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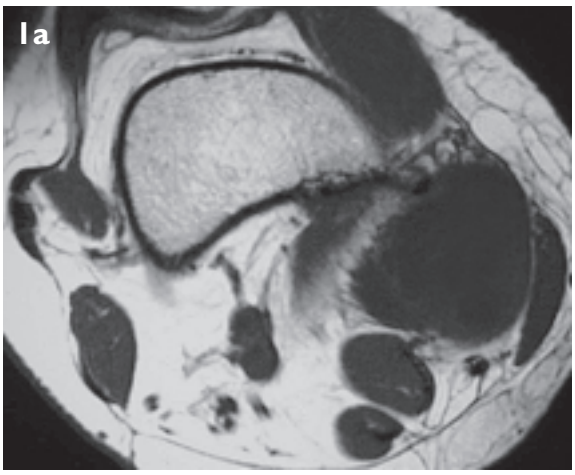

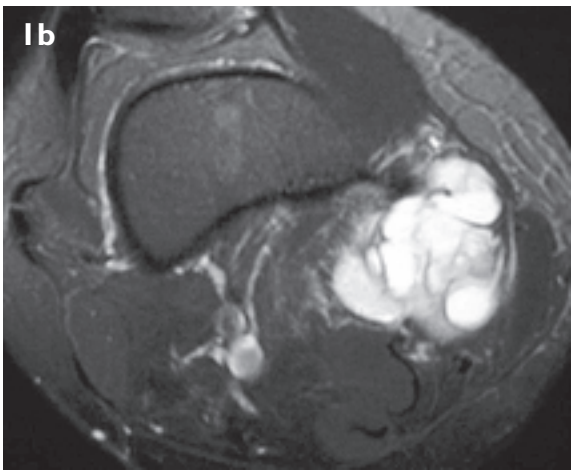

Fig. 1 Axial (a) T1-weighted and (b) fat suppressed T2-weighted and (c) coronal T2-weighted MR images of the knee.

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CASE PRESENTATION

A 50-year-old housewife presented with a swelling on the medial aspect of the right knee that was especially prominent during exercise. This was not associated with pain or a past history of knee injury. Physical examination revealed a 4 cm cystic swelling on the medial aspect of the knee. There was no tenderness or limitation of range of movement. Radiographs were normal. What do the magnetic resonance (MR) scans show (Figs. 1a-c)? What is the diagnosis?

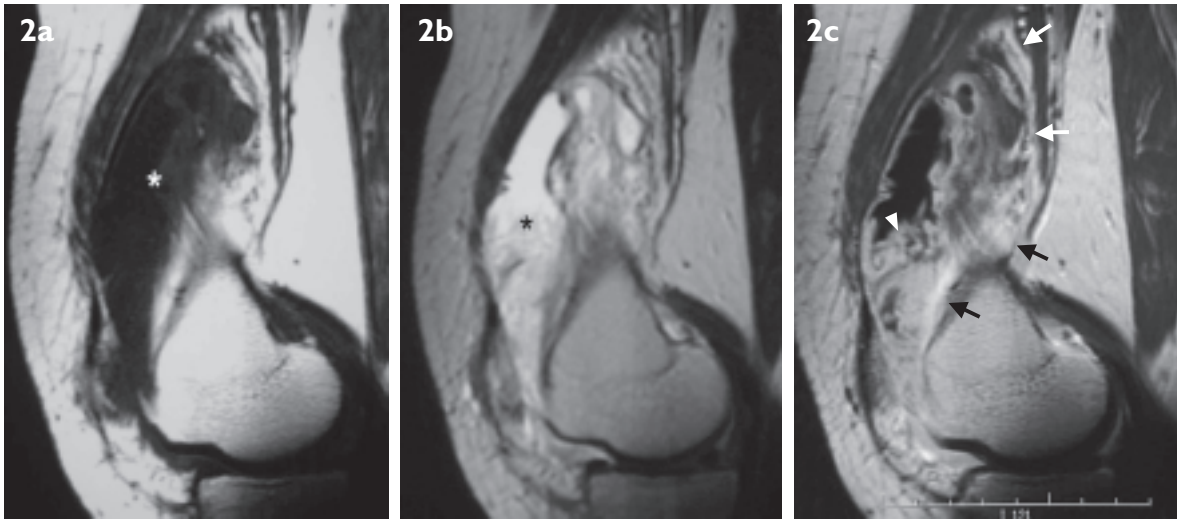

Fig. 2 Suprapatellar bursitis. Sagittal (a) T1-weighted and (b) T2-weighted MR images show a grossly enlarged suprapatellar bursa (asterisk) containing a moderate amount of fluid. (c) Enhanced sagittal T1-weighted MR image shows a thick enhancing wall (arrows) with numerous villous protrusions (arrowhead).

IMAGE INTERPRETATION

Axial and coronal T1- and T2-weighted MR images (Figs. 1a-c) showed a septated and lobulated cystic lesion adjacent to the posteromedial aspect of the distal femur. This lesion had low signal intensity on T1- weighted images and high signal intensity on T2-weighted images. It was located between the pes anserine tendons (consisting of the semitendinosus, gracilis and sartorius) superficially, and the medial collateral ligament. The underlying menisci, cruciate ligaments and bone were normal. No knee effusion was detected.

DIAGNOSIS

Pes anserine bursitis.

CLINICAL COURSE

The patient was treated with an intra-articular injection of steroid and local anaesthetic. She was started on physiotherapy while being maintained on non-steroidal anti-inflammatory drugs for pain relief. Her pain subsided after three weeks and did not recur on subsequent follow-up.

DISCUSSION

A wide range of examinations is available for imaging the knee, including radiography, ultrasonography, computed tomography (CT) and magnetic resonance (MR) imaging. The radiograph is the simplest and cheapest investigation. It provides basic information about the bones, and is particularly useful in the emergency setting. Ultrasonography of the knee can be used to assess soft tissues structures around the knee, including the tendons, muscles and ligaments. It can also demonstrate periarticular masses and joint effusions very well. Its ability to dynamically assess structures and easy comparison with the contralateral side are advantageous. CT is useful for defining the bony lesions but provide limited information on the soft tissues. MR imaging is superior to all these imaging modalities for tissue characterisation. Its multiplanar ability enables clear demonstration of the knee anatomy, and aids accurate diagnosis of the soft tissue pathology. It is especially useful in traumatic conditions. Lesions affecting structures such as the menisci, cruciate ligaments, and collateral ligaments are well depicted on MR imaging. Meniscocapsular separations, occult fractures and bone bruises are optimally demonstrated using MR imaging.

Various cystic lesions may be encountered in the soft tissues during imaging of the knee. These include normal structures such as bursae and recesses, pathological cysts such as meniscal and ganglion cysts, as well as benign and malignant soft tissue masses that may mimic cysts. Many of these lesions produce clinical features that may be suggestive of internal derangement of the knee. A firm clinical diagnosis may therefore be difficult as the symptoms often overlap. Even in cases where a lesion is strongly suspected e.g. popliteal cyst, imaging is often useful to exclude other pathologies e.g. popliteal artery aneurysm or to look for possible complications. MR imaging can demonstrate the cystic nature of these lesions as encapsulated fluid collections that exhibit low signal intensity on T1-weighted MR images and high signal intensity on T2-weighted images. The multiplanar imaging capability of MR imaging also allows for accurate depiction of the exact origin of the lesion and its relation to normal anatomical structures, aiding their diagnosis. Knowledge of the normal anatomy of the knee is essential for the diagnosis of cystic masses

Table I. Classification by location of cystic masses in and around the knee.

Location		Masses	Distinguishing features
Anterior	Above patella	Suprapatellar bursa	Communicates with joint space.
	Pre-patella	Prepatellar bursa	Located in subcutaneous plane.
	Below patella	Superficial infrapatellar bursa	Haemorrhagic bursitis due to trauma. Fluid in bursa associated with Osgood-Schlatter disease.
		Deep infrapatellar bursa	Small amount of fluid may be normal. Bursitis due to overuse of knee extensors.
Medial		Semimembranosus-tibial collateral ligament bursa	Located within the superficial and deep layers of the medial collateral ligament.
		Medial meniscal cyst	Associated with tears of medial meniscus.
		Pes anserine bursa	Located between the pes anserine tendons and the medial collateral ligament.
Lateral		Lateral meniscal cyst	Associated with tears of lateral meniscus.
		Iliotibial bursa	Between the distal iliotibial band near its insertion on the Gerdy's tubercle and the tibial surface.
Posterior		Popliteal cyst	Extends between the medial head of the gastrocnemius and semimembranosus.
		Popliteal varix	Connection with the popliteal vein, flow characteristics and blood products.
		Popliteal artery aneurysm	Connection with popliteal artery, pulsation artefacts and multilayered thrombus.
Intra-articular		Intra-articular ganglion	Arises from joint capsule, ligament and tendon sheath.
Mimics in any location		Tumour	Solid soft tissue components that enhance.
		PVNS	Contains haemosiderin.

in and around the knee joint. A classification by location of cystic masses and their characteristic features is summarised in Table I.

BURSAE AROUND THE KNEE

Bursae are synovial-lined sacs that facilitate the gliding movement of ligaments, tendons, and muscles. A normal bursa may either not be normally seen on MR imaging e.g. the infrapatellar bursa or may appear as a small fluid-filled sac in a characteristic anatomical location e.g. the suprapatellar bursa. Bursae may become inflamed due to overuse or repetitive trauma, infection, crystal deposition disease or inflammatory arthropathy. With bursitis, there is accumulation of fluid within the bursa, making it clearly seen on MR imaging. Acute bursitis may occasionally be confused with other periarticular cystic lesions, such as synovial or ganglion cysts. The key to its diagnosis is the specific anatomical location of the fluid collection. There may be associated synovial proliferation that is best demonstrated as enhancement of the inflammed synovial lining on contrast-enhanced images. It may also be the site of origin of synovial-based proliferative diseases such as pigmented villonodular synovitis (PVNS) or synovial osteochondromatosis.

Pes anserine bursitis

The pes anserine bursa serves to separate the pes anserine, which is formed by the distal tendons of the sartorius, gracilis and semitendinosus muscles, from the medial (tibial) collateral ligament. Bursitis in this location results from overuse, especially in runners. As it is also associated with obesity and degenerative joint disease, it not uncommonly occurs in obese middle-aged women. The patient often presents with medial joint line pain and swelling, mimicking a meniscal tear or medial collateral ligament injury. On MR imaging, this lesion appears as a fluid collection between the pes anserine tendons and the medial collateral ligament (Fig. 1) that does not communicate with the knee joint. It may appear septated or lobulated, and may surround the tendons. The bursa is best imaged in the axial and sagittal planes. Pes anserine tendinitis or tendinopathy can accompany the bursitis, a combination referred to as the pes anserine syndrome[1].

Suprapatellar bursitis

The suprapatellar bursa is a midline structure located between the suprapatellar and prefemoral fat pads, and is best visualised on the sagittal MR images (Fig. 2). Unlike other bursae around the knee,

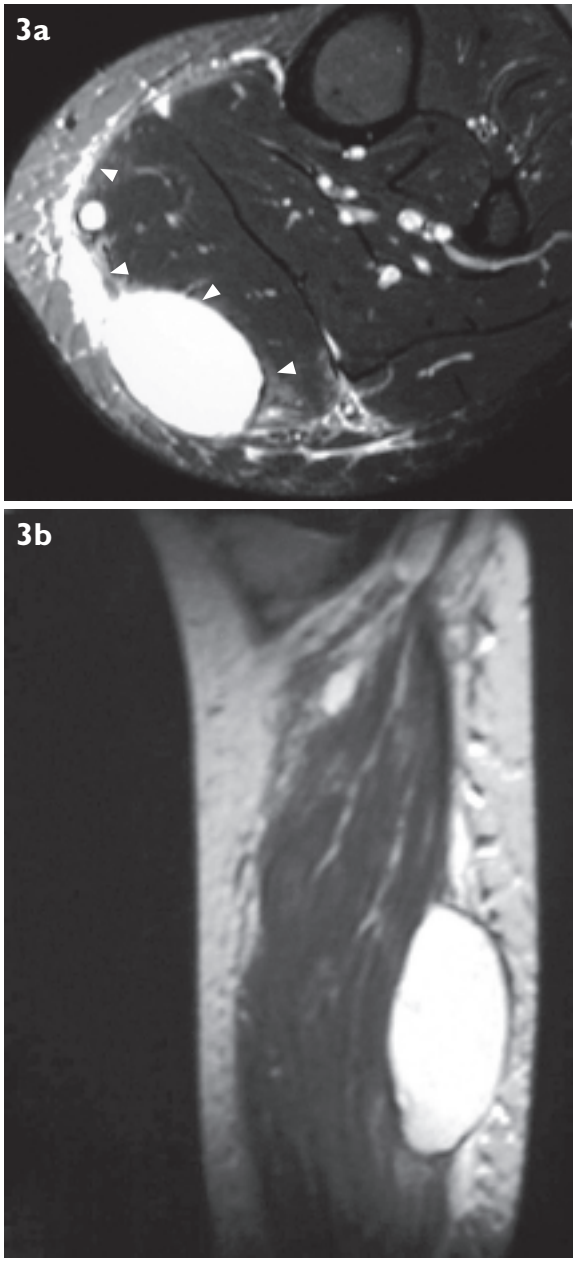

Fig. 3 Dissecting popliteal cyst. (a) Axial T2-weighted MR image taken at the level of the upper tibia shows fluid (arrowheads) dissecting between the gastrocnemius muscle and the subcutaneous fat layer of the posterior leg, compatible with a ruptured cyst. (b) Far-sagittal T2-weighted MR image of the upper calf shows the lower extent of the dissecting popliteal cyst.

it usually communicates with the knee joint unless the suprapatellar plica, a normal embryonic septum, fails to involute. Lipohaemarthrosis can occur in this bursa with an intra-articular fracture, resulting in layering of marrow fat above the blood layer. Loose bodies arising from the joint may also be located in this bursa.

Prepatellar bursitis

This commonly occurs due to chronic trauma such as recurrent kneeling. Gout and infection are other common causes. It is a true bursa that is located in the subcutaneous plane between the patella and the skin. As with the suprapatellar bursa, the prepatellar bursa is best demonstrated in the sagittal plane.

Superficial infrapatellar bursitis

Located between the anterior aspect of the distal end of the patella tendon and the subcutaneous fat, the superficial infrapatellar bursa is an uncommon site for bursitis. Direct trauma may cause a haemorrhagic bursitis. Fluid in this bursa is also associated with Osgood-Schlatter disease.

Deep infrapatellar bursitis

This bursa is located between the posterior margin of the distal part of the patellar tendon and the proximal tibia. A small amount of fluid in this bursa may be a normal finding in asymptomatic patients[2]. Deep infrapatellar bursitis commonly occurs from overuse of the knee extensor tendon, particularly in jumpers and runners. Affected patients present with anterior knee pain that mimics patellar tendinitis.

Semimembranosus-tibial collateral ligament bursitis

The semimembranosus-tibial collateral ligament bursa is a comma-shaped bursa located within the superficial and deep layers of the medial collateral ligament, and which wraps around the anterosuperior margin of the semimembranosus tendon. Bursitis results in medial joint line pain. On the sagittal and coronal planes, this cystic collection is seen at the level of the joint line in a posteromedial location.

Iliotibial bursitis

The iliotibial bursa is located between the distal part of the iliotibial band near its insertion on the Gerdy's tubercle and the adjacent tibial surface. Iliotibial bursitis may be associated with iliotibial tendinitis, and occurs as a result of overuse and varus stress. It may cause anterolateral knee pain and mimic a lateral meniscal injury. MR images show a distended bursa near the insertion of the iliotibial band. The finding of high T2 signal intensity within the iliotibial band may also allow the concomitant diagnosis of iliotibial tendinitis.

CYSTS ASSOCIATED WITH THE KNEE JOINT

Popliteal cyst

The gastrocnemius-semimembranosus recess (also known as a popliteal or Baker cyst) is lined with synovium, and extends between the medial head of the gastrocnemius and the semimembranosus muscle (Fig. 3). Its consistent anatomical position helps differentiate popliteal cysts from other cystic lesions

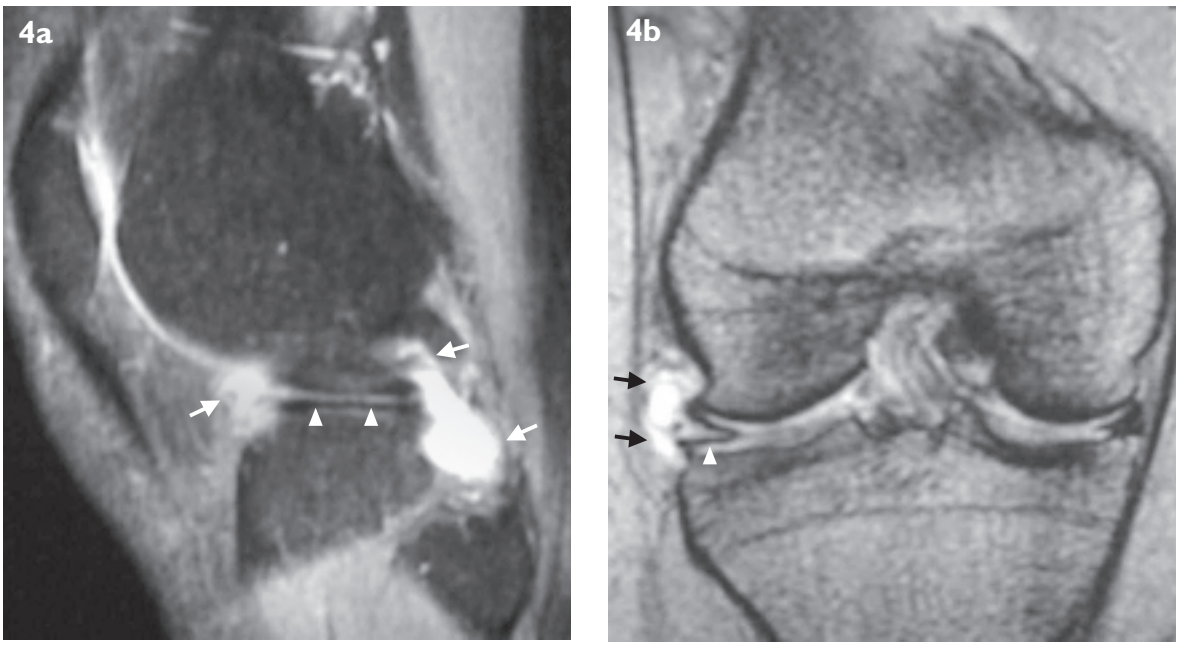

Fig. 4 Lateral meniscal cyst. (a) Sagittal T2-weighted MR image shows an extensive horizontal tear of the lateral meniscus (arrowheads), with extension into a cyst (arrows) adjacent to the tear. (b) Coronal T2*-weighted MR image shows the communication between the horizontal tear (arrowhead) and the adjacent meniscal cyst (arrows).

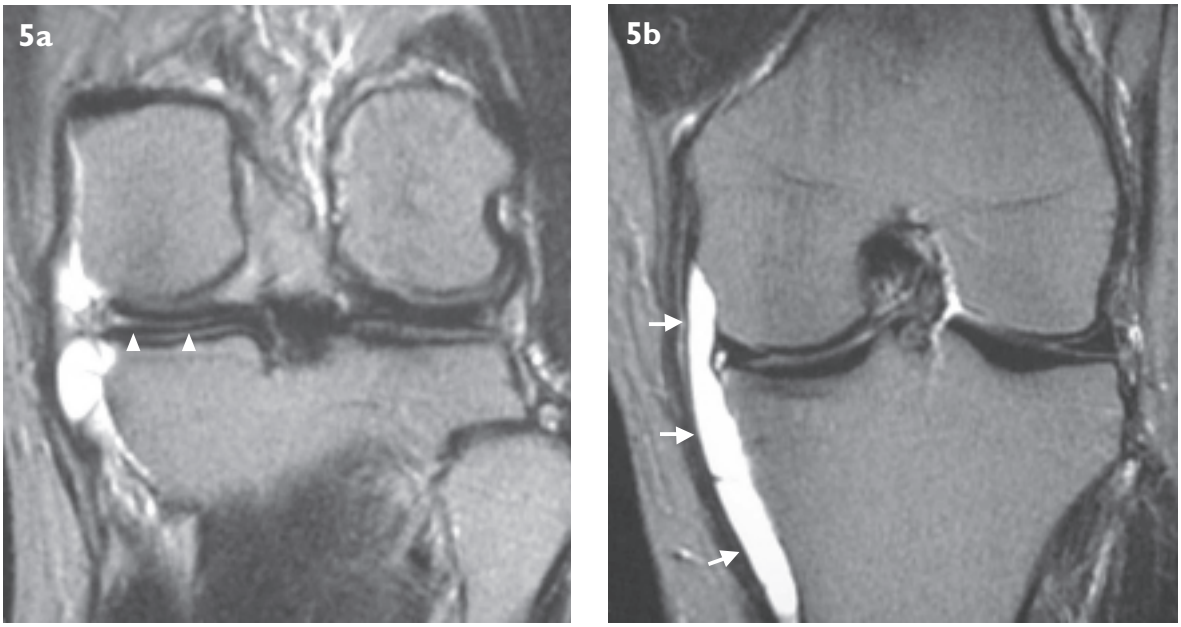

Fig. 5 Medial meniscal cyst. Coronal fat suppressed T2-weighted MR image shows a (a) horizontal tear (arrowheads) of the posterior horn of the medial meniscus that communicates with a (b) large meniscal cyst (arrows).

around the knee, particularly as a popliteal cyst can extend medial, lateral, deep, or superficial to the semimembranosus or gastrocnemius muscles. Approximately 5% to 32% of people with knee problems may have popliteal cysts, with two age peaks of four to seven years and 35-70 years, respectively[3]. When the cysts occur in older patients, they are usually associated with a joint abnormality. Diseases that cause chronic joint effusions, such as inflammatory arthritis, degenerative arthritis, crystal deposition diseases and internal derangements of the knee, are associated with popliteal cysts. The largest cysts are generally found in patients with rheumatoid arthritis. Indeed, popliteal cysts are very common in rheumatoid arthritis, with prevalence of 47.5% in a recent series, but may escape clinical detection[4]. Popliteal cysts may be asymptomatic or if large, may compress the popliteal vein and cause deep venous thrombosis. Rupture of the popliteal cyst is a potential complication, with distal rupture being more common. Acute rupture may clinically mimic deep venous thrombosis. MR imaging shows fluid dissecting into the soft tissues of the posterior leg (Fig. 3).

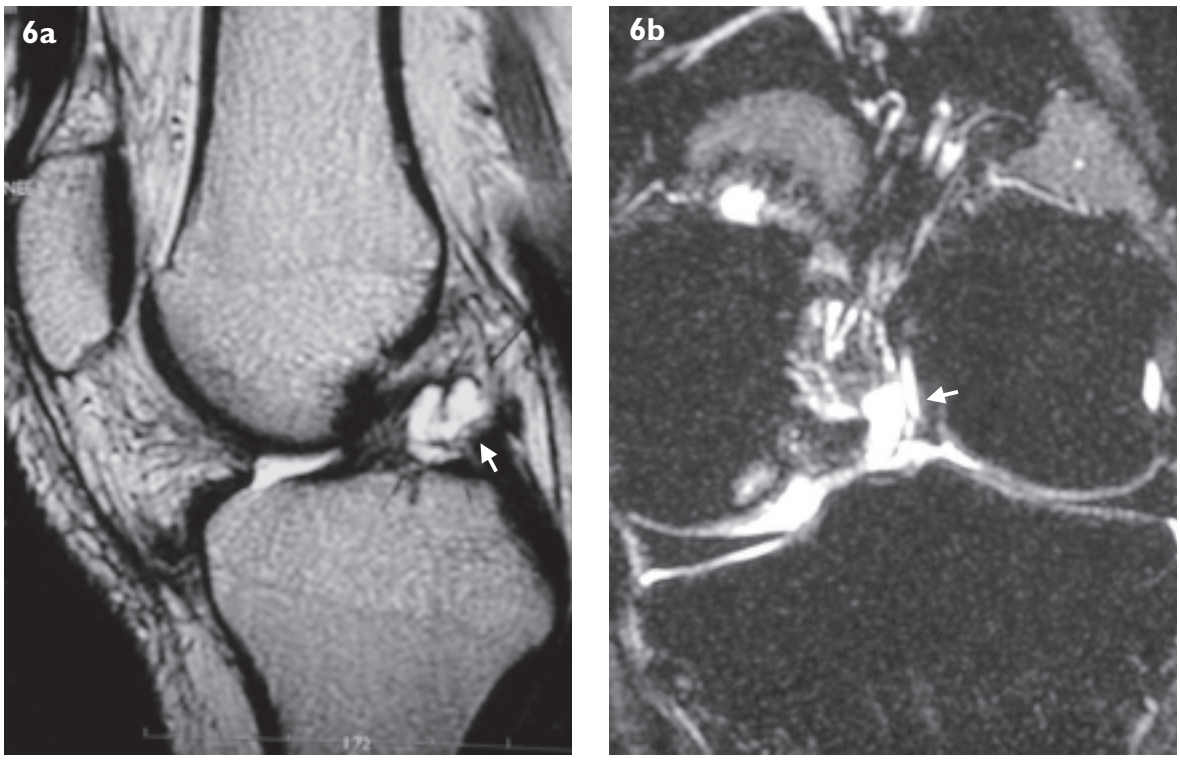

Fig. 6 Intra-articular ganglion. (a) Sagittal T2-weighted and (b) coronal fat suppressed T2-weighted MR images show a well-defined lobulated and septated cystic lesion (arrow) in the anterior cruciate ligament.

Meniscal cyst

Meniscal cysts arise in the parameniscal soft tissue as a result of joint fluid extrusion from a meniscal tear. The patient presents with knee pain, locking and a mass at the joint line. Although meniscal cysts were previously reported to occur more frequently at the lateral joint margin than at the medial joint margin, a recent MR imaging series found that meniscal cysts occur almost twice as often in the medial compartment as in the lateral compartment[5]. Medial meniscal cysts are most commonly located adjacent to the posterior horn, and lateral meniscal cysts are most commonly located adjacent to the anterior horn or body. On MR images, lateral meniscal cysts appear as well-defined rounded cysts located adjacent to a meniscal tear (Fig. 4). Medial meniscal cysts tend to be larger and dissect away from the site of the tear (Fig. 5). The meniscal tear is usually horizontal and extensive. When evaluating cystic lesions in these locations, it is important to look carefully for meniscal tears to distinguish meniscal cysts from other cystic lesions. This distinction has significant management implications as meniscal cysts often recur after excision and aspiration, unless the meniscal tear itself is repaired.

Intra-articular ganglion

Ganglia are cystic structures that may arise from the joint capsule, ligament, tendon sheath or bursa. A recent series found that most ganglia in the knee are related to the cruciate ligament, with 61% located in the intercondylar notch[6]. Pain is the most common symptom. Other symptoms include restricted knee flexion, joint locking and a palpable mass. On MR images, a ganglion appears as a septated ovoid cystic collection at the cruciate ligament (Fig. 6). It can be differentiated from a meniscal cyst by the absence of a meniscal tear and also by its location. Bony erosion of the femoral condyle or extensive dissection along a tissue plane may occur with a ganglion.

LESIONS THAT MIMIC CYSTS

Synovial osteochondromatosis

Synovial osteochondromatosis is characterised by cartilaginous bodies arising within the metaplastic synovium that may shed loose bodies into a joint or a bursa. It may present as a palpable soft tissue mass with joint pain and restricted movement. The loose bodies may calcify or ossify. In these instances, diagnosis can be made on conventional radiographs but MR imaging is useful in cases where the calcification/ossification has not occurred. On MR imaging, the signal pattern of the loose bodies is often mixed. Cartilaginous bodies show intermediate signal on T1- and high signal on T2-weighted images. Calcified or ossified loose bodies have low signal intensity on both T1- and T2-weighted images. Fatty marrow within ossified loose bodies produce central areas of high signal intensity on T1-weighted images.

Tumour

Malignant tumours that are more frequently seen around the knee include malignant fibrous histiocytoma, liposarcoma and synovial sarcoma. They may contain prominent areas of necrosis or myxoid degeneration, and hence may possibly mimic a cyst. These tumours typically have heterogeneous soft tissue components that enhance following intravenous contrast adminstration. The margins of these tumours may be irregular and infiltrate into the surrounding tissues. In pigmented villonodular synovitis (PVNS), haemosiderin is deposited in the hypertrophied synovium. It appears low in signal on both T1- and T2-weighted images, and demonstrates blooming on gradient-echo sequences due to magnetic susceptibility of the paramagnetic blood products. Deposition caused by gout and amyloidosis also appears low in signal on T1- and T2-weighted images but do not show blooming on gradient echo sequences.

Popliteal varix and aneurysm

Saccular dilatation of the popliteal vein occasionally results from trauma. MR images show flow characteristics or blood products, and identification of its connection with the popliteal vein allows a correct diagnosis. Complications of popliteal varices include thrombosis, embolism or rupture. Popliteal artery aneurysm may also mimic a cyst in the popliteal fossa. Characteristic MR imaging features include pulsation artefacts and multilayered thrombus.

CONCLUSION

Cystic lesions around the knee include enlargement of normal bursae and recesses, pathological cysts such as meniscal and ganglion cysts, as well as benign and malignant soft tissue masses that may mimic cysts. These lesions may produce overlapping clinical features that may suggest internal knee derangements. MR imaging of the knee is helpful to confirm the cystic nature of the lesion, and enables accurate depiction of the exact site of these lesions and their relation to normal anatomical structures. It is also helpful to exclude other pathologies or to look for possible complications.

ABSTRACT

Many cystic lesions occur around the knee and may produce overlapping clinical features, rendering the clinical diagnosis difficult. A 50-year-old woman presented with a soft tissue swelling on the medial aspect of her right knee. The diagnosis of pes anserine bursitis was made, based on typical MR imaging features. Cystic masses occurring in and around the knee, such as bursae and recesses, meniscal and ganglion cysts, and benign and malignant soft tissue masses that may mimic cysts, are classified and described. The role of MR imaging in making an accurate diagnosis and distinguishing among the various masses is discussed.

Keywords: Cyst, Knee mass, Bursitis, Pes anserine, Magnetic resonance (MR) imaging

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