Osteoarthritis and Cartilage (2001) **9,** 509–511

doi:10.1053/joca.2001.0430, available online at http://www.idealibrary.com on IDEAL®
1063–4584/01/060509+03 $35.00/0

Osteoarthritis and Cartilage
Journal of the OsteoArthritis Research Society International
OARSI OSTEOARTHRITIS RESEARCH SOCIETY INTERNATIONAL

Editorial

Modern patient management in rheumatology: interventional musculoskeletal ultrasonography

P. V. Balint, D. Kane and R. D. Sturrock
Centre for Rheumatic Diseases, University Department of Medicine, Glasgow Royal Infirmary, Alexandra Parade, Glasgow G31 2ER, U.K.

Aspiration of joint and bursal effusion and intraarticular and soft tissue injection are performed routinely as diagnostic and therapeutic procedures in clinical rheumatology. Only a few studies have examined the accuracy of intraarticular and soft tissue injection. These studies demonstrate a surprisingly low rate of accurate needle placement. Using an admixture of steroid and radiological contrast material, Eustace *et al.* found that only 37% of subacromial and glenohumeral joint injections were accurately placed[1] while Jones *et al.* could only confirm intraarticular needle placement in 56 (52%) out of 108 joint injections[2]. In both studies the accuracy of injection of the two most commonly injected large joints (shoulder and knee) was poor. In de Quervain's tenosynovitis, the larger, more superficial abductor pollicis longus tendon sheath was accurately injected in 84% of cases while the smaller, deeper extensor pollicis brevis tendon sheath was accurately injected in only 32% of cases[3]. In all three studies, accurately placed injections were associated with a superior clinical outcome.

Confirmation of accurate needle placement is usually obtained by free aspiration of synovial fluid. However, a 'dry tap' usually occurs in non-inflammatory joint disease such as osteoarthritis (OA), soft tissue injection, smaller joints or when a small effusion is present. Diagnostic aspiration may also be indicated in the absence of palpable effusion when septic or crystal arthritis is suspected. With the advent of the use of intraarticular sodium hyaluronate in the management of knee OA[4], rheumatologists are required to accurately inject into an increasing number of 'dry joints', leading to a need for alternative strategies to confirm needle placement.

A thorough knowledge of the surface anatomy of joints can be applied to improve the accuracy of joint injection. The knee can be reliably accessed from many different approaches. However other less superficial joints—such as the hip—are also affected by OA, and imaging may be required to accurately access the joint space. Fluoroscopic guidance is recommended for hip injection, but must be performed in an X-ray department and involves radiation exposure[5].

Ultrasound allows accurate and reproducible identification of the anterior part of hip joint and periarticular tissues[6]. Musculoskeletal ultrasonography (MSUS) can detect small or deeply located effusions not found on clinical examination. Cadaveric studies show that ultrasound can detect effusions of as little as 1 ml of fluid in hip joints[7] and 2 ml of fluid in the ankle[8]. MSUS can also provide information on the precise location, structure and extent of palpable effusions in addition to delineating surrounding tissues such as skin, vessels and nerves. This allows the safest route of injection to be identified and provides useful information on the depth to which the needle must be inserted. Thus MSUS improves detection and aspiration of joint effusions.

Intraarticular effusion is a recognized classification criteria for knee—but not hip—OA[9,10]. However, hip effusion has been demonstrated by ultrasonography in OA[11]. Effusions are usually differentiated from solid structures, as they are anechoic though they can appear hypoechoic if they contain reflective particles. MSUS may also detect intraarticular and intrabursal septae or complex multiloculated structures but cannot differentiate between inflammatory or non-inflammatory effusions, septic arthritis or haemarthrosis. Synovial proliferation also appears hypoechoic, though fluid can be confirmed by compression and/or displacement with transducer pressure. Newer techniques for differentiating between solid structures and effusions are in development, particularly in inducing and detecting acoustic streaming in breast cysts using real-time ultrasonography[12,13].

Interventional ultrasound is a reliable and safe technique[14]. The indications and contraindications for ultrasound guided joint and soft tissue injections are essentially the same as for unguided injection though most operators also use a combination of antiseptic liquids, sterile gels, sterile gloves, sheaths, condoms, or sterile latex and non-latex materials to cover the probe and maintain a sterile field. Some operators do not use a sterile covering on the probe, arguing the transducer does not come in close contact with the needle. Future developments in ultrasound technology such as cableless transducers and combined ultrasound injection probes will make aspiration and injection of the joint even easier.

Address correspondence to: Dr Peter V. Balint, Centre for Rheumatic Diseases, University Department of Medicine, Glasgow Royal Infirmary, QEB, 10 Alexandra Parade, Glasgow G31 2ER, U.K. Tel: 0141-211 4687; Fax: 0141-211 4878; E-mail: pb58v@clinmed.gla.ac.uk

Ultrasound-guided aspiration of the hip joint is not a new technique having been first described by Komppa *et al.* in 1985[15]. Pathological and non-pathological hip joint structures can be clearly identified, though in obese patients a 3.5–5 MHz probe may be necessary to identify deeper structures[16]. Imaging of the injection needle may present technical difficulties as the transducer and needle should be in the same plane producing a straight-line image with characteristic metallic reverberation artefacts. In deeper structures, such as the hip joint, the needle may be at an acute angle to the transducer and is subsequently difficult to visualize. Movement of the needle, re-insertion distal to the transducer or using a vibration apparatus at the correct frequency[17] allows it to be visualized. Color or power Doppler mode ultrasound can also be used to improve detection of the moving needle. Specific needles are manufactured for interventional ultrasound, but there is no data proving that they are superior to standard needles in the musculoskeletal field. To confirm the position of the needle a small amount (0.5 ml) of air can also be injected[18,19] as air is highly echogenic. The principal disadvantage of this technique is that structures behind the injected air cannot be imaged until the air has been absorbed. Qvistgaard *et al.* publish these methods in the current issue of the journal[20], demonstrating improved accuracy in injecting osteoarthritic knee and hip joints. In cases when we want to be absolutely certain that the needle is correctly placed in the joint we perform the ultrasound examination on a fluoroscope table where we can, if necessary, perform fluoroscopy after injecting contrast material into the joint[21].

It is also important to recognize that joint pain in OA may be due to extraarticular pathology[22]. MSUS is useful in diagnosing periarticular bursitis and/or enthesopathies and in guiding local steroid injection of these structures, providing effective symptom relief.

Once the needle position is confirmed, aspiration may be performed. If fluid is not obtained, a small amount of saline or lidocaine can be injected which will be visualized as an anechoic effusion with bulging of the joint capsule or bursal wall. Injection of large volumes of fluid produces sonoarthrography, allowing detection of loose bodies in the joint. If no fluid is obtained from an anechoic effusion despite confirmation of correct needle placement then a larger bore needle may be required. If no fluid is obtained from a hypoechoic collection then it is probably a solid structure (i.e. synovial proliferation). Experienced operators may attempt ultrasound-guided injection using a lateral approach in the midline of the short axis of transducer surface. The image of the needle is point-like, and not always easily detectable during the real-time examination. These techniques may be practiced on cadavers, animal tissues and phantom devices.

Using MSUS to guide injections improves accuracy and reduces the risk of injecting into tendon, adipose tissue, muscle, nerve or skin resulting in inefficacy and tissue damage. MSUS guidance will also allow more rapid diagnosis and a better appreciation of musculoskeletal anatomy. This may improve the operator's skills in examination and in unguided aspiration and injection, though this will need to be evaluated prospectively. As ultrasonography is used more widely in rheumatology—either in the clinic or at the bedside—it will be imperative to perform evidence based studies to validate the role of ultrasound in clinical practice. MSUS has the potential to become a standard tool in rheumatology for diagnosis and therapy in addition to extending our anatomical and pathological knowledge, resulting in improved patient management.

References

1. Eustace JA, Brophy DP, Gibney RP, Breshnihan B, FitzGerald O. Comparison of the accuracy of steroid placement with clinical outcome in patients with shoulder symptoms. Ann Rheum Dis 1997;56:59–63.
2. Jones A, Regan M, Ledingham J, Pattrick M, Manhire A, Doherty M. Importance of placement of intra-articular steroid injections. BMJ 1993;307:1329–30.
3. Zingas C, Failla JM, Van Holsbeeck M. Injection accuracy and cinical relief of de Quervain's tendonitis. J Hand Surg [Am] 1998;23:89–96.
4. Grecomoro G, Martorana U, Di Marco C. Intra-articular treatment with sodium hyaluronate in gonarthrosis: a controlled clinical trial versus placebo. Pharmatherapeutica 1987;5:137–41.
5. Hochberg MC, Altman RD, Brandt KD, Clark BM, Dieppe PA, Griffin MR, *et al*. Guidelines for medical management of osteoarthritis Part I. Osteoarthritis of the hip. Arthritis Rheum 1995;38:1535–40.
6. Balint PV, Sturrock RD. Intraobserver repeatability and interobserver reproducibility in ultrasound measurements of human hips and phantom RMI 403GS. (Abstract). Arthritis Rheum 2000;43(suppl S219): 914.
7. Marchal GJ, Van Holsbeeck MT, Raes M, Favril AA, Verbeken EE, Casteels-Vandaele M, *et al*. Transient synovitis of the hip in children: role of US. Radiology 1987;162:825–8.
8. Jacobson JA, Andresen R, Jaovisidha S, De Maeseneer M, Foldes K, Trudell DR, *et al*. Detection of ankle effusions: comparison study in cadavers using radiography, sonography, and MR imaging. AJR Am J Roentgenol 1998;170:1231–8.
9. Altman R, Asch E, Bloch G, Bole G, Borenstein D, Brandt K, *et al*. Development of criteria for the classification and reporting of osteoarthritis: classification of osteoarthritis of the knee. Arthritis Rheum 1986;29:1039–49.
10. Altman R, Alarcon G, Appelrouth D, Bloch D, Borenstein D, Brandt K, *et al*. The American College of Rheumatology criteria for the classification and reporting of osteoarthritis of the hip. Arthritis Rheum 1991;34:505–14.
11. Foldes K, Balint P, Gaal M, Buchanan WW, Balint GP. Nocturnal pain correlates with effusion in diseased hips. J Rheumatol 1992;19:1756–8.
12. Nightingale KR, Kornguth PJ, Trahey GE. The use of acoustic streaming in breast lesion diagnosis: a clinical study. Ultrasound Med Biol 1999;25:75–87.
13. Nightingale KR, Trahey GE. A finite element model for simulating acoustic streaming in cystic breast lesions with experimental validation. IEEE T Ultrason Ferr 2000;47:201–15.
14. Nolsoe C, Nielsen L, Torp-Pedersen S, Holm HH. Major complications and deaths due to interventional ultrasonography: a review of 8000 cases. J Clin Ultrasound 1990;18:179–84.
15. Komppa GH, Northern JR Jr, Haas, DK, Lisecki E, Ghaed N. Ultrasound guidance for needle aspiration of the hip in patients with painful hip prosthesis. J Clin Ultrasound 1985;13:433–4.
16. Christensen RA, Van Sonnenberg E, Casola G, Wittich GR. Interventional ultrasound in the musculoskeletal system. Radiol Clin North Am 1988;26:145–56.

17. Feld R, Needleman L, Goldberg BB. Use of a needle-vibrating device and color Doppler imaging for sonographically guided invasive procedures. AJR Am J Roentgenol 1997;168:255–6.
18. Lee TG, Knochel JQ. Air as an ultrasound contrast marker for accurate determination of needle placement. Tumor biopsy localization and other applications. Radiology 1982;143:787–8.
19. Carson BW, Wong A. Ultrasonographic guidance for injections of local steroids in the native hip. J Ultrasound Med 1999;18:159–60.
20. Qvistgaard E, Kristoffersen, Terslev L, Danneskiold-Samsoe B, Torp-Pedersen S, Bliddal H. Guidance by ultrasound of intra-articular injections in the knee and hip joints. Osteoarthritis Cart 2000;9:512–7.
21. Foldes K, Balint P, Konrad K, Sevcic K, Balint G. Late infections after hip joint arthroplasty. The role of ultrasonography-guided aspiration. New European Rheumatology 1994;2:13–5.
22. Balint G, Szebenyi B. Diagnosis of osteoarthritis. Guidelines and current pitfalls. Drugs 1996;52(suppl 3):1–13.