Knee bursitis: a sonographic evaluation

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Abstract

Objective To evaluate the use of ultrasound for the diagnosis of knee bursitis.

Materials and methods One-hundred and fifty-eight patients who, from May 2013 to May 2014, had an ultrasound examination of the knee and magnetic resonance imaging (MRI) of the knee during the following month were eligible for the study. The exams were reviewed by two musculoskeletal radiologists with 20 years of experience.

Results Of these patients, 15 (7 men, 8 women) had bursitis, while 143 (76 men, 67 women) had no bursitis. In evaluating knee bursitis, US, when compared to MRI, correctly identified 13 out of 15 cases of bursitis, showing a sensitivity of 86.67 %, specificity 100 %, and *K* index of 0.92. Particularly in the suprapatellar bursa, ultrasound showed bursitis in 5 cases versus 7 by MRI (sensitivity of 71.4 %, specificity of 100 %, and *K* index of 0.82).

Conclusion Ultrasound can be used as a valuable tool for the evaluation of bursitis of the superficial bursae in patients who cannot undergo MRI.

Keywords Ultrasound · Magnetic resonance imaging · Knee · Bursitis · Knee bursitis

Riassunto

Obiettivo Valutare l'utilizzo dello studio ecografico nella diagnosi delle borsiti del ginocchio.

Materiali e metodi Nello studio sono stati considerati centocinquanta pazienti tra Maggio 2013 e Maggio 2014 valutati con esame ecografico del ginocchio che sono stati rivalutati con Risonanza Magnetica entro un mese dalla valutazione ecografica. Gli esami radiologici sono stati esaminati da due radiologi con 20 anni di esperienza in campo muscolo scheletrico.

Risultati All'interno del gruppo di pazienti in studio 15 (7 uomini, 8 donne) hanno presentato diagnosi di borsite, mentre 143 pazienti (76 uomini, 67 donne) hanno presentato un esame negativo. L'ecografia comparata alla Risonanza magnetica nella valutazione delle borsiti del ginocchio ha evidenziato 13 casi su 15, mostrando una sensibilità del 86.67 %, specificità del 100 % e indice *K* di 0.92. In particolare a livello della borsa sopra patellare, l'ecografia ha mostrato la presenza di borsite in cinque casi, rispetto ai 7 pazienti della Risonanza Magnetica (Sensibilità 71.4 %, specificità 100 % e indice *K* 0.82).

Conclusioni L'ecografia può essere utilizzata come strumento efficace nella valutazione delle borsiti delle borse superficiali nei pazienti che non possono essere sottoposti a valutazione con Risonanza Magnetica.

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Introduction

The serous bursae consist of a synovial membrane enveloping a fluid film. They are located between moving structures, such as tendons, ligaments and bone surfaces, to reduce friction; when collapsed, they are not generally visible on sonography under physiological conditions. A

Fig. 1 Bursae of the anterior compartment of the knee. In the anterior compartment, there are four bursae: suprapatellar (1), prepatellar (2), superficial infrapatellar (3) and deep infrapatellar bursae (4)

variety of bursae may be encountered around the knee [1–3]: in the anterior compartment (Fig. 1), suprapatellar (Fig. 2), prepatellar (Figs. 3, 4), superficial infrapatellar [4] and deep infrapatellar bursae [5] (Figs. 4, 5), in the medial compartment pes anserine (Figs. 5, 6), medial collateral ligament (Figs. 7, 8) and semimembranosus–medial collateral ligament bursae, in the lateral compartment Iliotibial (Figs. 9, 10) [6] and lateral collateral ligament–biceps femoris bursae, and in the posterior compartment popliteal (Baker’s) cyst (Figs. 11, 12) [7]. They can communicate or not with the joint cavity [7–9]. A variety of disorders such as overuse [10], trauma [11], infection, hemorrhage, arthropathy, internal joint derangement, villonodular synovitis [12–14], and synovial osteochondromatosis [15] may cause the accumulation of fluid within the bursae and thickening of the synovia, allowing visualization on sonography. While the role of magnetic resonance imaging is widely described in the medical literature [1–3], the role of ultrasonography is poorly understood [4–6]. We have reviewed our ultrasound examinations of the knee over a period of one year and compared them with magnetic resonance imaging (MRI) scans to assess the limits and potential of ultrasound in the study of knee bursitis.

Fig. 2 Suprapatellar bursa, sagittal proton density fat suppressed image (a) and sonography (b). The suprapatellar bursa developing between the rectus femoris tendon and the femur; communication of the suprapatellar bursa with the knee joint is found in approximately 84 % of adults. In the absence of joint effusion, bursal effusion (arrows) may be considered as bursitis in the presence of joint effusion as effusion in a joint recess

Materials and methods

One-hundred and fifty-eight patients (83 men, 75 women, median age 41.2 years, age range 13–81 years) who, from May 2013 to May 2014, had an ultrasound examination of the knee and an MRI of the knee during the following month were eligible for the study. The only criterion for inclusion in the study was that an MRI was performed in the month following ultrasound.

Sonography was performed using a linear multi-frequency probe on an ACUSONS 2000 (Siemens, Erlangen, Germany), a Philips IU22 (Philips Medical System, The Netherlands), a GE LOGIC E9 (GE Healthcare, USA), a Toshiba Aplio 500 (Toshiba Corporation, Japan), or a Philips Epic 7 (Philips Medical System, The Netherlands) system.

A standardized ultrasound examination of the knee followed a sequence: anterior, medial, lateral, and posterior. For evaluation of the anterior knee, the patient was

Fig. 3 Prepatellar bursa, sagittal proton density fat suppressed image (a) and sonography (b). The prepatellar bursa (arrows) is usually located anterior to the patella; inflammation of the bursa can occur as a result of occupational kneeling

lying supine with the knee slightly flexed. To evaluate the medial and lateral aspects, the patient was asked to turn to one side or the other. For the posterior evaluation, the patient was asked to lie prone. Imaging of the contralateral knee was not performed nor was a dynamic examination. Total examination time was around 10 min.

At our institution, MRI of the knee is performed using a 1.5-T unit (Siemens Symphony, Erlangen, Germany) and a 0.25-T unit (Esaote E-scan, Genoa, Italy). Image acquisition includes sagittal T1-weighted and three orthogonal planes sequences with high contrast (short inversion time inversion recovery STIR, proton density, gradient echo, GRE), depending on the machine used.

To evaluate the performance of ultrasound with respect to MRI in the evaluation of the bursae of the knee, the exams were independently reviewed by two musculoskeletal radiologists with 20 years of experience. Effusion in each bursa was evaluated using a binary system (yes vs. no).

Fig. 4 Deep infrapatellar bursa, sagittal proton density fat suppressed image (a) and sonography (b). A deep infrapatellar bursa lying between the posterior aspect of the distal patellar tendon and the anterior tibia. A small fluid-filled in the deep infrapatellar bursa is seen in a large number of asymptomatic patients, while bursitis is characterized by more bursal distention

Fig. 5 Pes anserine bursa. The pes anserine bursa located on the medial aspect of the knee between the pes anserinus tendons and tibial condyle

Results

Of the examined patients, 15 (7 men, 8 women) had bursitis, while 143 (76 men, 67 women) had no bursitis; there was no statistical correlation between bursitis and gender. Patients with bursitis had a median age of 47.7 years, while the median age of the patients with no bursitis was 35.89 years. In evaluating knee bursitis, US, when compared to MRI, correctly identified 13 out of 15 patients with bursitis, showing a sensitivity of 86.67 %, a specificity of 100 %, and a *K* index of 0.92. Suprapatellar bursa ultrasound showed bursitis in five cases versus seven by MRI (sensitivity of 71.4 %, specificity of 100 %, *K* index

Fig. 6 Pes anserine bursa, coronal proton density fat suppressed image (a) and sonography (b). Acute pes anserine bursitis (arrows) can occur as an overuse injury, particularly in long-distance runners

Fig. 7 Medial collateral ligament bursa. The medial collateral ligament bursa is located between the deep and superficial fibers of the medial collateral ligament

of 0.82) (Figs. 1, 2), in the prepatellar bursa one case versus one by MRI (sensitivity of 100 %, specificity of 100 %, *K* index of 1) (Figs. 1, 3), in the deep infrapatellar bursa two cases versus two cases by MRI (sensitivity of 100 %, specificity of 100 %, *K* index of 1) (Figs. 1, 4), in the anserine bursa one case versus one by MRI (sensitivity of 100 %, specificity of 100 %, *K* index of 1) (Figs. 5, 6), in the medial collateral ligament two cases versus two cases by MRI (sensitivity of 100 %, specificity of 100 %, *K* index of 1) (Figs. 7, 8), in the iliotibial bursa one case

Fig. 8 Medial collateral ligament bursa, coronal proton density fat suppressed image (a) and sonography (b). Bursitis (arrows) may occur in osteoarthritis, inflammatory arthropathies or trauma

versus one by MRI (sensitivity of 100 %, specificity of 100 %, *K* index of 1) (Figs. 9, 10), and in Baker's cyst six cases versus six by MRI (sensitivity of 100 %, specificity of 100 %, *K* index of 1) (Figs. 11, 12).

In the absence of joint effusion, the suprapatellar recess (seven cases) (Fig. 2) and the popliteal (Baker's) cyst (six cases) (Fig. 12) were considered as bursae in the presence of joint effusion recesses. In the superficial infrapatella, in the semimembranosus–medial collateral ligament and in the lateral collateral ligament–biceps femoris bursae, we did not find bursitis.

Discussion and conclusions

Anteriorly, the suprapatellar bursa (Figs. 1, 2) develops between the rectus femoris tendon and the femur, the prepatellar bursa is located between the patella and the

Fig. 9 Iliotibial bursa. The iliotibial bursa is located between the iliotibial band and the lateral femoral condyle

subcutaneous tissues (Figs. 1, 3), the superficial infrapatellar bursa between the tibial tubercle and the overlying skin, and the deep infrapatellar bursa between the posterior aspect of the patellar tendon and the anterior tibia (Figs. 1, 4) (1, 2, 3). The prepatellar bursa may communicate with the superficial infrapatellar bursa; the deep infrapatellar bursa may communicate with the articular space. Medially, the anserine bursa along the medial aspect of the tibia separates the pes anserinus from the tibial insertion of the medial collateral ligament (Figs. 5, 6). The medial collateral ligament bursa is located between the superficial and deep layers of the medial collateral ligament (Figs. 7, 8). The semimembranosus–medial collateral ligament bursa is between the semimembranosus tendon and the medial collateral ligament, with a deeper part extending between the semimembranosus tendon and the medial tibial condyle [1–3].

Fig. 10 Iliotibial bursa, coronal proton density fat suppressed image (a) and sonography (b). Bursitis (arrows) is frequently related to intense exercise, as occurs in runners and cyclists

Laterally, the iliotibial bursa is located between the distal part of the iliotibial tract and the adjacent tibial surface (Figs. 9, 10). The lateral collateral ligament–biceps femoris bursa lies superficially to the lateral collateral ligament and deep in the anterior arm of the long head of the biceps femoris muscle as it crosses the lateral collateral ligament [1–3].

Posteriorly, the gastrocnemius–semimembranosus bursa (popliteal or Baker’s cyst) is located between the tendon of the semimembranosus and the medial head of the gastrocnemius (Figs. 11, 12). Communication between this bursa and the articular synovial space is present in a part (30 %) of the population [1–3]. Friction [10], joint fluid [8, 9], and synovial processes [3] can all cause bursal distention.

Distention of the suprapatellar recess and of the popliteal (Baker’s) cyst is often caused by joint effusion [3]; in fact, communication with the knee joint of the suprapatellar bursa is found in approximately 84 % of adults [3] and in 30 % of Baker’s cysts. So, there is a strong association between the suprapatellar recess and

Fig. 11 Popliteal (Baker's) cyst. Baker's cyst is located between the medial head of the gastrocnemius muscle and the semimembranosus tendon

popliteal (Baker's) cyst effusion with other abnormalities of the knee joint, such as meniscal tears, tears of the cruciate and collateral ligaments, osteoarthritis and inflammatory disease [3]. Rarely, overload can cause bursitis of Baker's cyst or of the suprapatellar bursa.

Superficial bursitis, as well as prepatellar, infrapatellar, medial collateral ligament, anserine, iliotibial tract, lateral collateral ligament–biceps femoris bursitis, often occurs as a result of overuse and may be caused by occupational or everyday activities [1–3]. Septic bursitis usually occurs as a result of penetrating trauma due to the superficial location of these bursae.

MRI is the best suited modality for the evaluation of knee bursae, allowing for an evaluation of the presence of even minimal effusion [1–3]. In our experience, ultrasound has low sensitivity with respect to MRI in the evaluation of only the suprapatellar bursa. However, ultrasound has the same sensitivity as MRI in the evaluation of superficial bursitis.

Limitations of the study are: the series of patients with knee effusions is relatively small and 1 month time as maximum gap between ultrasonography and MRI can affect the results, but in conclusion, certainly ultrasonography can

Fig. 12 Popliteal (Baker's) cyst, sagittal proton density fat suppressed image (a) and sonography (b). Communication of the Baker's cyst with the knee joint is frequent in adults. In the absence of joint effusion, bursal effusion (arrows) may be considered as bursitis in the presence of joint effusion as effusion in a joint recess

be used as a valuable tool for the evaluation of bursitis of the superficial bursae in patients who cannot undergo MRI.

Conflict of interest The authors declare that they have no conflict of interest.

Informed consent All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000 (5). All patients provided written informed consent to enrollment in the study and to the inclusion in this article of information that could potentially lead to their identification.

Human and animal studies The study was conducted in accordance with all institutional and national guidelines for the care and use of laboratory animals.

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