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RESEARCH ARTICLE

Study on Accuracy of Blind and Ultrasound-Guided Arthrocentesis of Hip Joint

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Abstract

Objective: To compare the accuracy of blind arthrocenthesis based on anatomic landmarks, and ultrasound (US) - guided arthrocentesis of hip joint (HJ).

Material and methods: Ninety-six patients with uni- or bilateral radiologically proven hip osteoarthritis (OA) were included in the study. A total number of 187 hip joints were injected. One blind arthrocentesis by lateral approach was performed on each patient. The accurate position of the needle was verified by a following injection of 0.5-1.0 ml contrast and radiological assessment. After seven days, the same patients (187) underwent a second arthrocentesis under US guidance.

Results: Seventy-four percent (97/131) of all blind arthrocentesis in Kellgren-Lawrence (K-L) radiological grade II OA patients were successful, and 26% (34/131) - unsuccessful. All US-guided arthrocentesis were successful (131/131). In radiological grade III OA patients successful blind arthrocentesis were performed in 61.3% (19/31) of the patients and unsuccessful - in 38.7% (12/31) of the patients. All patients with radiological grade III OA had succesfull US-guided arthrocentesis (31/31). In patients with radiological grade IV OA, successful "blind" arthrocentesis were performed in 40% (10/25) and unsuccessful - in 60% (15/25) of the patients. The success rate of US-guided arthrocentesis in the same group was 92% (23/25), while 8% (2/25) of arthrocentesis were unsuccessful.

Conclusion: The use of blind lateral approach for arthrocentesis of HJ is not recommended as a routine diagnostic or therapeutic procedute except for some cases with outpatient administration of local anaesthetics, and corticosteroids for temporary pain relieve. The US-guided arthrocentesis of HJ in patients with K-L grade II-III of OA reaches 100% accuracy. In K-L grade IV OA patients, presence of hip joint contracture and obesity could influence significantly the accuracy of arthrocentesis.

Keywords

Hip joint, Blind arthrocentesis, Ultrasound-guided arthrocentesis

Introduction

Arthrocentesis of the hip joint has always been a provocation for orthopedists, surgeons rheumatologists, anesthesiologists and interventional radiologists because of the deep location of the joint and the neurovascular bundle of the hip. The indications for hip joint arthrocentesis include a wide range of diagnostic and therapeutic interventions - joint fluid analysis to detect septic arthritis or infection of endoprosthesis, contrast-enhanced magnetic resonance (CE-MRI) or computed-tomography (CT) - imaging, injection of anesthetics, steroids, lubricants and antibiotics.

Numerous injection techniques of the hip have been described in the literature [1-3]. Injection of the hip using only anatomic landmarks have been reported. It yields reliable short-term pain relief, simultaneously endorsing accurate diagnosis of hip pathology [4]. When injection of a contrast dye is used to confirm needle position after arthrocentesis guided by anatomic landmarks, accuracy was found to be around 80% [3].

Fluoroscopy-guided (Fl-guided) arthrocentesis

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based on a direct visualization of the needle insertion and direction during arthrocentesis and detection of depo of intra-articularly (IA) injected contrast is very important in the cases of viscosupplementation, where the proper delivering of these drugs into the joint is crucial for the treatment. Fl-guided arthrocentesis is considered as a reference method together with CT- and MRI- visualization, concerning the accuracy of hip joint arthrocentesis. In some institutions, the hip is the most commonly injected joint under fluoroscopy [1].

In the past decade ultrasound has become a useful tool for repeated joint assessment and guiding the needle during IA injections. It is more commonly used in comparison with the fluoroscopic method because of some limitations of the latter, namely the radiological risk and the impossibility to follow up in the short term. US-guided hip injection has several advantages – avoids contrast in patients with history of allergies, cost-effective for patient, allows for immediate post injection reassessment, no radiation exposure [5]. Ultrasound-guided injections are overall more accurate than landmark-guided injections [6]. Detailed US-guided hip injection techniques have been described by Micu, et al. [7] and by Mulvaney, et al. [8].

Material and Methods

The present study was conducted in the surgery of UMHAT "Pulmed"- Plovdiv. Ninety-six patients (187 hip joints) with uni- or bilateral radiologically confirmed OA patients gave their informed consent for IA injection because of pain refractory to conventional therapy. The study was approved by the Local Ethics Committee of UMHAT 'Pulmed'. Patients were diagnosed with primary hip OA, according to American College of Rheumatology (ACR) criteria [9] and divided into three groups according to the radiological grade of hip OA based on the classification of Kellgren-Lawrence (K-L) as follows: I group K-L Rö II - 79 patients /131 hip joints; II group K-L Rö III - 27 patients / 31 hip joints, and III group K-L Rö IV - 20 patients /25 hip joints.

One blind arthrocentesis was performed on each patient (a total of 187 patients). Patients were in supine position. The anatomical bony landmarks and femoral vessels were marked. We used lateral approach to the hip at about 2.0 - 2.5 cm bellow the superior border of the greater trohanter. The entrance site was desinfected. The position of the needle was preliminary verified by an X-ray control for 1-2 sec. The needle for the arthrocentesis was 8-10 cm long (green or orange i.v. catheter). The needle was inserted from medially, at a 30-degree angle, visually controlled on the monitor by the operator. The target was to reach the head - neck junction. The confirmation of correct needle position was obtained by millimetric retraction and injection of 0.5-1.0 ml of contrast - Ultravist® - 370 - Bayer followed by an X-ray assessment. The correct IA position of the needle was verified by the demonstration of the femoral neck covered with contrast. If necessary the needle was redirected again under fluoroscopic control. The next step was injection of the drug. The injection site was covered by an ice package and the patient was monitored for 2-3 hours after the procedure.

The second arthrocentesis (187 in number), 7 days later, following treatment protocol, was performed under US-guidance. The patients were in supine position. The anatomical bony landmarks and neuro-vascular bundle were marked (Color Doppler). A preliminary US assessment was done by anterior longitudinal scan with a 2-5 MHz convex probe or 7.5 MHz linear probe, positioned by its long axis along the anterior femoral neck/femoral head. On this scan the classical image (with individual variability) of the contour of the femoral head and the femoral neck, depending on OA severity, was visualized. After determination of probe's position for every patient, the puncture site was marked. The overlying skin was cleaned and IA US- guided injection was performed by an anterior – parasagittal approach at about 2 cm below the lower end of the probe, hand-free technique. Immediately after visualization of the tip of the needle (needle length 8-10 cm), the arthrocentesis became visually controlled on the screen of the US machine. The access to the joint cavity was guided using the head-neck junction as a target. The confirmation of the correct IA needle placement was achieved by injecting 1 ml of saline, resulting in a typical convex shape of the capsule. This was followed by an injection of the drug and monitoring the patient for the next 2-3 hours.

Successful arthrocentesis were those, where imaging control verified the correct positioning of the needle, and the presence of depot of intra-articular contrast. All arthrocentesis with the presence of a depot of contrast extra-articullarly, despite correct positioning of the needle, were considered unsuccessful.

For the Fl-control an apparatus "AXIOM Iconos R 200" (125kV; 650mA) was used. US - guided arthrocentesis were performed by the use of Philips HD7 -2008.

Results

The number of patients (96) differs from the sum of patients in the groups, because 17 patients from group I had bilateral hip OA Rö II/III grade, and 9 patients had bilateral hip OA Rö grade II/IV. Four patients from group II had bilateral hip OA Rö III/IV grade, i.e, 126 - (17 + 9 + 4) = 96. The distribution of the cohort, according to K-L radiological classification is presented on Table 1.

The effect of the body mass index (BMI) on the accuracy of blind and US-guided arthrocentesis was evaluated. BMI 21-26 kg/m^2 is considered as normal for people aged 35-44. Fifty-nine (45%) of the patients had normal BMI ≤ 26, fifty-seven patients (43.5%) were overweight (26 < BMI ≤ 32), and fifteen patients (11.5%) were obese with BMI > 32. No patients with obesity had

Table 1: Distribution of patients and hip joints based on the severity of hip OA.

K-L Grade	Group I K-L Rö II patients/HJ	Group II K-L Rö III patients/HJ	Group III K-L Rö IV patients/HJ	Unilateral hip OA	Total number of hip joints
K-L Rö II patients/HJ	52/104	17/17	9/9	1/1	**131**
K-L Rö III patients/HJ	17/17	4/8	4/4	2/2	**31**
K-L Rö IV patients/HJ	9/9	4/4	5/10	2/2	**25**
Unilateral Hip OA	1/1	2/2	2/2		
Total number of patients	**79**	**27**	**20**		**joints 187 patients 126**

Table 2: Number of successful versus unsuccessful blind arthrocentesis in OA patients K-L Rö II.

Accuracy of blind arthrocentesis	K-L Rö II 131 HJ	18.5 < BMI ≤ 32 116 HJ	32 < BMI ≤ 38 15 HJ
Successful	97/131 (74%)	88/116 (75.9%)	9/15 (60%)
Unsuccessful	34/131 (26%)	28/116 (24.1%)	6/15 (40%)

Table 3: Number of successful versus unsuccessful blind arthrocentesis in OA patients K-L Rö III.

Accuracy of blind arthrocentesis	K-L Rö III 31 HJ	18.5 < BMI ≤ 32 27 HJ	32 < BMI ≤ 38 4 HJ
Successful	19/31 (61.3%)	17/27 (63.0%)	2/4 (50%)
Unsuccessful	12/31 (38.7%)	10/27 (37.0%)	2/4 (50%)

Table 4: Number of successful versus unsuccessful blind arthrocenthesis in OA patients K-L Rö IV.

Accuracy of "blind" arthrocentesis	K-L Rö IV 25 HJ	18.5 < BMI ≤ 32 23 HJ	32 < BMI ≤ 38 2 HJ
Successful	10/25 (40%)	10/23 (43.2%)	0 (0%)
Unsuccessful	15/25 (60%)	13/23 (56.8%)	2/2 (100%)

BMI > 38.

Our results demonstrate the combined effect of the BMI and the severity of OA on the accuracy of blind arthrocentesis. The data is presented on Table 2, Table 3 and Table 4.

All arthrocentesis in OA patients K-L Rö II, performed under US-guidance were successful - 131/131 (100%) Table 2.

All US-guided arthrocenthesis in OA patients K-L Rö III were also successful - 31/31 (100%) Table 3.

In patients with K-L Rö IV 92% (23/25) of US-guided arthrocentesis were successful and 8% (2/25) - unsuccessful Table 4.

Discussion

Our results demonstrate correlation between the severity of OA and the percentage of successful/unsuccessful blind arthrocentesis, and the combined effect of the BMI and severity of OA on success rate as follows: 74% of accurate "blind" arthrocentesis in patients K-L grade II: 75.9% in patients who were with normal weight or overweight (BMI ≤ 32), and 60% in patients with obesity (BMI > 32) - Table 2; 61.3% accuracy in patients K-L grade III: 63.0% in patients who were with normal weight or overweight (BMI ≤ 32), and 50% in patients with obesity (BMI > 32) - Table 3; 40% accuracy in patients K-L grade IV: 43.2% in patients who were normal or overweight. In this group there were two patients with obesity, and in none of them the arthrocentesis was successful - Table 4.

These results are similar to the results reported in the literature. Diracoglu D. et al. [10] achieved accuracy of 50,9% in patients K-L II-III grade and BMI < 34. Mauffrey, et al. [2] reported 95% accuracy of blind lateral approach, but only with radiological verification

of the correct position of the needle, without using contrast. Diracoglu D, et al. [10] demonstrated that from 38 correct, fluoroscopically confirmed arthrocentesis, 29 (76%) were with correct intra-articular positioning of the needle.

The results from these studies confirmed that most of the documented mistakes of "blind" arthrocentesis were associated with acetabular brow, with big trohanter/big osteophytes or excessive return of the needle after touching the bony surface.

Our results concerning US-guided arthrocentesis demonstrated high accuracy of anterior parasagittal approach – 100% successfully applied arthrocentesis in patients with K-L grade II-III and 92% (23/25) in patients K-L grade IV. One unsuccessful arthrocentesis was in a patient with flexor-adductor contracture of 13° and BMI 26.2 kg/cm^2, the other - in a patient with contracture of 6 °C and BMI 33.9. In both cases anterior-lateral (parasagittal) approach was difficult. The rate of unsuccessful US-guided arthrocentesis of hip joint in the present study was 1% (2/187).

It is a well-known fact that US-guided arthrocentesis performed by an experienced operator are characterized by high accuracy. Pourbarger, et al. [11] performed 30 arthrocentesis using anterior parasagittal approach, and CT-controlled positioning of the needle and injecting of a contrast depot in the joints. The authors reported 100% accuracy, confirmed by CT. Balog, et al. reported 96% accuracy of US-guided hip injections [5]. Smith, et al. used an anterior parasagittal approach in 28 patients (30 HJ) and Fl – verification of the position of the needle, and injection of contrast. The accuracy of US- guided arthrocentesis in their study was 97% (29/30) [12]. Mulvaney, et al. [8], Smith, et al. [12,13], Rowbothman, et al. [14] had published techniques for aspiration and intra-articular injections in HJ with US-guidance. In the last decade US has became widely used imaging tool for diagnostic and therapeutic interventions [15].

Conclusion

The accuracy of arthrocenthesis of HJ by blind lateral approach depends on the radiological grade of the OA, and the patient's BMI. This technique is not recommended as a routine diagnostic or therapeutic procedure except for some cases with outpatient administration of local anaesthetics, and corticosteroids for temporary pain relieve.

The US-guided arthrocentesis of HJ in patients K-L grade II-III reaches 100% accuracy. In patients with grade IV K-L OA, the presence of joint contractures and obesity could influence significantly the accuracy of arthrocentesis.

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