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Effectiveness of the Suprainguinal Ultrasound-Guided Block for the Management of Postoperative Pain after Application of a Total Hip Prosthesis

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Abstract

Objective: To assess the effectiveness of ultrasound-guided supraginguinal block (SIB) in the management of pain after total hip replacement. **Material and Methods:** This was a prospective, randomized, single-blind controlled study carried out in the anesthesia-intensive care unit of the Donka National Hospital in Conakry, over a period of 06 months (01/01/2020 to 30/06/2020). It concerned 32 patients: 16 patients in the "ultrasound-guided SIB" group and 16 patients in the "standard analgesia" group. **Results:** The pain scores assessed by the simple verbal scale and collected at the different time intervals (6H, 12H, 24H, 36H, 48H) showed mean scores < 1 in the ultrasound-guided SIB group while the mean scores were ≤3 in the standard analgesia group (P < 0.001). On movement, the mean pain scores were ≤1 for the ultrasound-guided SIB group versus mean scores > 3 in the standard analgesia group (P < 0.001). The time to mobilization was greater than 48 hours in all patients in the standard analgesia group while it was less than 48 hours in the majority of patients (75%) in the ultrasound-guided SIB group. Nausea and vomiting were the most observed side effects. We did not observe any respiratory distress. The length of day hospitalization of patients in the ultrasound-guided SIB group was on average 5.50 ± 0.52 compared with 13.44 ± 1.55 in the group of standard analgesia patients (P = 0.001). The vast majority of patients in the ultrasound-guided SIB group were satisfied and unhappy in the standard analgesia group. **Conclusion:** Our study demonstrated that echo-guided

SIB provided better analgesia compared to standard analgesia for the management of postoperative pain after total hip replacement.

Keywords

Ultrasound-Guided Suprainguinal Block, Total Hip Replacement, Postoperative Pain, Conakry

1. Introduction

The first hours after total hip replacement (THR) surgery are often marked by moderate to severe postoperative pain lasting from 36 to 72 hours. It is often exacerbated on movement or by reflex quadriceps spasms [1]. Its management uses opiates, in particular intravenous morphine, which is a very popular alternative for the treatment of this pain. However, its use is often associated with several adverse effects such as hyperalgesia, nausea, vomiting, pruritus, sedation. These debilitating adverse effects delay the post-operative rehabilitation of patients and help to lengthen their hospital stay [2]. There are other methods for postoperative pain control after THR. Among these methods, we have ultrasound-guided suprainguinal block (SIB). This block is a recent technique of locoregional anesthesia device first described over two decades ago. It consists of injecting, under ultrasound control, a local anesthetic under the fascia of the iliac muscle causing total or partial blockage of the nerves involved in the genesis of postoperative pain after THR. These nerves are represented by the nerves femorolateral cutaneous, genitofemoral, femoral and obturator [1]. The benefits of using ultrasound guided SIB for the management of postoperative pain after THR have been demonstrated in several publications [3] [4]. In Africa, the literature remains limited on the subject. The objective of this work was to assess the effectiveness of ultrasound-guided SIB in the management of pain after total hip replacement.

2. Materiel and Methods

This was a prospective, randomized, single-blind, randomized controlled study. It was carried out in the anesthesia-resuscitation department of the Donka National Hospital in Conakry, over a period of 06 months, from January 01, 2020 to June 30, 2020. After obtaining the approval of the ethics committee and obtaining from the informed consent of the patients, we included 32 ASA I to III patients, aged ≥ 18 years, operated for THA, having benefited from ultrasound guided BSI or standard IV analgesia. We excluded from this study all patients who presented with injection site infection, allergy to bupivacaine, contraindication to tramadol, and hemostasis disorder. We did not perform a calculation for the sample size, it was established based on our study period. We divided the patients into 02 groups of 16 people, by randomization from a random list pro-

posing the protocol of the "ultrasound-guided SIB" group or the protocol of the control group (standard IV analgesia). All the patients benefited from a pre-anesthetic consultation 24 hours minimum before the date scheduled for the surgery and information on the analgesia technique. All ultrasound guided SIB were performed by the same anesthesiologist before the spinal anesthesia. Pre-medication with hydroxyzine was carried out 1 hour before the operation.

- **Performing ultrasound-guided supra-inguinal block:**

The patient was installed in the supine position, the skin in the inguinal region was disinfected with an antiseptic (Dakin Cooper). The 13 - 16 MHz low-frequency linear ultrasound probe was placed transversely along the inguinal fold, parallel to the antero-superior iliac spine on the side to be operated on, so as to identify from the surface to the depth, the fat under-cutaneous, the internal oblique muscle, the transverse muscle of the abdomen, the iliac aponeurosis covering the iliac muscle, and the iliac muscle itself. The probe was moved laterally until the sartorius muscle was identified. Local anesthesia of the skin with 5 cc of 2% lidocaine was performed before insertion of the 80 mm stimuplex B. Braun 20 G needle with short bevel in the plane 1 cm from the ultrasound probe. Once the needle was in the correct plane, that is to say between the aponeurosis and the ilio-psoas muscle, 1 to 2 ml of local anesthesia was injected to confirm the correct position of the needle. This was confirmed during injection by the separation of the fascia and ilio-psoas muscle in the medial-lateral direction of the injection site. Then 30 ml of 0.25% bupivacaine (without exceeding 1 ml/Kg) associated with 8 mg of dexamethasone was injected between the aponeurosis and the ilio-psoas muscle; 20 minutes after the injection, a cold test on the entire thigh was performed with ice in order to assess the sensitivity of the different areas covered by the femoral nerve, the genitofemoral nerve, the obturator nerve and the femoro-lateral cutaneous nerve. The block was effective when that is, between the aponeurosis and the ilio-psoas muscle, 1 to 2 ml of local anesthesia was injected to confirm the correct position of the needle. This was confirmed during injection by the separation of the fascia and ilio-psoas muscle in the medial-lateral direction of the injection site. Then 30 ml of 0.25% bupivacaine (without exceeding 1 ml/Kg) associated with 8 mg of dexamethasone was injected between the aponeurosis and the ilio-psoas muscle; 20 minutes after the injection, a cold test on the entire thigh was performed with ice in order to assess the sensitivity of the different areas covered by the femoral nerve, the genitofemoral nerve, the obturator nerve and the femoro-lateral cutaneous nerve. The block was effective when that is, between the aponeurosis and the ilio-psoas muscle, 1 to 2 ml of local anesthesia was injected to confirm the correct position of the needle. This was confirmed during injection by the separation of the fascia and ilio-psoas muscle in the medial-lateral direction of the injection site. Then 30 ml of 0.25% bupivacaine (without exceeding 1 ml/Kg) associated with 8 mg of dexamethasone was injected between the aponeurosis and the ilio-psoas muscle; 20 minutes after the injection, a cold test on the entire thigh was performed with ice in order to assess the sensitivity of the different areas covered by the femoral

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lowed by surgery for PTH.

- **Standard IV analgesia (Control group)**

  At the end of the surgery, all patients in this group were subjected to:

  - Paracetamol at a dose of 1 g every 6 hours

  - Tramadol 100 mg every 8 hours

  - ketoprofen 100 mg every 12 hours

  All the patients in the 2 groups were operated on under spinal anesthesia performed with bupivacaine 0.5% isobaric associated with 25 μg of fentanyl and received paracetamol systematically every 6 hours.

  In each group, after the disappearance of the primary anesthesia (spinal anesthesia), we assessed the pain scores with the simple verbal scale (SVS) at rest and on movement at 6 hours, 12 hours, 24 hours, 36 hours and 48 hours. We also assessed the time to mobilization, the incidence of side effects of tramadol, the duration of hospitalization and the satisfaction of the patients in the 2 groups.

  ### Statistical analysis

  The data were collected as the different techniques were performed and as the patients fulfilled our inclusion criteria. The count was manual. Data was processed using Office 2019 Pack software and SPSS software. Statistical analysis was performed using Stata 15.0 software. Qualitative data were presented in terms of frequency and proportion. Quantitative variables were evaluated as the mean (± standard deviation) extremes and the median. For qualitative variables; chi-square test or Fisher's exact test was performed for the comparison of proportions. The Wilcoxon-Mann-Whitney nonparametric test was performed for the comparison of quantitative variables. The significance level was set at $P < 0.05$.

3. Results

Out of all 02 study groups, we recorded 32 patients during our study: 16 patients in the "ultrasound-guided SIB" group and 16 patients in the "standard analgesia" group (control group). There was a male predominance in both groups. The mean age of patients in the ultrasound-guided BSI group was 50.06 ± 17.27 compared to 47.38 ± 13.43 in the standard analgesia group. The patients were ASA I (62.5%), ASA II (12.5%) and ASA III (25%) in the SIB echo guide group while they were ASA I (68.7%) and ASA III (31, 2%) in the standard analgesia group. Table 1 describes the socio-demographic characteristics of the patients included. Pain scores assessed by the simple verbal scale and collected at different time intervals (6H, 12H, 24H, 36H, 48H) showed mean scores < 1 in the ultrasound-guided SIB group while the mean scores were ≥3 in the standard analgesia group ($P < 0.001$). On movement, the mean pain scores were ≤1 for the ultrasound-guided SIB group versus mean scores > 3 in the standard analgesia group ($P < 0.001$). The averages of the EVS scores in the 02 groups at rest and during movement are shown in Table 2 and Table 3, respectively. In our series, we observed a mobilization time greater than 48 hours in all patients in the

Table 1. Basic characteristics of patients in the 02 study groups.

Characteristics	SIB guided echo	Standard analgesia
Sex		
Feminine	07 (43.75%)	05 (31.25%)
Male	09 (56.25%)	11 (68.75%)
Age		
Mean ± SD	50.06 ± 17.27	47.38 ± 13.43
Median	51	42.50
Profession		
Mechanics	01 (6.25%)	03 (18.75%)
Drivers	02 (12.50%)	02 (12.50%)
Tradespeople	07 (31.25%)	01 (6.25%)
Students	07 (25%)	04 (25%)
Other* ASA class	04 (25%)	06 (37.50%)
I	10 (62.50%)	11 (68.75%)
II	02 (12.50%)	00
III	04 (25%)	05 (31.25%)
Indications		
Coxarthrosis	09 (56.25%)	06 (37.50%)
Post-traumatic femoral neck fracture	04 (25%)	07 (43.75%)
Osteonecrosis of the femoral head	03 (18.75%)	03 (18.75%)

*Other = worker (3), teacher (3), housewife (2), seamstress (2).

Table 2. Assessment of SVS scores in the 2 groups at rest

SVS at rest	SIB guided echo	Standard analgesia	P
SVS at 6H			<0.001
Average ± SD	0.38 ± 0.50	2.38 ± 0.50	
Median	0	2	
Extreme	0 - 1	2 - 3	
SVS at 12H			
Average ± SD	0.38 ± 0.50	3.13 ± 0.52	
Median	0	3	
Extreme	0 - 1	2 - 4	
SVS at 24H			
Average ± SD	0.86 ± 0.34	3.56 ± 0.51	
Median	1	4	
Extreme	0 - 1	3 - 4	
SVS at 36H			
Average ± SD	0.75 ± 0.45	3.38 ± 0.50	

Continued

Median	1	3
Extreme	0 - 1	3 - 4
SVS at 48H		
Average ± SD	0.88 ± 34	2.81 ± 0.54
Median	1	3
Extreme	0 - 1	2 - 4

Table 3. Evaluation of SVS scores in the 2 movement groups.

SVS in motion	SIB guided echo	Standard analgesia	P
SVS at 6H			<0.001
Average ± SD	0.56 ± 0.63	3.13 ± 0.62	
Median	0.5	3	
Extreme	0 - 2	2 - 4	
SVS at 12H			
Average ± SD	1.06 ± 0.44	3.81 ± 0.40	
Median	1	4	
Extreme	0 - 2	3 - 4	
SVS at 24H			
Average ± SD	0.88 ± 0.34	3.69 ± 0.48	
Median	1	4	
Extreme	0 - 1	3 - 4	
SVS at 36H			
Average ± SD	0.88 ± 0.34	3.88 ± 0.34	
Median	1	4	
Extreme	0 - 1	3 - 4	
SVS at 48H			
Average ± SD	0.88 ± 0.34	3.13 ± 0.50	
Median	1	3	
Extreme	0 - 1	2 - 4	

standard analgesia group, whereas it was less than 48 hours in the majority of patients (75%) in the ultrasound-guided BSI group. Side effects were only noted in the standard analgesia group in 43.75% of patients; and these were vomiting (71.42%) and nausea (28.57%) (p = 0.007). All patients who received standard analgesia were unhappy with it, while all patients on ultrasound-guided SIB were satisfied. The length of day hospitalization of patients in the ultrasound-guided SIB group was on average 5.50 ± 0.52 compared with 13.44 ± 1.55 in the group of standard analgesia patients (P = 0.001).

4. Discussion

Our study showed that ultrasound guided SIB was effective in the management of postoperative pain after THR. This management represents one of the cornerstones to obtain a better functional result for this surgery. During our study, we observed mild postoperative pain scores at rest and movement in the ultrasound-guided SIB group compared to that of the standard analgesia group where the pain scores on the SVS varied from moderate to severe at rest and movements with a statistically significant difference (p = 0.001). Our results are similar to those found by Xiao-yan Z. *et al.* in China in 2018 who reported mild postoperative pain scores at rest and movement in patients who underwent echo-guided SIB compared to patients with standard analgesia who had scores ranging from moderate to severe [4]. In fact, postoperative pain after THR is caused by joint damage involving the capsule and the synovium. Anatomically, the anterior surface of the capsule, the joint and the upper end of the femur are innervated by the branches of the rectus femoris and internal musculo-cutaneous, the branches of the posterior branch of the obturator and the obturator nerve accessory [5]. All these nerve areas involved in the genesis of postoperative pain after THR are covered by ultrasound guided SIB. Otherwise, this effective analgesia provided by this block could also be explained by the injection of local anesthesia in the correct anatomical space, that is to say between the iliac aponeurosis and the ilio psoas muscle and this thanks to the use of ultrasound. The latter plays a big role in locating this space because it provides a visual approach of the different anatomical structures essential for the realization of the block, it also makes it possible to direct the needle with precision in the space of the fascia. During our study, all suprainguinal blocks were performed under ultrasound, which positively influenced their success rate, that is, between the iliac aponeurosis and the ilio-psoas muscle and this through the use of ultrasound. The latter plays a big role in locating this space because it provides a visual approach of the different anatomical structures essential for the realization of the block, it also makes it possible to direct the needle with precision in the space of the fascia. During our study, all supra inguinal blocks were performed under ultrasound, which positively influenced their success rate, that is, between the iliac aponeurosis and the ilio-psoas muscle and this through the use of ultrasound. The latter plays a big role in locating this space because it provides a visual approach of the different anatomical structures essential for the realization of the block, it also makes it possible to direct the needle with precision in the space of the fascia. During our study, all supra-inguinal blocks were performed under ultrasound, which positively influenced their success rate. The duration of the postoperative pain is maximum the first six hours then decreases until the 36th hour. In the end, the postoperative pain after THR is relatively short-lived, estimated between 36 and 72 hours [6]. The analgesia provided by the guided echo SIB is subject to a time constraint strongly dependent on the duration of action of the local anesthesia used. This duration of action can be extended beyond 24

hours by adding dexamethasone to local anesthesia. The value of dexamethasone as an adjuvant has been demonstrated by Beloeil H. *et al.* [7]. The latter showed in their study that dexamethasone at a dose of 8 mg associated with local anesthesia provided analgesia lasting ≥ 48 hours. During our study, we used 8 mg of dexamethasone in combination with 0.25% bupivacaine in order to prolong the duration of action of this block. Thus, all of our patients in the ultrasound-guided SIB group benefited from analgesia lasting ≥ 48 hours.

Analgesia is a centerpiece for post-operative rehabilitation as it enables more aggressive rehabilitation by combating not only the deleterious effects of surgery such as musculotendinous adhesions, capsular retractions, muscle atrophy and bone resorption. These changes set in three to five days and can become permanent after eight weeks [1]. In our series, patients in the ultrasound-guided SIB group had much faster postoperative rehabilitation than those in the standard analgesia group. Variables such as time to mobilization, side effects and length of hospital stay supported the hypothesis that ultrasound-guided SIB allowed rapid postoperative rehabilitation. The possibility of early passive and active mobilization is a guarantee of the functional success of the surgical procedure [1]. In our series, the time to mobilization was much earlier in the ultrasound-guided SIB group compared to that in the standard analgesia group (p = 0.001). This early mobilization delay in the ultrasound-guided SIB group was linked to the effectiveness of the block, which provided good analgesia, from the first hours of the postoperative period. As for the side effects, they were only present in the standard analgesia group represented mainly by nausea and vomiting (p = 0.007). Our results are similar to those reported by Liyang C *et al.* in China in 2019, which found side effects in patients in the standard analgesia group represented by nausea [3]. The side effects found in our series are inherent to the use of tramadol. The length of hospital stay is on average six days (five to eight days) currently and tends to be reduced [1]. The length of hospital stay in the ultrasound-guided SIB group was less than that in the standard analgesia group with a significant difference (p = 0.001). Our results are similar to those found by Liyang C. *et al.* [3] and Xiao-yang Z. *et al.* [4] in China, who reported in meta-analyzes carried out in 2019 and 2018 respectively, a reduction of the average length of hospital stay. This reduced hospital stay found in the ultrasound-guided SIB group in our series could be due to the good management of the postoperative pain associated with the early mobilization of the patients and also to the absence of side effects. Patient satisfaction depends on its time to recovery, its comfort (relief) at rest and movement, the length of early rehabilitation and the lack of complications [8]. In our study, patients in the SIB echo-guided group were very satisfied unlike the standard analgesia group which was not satisfied with the analgesia technique. This satisfaction obtained in the ultrasound-guided SIB group could be explained by the absence of side effects, by the early mobilization time and especially by the good analgesia provided by the ultrasound-guided SIB. The main weakness of our study is its lack of power due to the small sample size. However, the results obtained by this prospective study

provide precise information which could not have been found by a retrospective study.

5. Conclusion

Our study demonstrated that ultrasound-guided SIB provided better analgesia than standard analgesia in the management of pain after THR. It also reduces the time to mobilization after surgery as well as the side effects associated with the use of drugs such as opioids. Finally, this block reduces the length of hospitalization after THR surgery and improves patient satisfaction. The use of ultrasound guided SIB by hospital practitioners for the management of pain after THR could be included in the multimodal analgesia protocol for better patient management. It could also extend to other surgeries involving the femur.

Conflicts of Interest

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

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