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Practice of Ultrasound-Guided Axillary Block for the Creation of Arteriovenous Fistulas at the University Hospital Center of Libreville

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Abstract

Introduction: The use of ultrasound has revolutionized the practice of regional anesthesia and expanded its indications to several specialties. Previously performed only through neurostimulation a few years ago in our context, the recent availability of ultrasound in the operating room has promoted the practice of ultrasound-guided axillary block by the new generation of anesthesiologists. Our objective was to evaluate the practice of ultrasound-guided axillary block in the creation of arteriovenous fistulas at the Libreville University Hospital Center (CHUL). **Patients and Methods:** A prospective study with a descriptive aim was conducted over a three-month period. Included were patients who were to undergo the creation of an arteriovenous fistula and who had given their prior consent for the performance of an ultrasound-guided axillary block. The parameters studied were sociodemographic data, comorbidities, the American Society of Anesthesiologists (ASA) classification, the type of approach, the arrangement of the different nerves, the technique of local anesthetic injection, the procedure time, the onset time of the anesthetic block, the duration of the anesthetic block, and any incidents. **Results:** Fifty patients were included, with a mean age of 54 ± 14.4 years. Hypertension and diabetes were the main comorbidities. The operator was experienced in 78% of the cases. The needle approach was in the plane of the ultrasound in all cases. The median nerve was the easiest target to approach. The injection of the local anesthetic was perineural in 86% of the cases. The average procedure time was 17.9 minutes, and the average duration of the sensory block was 208.5 minutes. The success rate was 94% for the median and musculocutaneous nerves and 92% for the radial and ulnar nerves. As incidents, five acci-

dental venous punctures were noted. **Conclusion:** Ultrasound-guided axillary block is performed with a high success rate in the creation of arteriovenous fistulas. The anesthesia is of good quality, and complications are rare.

Keywords

Ultrasound-Guided Axillary Block, Arteriovenous Fistula, Libreville

1. Introduction

The axillary block is a regional anesthesia technique indicated for surgery of the elbow, forearm, and hand. It is increasingly performed with the help of ultrasound, which allows a visual approach to the needle and its relationship with different anatomical structures. This increases the success rate, reduces the risk of potential complications, and decreases the volume of local anesthetics used [1]. The creation of an arteriovenous fistula (AVF) for hemodialysis, often performed in our facility under local anesthesia with repeated lidocaine infiltration, provides less comfort for both the patient and the surgeon. Ultrasound-guided axillary block thus presents an alternative to this method. The objective of the study was therefore to assess the practice of ultrasound-guided axillary block in arteriovenous fistula surgery at the University Hospital Center of Libreville.

2. Patients and Method

This was a single-center, prospective study with a descriptive aim conducted over a period of 3 months in the general operating theater of CHUL. Included were patients scheduled to undergo the creation of an arteriovenous fistula who had given their consent during the anesthesia consultation for an ultrasound-guided axillary block. All had undergone this pre-anesthetic consultation, at the end of which the anesthetic technique, preoperative instructions, and procedure were clearly explained (preoperative fasting, possible discontinuation of medications, and preoperative, intraoperative, and postoperative steps). The exclusion criteria were patient refusal, the existence of a coagulation disorder, the presence of numbness or swelling in the upper limb, an infection at the puncture site, or anatomical changes related to multiple previous axillary punctures. On the day of the procedure, the axillary block was performed in the post-anesthesia care unit (PACU) on a patient in the supine position with multiparametric monitoring (ECG, NIBP, SpO_2), the arm abducted at 90 degrees, and the ultrasound set to a field depth of 3 to 4 cm, positioned facing the operator. Sociodemographic, clinical, and paraclinical data, as well as the American Society of Anesthesiologists (ASA) classification, were recorded on a pre-designed questionnaire. After surgical hand washing, sterile gloves were worn, and the axillary area was disinfected with Betadine; the high-frequency linear probe, covered with a sterile glove, was placed transversely in the axillary fossa for localization. Visualization of the main

nerves was considered easy when it matched the usual anatomical description around the axillary artery: radial nerve between 3 and 6 o'clock; median nerve between 9 and 12 o'clock; ulnar nerve between 12 and 3 o'clock; musculocutaneous nerve between 7 and 9 o'clock [2]. The needle used was a short-bevel needle measuring 80 mm in length and 22G in diameter. After an aspiration test, 15 to 20 ml of an isovolumetric mixture containing 0.25% Bupivacaine (37.5 to 50 mg) and 1% Lidocaine (75 to 100 mg) were injected around the nerves (perineural injection, PN) or around the artery (periarterial injection, PA) at a rate of 3 to 5 ml for each target. Toxicity was immediately monitored through patient complaints, clinical status, and monitor parameters (ECG, BP, HR, RR, SpO_2). The following additional parameters were then collected: the time to perform the block, incidents (arterial or venous puncture), the time for anesthesia onset, the quality of anesthesia in each innervation territory (satisfactory in the absence of pain perception or unsatisfactory in the case of pain perception requiring supplementation), the duration of surgery, and the time to recovery of sensation and motor function. Data analysis was performed using Microsoft Excel software. The results were expressed as mean ± standard deviation or as a percentage. The study was conducted with the authorization of the CHUL authorities. Informed and voluntary consent was obtained from the patients beforehand. The confidentiality of patient data was ensured through the assignment of an anonymity number.

3. Results

In a sample of 59 patients, there were 4 refusals, 3 anatomical modifications, 2 coagulation disorders, and 50 patients were retained. The mean age was 54 ± 14.4 years, and the sex ratio was 1.2. The comorbidities found were hypertension in 78% (n = 39) and diabetes in 28% (n = 14). Patients were classified as ASA III in 96% (n = 48) and ASA IV in 4% (n = 2). The axillary block had been performed at least once in 70% of the patients. The operator was an experienced doctor (with at least 100 successful blocks) in 78% (n = 39) and an inexperienced doctor (in the anesthesia specialty) in 22% (n = 11). The identification of the nerves was considered easy for the median nerve (MN) and the musculocutaneous nerve (MCN) in 96% (n = 48) and 84% (n = 42) of cases. The radial nerve (RN) and the ulnar nerve (UN) were difficult to identify in 26% (n = 13) and 22% (n = 11) of cases (**Table 1**).

The needle insertion was performed in the anteroposterior plane in all cases. The injection of the anesthetic mixture was perineural in 100% of cases for the MCN, 98% (n = 49) for the MN, and 84% (n = 42) for the UN (**Table 1**). Specifically, it was unique for the experienced practitioner in 89.7% (n = 35) of cases and in 45.5% (n = 5) for the physician in training. The overall average duration for performing the block was 17.92 ± 4.30 minutes. The time to perform the block by an experienced physician was 15.09 ± 3.60 minutes, and for the physician in training, it was 19.9 ± 2.95 minutes. The average time for block setup was 10.56 ± 2.58 minutes. An accidental venous puncture occurred in 10% (n = 5) of cases when the block was performed by the physician in training. The quality of the block was

satisfactory in 46 cases, giving a success rate of 93%. Sedation was used as supplementary anesthesia in 1 case and lidocaine infiltration in 3 cases. The average duration of the block was 208.5 ± 57.6 minutes. The created AVF was radial-type in 30% (n = 15), cephalic in 60% (n = 30), or basilic in 10% (n = 5).

Table 1. Distribution according to target identification, local anesthetic injection techniques, and block quality.

	DOCTOR	DETECTION		INJECTION TECHNIQUE		BLOC QUALITY	
		Easy	Difficult	PNI	PAI	Satisfactory	Not satisfactory
RN	Experienced	31	8	37	2	38	1
	Inexperienced	6	5	3	8	8	3
	Total	**37 (74%)**	**13 (26%)**	**40 (80%)**	**10 (20%)**	**46 (92%)**	**4 (8%)**
UN	Experienced	32	7	37	2	37	2
	Inexperienced	7	4	5	6	9	2
	Total	**39 (78%)**	**11 (22%)**	**42 (84%)**	**8 (16%)**	**46 (92%)**	**4 (8%)**
MN	Experienced	37	2	39	0	39	0
	Inexperienced	11	0	10	1	8	3
	Total	**48 (96%)**	**2 (4%)**	**49 (98%)**	**1 (2%)**	**47 (94%)**	**3 (6%)**
MCN	Experienced	34	5	39		39	0
	Inexperienced	8	3	11		8	3
	Total	**42 (84%)**	**8 (16%)**	**50 (100%)**		**47 (94%)**	**3 (6%)**

RN: radial nerve; UN: ulnar nerve; MN: median nerve; MCN: musculocutaneous nerve; PNI: perineural injection; PAI: periarterial injection.

4. Discussion

The single-center nature of this study did not allow for a larger number of patients, varied indications to better assess the effectiveness of the block, or a diversity of practitioners outside the CHUL to reduce biases related to practice influences. The maturation of the AVF, the search for postoperative neurological complications, and the satisfaction of patients and the surgeon, which were not addressed in this work, are areas to be further explored to better understand the issue. However, this study, which had not been previously conducted in our practice, reports an experience of regional anesthesia at the CHUL.

The axillary block provides anesthesia of the forearm and hand, making it an appropriate option for the creation of an AV fistula. To this end, 93% of our patients underwent surgery under axillary block alone. The effectiveness of this technique is also reported by Zida *et al.* in AV fistula creation [3] and by Matsanga *et al.* in the management of upper limb trauma [4]. Failures are possible and often require supplementary anesthesia. Thus, with 7% of incomplete anesthesia, sedation and lidocaine infiltration were the methods used to address the failure, as also reported by Andrianiaina *et al.* [5]. Recently, Chi Ho Chan *et al.* highlighted the block of the axillary plane of the serratus anterior muscle, a new technique to anesthetize the intercostobrachial nerve and address this insufficiency during the

axillary and supraclavicular block [6]. The creation of an AVF facilitates hemodialysis and is part of the management of end-stage chronic kidney disease, thus explaining the high average age of our patients, the predominance of males, and the prevalence of hypertension and diabetes among comorbidities. This profile is also observed in Dakar by Dieng *et al.* [7]. Most patients had already undergone an axillary block at least once, highlighting the high number of reinterventions in this surgery [3] [7]. Although it did not affect the success rate [8], the in-plane approach was preferred because it allowed visualization of the needle along its length and its relationships with the various anatomical structures. Despite this, 5 venous punctures were detected by the aspiration test before the injection of the local anesthetic. Veins, due to their multiplicity and their ability to collapse under the pressure of the ultrasound probe, become invisible, promoting inadvertent venous punctures. Hence the importance of the aspiration test before injecting the local anesthetic. Regarding target identification, our study notes that the MN is easy to identify due to the low variation in its anatomical position, unlike the RN, UN, and MCN, whose identification was considered difficult in 26%, 22%, and 16% of cases, respectively. A great variability in their anatomical position, reaching up to 30%, has been reported in the literature [9]. Precise identification is necessary because it allows for more accurate targeting and the peri-neural injection of each of the four nerves, which is the most effective technique for blocking the brachial plexus at the axillary level [10]. Performed by a mixed team of experienced and inexperienced doctors, our study found a longer procedure time of 17.92 ± 4.30 minutes. This duration was 13.74 minutes in the study conducted by Leye *et al.* and 5 minutes in that of Matsanga *et al.*, with variations attributed to the quality of needles used, the obese condition, and especially the experience of the practitioners [4] [8]. In our study, apart from the limited experience of some doctors, the setting was characterized by a high number of reoperations. Indeed, these chronically dialyzed patients then had anatomical changes, particularly vascular, making the identification of targets sometimes more difficult. The average duration of the block was 208.5 ± 57.6 minutes, more than sufficient for the creation of an AV fistula. This duration is close to that reported by several African authors who used bupivacaine as a local anesthetic [8] [11]. Longer durations can be achieved by using Levobupivacaine or by adding dexamethasone [12] [13].

5. Conclusion

Ultrasound-guided axillary block for creating AV fistulas is increasingly practiced in our setting. Ultrasound detection of the nerves is often easy, the approach to the targets is made in-plane, and the injection is mostly perineural. The success rate is high and complications are rare.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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