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Popliteal cysts in children: prevalence, appearance and associated findings at MR imaging

Received: 20 August 1998
Accepted: 15 February 1999

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Abstract *Objective.* The purpose of this study was to determine the prevalence of Baker's cysts on MR images in a paediatric orthopaedic population, to investigate the association of Baker's cyst with joint fluid and joint disorders in children, and to compare the MR appearance of Baker's cysts in children with that previously reported in adults.

Materials and methods. Reports from 393 MR studies of the knee performed in children aged from 1 to 17 years were retrospectively reviewed for the presence of a Baker's cyst, joint effusion, meniscal tear, anterior cruciate ligament tear, or any other joint disorder.

Results. A Baker's cyst was identified in 6.3% (25/393) of patients. The MR images and clinical charts of patients with a Baker's cyst were reviewed. None of the 25 patients with a Baker's cyst had an associat-

ed anterior cruciate ligament tear or meniscal tear. Two patients had osteochondritis dissecans and two others had synovial disease (infection and juvenile rheumatoid arthritis). Joint fluid was demonstrated in 16% (4/25) of patients with a Baker's cyst. There was no statistically significant association between presence of a Baker's cyst and presence of joint fluid.

Conclusions. Baker's cyst is less prevalent in a paediatric orthopaedic population than in an adult population. In children, it seems that Baker's cyst is seldom associated with joint fluid, meniscal tear, or anterior cruciate ligament tear. On MR images, a communication between the Baker's cyst and the joint was not demonstrated in any of the patients. In addition, the presence of debris and cyst leakage was not observed.

Introduction

Dupuytren first described Baker's cysts in 1829 [1]. Several studies have since dealt with the anatomy, pathogenesis and imaging aspects of Baker's cysts. Miller et al. [2] recently showed that in adult patients, Baker's cysts are often associated with knee-joint effusion and internal derangement. When a joint effusion is present, fluid may be forced into the potential space of the gastrocnemius-semimembranosus bursa. In some patients, a Baker's cyst may even occur in the absence of intra-articular joint fluid. It has been speculated that in such cases joint fluid may be directed towards the Baker's cyst through a valve

mechanism secondary to altered biomechanics of the injured knee joint [2, 3]. Considerable controversy over the origin of Baker's cysts still exists, however. In addition, different mechanisms are thought to play a role in the development of Baker's cysts in children as compared to adults. In children, Baker's cysts may be caused by direct trauma to the gastrocnemius-semimembranosus bursa [4]. We felt it would be of interest to study whether these presumed differences in pathogenesis of Baker's cysts in children as compared to adults would be reflected in a different prevalence, in different associations with other joint disorders, and in different MR imaging appearances. Hence we compared the findings

obtained in this investigation of paediatric patients with the findings reported by Miller et al. [2] who performed a similar study in adults.

Materials and methods

Reports on the knee MR examinations of 393 paediatric patients seen at our MR department from 1993 to 1998 were reviewed. The patients were evaluated for various clinical reasons, the most common being knee pain. In six patients both knees were examined. In all patients, images were obtained in three perpendicular planes. Sagittal MR images were obtained using proton density and T2-weighted (T2-W) spin-echo (SE) MR sequences (TR/TE 2,400/20/70; 1 signal acquisition; FOV 185 mm; matrix size 220 × 256). Coronal and transverse fast SE MR images were also obtained (TR/TE 4,700/19/70; 1 signal acquisition; FOV 160 mm; matrix size 162 × 256). Occasionally other sequences were performed, including gradient echo sequences, T1-weighted (T1-W) SE sequences, short tau inversion recovery sequences, and T1-W sequences following i.v. administration of contrast agent. All images were obtained on either a 1.0- or 1.5-T clinical system.

The initial reports were made by the same paediatric radiologist in concert with a musculoskeletal radiologist. The reports were reviewed and the presence of a Baker's cyst, joint effusion, internal derangement [meniscal tear, anterior cruciate ligament (ACL) tear], and other joint disorders (synovial disease, osteochondritis dissecans) were recorded. Both readers used diagnostic criteria as described in the literature [5]. An abnormal joint effusion was considered to be present when the AP size of the suprapatellar recess was equal to or greater than 2 mm. Twenty-five patients were found to have a Baker's cyst. In 18 of these 25 patients the clinical charts and imaging files were available for review. The images of these 18 patients were evaluated retrospectively by consensus of two musculoskeletal radiologists. The findings that were evaluated included cyst size, presence of debris and leakage, cyst location, presence of a connection to the knee joint, and presence of septations and lobulated margins. The principal investigator reviewed the clinical charts of these 18 patients. Histological data were available in three patients who underwent excision of the Baker's cyst. The association between Baker's cyst and joint fluid was assessed using a chi-square test (SPSS Student version 6.1.3, SPSS Inc., Chicago, Ill.).

Results

Baker's cysts were identified in 6.3% (25/393) of patients. Joint fluid was observed in 18.8% (74/393), ACL tear in 4% (16/393), medial meniscal tear in 3.3% (13/393), lateral meniscal tear in 1.7% (7/393), and synovial pathology in 2.8% (11/393) (Table 1). None of the 25 patients with a Baker's cyst had an associated anterior cruciate ligament tear or meniscal tear. Two had osteochondritis dissecans and two others had synovial disease (infection, juvenile rheumatoid arthritis). Joint effusion was seen in 16% (4/25) of patients with a Baker's cyst. No statistically significant association was found between presence of a Baker's cyst and presence of joint fluid ($P > 0.5$). The mean age of the patients with a Baker's cyst was 8.2 years compared to 12.4 years

Table 1 Prevalence of joint fluid and internal derangement in 393 patients (first column) and in patients with a Baker's cyst (second column)

	All patients (%)	Patients with Baker's cyst (%)
Joint fluid	18.8	16
ACL tear	4	0
Medial meniscal tear	3.3	0
Lateral meniscal tear	1.7	0
Synovial pathology	2.7	8

for patients without a Baker's cyst. Sixty per cent of patients with a Baker's cyst were male and 40% were female. Clinical symptoms in patients with a Baker's cyst included popliteal pain, swelling, or both pain and swelling. On MR images in the sagittal plane, the length of the cyst ranged from 1.5 to 6 cm (mean 4 cm). In the transverse plane, the AP size of the cyst ranged from 0.5 to 2 cm (mean 1.6 cm), whereas the mediolateral size ranged from 2.5 to 3.5 cm (mean 2.8 cm). No leakage or debris was demonstrated in any of the cases. All cysts were located along the posteromedial aspect of the knee joint. In 86% of Baker's cysts, the epicentre was located at the level of the joint space, whereas in 14% the epicentre was located slightly superior to the level of the joint space. A smaller subgastrocnemius bursa was depicted in 78% of cases, but a slitlike communication between the gastrocnemius-semimembranosus bursa and the subgastrocnemius bursa was evident only in 60% of cases (Figs. 1–3). A communication between the joint space and Baker's cyst could not be demonstrated in any of the cases. Septations were seen in 50% of cases and lobulated cyst margins were observed in 14% of cases (Fig. 4). In three patients, the Baker's cyst was resected. Histologically, synovial tissue interspersed among mucoid fluid was evident in all three cases.

Discussion

Baker's cysts have been investigated in anatomical, biomechanical, and imaging studies. It has been shown that in adults, Baker's cysts arise secondary to intra-articular effusions, which in turn may be caused by various joint disorders [2]. Baker's cysts may be encountered in patients with meniscal tears, degenerative arthropathy, rheumatoid arthritis, pyogenic arthritis, and pigmented villonodular synovitis [2–4, 6]. It is generally thought that the pathogenesis of Baker's cysts in children is different from that in adults. It is speculated that in children, Baker's cysts may occur following direct trauma to the popliteal fossa, although the precise mechanism of such trauma remains unclear [4].



Fig. 1 Sagittal T2-W MRI (TR/TE, 2,400/80) in a 9-year-old boy. Both the gastrocnemius-semimembranosus bursa (*long white arrows*) and the subgastrocnemius bursa (*bold arrowheads*) are seen. No significant intra-articular joint effusion was observed in this patient

Fig. 2 Transverse gradient-echo MRI in a 7-year-old girl. The gastrocnemius-semimembranosus bursa is seen along the posteromedial aspect of the left knee (*G*). A small slitlike connection (*long white arrows*) with the subgastrocnemius bursa (*arrowhead*) also is seen

Fig. 3 Coronal T2-W MRI (TR/TE, 4,700/70) in a 9-year-old boy. Oval-shaped Baker's cyst (*G*) is seen along the posteromedial aspect of the knee. Note the semimembranosus muscle and tendon (*asterisk*) and the medial gastrocnemius muscle (*arrowheads*)

Fig. 4 Sagittal T2-W MRI (TR/TE 2,400/80) in a 4-year-old boy. A Baker's cyst (*G*) with lobulated margins and a few septations is seen

Before the advent of cross-sectional imaging there was no adequate method, short of dissection, for direct evaluation of the popliteal fossa. Routine MR imaging of the knee includes transverse, coronal, and sagittal images that allow accurate depiction of Baker's cysts and detailed evaluation of their imaging characteristics. Baker's cysts are typically located along the posteromedial aspect of the knee joint and generally consist of two distended bursae. The largest gastrocnemius-semimembranosus bursa is located superficial to the medial gastrocnemius muscle and tendon, whereas a smaller bursa is located deep to the medial gastrocnemius muscle and tendon [1, 2]. A slitlike communication may be observed between both bursae (Figs. 1, 2).

In children, Baker's cysts usually present as a painless tumour along the posteromedial aspect of the knee joint. In some patients pain may be evident, although the relationship between the pain and the Baker's cyst may be questionable. Occasionally, paediatric patients are referred for imaging studies because of concern of malignancy. Imaging studies performed in patients with Baker's cyst include arthrography, sonography, CT or MR imaging [4, 7, 8]. A drawback of arthrography may be that a potential gastrocnemius-semimembranosus bursa may be filled during arthrography, leading to a false-positive diagnosis [9]. At sonography, Baker's cysts are typically located along the posteromedial aspect of the knee and exhibit a hypoechoic aspect. On MR images, Baker's cysts usually present as well-defined masses with low signal intensity on T1-W and high signal intensity on T2-W MR images. This MR imaging appearance was evident in all patients evaluated in this study.

Because associated internal derangement is usually absent in children, surgery or arthroscopy of the knee joint is often not required, and treatment has to be conservative. Spontaneous involution of popliteal cysts in children appears to be the rule. Surgery is only necessary for painful cysts or when restriction of motion is present.

In this study we attempted to study the prevalence of Baker's cysts in a paediatric population. Multiplanar MR images allowed for a detailed evaluation of the imaging features of Baker's cysts and for assessment of associated knee-joint disorders.

Our data showed that the prevalence of Baker's cysts on MR images in the paediatric orthopaedic population was 6.3%, which is lower than the prevalence reported for adults (19%) [2]. We believe that this finding may be in accordance with the higher prevalence of various joint disorders in adults. The mean age of patients with Baker's cysts in this study was 8.2 years. Although this is slightly older than the mean age reported by Gristina and Wilson [4], the predilection for younger children is confirmed in our study. Our findings indicated that Baker's cysts are slightly more common in boys than in girls. This predilection for boys has been previously reported and is compatible with the increased physical activity of boys.

In this study, none of the 25 patients with a Baker's cyst had a meniscal tear or ACL tear. This finding may suggest that, in children, a Baker's cyst is seldom associated with lesions of the meniscus or cruciate ligament. Two patients with a Baker's cyst, however, had osteochondritis dissecans and two others had synovial disease. Szer et al. [10] showed that in the setting of juvenile rheumatoid arthritis, popliteal cysts are quite common (61%), and in this population the presence of a Baker's cyst may correlate with the presence of a joint effusion.

Results from our analysis of imaging features showed that on MR images, the mean length of Baker's cysts in the sagittal imaging plane was 3.6 cm. This length is similar to that reported in adults, although both smaller as well as larger sizes may be encountered in adults [2]. A subgastrocnemius bursa is slightly more common in children (78%) as compared to adults.

When the subgastrocnemius bursa is present, a communication between the gastrocnemius-semimembranosus bursa and the subgastrocnemius bursa is commonly seen in both children and adults [2]. A communication between the Baker's cyst and the joint space could not be demonstrated on MR images in any of the patients evaluated in this study. This finding may suggest that in children the development of Baker's cyst is not related to the presence of a joint effusion. Our observations showed that septations were present in about half of the children. These data are similar to those reported for adults [2]. The presence of septations does not, however, appear to have any pathological significance. Debris and leakage of the cyst are occasionally observed in adults, whereas these findings were absent in all paediatric patients in this study.

Recognised limitations of this study include the retrospective evaluation of MR imaging reports. However, because initial interpretations were always made by consensus of two senior radiologists, we consider subjectivity to be sufficiently reduced. Secondly, the distinction between normal and pathological joint effusion was somewhat arbitrarily chosen and no attempt was made to stratify the effusion by size. Thirdly, diagnosis of meniscal tear, ACL tear, and Baker's cyst was based on MR criteria. Although arthroscopic findings would have been more accurate, the reported accuracy of MR imaging for detection of these lesions is quite high [5, 11]. Because the prevalence of internal derangement and Baker's cysts in this paediatric population was low, a statistical analysis of associations was not possible for all variables. Finally, because T1-W images were not routinely used in our imaging protocol, haemorrhagic debris may not have been identified.

In summary, Baker's cysts are less prevalent on MR images obtained in a paediatric orthopaedic population than in an adult orthopaedic population. In children, Baker's cysts do not seem to be associated with joint effusion. In addition, in the present study, none of the patients with a Baker's cyst had a meniscal tear or ACL tear. In four patients, however, either synovial pathology or osteochondritis dissecans was present. The mean length of Baker's cysts appears similar in adults and children, although the range of sizes is greater in adults. In general, Baker's cysts in adults and children appear remarkably similar, although a communication with the knee joint and presence of debris or leakage are unusual findings on MR images of children with Baker's cysts.

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