



## Original Article

## Ultrasound-Guided Loco-Regional Anesthesia of Limb Surgery in Mali

### *Anesthésie Loco-Régionale Échoguidée dans la Chirurgie des Membres au Mali*

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#### ABSTRACT

**Introduction.** Echo guidance improves patient safety in locoregional anesthesia (LRA). **Objective.** To evaluate the practice of ultrasound-guided blocks in adults in Malian adults. **Patients and Methods.** Our prospective cross-sectional observational study was conducted in the anesthesia-intensive care unit, orthopedic traumatology, and thoracic and cardiovascular surgery departments of Hopital du Mali (Bamako) from August 2022 to January 2023 (six months). **Results** During the study period, 30 patients met our criteria (2.2%). The sex ratio was 5. The mean age was  $40.8 \pm 18.5$  years. Most patients came from the orthopedic traumatology department (90%) and had scheduled surgeries (60%). The ASA score was mostly ASA I (66.7%). Pharmacological premedication was done in 23.3% of patients. Axillary block was performed in 53.3% of cases. Bupivacaine was the most commonly used drug, with dexamethasone as an adjuvant in 30% of cases. The mean anesthetic volume was  $21.2 \pm 2.8$  mL, with a delivery time of  $9.5 \pm 3.55$  minutes and an installation time of  $11.5 \pm 6.3$  minutes. The combination of bupivacaine and lidocaine led to a faster installation. An accident occurred in 3.3% of cases. Surgery lasted  $58.4 \pm 31.5$  minutes and the sensory block duration was  $271.07 \pm 107.98$  minutes. Postoperatively, morphine sparing was possible in 93.4% of patients with reduced hospital stay and high satisfaction in 86.7% of cases. **Conclusion.** Ultrasound-guided LRA should be promoted, particularly in ambulatory limb surgery.

#### RÉSUMÉ

**Introduction.** Le guidage échographique améliore la sécurité des patients lors de l'anesthésie locorégionale (ALR). **Objectif.** Évaluer la pratique des blocs échoguidés chez l'adulte au Mali. **Patients et méthodes.** Notre étude observationnelle transversale prospective a été menée dans les services d'anesthésie-réanimation, de traumatologie orthopédique et de chirurgie thoracique et cardiovasculaire de l'hôpital du Mali (Bamako) d'août 2022 à janvier 2023 (six mois). **Résultats** Durant la période d'étude, 30 patients répondaient à nos critères (2,2 %). Le sex-ratio était de 5. L'âge moyen était de  $40,8 \pm 18,5$  ans. La plupart des patients provenaient du service de traumatologie orthopédique (90%) et avaient des chirurgies programmées (60%). Le score ASA était principalement ASA I (66,7 %). Une prémédication pharmacologique a été réalisée chez 23,3 % des patients. Un bloc axillaire a été réalisé dans 53,3 % des cas. La bupivacaine était le médicament le plus couramment utilisé, avec la dexaméthasone comme adjuvant dans 30 % des cas. Le volume anesthésique moyen était de  $21,2 \pm 2,8$  ml, avec un temps d'administration de  $9,5 \pm 3,55$  minutes et un temps d'installation de  $11,5 \pm 6,3$  minutes. La combinaison de bupivacaine et de lidocaïne a permis une pose plus rapide. Un accident est survenu dans 3,3 % des cas. L'intervention chirurgicale a duré  $58,4 \pm 31,5$  minutes et la durée du bloc sensoriel a été de  $271,07 \pm 107,98$  minutes. En postopératoire, l'épargne morphinique a été possible chez 93,4 % des patients avec une durée d'hospitalisation réduite et une grande satisfaction dans 86,7 % des cas. **Conclusion.** L'ARS guidée par ultrasons devrait être promue, en particulier dans la chirurgie ambulatoire des membres.

**HIGHLIGHTS****What is already known on this topic**

Ultrasound guidance enhances patient safety in regional anesthesia, requiring specific skills and maintenance.

**What question this study addressed**

To evaluate the practice of ultrasound-guided blocks in adults limb surgery at the University Hospital "Hôpital du Mali".

**What this study adds to our knowledge**

Ultrasound-guided PNBs for adult limbs at the University Hospital "Hopital du Mali" provides effective anesthesia and analgesia, early rehabilitation, and reduced hospital stay.

**How this is relevant to practice, policy or further research.**

Advancing ultrasound technology, personalized analgesia protocols, and comprehensive training programs for non-specialists can significantly enhance the accessibility and effectiveness of these procedures in diverse healthcare settings.

**INTRODUCTION**

Regional anaesthesia (LRA) is a technique that temporarily and reversibly interrupts nerve conduction. It includes central and peripheral ALR, targeting nerve trunks and plexuses [1]. Perinervous loco-regional anesthesia (ALR-PN) is vital in intensive care for both anesthesia and postoperative analgesia [2].

Postoperative pain, particularly after orthopedic surgery, can be severe and impact surgical outcomes [3]. Ultrasound guidance enhances patient safety in ALR [4], requiring specific skills and maintenance [4].

LRA-PN offers advantages over general anesthesia (GA) including better analgesic efficacy, morphine savings, reduced side effects, shorter postoperative monitoring time, quicker outpatient discharge, improved patient satisfaction, reduced hospital stay, and faster recovery [5, 6]. This study aimed to evaluate the practice of guided echo truncular blocks in adult limb surgery.

**PATIENTS AND METHODS**

We conducted this study in the anesthesia-intensive care unit, orthopedic traumatology, and thoracic and cardiovascular surgery departments. It was a prospective observational study over six months (August 2022 to January 2023). The study included patients aged 18 or older undergoing emergency or scheduled limb surgery with informed consent. Exclusions were patient refusal, allergy to anesthetic products, hemostasis disorders, infections or wounds at the puncture site, and technique failures.

**Study Conduct**

Patients were recruited during scheduled anesthesia consultations or emergencies. The study's objectives and methodology were explained to them, including the Pain Assessment Method (VAS) and the puncture technique. Informed consent was obtained and recorded on the anesthesia sheet. An individual postoperative collection

and monitoring sheet was developed. Data collection began upon patient admission to the operating room.

After a checklist (drugs, emergency intubation tray, defibrillator, etc.), patient installation, multiparametric monitoring, peripheral venous line intake, and monitoring via electrocardioscope were performed. Premedication was administered based on the degree of cooperation. We used a MIDRAY LW-39000970 portable ultrasound machine with 7MHz and superficial probes. Sterile equipment and anesthetic products (bupivacaine 0.5%, lidocaine 2%, ropivacaine 1%, dexamethasone 4mg for lower limbs) were prepared.

The procedure involved cleaning the ultrasound probe, protecting it with a sterile glove, and cleaning the puncture area with dermal betadine. The needle was introduced under ultrasound control, and after the suction test, the anesthetic was injected near the nerve. Sensory block was verified by the pick-test and motor block by limb mobilization.

Postoperative analgesic treatment was administered based on VAS scores. Data were collected through an individual survey sheet and analyzed using Word 2016 and SPSS 22. Variables studied included age, sex, clinical, radiological and biological data, surgical indications, surgical technique, events, VAS evaluation at various time points, time to analgesic request, morphine consumption, complications, patient satisfaction, and length of stay.

**Ethical Considerations**

We obtained authorization from department heads. Patients received detailed information about the study protocol and provided informed consent. Data confidentiality and anonymity were maintained.

**Operational definitions**

**Postoperative rehabilitation:** Is a concept from the 90s that consists of a rapid acceleration of the recovery process.

**The Visual Analogue Scale (VAS):** is a score that assesses pain. Pain was assessed by a ruler with a slider and a diseased side with the words "absence of pain" or "intense or unbearable pain" on both ends and an evaluator side. The interpretation was as follows:

- 0-3: the pain is Low,
- 4-7: moderate pain,
- 8-10: Strong to unbearable.

**Satisfaction:** Patient satisfaction was left to the discretion of patients and was determined based on overall pain experience during the first 72 hours postoperatively. It was rated as excellent, good, fair or no satisfied.

**RESULTS**

During the study period, thirty (30) patients met our criteria, representing 2.2% of anesthesia performed. The mean age was  $40.8 \pm 18.5$  years old, with a male predominance (sex ratio 5). **Table I** shows the age, sex of the patients and original service. A medical history was found in 30% of patients. Most patients (90%) came from orthopedic and trauma surgery, with the upper limb most represented (70%)... The information is illustrated in **Table II**. Scheduled surgeries accounted for 60% of cases. ASA I score was 66.7%, and pharmacological

premedication was done in 23.3%. Axillary block was the most common (53.3%), followed by common popliteal sciatica block (20%) and interscalene block (16.7%). Sensory-motor block was common (70%). Bupivacaine was the most used anesthetic, with dexamethasone as an adjuvant in 30% of cases (9 patients). The mean anesthetic volume was  $21.2 \pm 2.8$  mL, with a delivery time of  $9.5 \pm 3.55$  minutes and an installation time of  $11.5 \pm 6.3$  minutes. **Table III** shows the local anesthetics used and the volume used according to the type of block. An accident occurred in 3.3% of cases (1 patient). Surgery lasted  $58.4 \pm 31.5$  minutes, and the sensory block duration was  $271.07 \pm 107.98$  minutes. On admission to the inpatient ward, all patients had absent to mild pain. **Table IV** illustrates the assessment of pain at admission, at H6 and H24. The mean duration was  $1.6 \pm 0.82$  days. Patient satisfaction was good to excellent in 86.7% (26 patients).

## DISCUSSION

This study evaluated ultrasound-guided peripheral blocks in adults at the CHU Hôpital du Mali. The acceptance of peripheral nerve blocks (PNBs) is growing, but they are still underused in our country. In France, PNBs account for 8.9% of intraoperative and postoperative analgesic treatments [7], 18% of anesthetic activity in university hospitals in Dakar [8, 9], and 1.3% of all anesthetic techniques at Yaoundé Central Hospital [10].

### Age and sex

The mean age was  $40.8 \pm 18.5$  years with the extremes (18 years and 78 years). Male sex largely predominated in our study with a ratio of 5. In Guinea, the mean age was  $46 \pm 17$  years and  $44 \pm 20$  years in the Ropivacaine group and a male predominance (sex ratio 5.3) [11]. In Senegal, the mean age was  $32.54 \pm 4$  years with a male predominance (48 men/13 women) [12]. These results can be explained by the fact that the search for daily bread is an activity that falls to young males in our society and they are frequently victims of trauma following accidents.

### Department of origin of patients and type of surgery

In Senegal, trauma emergencies accounted for 65.6%. The remainder were infections with 26.2% of cases and 8.2% of patients were scheduled for orthopaedic surgery [12]. In Cameroon, 54.5% of GNPs were carried out in an emergency [10]. In our study, 90% of patients came from orthopedic and trauma surgery. The upper limb was the most represented (70%). The blocks were performed during a scheduled surgery in 60%. This state of affairs could be explained by the rigorous application of the protocol that was explained to the patient, understood and evaluated before the start of the intervention.

### Anesthesia

The ASA Physical Status score is an estimate of operative risks, independent of the patient's age and type of surgery. It is one of the most frequently used classifications in anesthesia. The ASA score is based on the search for two elements: the absence or presence of a systemic disease and the evaluation of its degree of severity [13]. In our study, a medical history was found in 30%. ASA I accounted for 66.7%, ASA II 10% and ASA III 23.3%. In Cameroon, 54.5% of patients were classified ASA I, and

45.5% classified ASA II. Trauma occurred in healthy and active subjects [10]. In our study, three cases of arteriovenous fistula (AVF) were performed for dialysis in the field of chronic kidney failure. In Senegal, premedication by venous route before the block was performed in some patients depending on their degree of cooperation. The products used were: diazepam 0.05 mg/kg, fentanyl 1.5  $\mu$ g/kg [12]. In our study, pharmacological premedication was performed in 23.3% (midazolam 0.1 mg per kg weight). Axillary block was the most performed (53.3%) followed by common popliteal sciatica block (20%) and interscalene block in 16.7%. The combination of bupivacaine and lidocaine allowed the installation of the operating room in about 5 minutes. In Senegal, an isovolume mixture of lidocaine 2% and bupivacaine 0.5% was made [12]. In Cameroon, lidocaine 2% and bupivacaine 0.5% isobaric were injected near the nerve [10]. Ropivacaine is a high-potency local anesthetic. It was characterized by a short onset time, long duration of action, and low neurotoxicity and cardiotoxicity. Lidocaine, on the other hand, is a medium-strength local anesthetic. It had a duration of action that varied depending on the injection site and whether or not a vasoconstrictor was added. Lidocaine 1.5% adrenalin at 1/200000 could be a good alternative to ropivacaine 0.5% for the performance of ultrasound-guided axillary blocks in resource-limited countries. In Guinea, they found that lidocaine 1.5% adrenalin was identical to that of ropivacaine [11]. In our study, bupivacaine 0.5% isobaric was the most commonly used anesthetic, followed by its combination with lidocaine, ropivacaine in 13.3%. In the literature, adjuvants to local anesthetics can be used to prolong the duration of peripheral nerve blocks; Adrenaline and clonidine have been shown to be effective [14, 15]. In our study, dexamethasone 8 mg peri-nerve injection was the only adjuvant used in 9 patients (30%). We found a prolongation of postoperative analgesia with an average duration of 361 minutes. In our study, the mean anesthetic volume was:  $21.2 \pm 2.8$  mL with extremes of 10 to 30 mL. In Senegal, it was  $28 \pm 5$  mL [12]. In Cameroon for anesthetic induction, a mixture of 40 ml of local anesthetics combining 20 ml of 2% lidocaine and 20 ml of 0.5% isobaric bupivacaine was injected near the nerve [10]. The average production time was  $13.74 \pm 1.51$  minutes with extremes of 5 and 30 minutes in Senegal [12]. That of the sensory block was  $265 \pm 63$  minutes, or about 04 h 20 minutes [extremes: 130 and 380 minutes]. In our study, this time was  $9.5 \pm 3.55$  minutes with extremes of 5 and 17 minutes. The average block installation time was  $11.5 \pm 6.3$  minutes with extremes of 5 and 30 minutes. The mean duration of sensory block was  $271.07 \pm 107.98$  minutes, the median was 285 minutes with the extremes of 60 and 480 minutes. Similar results were observed in Guinea with a completion time of  $8.7 \pm 2.1$  minutes and a mean duration of  $260 \pm 75$  minutes in the ropivacaine group [11]. In Cameroon, a mixture of local anesthetics combining lidocaine 2% and bupivacaine 0.5% isobaric has been used [10] as in the studies of Beye [16] and Owono Etoundi [17]. This mixture of local anesthetics provided a quick set-up time and less cardiac toxicity than with bupivacaine alone. However,

neurological toxicity may be additive in the event of significant systemic resorption or direct intravascular injection. The duration of action is intermediate between that of lidocaine and that of bupivacaine [16]. The majority of teams today use ropivacaine or levobupivacaine, whose main clinical characteristics are: a rapid onset time, a sensory block that is more intense than the motor block, a prolonged duration of action and less systemic toxicity [16, 17], these drugs are still not widely available in Cameroon and their cost is high. We made the same observations. Guided echo reduces the incidence of complications related to the technique, in particular vascular punctures. Vascular puncture can be arterial or venous, but the latter is more frequent, favoured on the one hand by the ability of the vein to collapse when the probe is pressed until it becomes virtual, and on the other hand, by the presence of several veins nearby. In our study, we recorded one case of vascular injection (3.3%) resulting in headache, dizziness, chills and respiratory distress. He was intubated and ventilated. The follow-up was favourable. In Senegal, two cases of vascular punctures without hematoma were reported (3.27%) [12]. In the literature, NPPs are as effective as epidural analgesia [18]. They provide significant morphine savings close to 100% [19], with fewer side effects, lower pain VAS scores, no overall impact, higher patient satisfaction rates, and a reduction in the length of hospital stay [20, 21]. In our study, morphine sparing (93.34%) and good to excellent patient satisfaction (86.3%) were observed. Our satisfaction rate was higher than that of Afane Ela A (78.8%) [10] and lower than that of the ropivacaine group in Guinea (94.7%) [11]. Our average length of stay was  $1.6 \pm 0.82$  days with the extremes of 1 and 10 days.

### Study Limitations

Our study had some limitations:

- The rigorous application of the protocol required obtaining informed consent, which was long in our context,
- The size of our sample: the sampling was not exhaustive, which did not allow us to have a significant size.
- The duration of the study (6 months): another longer study with a large size would be desirable to confirm these results

### CONCLUSION

Ultrasound-guided PNBs for adult limbs at the University Hospital "Hopital du Mali" provided effective anesthesia and analgesia, early rehabilitation, and reduced hospital stay. Patient satisfaction was high, making this technique valuable in resource-limited settings and outpatient surgery. Future studies should focus on long-term outcomes and comparative efficacy of different peripheral nerve block techniques, especially in special populations like pediatric and geriatric patients. Additionally, advancing ultrasound technology, personalized analgesia protocols, and comprehensive training programs for non-specialists can significantly enhance the accessibility and effectiveness of these procedures in diverse healthcare settings.

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**Table I: Age, sex and origin of patients**

	Frequency	Percentage
<b>Age group (years old)*</b>		
18-28	11	36.7
29-38	6	20
39-48	4	13.3
49-58	2	6.7
≥ 59	7	23.3
<b>Sex</b>		
Male	25	83.3
Feminine	5	16.7
<b>Provenance Service</b>		
Trauma and orthopaedic surgery	27	90
Thoracic and cardiovascular surgery	3	10

\* Average age: 40.8 ±18.5 years old Extremes: 18 years old- 78 years old

**Table II : Indications**

Indication	Frequency	Percentage
Osteosynthesis of the upper limb	07	23.3
AMOS of the upper limb	05	16
Amputation of the lower 1/3 of the leg	03	10.0
Fabrication of AVF of the upper limb	03	10.0
Upper limb musculo-ligament release	03	10.0
Upper limb musculo-ligament release	03	10.0
Osteotomy of the lower limb (leg)	02	06.7
Amputation of the big toe	02	06.7
Wrist cystectomy (upper limb)	01	03.3
<b>Total</b>	<b>30</b>	<b>100.0</b>

**Table III: local anesthetics and the volume used depending on the type of block**

Products	Frequency	Percentage
Bupivacaïne 0.5%	14	46.7
Bupivacaïne 0.5% + Lidocaine 2%	12	40
Ropivacaïne 1%	4	13.3
<b>Total</b>	<b>30</b>	<b>100</b>
<b>Adjuvant used</b>	<b>Frequency</b>	<b>Percentage</b>
Dexamethasone 8 mg	9	30

		Anesthetic used (mL)				Total
		10	15	20	30	
Types of peri-nervous anesthesia*	BAX	0	4	12	0	16
	BIS	2	1	2	0	5
	BS	0	0	1	5	6
	BS+BF	0	0	0	3	3
<b>Total</b>		<b>2</b>	<b>5</b>	<b>15</b>	<b>8</b>	<b>30</b>

Average volume: 21.2 ± 2.8 mL Extremes: 10 mL and 30 mL.  
 \*BAX: Axillary block BIS : Interscalene block BS : Sciatic block BS+BF: Sciatic block + Femoral block

**Table IV: Pain assessment on admission, H6 and H24**

**Pain on admission**

VAS	At rest		After painkillers	
	Frequency	Percentage	Frequency	Percentage
0	27	90	27	90
1	0	0	2	6.7
2	3	10	1	3.3
<b>Total</b>	<b>30</b>	<b>100</b>	<b>30</b>	<b>100</b>

**Pain at H6**

VAS	At rest		On mobilization		After painkillers	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
0	12	54.5	11	50	20	90
1	8	36.4	2	9	2	10
2	2	9.1	9	41	0	0
<b>Total</b>	<b>22</b>	<b>100</b>	<b>22</b>	<b>100</b>	<b>22</b>	<b>100</b>

**Pain at H24**

VAS	At rest		On mobilization		After painkillers	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
0	4	33.3	1	8.3	58.3	58.3
1	7	58.3	5	41.7	41.7	41.7
2	1	8.3	5	41.7	0	0
3	0	0	1	8.3	0	0
<b>Total</b>	<b>12</b>	<b>100</b>	<b>12</b>	<b>100</b>	<b>12</b>	<b>100</b>

\*VAS: Visual Analogue Scale