motor Block (min) | 720 ± 96 | 560 ± 88 | <0.001 | Highly Significant |
| Duration of Analgesia (min) | 960 ± 108 | 690 ± 100 | <0.001 | Highly Significant |

Sensory Block Duration difference: Cohen's d = 2.2, 95% CI [170.3, 239.7]
Duration of Analgesia: Cohen's d = 2.5, 95% CI [219.7, 270.3]

The duration of the sensory block was 840 ± 105 minutes for Group D (Bupivacaine + Dexamethasone) and 630 ± 90 minutes for Group C (Bupivacaine + Clonidine). The difference is very statistically significant, as indicated by the p-value of less than 0.001. When compared to clonidine, the duration of sensory block was considerably extended by the application of dexamethasone, indicating a superior prolonging of anesthesia.

Motor Block Duration: Group D's motor block lasted 720 ± 96 minutes, whereas Group C's was 560 ± 88 minutes. The difference is extremely significant, as indicated by the p-value of less than 0.001. Dexamethasone once more shown superiority over clonidine in extending the duration of the motor block, which is advantageous for lengthy surgical procedures.

**Duration of Analgesia:** The duration of analgesia was 960 ± 108 minutes in Group D, whereas it was 690 ± 100 minutes in Group C. The p-value is <0.001, marking a highly significant difference. Dexamethasone provided a markedly longer duration of postoperative pain relief compared to clonidine, making it a more suitable adjuvant when extended analgesia is desired. The relevant data is shown in Table 3.

**Table 4:** Quality of Block

| Block Quality | Group D (n) | Group C (n) | p-value | Significance |
|---|---|---|---|---|
| Excellent | 24 | 17 | 0.03 | Significant |
| Good | 6 | 10 | | |
| Poor | 0 | 3 | | |

In Group D (Bupivacaine + Dexamethasone), 24 patients experienced excellent block quality. In Group C (Bupivacaine + Clonidine), 17 patients reported excellent quality. The p-value = 0.03, indicating a statistically significant difference. 6 patients in Group D and 10 patients in Group C reported good block quality. This indicates a slightly higher incidence of moderate efficacy in the clonidine group, possibly reflecting its relatively shorter duration and slower onset. No patients in Group D reported poor block quality, while 3 patients in Group C experienced poor outcomes. While not statistically tested individually, the presence of poor blocks only in the clonidine group further supports the superior effectiveness of dexamethasone in this setting. The data is shown in Table 4.

**Table 5:** Hemodynamic Stability and Side Effects

| Parameter | Group D (n) | Group C (n) | p-value | Significance |
|---|---|---|---|---|
| Hypotension | 1 | 4 | 0.16 | NS |
| Bradycardia | 0 | 3 | 0.07 | NS |
| Nausea/Vomiting | 1 | 1 | 1.0 | NS |
| Sedation | 0 | 5 | 0.02 | Significant |

Hypotension occurred in four patients in Group C (Bupivacaine + Clonidine) and one patient in Group D (Bupivacaine + Dexamethasone). Not statistically significant is the p-value of 0.16. Despite the fact that the clonidine group experienced hypotension more frequently, the difference was not statistically significant, suggesting that the incidences of the two groups were similar. Three patients in Group C had bradycardia, but none in Group D. Although not statistically significant, the p-value of 0.07 is on the rise to significance. Only the clonidine group experienced bradycardia, which may indicate a circulatory depressive effect of the drug; nevertheless, additional data is required for statistical proof. The data is represented in table 5.One patient in each group had nausea or vomiting. The p-value = 1.0, indicating no difference between the groups. Nausea and vomiting were rare and equally distributed, showing that both adjuvants are well-tolerated in this regard. The p-value = 0.02, which is statistically significant. Sedation was significantly more common in the clonidine group, indicating its centrally acting sedative effect, which may be undesirable in certain clinical settings. The data is represented in Table 5.

# Discussion

The effectiveness and safety profiles of bupivacaine (0.5%) with dexamethasone (Group D) and bupivacaine (0.5%) with clonidine (Group C) were assessed in the setting of upper limb nerve blocks in this prospective, comparative clinical trial. Onset times, block durations, anesthetic quality, analgesia duration, and side effects were the main factors evaluated.

With a p-value of 0.03, Group D experienced the sensory block onset considerably faster (5.4 ± 1.2 min) than Group C (6.1 ± 1.4 min). The dexamethasone group had motor block earlier (7.6 ± 1.5 min vs. 8.2 ± 1.6 min), but the time difference was not statistically significant (p = 0.08).

These results are consistent with a study that found that adding dexamethasone to bupivacaine in supraclavicular brachial plexus blocks accelerated the start of sensory block. By boosting bupivacaine's local action and decreasing its systemic absorption, the steroid most likely has a local vasoconstrictive effect (6).

In contrast, clonidine, though an alpha-2 adrenergic agonist, may exert a slightly delayed onset due to its central mechanism of action, as suggested in the study where clonidine prolonged duration but did not significantly hasten block onset (7).

## Duration of Sensory and Motor Block

The addition of dexamethasone led to a significantly prolonged duration of sensory block (840 ± 105 min) and motor block (720 ± 96 min) compared to clonidine (630 ± 90 min for sensory and 560 ± 88 min for motor), with p-values < 0.001 for both.

This observation corroborates the findings of study in 2011, who demonstrated that perineural dexamethasone significantly increased the duration of both sensory and motor block in interscalene nerve blocks (8). Similarly a study

concluded in a meta-analysis that dexamethasone as an adjuvant to local anesthetics significantly prolongs nerve block duration (9).

While clonidine also prolongs nerve blocks, its effect appears to be inferior to dexamethasone, possibly due to its central action and more variable peripheral effectiveness, as indicated by study done in 1996 (10).

The duration of postoperative analgesia was markedly longer in Group D (960 ± 108 min) than in Group C (690 ± 100 min), with a highly significant p-value < 0.001. This finding is consistent with the literature, particularly a study which highlighted that dexamethasone increases the duration of analgesia after nerve block by over 50% compared to control (11).

Dexamethasone's anti-inflammatory properties at the site of nerve damage and its ability to reduce ectopic neuronal discharge may be responsible for this greater analgesic effect. With 24 patients reporting excellent blocks, Group D's nerve block quality was considerably higher than Group C's (17 patients; p = 0.03). Furthermore, three patients in the clonidine group experienced poor-quality blocks, whereas none in the dexamethasone group did.

Similar results were shown in a randomized controlled experiment, wherein dexamethasone was linked to better block quality and less conversion-to-GA (general anesthetic)
requirements in upper limb procedures when compared to clonidine (12).

Sedation was more common in Group C (n = 5 vs. 0), and this difference was statistically significant (p = 0.02). Although they were more common in Group C, other adverse effects such as bradycardia, hypotension, and nausea did not achieve statistical significance. These findings are in line with the study which observed a higher sedation profile and hemodynamic instability with clonidine as an adjuvant (13).

The lack of significant side effects in the dexamethasone group highlights its superior safety profile, making it a preferable choice in outpatient and ambulatory settings where rapid recovery and minimal systemic effects are desired. Dexamethasone significantly shortens block onset, prolongs block and analgesia duration, and improves block quality more than clonidine. Clonidine, though effective, is associated with higher sedation and cardiovascular side effects, which may limit its utility in certain populations. The results are consistent with multiple studies, validating dexamethasone as a superior adjuvant for upper limb nerve blocks (14, 15).

A key limitation is the single-center design, which may affect the generalizability of the results. Differences in operator skill, patient population, and anesthesia practices in other institutions may influence outcomes. Multicentric studies with larger and more diverse populations are recommended to validate these findings.

# Conclusion

This study concludes that bupivacaine (0.5%) with dexamethasone offers superior sensory and motor block duration, prolonged analgesia, better block quality, and fewer side effects compared to clonidine. We recommend dexamethasone as the preferred adjuvant for supraclavicular brachial plexus blocks in ASA I–II patients undergoing elective upper limb surgeries**.** Future research should focus on long-term safety**,** comparison with other adjuvants like dexmedetomidine**,** and effectiveness in high-risk patient groups or ambulatory settings.

These results suggest that dexamethasone is a more effective and safer adjuvant for enhancing the quality and duration of nerve blocks, making it a preferable choice for clinicians performing upper limb surgeries. In contrast, although clonidine also showed benefits, its higher sedation and potential for cardiovascular side effects may limit its widespread use, especially in settings where rapid recovery and minimal side effects are essential. Given the favorable outcomes with dexamethasone, further large-scale studies with long-term follow-ups are warranted to confirm its safety and efficacy across various types of nerve blocks and surgical settings.

## Abbreviation

None.

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## Author Contributions

All authors are equally contributed.

## Conflict of Interest

The authors declare no conflict of interest.

## Ethics Approval

Not applicable.

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