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Original Research Article

Dexamethasone versus Clonidine as Adjuvants in Ultrasound Guided Axillary Blocks for Upper Limb Surgery

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Abstract: ***Introduction*****:** Ultrasound-guided axillary block is a widely used regional anaesthesia technique for upper limb surgery. Adding adjuvants to local anaesthetics can enhance block quality and prolong postoperative analgesia. This study aimed to compare onset time, duration of action, and analgesia within the first 24 postoperative hours between axillary blocks using clonidine versus dexamethasone as adjuvants. ***Patients and Methods*****:** A descriptive and analytical prospective study was conducted over eight months. Patients were allocated into two groups according to the adjuvant used: clonidine or dexamethasone, combined with 0.5% ropivacaine. Outcomes included sensory and motor block onset, block duration, postoperative pain intensity, analgesic consumption, complications, and patient and surgeon satisfaction. Statistical analysis was performed using SPSS 26.0, with significance set at $p < 0.05$. ***Results*****:** Among 109 patients undergoing upper limb surgery, 53 received an axillary block. Three were excluded, leaving 50 participants: 25 in the dexamethasone group and 25 in the clonidine group. The mean age was 43.6 ± 17.9 years, with a male predominance (76%). No statistically significant differences were found between groups regarding sensory or motor block onset, block duration, or postoperative analgesia ($p > 0.05$). No major complications occurred, and patient satisfaction was high. ***Conclusion*****:** Ultrasound-guided axillary block with either clonidine or dexamethasone as adjuvants is an effective and safe anaesthetic technique for upper limb surgery. No significant differences were observed between groups in block onset, duration, or postoperative analgesia.

Keywords: Axillary Block, Ultrasound Guidance, Clonidine, Dexamethasone, Regional Anaesthesia.

INTRODUCTION

Anaesthesia has undergone major advances in recent decades, evolving from empirical methods aimed at attenuating pain to modern techniques providing effective and safe analgesia. Peripheral nerve blocks, initially performed using anatomical landmarks or blind techniques, have now become a gold standard in anaesthetic practice, particularly in high-income countries.

The introduction of nerve stimulation revitalised regional anaesthesia techniques approximately twenty years ago, reducing the risk of nerve injury. The advent of ultrasound has further expanded the use of peripheral nerve blocks. Ultrasound guidance improves block efficacy, reduces performance time, decreases the required dose of local anaesthetic, and lowers the risk of systemic toxicity and nerve injury.

Axillary brachial plexus block is a regional anaesthesia technique used for elbow, forearm, and hand surgery. It involves perineural infiltration of local anaesthetic. Axillary block plays a central role in the anaesthetic management of upper limb surgery due to its advantages over general anaesthesia. It is an integral component of enhanced recovery after surgery (ERAS) pathways, reducing morbidity, mortality, opioid requirements, hospital costs, and length of stay.

Previous studies have reported variable frequencies of brachial plexus blocks. The limited duration of local anaesthetics has led to the use of adjuvants to optimise block quality and prolong postoperative analgesia. Among these adjuvants, dexamethasone and clonidine are frequently used, but their comparative effects on analgesic duration and adverse events remain debated. This study aimed to

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describe axillary block practice and compare the efficacy of dexamethasone versus clonidine as adjuvants to local anaesthetics in ultrasound-guided axillary blocks for upper limb surgery.

PATIENTS AND METHODS

This was a descriptive and analytical prospective study conducted from 1 December 2022 to 31 July 2023 (eight months) in the operating theatres of the University Emergency Reception Clinic (CUAU) and the main operating theatre of the Hubert Koutoukou Maga National University Hospital Centre (CNHU-HKM).

The source population comprised all patients scheduled for surgery in either the CUAU or the main operating theatre for trauma or vascular procedures. The target population included all patients undergoing upper limb surgery (from the distal third of the arm to the hand) in these theatres. Inclusion criteria were: age ≥ 15 years, haemodynamically stable or stabilised patients undergoing urgent or elective upper limb surgery, and absence of contraindications to regional anaesthesia (RA). Patients with any contraindication to RA were excluded. Data were collected from pre-anaesthetic consultation forms, intraoperative monitoring sheets, postoperative recovery unit records, or direct investigator–patient interviews.

Patient recruitment occurred during pre-anaesthetic consultations. The anaesthetic technique was explained, and informed consent obtained. Axillary block was performed in the operating theatre under ultrasound guidance, following strict aseptic conditions, using a 50-mm or 80-mm Stimuplex needle. When the needle approached each nerve (median, ulnar, radial, and musculocutaneous), approximately 5 ml of local anaesthetic was injected. The anaesthetic solution consisted of 0.5% ropivacaine (maximum dose 3 mg/kg) combined with either clonidine (1 µg/kg perineural) or dexamethasone (0.15 mg/kg intravenous). Group a received ropivacaine 0.5% plus perineural clonidine, while Group B received ropivacaine 0.5% perineural plus intravenous dexamethasone.

Following block performance, sensory and motor block were assessed every five minutes for 20 minutes.

Motor block was evaluated using the modified Bromage scale:

- **0:** no motor block – full movement of hand, wrist, and elbow
- **1:** partial block – movement of fingers and wrist preserved, elbow extension impossible
- **2:** marked paresis – movement limited to fingers only
- **3:** complete paralysis – no movement

Sensory block was assessed using the "pinprick–touch" test across all nerve territories.

- **Complete sensory block:** absence of sensation to pinprick and light touch
- **Incomplete sensory block:** reduced sensation
- **No sensory block:** normal sensation

Block success was defined as complete sensory block and Bromage score > 0. Absence of these criteria at 20 minutes indicated block failure, in which case general anaesthesia was administered and the patient excluded.

If the patient reported pain at the start of surgery (VAS > 4), 5 µg of intravenous sufentanil was administered. Persistent pain preventing surgery completion was considered block failure, leading to conversion to general anaesthesia and exclusion.

Block performance time was measured from needle insertion to completion of local anaesthetic injection. Sensory block onset was defined as the time from injection completion to loss of pain sensation. Motor block onset was defined as the time from injection completion to complete motor block.

Neither the patient nor the assessing anaesthetist was aware of the adjuvant used. Complications were monitored during block performance, intraoperatively, and postoperatively. Intraoperative monitoring occurred every five minutes. Analgesia duration was defined as the time from injection completion to onset of postoperative pain (VAS ≥ 3).

Pain intensity at rest and during mobilisation was assessed hourly until VAS exceeded 3, marking block resolution. Postoperative analgesia was then provided using a multimodal regimen combining step-1, step-2, or step-3 analgesics. Variables studied included sociodemographic, clinical, surgical, and block-related data. Data were entered using Epi Info 7 and analysed with SPSS 26. Quantitative variables were expressed as mean ± standard deviation; qualitative variables as proportions with 95% confidence intervals. Chi-square and Student's t-tests were used for comparisons, with significance set at $p < 0.05$. Ethical approval was obtained from CNHU-HKM academic and health authorities.

RESULTS

Frequency of Axillary Block

During the study period, 109 patients underwent upper limb surgery. Among them, 53 received an axillary block. Three patients were subsequently excluded, leaving 50 participants for analysis, corresponding to a frequency of 45.87%.

Sociodemographic and Clinical Characteristics

Age and Sex

The mean age of the patients was 43.6 ± 17.9 years, ranging from 15 to 74 years, with a marked male predominance (sex ratio 3.16).

Surgical Indications and Type of Surgery

The most common surgical indications were hand or forearm injuries (34%), followed by arteriovenous fistula creation (26%), and forearm fractures (12%). Most axillary blocks were performed for elective procedures (52%), followed by semi-urgent (34%) and urgent surgeries (14%).

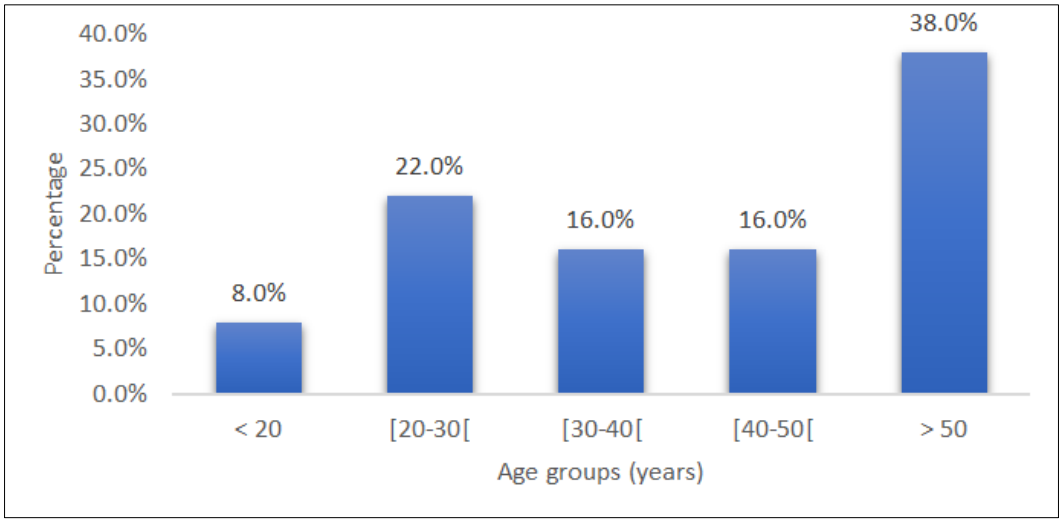

Figure 1: Patients according to age groups (n=50)

ASA Score and Type of Block

Most patients were classified as ASA I (44%), followed by ASA III (34%) and ASA II (22%). All axillary blocks were performed for anaesthetic purposes.

All blocks (100%) were performed under ultrasound guidance using an in-plane approach. Half of the blocks (50%) were performed using an 80-mm B. Braun Stimuplex needle. All patients were monitored during block performance.

Technique and Conditions of Block Performance

Table I: Distribution of patients by needle type (n=50)

	Frequencies (n=50)	Percentage (%)
STIMUPLEX 50 mm	15	20,0
STIMUPLEX 80 mm	25	50,0
STIMUPLEX 100 mm	10	20,0

Dose of Local Anaesthetic

The mean dose of ropivacaine administered was 127.5 ± 32.1 mg, ranging from 100 to 200 mg, corresponding to a mean volume of 25.3 ± 6.4 ml (range: 20–40 ml).

Block Performance Time

The mean time required to perform the axillary block was 23.08 ± 10.1 minutes, with a minimum of 5 minutes and a maximum of 58 minutes.

Intraoperative Course

The mean duration of surgery was 154.88 ± 98.3 minutes, ranging from 10 to 450 minutes.

Comparison: Dexamethasone versus Clonidine

Onset of Sensory and Motor Block

Mean sensory and motor block onset times were 15.04 ± 8.5 min and 14.6 ± 8.4 min respectively in the dexamethasone group, and 14.4 ± 9.8 min and 14.96 ± 8.4 min in the clonidine group.

No statistically significant differences were observed (p = 0.805 and p = 0.894).

Table II: Sensory and motor block onset times

Variables	Total N=50	Dexamethasone N=25	Clonidine N=25	*p*
Mean time to onset of sensory block ± standard deviation	14,7 ± 9	15,04 ± 8,5	14,4 ± 9,8	0,805

Mean time to onset of motor block ± standard deviation	14,8 ± 8,3	14,6 ± 8,4	14,96 ±8,4	0,894

Duration of Sensory and Motor Block

Mean sensory block duration was 397.4 ± 93.3 min in the dexamethasone group and 357.9 ± 132.4 min in the clonidine group (p = 0.231).

Mean motor block duration was 388 ± 129.7 min versus 372.9 ± 129.6 min (p = 0.685).

No statistically significant differences were found.

Table III: Duration of motor and sensory blocks.

Variables	Total N=50	Dexamethasone N=25	Clonidine N=25	*p*
Mean duration of sensory block + Standard deviation	378,06 ± 114,7	397,4 ± 93,3	357,9 ± 132,4	0,231
Mean duration of motor block + Standard deviation	380,6 ± 128,6	388 ± 129,7	372,9 ± 129,6	0,685

Postoperative Pain Assessment

A small proportion of patients experienced VAS ≥ 3 during the early postoperative hours. Most reported VAS ≥ 3 from postoperative hour 9 onwards.

No significant differences were observed between groups at any time point (p > 0.05):

H0 (p = 0.417), H3 (p = 1.000), H6 (p = 0.349), H9 (p = 0.733).

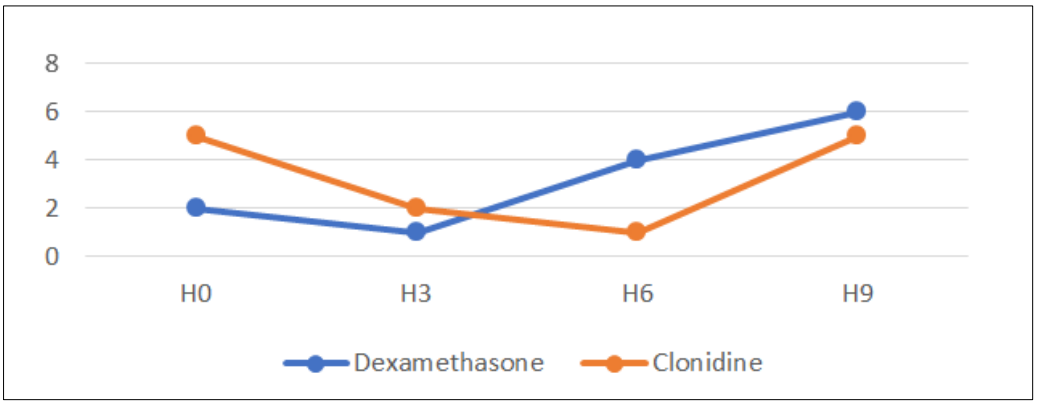

Figure 2: Postoperative pain evaluation over time

Postoperative Analgesic Use

Postoperative analgesia mainly consisted of step-1 and step-2 analgesics.

Compared with the dexamethasone group, patients in the clonidine group received more step-1 and step-2 analgesics (68% vs 60%) and more step-3 analgesics (8% vs 0%), although differences were not statistically significant (p = 0.187).

Patient and Surgeon Satisfaction

Overall, 90% of patients were satisfied with the axillary block.

Satisfaction was slightly lower in the clonidine group, but without statistical significance (p = 0.349).

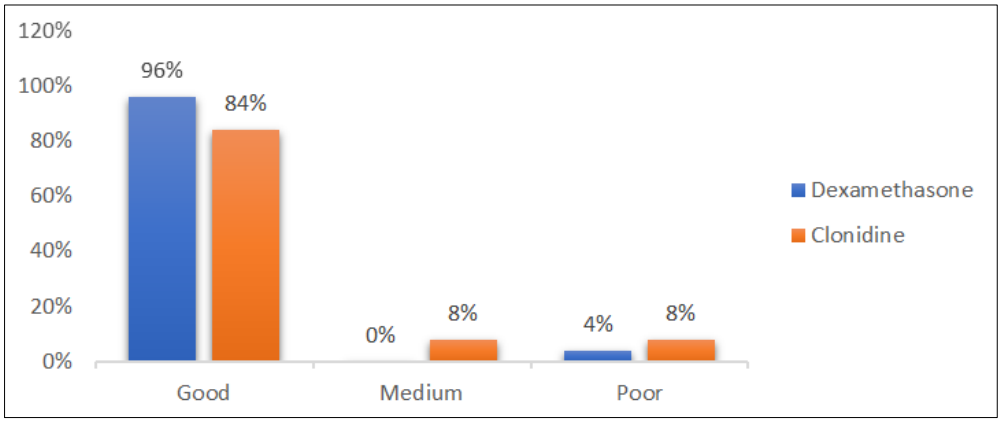

Figure 3: Patient satisfaction scores in both groups

DISCUSSION

We enrolled a total of 50 participants over an eight-month period. This number differs from that reported by Metogo *et al*., who included 76 patients over nine months. This discrepancy may be explained by differences in recruitment duration and by the fact that axillary blocks are not yet routinely performed at CNHU Cotonou.

The mean age in our study was 43.6 ± 17.9 years, with a predominance of patients over 50 years (38%). This finding is comparable to that reported by Donamou in 2017. Regarding surgical indications, upper limb injuries accounted for the largest proportion (34%), followed by arteriovenous fistula creation (26%) and osteosynthesis procedures (12%). Metogo *et al*., similarly reported a predominance of arteriovenous fistula procedures (53.7%) and osteosynthesis (25%). The higher proportion of traumatic injuries in our study likely explains this difference. Owono *et al*., also highlighted the value of plexus blocks in trauma surgery, particularly for perioperative analgesia.

In terms of anaesthetic risk assessment, most patients were classified as ASA I (44%) and ASA III (34%), consistent with findings from Donamou *et al*., and Metogo *et al*., All axillary blocks in our study were performed under ultrasound guidance. Metogo *et al*., also used ultrasound guidance exclusively, whereas Owono *et al*., relied solely on nerve stimulation. Ultrasound guidance is now considered the reference technique for brachial plexus blocks due to improved success rates, reduced local anaesthetic volumes, and fewer complications.

The mean total dose of ropivacaine used was 127.5 ± 32.1 mg, corresponding to a mean volume of 25.3 ± 6.4 ml. These values align with current recommendations and published data reporting volumes between 20 and 40 ml for effective ultrasound-guided axillary blocks.

The mean block performance time was 23.08 ± 10.1 minutes. Metogo *et al*., reported a shorter time (5.95 ± 0.7 minutes). Although our duration was longer, this may reflect the learning curve, as 90% of blocks were performed by anaesthesia residents. Several authors have noted that block performance time decreases significantly with operator experience.

In our study, no statistically significant differences were found between dexamethasone and clonidine regarding sensory or motor block onset ($p > 0.05$). Sensory block onset was clinically shorter in the clonidine group (14.4 ± 9.8 minutes) compared with dexamethasone (15.04 ± 8.5 minutes), while motor block onset was similar between groups. These results are consistent with those of Metogo *et al*., although differences in local anaesthetic choice (bupivacaine versus ropivacaine) may explain variations in onset times.

Mean sensory block duration was longer in the dexamethasone group (397.4 ± 93.3 minutes) compared with clonidine (357.9 ± 132.4 minutes), although the difference was not statistically significant. Motor block duration followed the same trend. Brian *et al*., demonstrated in 2014 that low-dose dexamethasone prolongs peripheral nerve block duration through anti-inflammatory and vasoconstrictive effects. Vikram *et al*., reported prolonged sensory block with clonidine at 2 µg/kg, suggesting that dose differences may explain variability in results.

Postoperative pain assessment showed a generally low proportion of patients with VAS ≥ 3 during the early postoperative hours. Beyond the eighth hour, a higher proportion of patients experienced VAS ≥ 3, reflecting the overall effectiveness of axillary block analgesia in both groups. No significant differences were found between clonidine and dexamethasone, consistent with several comparative studies reporting improved postoperative analgesia with both adjuvants.

Postoperative analgesic consumption was clinically lower in the dexamethasone group, although not statistically significant ($p = 0.187$), suggesting a potential clinical advantage in favour of dexamethasone.

No major complications related to the axillary block or adjuvants were observed. The absence of neurological, cardiovascular, or respiratory complications confirms the safety of ultrasound-guided axillary block when performed according to best practice standards. These findings are consistent with published data reporting very low rates of serious complications with systematic ultrasound guidance.

Patient satisfaction was high (90%). Metogo *et al*., reported similar satisfaction (92.1%). In our study, dissatisfaction was slightly higher in the clonidine group, although not statistically significant ($p = 0.349$). This may be explained by earlier resolution of sensory block in some clonidine patients, requiring intraoperative sedation to complete surgery. Using a subjective clinical score, patients in the dexamethasone group appeared more satisfied, likely due to longer analgesia duration.

The strengths of this study include its originality and methodology. Both dexamethasone and clonidine can be used as adjuvants in ultrasound-guided axillary blocks for elective or emergency surgery. The main limitation is the relatively small sample size, which limits generalizability.

CONCLUSION

This study compared the effectiveness of clonidine and dexamethasone as adjuvants to ropivacaine in ultrasound-guided axillary brachial plexus block. All blocks were performed under ultrasound guidance, confirming the adoption of this modern and safe

technique in our clinical setting. No statistically significant differences were observed between clonidine and dexamethasone regarding sensory and motor block onset times or block duration. However, a trend towards longer block duration with dexamethasone was noted.

Both adjuvants provided satisfactory postoperative analgesia, characterised by low pain intensity and limited use of higher-tier analgesics. The absence of major complications and the high satisfaction rates among both patients and surgeons underscore the safety and effectiveness of ultrasound-guided axillary block for upper limb surgery.

These findings support the use of either clonidine or dexamethasone as adjuvants in axillary blocks, while highlighting the potential clinical advantage of dexamethasone in prolonging analgesia. Further studies with larger sample sizes are warranted to confirm these observations and strengthen the evidence base for optimal adjuvant selection in regional anaesthesia.

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