Ultrasound imaging for the rheumatologist III. Ultrasonography of the hip

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ABSTRACT
Ultrasonography (US) is a reliable and useful diagnostic tool for the assessment of hip pathology. It depicts changes within the coxo-femoral joint (synovitis, erosions, osteophytes) and in the adjacent peri-articular tissues (calcifications, tendonitis, enthesitis, bursitis) in many rheumatic diseases (rheumatoid arthritis, spondyloarthritis, osteoarthritis, polymyalgia rheumatica) and in some orthopaedic disorders (septic arthritis, trauma, abscess, painful hip after arthroplasty). It is commonly used both in adults and in children. In the assessment of hip joint pathology, US exerts considerable diagnostic supremacy over physical examination. In fact, by virtue of its size and position, reliable physical examination of the hip is often difficult thus making US particularly useful as a bedside tool for the evaluation of a painful hip. Hip US has also proven to be of great practical benefit when performing aspiration and injection within the joint and in the periarticular soft tissues. The relatively limited acoustic windows available to the US beam is the principal limitation to hip US thereby making detailed examination of some important structures impossible together with the interpretation of power Doppler signal sometimes unreliable. In addition, the deep location of the hip can confer further problems to US scanning in obese or particularly muscular subjects.

Introduction

Ultrasonography (US) is a useful diagnostic tool for the assessment of hip pathology (1-6). It depicts changes within the coxo-femoral joint and in the adjacent peri-articular tissues in many rheumatic diseases and in some orthopaedic disorders. It is commonly used both in adults and in children (7-9). By virtue of its size and position, reliable physical examination of the hip is often difficult thus making US particularly useful as a bedside tool for the evaluation of a painful hip.

Table I. Indications for hip joint US.

- Coxo-femoral joint
  - Synovitis
  - Septic arthritis
  - Erosions
  - Osteophytes
  - Perthes disease
  - Slipped femoral epiphysis
  - Congenital dysplasia of the newborn
  - Avascular necrosis
- Periarticular soft tissues
  - calcification
  - tendonitis/tendinosis
  - bursitis

Indications

Table I lists the indications for US assessment of the hip. It is particularly indicated in the evaluation of various conditions involving the coxo-femoral joint, surrounding tendons, muscles and bursae (10-19). Hip US has proven to be of great practical benefit when performing aspiration and injection of the joint (20-22).

Equipment

For US assessment of the hip high quality equipment is necessary and 5-7.5 MHz transducers should be used to permit deeper penetration of the US beam through the soft tissues. In adipose or muscular subjects lower frequency probes (3.5 MHz) may be used. In children 10 MHz transducers are recommended due to the relatively superficial position of the hip joint. In cases where inflammatory pathology is suspected, power Doppler techniques should be used for the evaluation of increased local perfusion (Table II) (23).

Table II. Equipment required.

- High quality machines
- Probe requirements:
  - linear high resolution transducers
  - medium-large footprint
  - 3.5 - *5 / 7.5* - 10 MHz
  - Colour / Power-Doppler

Table III. US scans for the hip.

- Anterior longitudinal scan (*Oblique sagittal plane along the axis of the femoral neck*)
- Anterior transverse scan
- Lateral longitudinal scan

Optional scans
- Lateral transverse scan
- Dorsal oblique scan

Examination

With the patient lying supine a mild degree of external rotation of the hip is obtained with the heels together. In that position a wider acoustic window is obtained and a larger area of the joint is exposed to the US beam on anterior scans (24).

Similar to other areas, a standard scanning protocol is recommended to avoid oversights and incompleteness. The appropriate scans for adequate assessment of the hip joint and local soft tissues are listed in Table III.

Lateral scans are particularly useful in patients with regional pain syndromes due to the involvement of local periarticular soft tissues, such as tendons and bursae (25). Examination of the contra-lateral hip is advisable for comparison (24, 26).

Table IV. US anatomy.

Hip joint (Anterior longitudinal scan)
- Bright bony profile of the femoral head and neck
- Concave, thin joint capsule
- 'Stripe sign' and hypoechoic joint space
- Capsule-bone distance < 7 mm and symmetry (right-left difference ≤ 1 mm)
- No hyperemia

Tendons
- Longitudinal: ribbon-like layer (iliopsoas tendon) or convex-shaped structures (gluteus medius and minimus tendons); fibrillar pattern; regular margins
- Transverse: oval or round hyperechoic structures with crowded echoic spots

Bursae
- Multiplanar scans: hyperechoic wall with possible visualization of fluid within them

Sonographic anatomy

Hip joint

The hip is a ball-and-socket joint between the spherical femoral head and the hollow semi-spherical acetabulum. In anterior longitudinal scans it is possible to visualize the curved profile of the femoral head and the linear hyperechoic bony profile of the neck (1, 14, 18). The joint capsule has its insertion onto the acetabular rim and the femoral surface and on US appears as a thin concave echoic line which is parallel to the bone surface. It bounds the joint cavity which appears as a hypo-anechoic area, containing a small physiologic amount of synovial fluid (2, 15, 16). In normal joints a linear echoic line, parallel to the capsule, is visualized within the joint ("stripe sign") and it represents a collapsed recessus. As it disappears in case of effusion/synovitis, its identification is indicative of a normal joint.

The greatest distance between the bony profile and the capsule is generally less than 7-8 mm in normal joints, with evidence of symmetry between the two sides (left-right difference < 1 mm) (24, 27). Anterior transverse scans are commonly used during US guided procedures to identify vessels and structures of the inguinal area and ensuring the correct needle position within the joint.

Periarticular tissues

Lateral scans are commonly used for the assessment of the trochanteric area where gluteus medius and minumus tendons are visualized. In longitudinal scans they appear as mildly convex-shaped bands, with a fibrillar pattern and regular margins. Trochanteric bursae are usually not visible in normal joints.

Anterior scans show the iliopsoas tendon bounding the joint (28). It is intimately related to the anterior aspect of the joint capsule and has a ribbon-like shape on longitudinal scans. The Iliopsoas bursa, which communicates with the hip joint cavity in 10-15 % of cases, is usually only identified by US in pathologic conditions (10, 13).

Pathologic findings

In the assessment of hip joint pathology, US exerts considerable diagnostic supremacy over physical examination. Tables V and VI list the pathological findings amenable to US examination.

Table V. Pathologic findings – hip joint.

- Joint effusion / Synovitis
  - Anechoic/hypoechoic joint cavity
  - Capsular convexity/distension
  - ≥ 2 mm side difference
  - Longest bone-capsule distance > 7/8 mm
  - No stripe sign
  - Hyperemia (Doppler)
- Thickening of the joint capsule
- Irregularities of the bony profile
  - Osteophytes: irregularities of the bony profile at the joint margins for new bone formation
  - Erosions: cortical defect with an irregular floor (both in longitudinal & transverse scans).

Table VI. Pathologic findings – periarticular soft tissues.

Tendons
- tendonitis: focal or diffuse hypoechogenicity and thickening with or without Doppler signal
- enthesopathy/enthesitis: (at the enthesis) thickening and/or hypoechogenicity and/or Doppler signal and/or calcification

Calcifications
- hyperechoic areas or lines with possible acoustic shadowing

Bursae
- distension of the wall and presence of fluid collection within the bursa
- synovial proliferation within the bursa with or without local hyperemia (Doppler).

Effusion and synovitis of the coxo-femoral joint (7, 9, 18) are demonstrated by anterior scans and may be confirmed by posterior-dorsal views. In case of active synovitis, power Doppler is a useful tool for the demonstration of local synovial hyperaemia (23). In patients with chronic pathology such as osteoarthritis, thickening of the joint capsule due to fibrotic change may also be revealed. Irregularities of the bony profile eg. erosions, osteophytes and fractures can freely be identified by US examination.

In cases where periarticular involvement is suspected, bursitis (trochanteric, ischio-gluteal or iliopsoas) can be demonstrated by distension of the bursal sac with synovial fluid and/or synovial proliferation and power Doppler signal.

In patients with a painful hip US may also show signs of tendinopathy (25, 28) involving the iliopsoas, gluteus

Table VII. Limits.

- Only partial view of the joint (limited size and number of acoustic windows)
- Operator dependence
- Limited information from Doppler
- Little information in case of fractures, labral tears
- No information about cartilage changes
- Anatomical difficulties in obese subjects

minimus and gluteus medius tendons characterised by alteration in the fibrillar pattern, tendon size and/or the regularity of the margin. Thickening and diffuse hypoechogenicity are usually due to tendonitis and the presence of power Doppler signal provides further information.

Intratendinous calcification may also be identified and appear as one or more hyperechoic foci within the body of the tendon with a possible accompanying posterior acoustic shadow.

The majority of publications relating to Hip US have emanated from paediatric orthopaedics particularly in the study and diagnosis of congenital dysplasia of the newborn and has also been extended to include investigation of cases of juvenile idiopathic arthritis, septic arthritis, transient synovitis, pyomyositis, pyogenic psoas abscess, Legg-Calve-Perthes disease and slipped capital femoral epiphysis (11, 17).

Limits

The relatively limited acoustic window available to the US beam is the principal limitation to hip US thereby making detailed examination of some important structures e.g. the femoral cartilage impossible together with the interpretation of power Doppler signal unreliable. In addition the deep location of the hip can confer further problems to US scanning in obese or particularly muscular subjects. These limits are summarized in Table VII.

Clinical efficacy

Hip US has a high sensitivity for the detection of joint effusion and synovitis and offers the possibility to assess and monitor disease activity in inflammatory conditions involving the hip (23). It is a highly cost-effective and well tolerated examination by patients and it represents a valuable imaging tool in daily rheumatology practise.

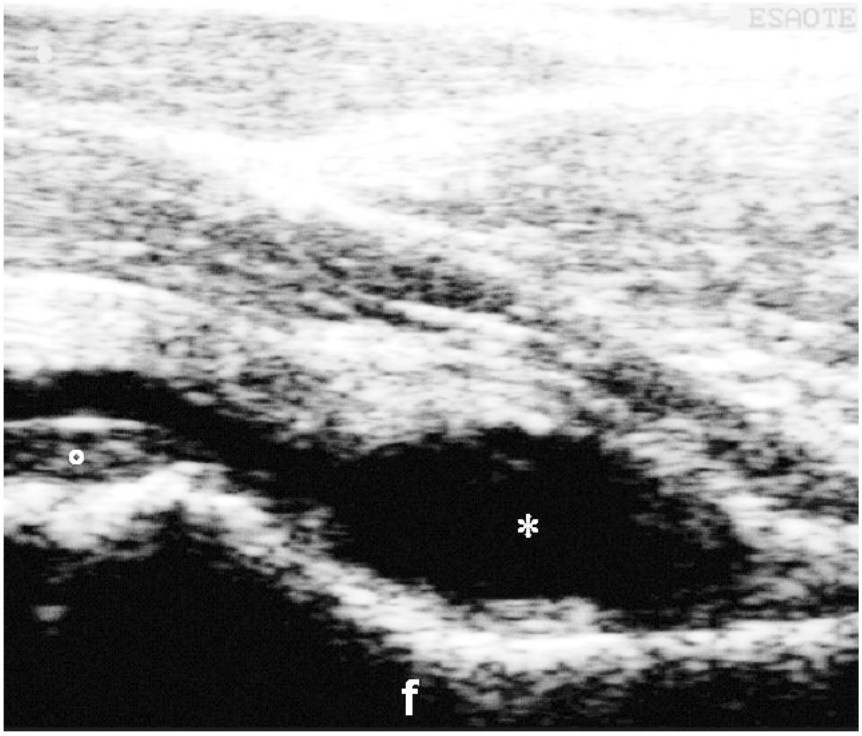

Fig. 1. Transient hip synovitis, hip joint; grey scale US using AU4 "Idea" (Esaote bBomedica, Genova, Italy) with a linear 7.5-10 MHz probe. Anterior longitudinal scan, exudative synovitis of the hip. Note the marked joint cavity widening and the consequent convexity of the joint capsule. Despite the high level of the gain, the joint cavity content is anechoic. ᶠfemur; *synovial fluid; °articular cartilage of the femoral neck.

For further ultrasound images, please go to www.clinexprheumatol.org

Sonographic guided procedures

US guided fluid aspiration and injection appear very safe and particularly easy to perform in the hip region (20). Different techniques have been reported to identify the exact needle location within the hip joint or the periarticular tissues (21-2). These include the injection of air prior to the medication in order to take advantage of its particular acoustic impedance and also the use of Doppler signal during the manoeuvre.

Link

For further ultrasound images, go to www. clinexprheumatol.org/ultrasound

References

1. SOINI I, KOTANIEMI A, KAUTIAINEN H, KAUPPI M: US assessment of hip joint synovitis in rheumatic diseases. A comparison with MR imaging. *Acta Radiol* 2003; 44: 72-8.
2. CHO KH, PARK BH, YEON KM: Ultrasound of the adult hip. *Semin Ultrasound CT MR* 2000; 21: 214-30.
3. BIERMA-ZEINSTRA SM, BOHNEN AM, VERHAAR JA, PRINS A, GINAI-KARAMAT AZ, LAMERIS JS: Sonography for hip joint effusion in adults with hip pain. *Ann Rheum Dis* 2000; 59: 178-82.
4. JACOBSON JA: Musculoskeletal sonography and MR imaging. A role for both imaging methods. *Radiol Clin North Am* 1999; 37: 713-35.
5. WANG SC, CHHEM RK, CARDINAL E, CHO KH: Joint sonography. *Radiol Clin North Am* 1999; 37: 653-68.
6. SEBAG GH: Disorders of the Hip. *Magn Reson Imaging Clin N Am* 1998; 6: 627-41.
7. CANTINI F, NICCOLI L, NANNINI C *et al*.: Inflammatory changes of hip synovial structures in polymyalgia rheumatica. *Clin Exp Rheumatol* 2005; 23: 462-8.
8. FROSCH M, FOELL D, GANSER G, ROTH J: Arthrosonography of hip and knee joints in the follow up of juvenile rheumatoid arthritis. *Ann Rheum Dis* 2003; 62: 242-4.
9. IAGNOCCO A, COARI G, MAMMARELLA A *et al*.: Joint sonography in asymptomatic patients with HCV correlated hepatitis. *Clin Exp Rheumatol* 2004; 22: 43-8.
10. REZIG R, COPERCINI M, MONTET X, MARTINOLI C, BIANCHI S: Ultrasound diagnosis of anterior iliopsoas impingement in total hip replacement. *Skeletal Radiol* 2004; 33: 112-6.
11. DORIA AS, GUARNIERO R, DE GODOY JR RM *et al*.: Contrast-enhanced power Doppler imaging: comparison with scintigraphic phases of revascularization of the femoral

head in Legg-Calve-Perthes disease. *J Pediatr Orthop* 2002; 22: 471-8.
12. BASS CJ, CONNELL DA: Sonographic findings of tensor fascia lata tendinopathy: another cause of anterior groin pain. *Skeletal Radiol* 2002; 31: 143-8.
13. WUNDERBALDINGER P, BREMER C, SCHELLENBERGER E, CEJNA M, TURETSCHEK K, KAINBERGER F: Imaging features of iliopsoas bursitis. *Eur Radiol* 2002; 12: 409-15.
14. KOSKI JM: Ultrasonographic evidence of synovitis in axial joints in patients with polymyalgia rheumatica. *Br J Rheumatol* 1992; 31: 201-3.
15. KOSKI JM, ISOMAKI H: Ultrasonography may reveal synovitis in a clinically silent hip joint. *Clin Rheumatol* 1990; 9: 539-41.
16. KOSKI JM: Ultrasonographic evidence of hip synovitis in patients with rheumatoid arthritis. *Scand J Rheumatol* 1989; 18: 127-31.
17. TRUSEN A, BEISSERT M, SCHULTZ G, CHITTKA B, DARGE K: Ultrasound and MRI features of pyomyositis in children. *Eur Radiol* 2003; 13: 1050-5.
18. COARI G, IAGNOCCO A, MAGGI S *et al*.: Sonographic findings in haemodialysis-related chronic arthropathy. *Eur Radiol* 1996; 6: 890-4.
19. HAMANO S, KIYOSHIMA K, NAKATSU H, MURAKAMI S, IGARASHI T, ITO H: Pyogenic psoas abscess: difficulty in early diagnosis. *Urol Int* 2003; 71: 178-83.
20. FOLDES K, BALINT P, BALINT G, BUCHANAN WW: Ultrasound-guided aspiration in suspected sepsis of resection arthroplasty of the hip joint. *Clin Rheumatol* 1995; 14: 327-9.
21. QVISTGAARD E, KRISTOFFERSEN H, TERSLEV L, DANNESKIOLD-SAMSOE B, TORP-PEDERSEN S, BLIDDAL H: Guidance by ultrasound of intra-articular injections in the knee and hip joints. *Osteoarthritis Cartilage* 2001; 9: 512-7.
22. KOSKI JM, SAARAKKALA SJ, HEIKKINEN JO, HERMUNEN HS: Use of air-steroid-saline mixture as contrast medium in greyscale ultrasound imaging: experimental study and practical applications in rheumatology. *Clin Exp Rheumatol* 2005; 23: 373-8.
23. WALTHER M, HARMS H, KRENN V, RADKE S, KIRSCHNER S, GOHLKE F: Synovial tissue of the hip at power Doppler US: correlation between vascularity and power Doppler US signal. *Radiology* 2002; 225: 225-31.
24. KOSKI JM, ANTTILA PJ, ISOMAKI HA: Ultrasonography of the adult hip joint. *Scand J Rheumatol* 1989; 18: 113-7.
25. LEHTINEN A, TAAVITSAINEN M, LEIRISALO-REPO M: Sonographic analysis of enthesopathy in the lower extremities of patients with spondylarthropathy. *Clin Exp Rheumatol* 1994; 12: 143-8.
26. KOSKI JM, ANTTILA P, HAMALAINEN M, ISOMAKI H: Hip joint ultrasonography: correlation with intra-articular effusion and synovitis. *Br J Rheumatol* 1990; 29: 189-92.
27. SCHMIDT WA, SCHMIDT H, SCHICKE B, GROMNICA-IHLE E: Standard reference values for musculoskeletal ultrasonography. *Ann Rheum Dis* 2004; 63: 988-94.
28. JOHNSTON CA, WILEY JP, LINDSAY DM, WISEMAN DA: Iliopsoas bursitis and tendinitis. A review. *Sports Med* 1998; 25: 271-83.