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ORIGINAL ARTICLE

Is Subcutaneous Local Anesthesia Necessary in Ultrasound-guided Hip Magnetic Resonance Arthrography?

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Background: Ultrasound (US)-guided injection is increasingly used for magnetic resonance (MR) arthrography of the hip. There is no information regarding the utility of anesthetizing the needle path before joint puncture. Thus, the aim of this study was to retrospectively compare the efficacy of the technique and discomfort in patients undergoing US-guided arthrography of the hip using a fixed guide, with or without the use of subcutaneous local anesthesia. **Materials And Methods:** Eighty-two patients underwent anterior US-guided MR arthrography of the hip, of whom 33 had received anesthesia and 49 had not; these patients were compared for differences in the efficacy of arthrography and the subsequent complications. They were also asked to report the intensity of discomfort using a visual analog scale (VAS). **Results:** Hip joint arthrography was successful in all cases with no complications. There were no significant differences between the anesthetized and non-anesthetized groups in terms of sex, age, body mass index, side, success rate on first attempt, and extra-articular contrast leakage on MR ($P > 0.05$). The mean VAS scores were 23.3 (median 25.0; SD 13.3) in anesthetized patients versus 23.6 (median 20.0; SD 19.2) in those who were not anesthetized ($P = 0.12$, Mann–Whitney U test). **Conclusion:** Routine local anesthesia is possibly unnecessary in US-guided MR arthrography of the hip using a fixed guide.

Key words: Arthrography, hip, local anesthesia, magnetic resonance imaging, ultrasonography-guided

INTRODUCTION

Magnetic resonance (MR) arthrography of the hip is a well-proven and useful technique for the diagnosis of intra-articular lesions, especially of the acetabular labrum.[1-3] Information about the safety of hip arthrography and about the patients' tolerance of the procedure has become more important, with an increase in the number of intra-articular contrast injections that are performed.

The routine use of subcutaneous local anesthesia before intra-articular injection for hip arthrography has been reported in literature.[4-6] The most commonly described techniques that use fluoroscopic guidance have good feasibility, although needle repositioning or difficulty in injecting lead to occasional discomfort.[5] Local anesthetics are especially useful when the needle tip has to be repositioned because of an earlier unsuccessful attempt to reach the joint. It has been possible to omit the routine use of subcutaneous infiltration of local anesthesia for arthrography of the shoulder and knee joints.[7,8] Thomas suggested that local anesthesia for knee arthrography should be avoided because the injection of the local anesthetic itself is painful.[8] Moreover, Mika described that local anesthetic use may affect the expectations of the forthcoming procedure, being a portent of a painful procedure, and thus exaggerating pain perception.[7]

US-guided injection of a contrast agent into the hip joint has advantages over fluoroscopy-guided injection, including a higher accuracy of intra-articular needle placement, the absence of radiation exposure, a higher success rate, and the ability to directly visualize the vascular structure.[4,6,9,10] Subcutaneous local anesthesia is still used because of the anticipated difficulty in accurately identifying the needle tip during US-guided procedures, especially in the hands of inexperienced radiologists.[4,6] Our previous report has shown US-guided hip arthrography using a fixed guide to be less time-consuming in comparison to arthrography using freehand US-guided injection, because fixing the trajectory of the needle facilitates the procedure and increases the confidence of the radiologist performing the injection.[11] Thus, we hypothesized that it was unnecessary to use subcutaneous local anesthetics in US-guided hip injection with a fixed needle.

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The purpose of our study was to compare the efficacy of the procedure and the discomfort retrospectively, in patients undergoing US-guided arthrography of the hip using a fixed guide, with or without the use of local anesthesia.

MATERIALS AND METHODS

Patients

This study was approved by the Institutional Review Board of the Tri-Service General Hospital; patient consent was not required for the retrospective review of records and images, because patient anonymity was preserved. Initially, we used to induce local anesthesia two to four minutes prior to the joint puncture by infiltrating 2-3 mL of lidocaine (10 mg/mL) along the needle path and on the anterior surface of the hip, by using a 22-gauge needle, under US guidance. We omitted the routine use of the local anesthetic in 2010, as we suspected that its benefit for the patient was minimal.[7,8] During the period of transition, we surveyed patients and routinely asked them to rate puncture-related discomfort after arthrography on a visual analog scale (VAS). Absolute pain during the procedure, as represented on the VAS, ranged from zero standing for 'did not feel anything' to 100 indicating 'unbearable pain'.[5,12] In order to improve the patients' comprehension of the discomfort during arthrography, we attempted to couple the VAS directly to specific points along a line, labeled with intensity-denoting adjectives or numbers and explained the scale to the patients before arthrography [Figure 1].[13] This scale was called a graphic rating scale (GRS). The patients were asked to indicate which point along the line best represented their pain intensity. We also assessed the pain severity according to the VAS pain score by correlating the VAS score with the Verbal GRS. It consisted of a list of phrases (no pain: VAS = 0; mild pain: VAS scale <30; moderate pain: 30 ≦ VAS scale <70; severe pain: 70 ≦ VAS scale ≦ 100). The respondents selected a single phrase that best characterized their pain intensity. Eighty-nine consecutive patients who referred for MR arthrography of the hip at our hospital from February 2010 to January 2013 were included in this study. Only adults with sufficient knowledge of the local language were included. Two patients, who did not answer the question on puncture-related discomfort, were excluded. Five patients with prior hip surgery or experience of hip arthrography were also excluded. Altogether 82 patients (38 women and 44 men; with a mean age of 42 years; age range 20-69 years) received injections for hip arthrography. Forty-nine of these patients had not received a local anesthetic for the needle path, while there were 33 patients who insisted on receiving a subcutaneous local anesthetic prior to arthrography. The decision to receive local anesthesia for the needle insertion procedure was made by the patients themselves. Ultrasonography was performed before MR-arthrography by using a US scanner (Nemio XG; Toshiba. Tokyo, Japan), with a 3-6-MHz curved array transducer (PVM-375AT). No participant had joint effusion on US examination before hip arthrography.

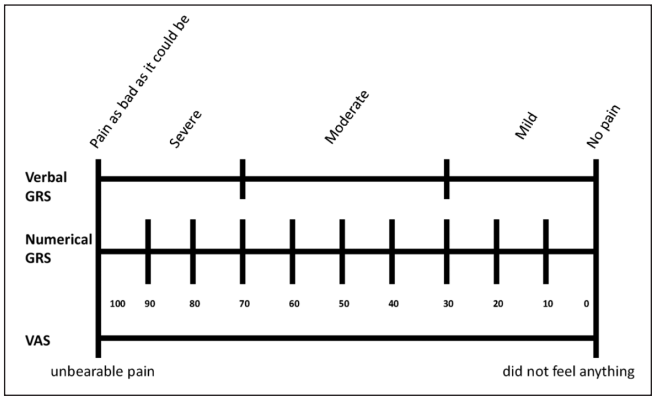

Figure 1. The visual analog scale (VAS), aligned with the verbal graphic rating scale (Verbal GRS) and the numerical graphic rating scale (Numerical GRS)

Approach technique

The patient's leg was then placed in a neutral position and the skin of the anterior aspect of the hip was cleaned with a standard solution. We made inquiries to make sure that the patients had no discomfort with the hip in this position before starting the injection. The US-guided technique was performed using a scanner (Nemio XG; Toshiba. Tokyo, Japan), with a 3-4-MHz linear transducer (PLF-308P). The linear transducer was sterilized with CIDEX® OPA solution before injection. After cleaning the skin and transducer with alcohol, we slid the probe laterally along the femoral vessels to the most lateral part of the superior acetabulum and placed it vertical to the latter by using a parasagittal approach. A 3.5-inch long, 22-gauge spinal needle was used for all procedures. In the fixed US-guided technique, the needle was inserted into the needle guide hole and directed toward the hip joint, targeting the femoral head or femoral neck [Figure 2]. The needle was advanced until the bone of the femoral neck was reached. Before arthrography of the hips, a standard protocol for anesthesia of the needle path under the fixed US-guided technique was used in the group of patients receiving subcutaneous local anesthetic. We first advanced the needle until the femoral bone was reached and then withdrew the needle from the hip capsule. Finally, we slowly injected a maximum of 2 ml of lidocaine 2%, while the needle was gradually left under the skin.

When the arthrography was performed under US-guidance, a test injection of 2 mL of contrast agent was administered to confirm accurate needle placement, which was followed by injection of approximately 8 mL of contrast agent into

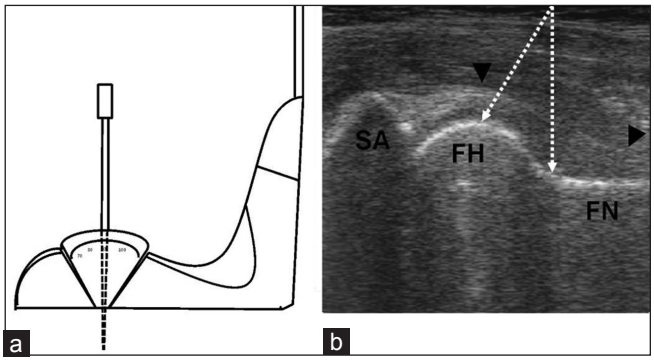

Figure 2. Schematic diagram of the fixed-guide, US-guided injection technique A suitable biopsy adaptor and biopsy needle is chosen for the procedure. The biopsy adaptor sets the angle of the biopsy needle (a) A parasagittal sonogram (b) obtained at the anterior aspect of the hip joint and vertically, along the most lateral point of the superior acetabulum, shows the femoral head (FH), femoral neck (FN), superior acetabulum (SA), and anterior hip joint capsule (arrowheads). The orientation of the needle for the US-guided technique is indicated by the long, white dotted arrow

the hip joint by using the end of the extension tube as a port. Patients were injected with 10 mL of a contrast mixture of diluted (2 mmol/L) gadopentetate dimeglumine (Magnevist; Bayer Schering Pharma AG, Berlin, Germany) according to the standard protocol. When the needle tip was correctly positioned, there was very little or no resistance to the injection.[5] Whenever the test injection was difficult and there was no accumulation of contrast in the joint, we rotated the bevel of the needle counterclockwise, while continuing the test injection of the contrast agent until no resistance to the injection was encountered.[7] If the contrast agent was still difficult to inject, the needle was left under the skin and a second insertion was attempted. We obtained and recorded the US image of each attempt of injection.

The injections were performed during a 36-month period (February 2010 to January 2013) by one of two radiologists (YCH, HLK) experienced in performing joint injections in a standardized fashion. Time from the injection to the onset of the MR scan was not measured, but was typically within 30 minutes.

Data collection

All patients were asked by an independent resident (YCW) to comment freely on their experience immediately after arthrography. For each procedure, the extra-articular contrast leakage was evaluated by MR arthrography and documented with a two-point scale: A score of 0 indicating no or mild extra-articular contrast leakage and a score of 1 indicating moderate-to-severe contrast leakage.[10] Two radiologists with 10 (YCH) and 25 years (GSH) of experience in musculoskeletal radiology analyzed all the MR arthrographic images together, to reach a consensus opinion. The patients' medical records were reviewed by a radiologist (YCH) with 10 years of experience in US, arthrography, and musculoskeletal radiology. The medical records were examined one week after injection to enable the assessment of adverse effects after the procedure. We recorded the number of attempts at US-guided injection and the clinical data, such as, height and weight, to estimate the body mass index (BMI).

Statistical analysis

The χ^2 test was used for the analysis of sex, side of injection, success rate at first attempt, extra-articular contrast leakage, and Verbal GRS. Student's *t* test was used to analyze the age and BMI. Mann–Whitney *U* test was used for VAS. Statistical analyses were performed using the SPSS software (Version 16; SPSS. Chicago, IL, USA). Significance values were calculated with respect to a two-tailed alternative hypothesis. Differences were considered statistically significant at a *P*-value of less than 0.05.

RESULTS

Eighty-two hip arthrographic examinations were performed retrospectively in 82 consecutive patients. The puncture was successful in all of the cases, and images were considered adequate for interpretation of the MR arthrography. No complications, such as intense pain, bleeding, paresthesia, mobility restriction, syncope, allergic reactions, fever, or infection, were observed during or after the procedure.

Table 1 summarizes the demographic data and the statistical analysis. There was no significant difference between the groups with respect to sex, side, age, BMI, attempts of injection, extra-articular contrast leakage, VAS pain score, and Verbal GRS pain score ($P > 0.05$). No patient in the group that did not receive local anesthetics along the needle path, requested for anesthesia during arthrography. The mean VAS pain score of those who received a local anesthetic along the needle path was 23.3 (median 25.0; SD 13.3), while it was 23.6 (median 20.0; SD 19.2) for those who did not receive local anesthesia ($P = 0.12$; Mann–Whitney *U* test) [Figure 3].

DISCUSSION

Our study findings demonstrate that anterior fixed US-guided injections for hip arthrography are safe and technically feasible. In fact, as indicated by our results, the average pain in US-guided MR arthrography of the hip using a fixed guide is relatively minor and the routine use of local anesthetic is unnecessary.

Table 1. Demographic data of patients and differences in technical factors between patient groups subjected to femoral head and neck injection, with and without subcutaneous anesthesia

Parameter	Without subcutaneous local anesthetic	With subcutaneous local anesthetic	*P* value
Number of patient	49	33	
First attempt success*	37	24	0.98
Sex*			
Male	28	16	0.59
Female	21	17	
Side*			
Right	31	22	0.94
Left	18	11	
Extra-articular contrast leak*			
Small	32	23	0.86
Large	17	10	
Age (years)	43.6±13.4	40.5±13.6	0.30
BMI (kg/m^2)	22.4±2.8	23.7±3.9	0.08
VAS	23.6±19.2	23.3±13.3	0.12
Verbal GRS*	34	26	0.49
	15	7	

VAS = Visual analog scale; GRS = Graphic rating scale; BMI = Body mass index; M = Male, F = Female, R = Right; L = left. *Figures indicate the number of patients or incidents, except in the case of Age, BMI, and VAS pain scores.

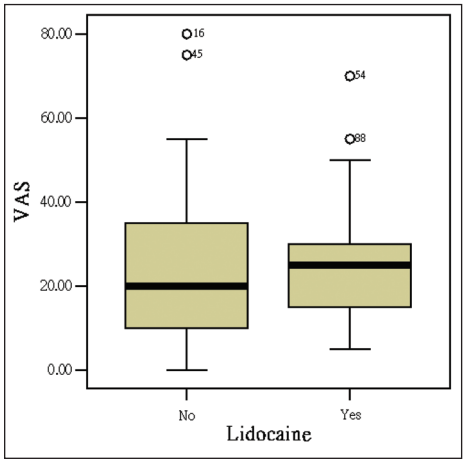

Figure 3. Distribution of VAS scores between the two groups, with or without lidocaine injection, from the pain survey

Although the use of a local anesthetic may reduce superficial pain during joint puncture, infiltration of the anesthetic requires an additional needle prick, and at least in theory, carries an increased risk of infection and allergic reaction. Moreover, one seldom waits long enough for the local anesthetic to take effect, because an ultrasound-guided arthrography injection without local anesthesia takes only a few minutes in any case. Even then, some of our patients insisted on receiving a subcutaneous local anesthetic prior to arthrography because of undue apprehension of arthrography-related discomfort, as has been described previously.[14] Close personal contact with a clinician during the arthrographic procedure was reassuring; similarly a radiologist's reassuring, thoughtful, and composed manner in a peaceful environment was important when performing such an unfamiliar intervention.[7]

The major challenges in learning US-guided techniques are ensuring a proper target, and keeping the needle in the imaging plane of the transducer during US examination.[4,6,7,9,10] These obstacles may lead to unsuccessful attempts to reach the joint, which made it necessary to use local anesthetics for US-guided hip arthrography. At our institution, we found that using a landmark that lay vertical to the lateral edge of the superior margin of the acetabulum, made it easier to learn US examination and led to successful first attempts with both needle-guided and freehand US-guided techniques, because the superior margin of the acetabulum was an easily recognized landmark and the femoral head-neck junction was a broad and definite target.[4,6] Sixty-one of the 82 injections (74%) were completed at the first attempt in our series, which was similar to the 82% rate of successful first attempts in freehand US-guided hip arthrography reported in the literature.[10] Moreover, the use of subcutaneous anesthesia made no significant difference to the rate of success at first attempt in US-guided hip arthrography using a fixed guide, in our study (p = 0.98). In our experience of performing US-guided hip arthrography without the use of local anesthesia, many patients seemed to easily tolerate the pain or discomfort related to the procedure. Our results indicate that the routine use of local anesthetic in this procedure is possibly unnecessary.

The pain, caused by skin penetration during arthrography in patients who are not given subcutaneous local anesthetic, might cause a change in the position of the targeted hip joint and lead to a transient loss of the needle tip on real-time US imaging, among patients in whom US guidance was used. It is more difficult to inject the hips in obese patients because of the decreased spatial resolution resulting from the increased thickness of the overlying soft tissues, along with the need for the needle tip to travel a greater distance to the joint space.[4] These conditions might lead to difficulty during US-guided hip arthrography and make it impossible to omit the use of local anesthetic. However, US-guided injection using a fixed guide could overcome these obstacles because the needle could be advanced along a fixed trajectory until the bone of the femoral neck or femoral head was reached.[11] Advancing the needle until the bone was reached could also overcome

the major drawback of the needle being advanced beyond the intended and visualized target.[15]

The present study has several limitations, including its retrospective design. Although the wide dispersal of VAS pain scores accounted for the large variability in pain intensity among our patients, we chose the VAS to measure the patients' perception of discomfort, as it was more sensitive than the semi-quantitative methodology for measuring pain.[16] In addition, we acquired the pain score data only in patients who were eager to cooperate, and this may have resulted in a selection bias. Furthermore, the technician assessed the pain score directly after injection, and this could have led to patient bias.

In conclusion, US-guided injection of a contrast agent for hip MR-arthrography using a fixed guide is an effective technique. Our results indicate that the routine use of local anesthetic in this procedure is possibly unnecessary.

DISCLOSURE

All authors declare no competing financial interests. The Institutional Review Board for Human Investigation (TSGHIRB 1-101-05-109) has approved this study.

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