Baker's Cysts in Calcium Pyrophosphate Dihydrate Deposition Disease: A Musculoskeletal Ultrasound Study

Shun-Ban Tai[1], Chun-Chi Lu[2], Chen-Hung Chen[2], Yu-Ching Chou[3], and Chi-Ching Chang[4]

[1]Division of Rheumatology, Immunology and Allergy, Department of Internal Medicine, Zuoying Branch of Kaohsiung Armed Forces General Hospital;
[2]Division of Rheumatology, Immunology and Allergy, Department of Internal Medicine, Tri-Service General Hospital, National Defense Medical Center;
[3]Institute of Public Health, National Defense Medical Center;
[4]Division of Rheumatology, Immunology, and Allergy, Department of Internal Medicine, Taipei Medical University Hospital

Abstract

To investigate the clinical presentation of Baker's cyst in patients with calcium pyrophosphate dihydrate (CPPD) calcifications of the knee, the most commonly affected site in CPPD deposition disease, with the use of high-resolution musculoskeletal ultrasound (MUS). This was a prospective clinical and MUS study conducted in 60 patients with CPPD deposition disease of the knee. The patients' synovial fluid was aspirated and examined for the identification of crystals. The relationships between the Baker's cyst and occurrence of joint effusion, synovitis, chondrocalcinosis, and osteophytes were analyzed. Baker's cysts were demonstrated by MUS in 17 (28.3%) of the 60 patients. Joint effusion was present in all 60 (100%) patients. In addition, 55 (91.7%) patients had synovitis, 11 (18.3%) had chondrocarcinosis, and 45 (75.0%) had osteophytes. There was no significant correlation between the occurrence of Baker's cyst and the occurrence of effusion, synovitis, chondrocarcinosis, and osteophytes ($p > 0.05$). These results indicate that Baker's cysts are a common occurrence in patients with CPPD deposition disease, affecting 28% of this population and that they can be accompanied by joint effusion, synovitis, chondrocalcinosis, and osteophytes. Baker's cysts are easily missed on clinical examination without image guidance, but can be accurately identified with the use of MUS. Therefore, MUS should be more widely employed by clinicians in the diagnosis of Baker's cysts. (J Intern Med Taiwan 2014; 25: 281-287)

Key Words: Baker's cyst, Musculoskeletal ultrasound (MUS), Calcium pyrophosphate dehydrate (CPPD)

Reprint requests and correspondence：Dr. Shun-Ban Tai
Address：Division of Rheumatology, Immunology, and Allergy, Department of Internal Medicine, Zuoying Branch of Kaohsiung Armed Forces General Hospital, No.553, Junxiao Rd., Zuoying Dist.813, Kaohsiung City, Taiwan

Introduction

A Baker's cyst, also known as a popliteal cyst, represents a fluid distention of the gastrocnemius-semimembranosus bursa through a communication with the knee joint[1].

It presents with a mild to moderate deformity, posterior knee pain, lower leg pain, and end range motion restriction in the knee[2]. Progressively enlarged Baker's cysts may cause pseudothrombophlebitis due to leakage or rupture and deep venous thrombosis as a result of direct compression of the popliteal vein and artery, respectively[3].

Knee disorders, including rheumatoid arthritis, osteoarthritis, gout, and meniscal injuries may be a frequent cause of Baker's cysts[4,5]. The prevalence of Baker's cysts in patients with CPPD deposition disease is unknown.

We aimed to investigate the clinical presentation of Baker's cysts in patients with CPPD deposition disease and the relationship between Baker's cysts and occurrence of joint effusion, synovitis, chondrocalcinosis, and osteophytes with the use of MUS.

Materials and methods

Patients

In this retrospective study, we reviewed all patients with a definitive diagnosis of CPPD deposition disease at the Tri-Service General Hospital. CPPD crystal deposition was confirmed in all patients by examination of the aspirated synovial fluid. The ultrasound examinations and arthrocentesis were performed by rheumatology specialists.

Clinical assessment

A clinical examination of the knees was performed using standard techniques[6] to assess tenderness and swelling by two of the authors. A diagnosis of knee joint effusion was made if fluctuant fluid was observed in either the medial or the lateral compartments of the knee or if a patellar tap was demonstrated. The patient was diagnosed with a Baker's cyst if, on palpation, swelling or tenderness was noted in the popliteal fossa or medial head of the gastrocnemius muscle[7] and if the swelling was firm with full knee extension and soft with knee flexion (Foucher's sign)[8].

Synovial fluid analysis

All synovial fluid analyses were performed by one experienced medical technologist; CPPD crystal identification was done using a polarized-light microscope (Carl Zeiss, Axioskop, ELEinsatz).

Ultrasound evaluation

The MUS examination was performed with a multi-frequency linear transducer (7–12 MHz) and color Doppler ability. Both axial and longitudinal scans were performed without lifting the probe along the entire portion of the cartilage and fibrocartilage to identify any type of deposit. Joint effusion detected by MUS was defined as an anechoic area. Synovitis was defined as hypoechoic synovial hypertrophy with a thickness >2 mm[9]. Osteophytes were detected as irregularities in the bone contour[10]. Baker's cyst was identified when the gastrocnemio-semimembranosus bursa was filled with anechoic or hypoechoic fluid and had a transverse diameter >4 mm[11,12]. Chondrocalcinosis was defined as the presence of bright stippled foci, a thin hyperechoic band parallel to the surface of the hyaline cartilage, and calcification of fibrocartilage[13,14].

Statistical Analysis

Statistical analysis was performed using the Statistics Package for Social Science (SPSS) software, version 12 for Microsoft Windows. Fisher's exact test was used to evaluate the correlations of Bakers' cyst with effusion, synovitis, chondrocalcinosis, and osteophytes. P-values <0.05 were considered significant.

Results

Sixty patients with a definitive diagnosis of CPPD deposition disease were enrolled in this study. The clinical and MUS findings of the patients are presented in Table 1. Forty-two of the 60 patients were women (70%) and 18 were men (30%). The mean age of the patients was 80.5 years (SD 9.8, range 34–94). Synovial fluid analyses revealed that the average total white blood cell count was 30852 ± 19647.01/mm^3 with a significant neutrophil predominance. Baker's cysts were demonstrated by MUS in 17 (28.3%) of the 60 patients. Hypoechoic fluid with a hyperechoic and floating spot was observed in the longitudinal ultrasound of the knee joint (Figure 1a). The neck of Baker's cyst was situated between the semimembranosus tendon medially and the medial head of gastrocnemius laterally. A septum was identified within the superficial portion (Figure 1b). Joint effusion was detected in all patients. Synovitis, chondrocalcinosis, and osteophytes were detected in 55 (91.7%), 11(18.3%), and 45 (75.0%) of the knees, respectively.

Relationships between the occurrence of knee effusion, synovitis, chondrocarcinosis, and osteophytes and the occurrence of Baker's cyst are presented in Table 2. Joint effusion was present in all the 17 (100.0%) knees with cysts compared to 34 of 43 (79.1%) knees without cysts. Synovitis was present in 14 of 17 (82.4%) knees with cysts compared to 41 of 43 (95.3%) knees without cysts. Chondrocalcinosis was present in 3 of 17 (17.6%) knees with cysts compared to 8 of 43 (18.6%) knees without cysts. Osteophytes were present in 13 of 17 (76.5%) knees with cysts, compared to 32 of 43 (74.4%) knees without cysts. There was no significant correlation between the occurrence of Baker's cyst and occurrence of effusion, synovitis, chondrocarcinosis, and osteophytes ($p > 0.05$).

Discussion

CPPD deposition disease is one of the most common crystal arthropathies, affecting 5% of the middle-aged and elderly population[15]. It is primarily idiopathic, but is associated with other disorders such as primary hyperparathyroidism, hemochromatosis,

Table 1. Clinical and musculoskeletal ultrasound findings in 60 patients with CPPD disease of the knee

Clinical findings	
Age (years), (mean ± SD)	80.47 ± 9.80
Sex (male), *n* (%)	18 (30%)
Synovial fluid	
WBC (counts)	30852 ± 19647.01
CPPD	60 (100%)
MUS findings	
Baker's cyst, *n* (%)	17 (28.3)
Effusion, *n* (%)	60 (100)
Synovitis, *n* (%)	55 (91.7)
Chondrocalcinosis, n (%)	11 (18.3)
Osteophytes, n (%)	45 (75.0)

Table 2. Relationships of knee effusion, synovitis, chondrocarcinosis, and osteophytes with Baker's cysts

Predictive factor	Baker's cyst		
	Present	Absent	p-value[a]
Effusion			0.193
Present, n (%)	17 (100.0)	34 (79.1)	
Absent, n (%)	0 (0)	9 (20.9)	
Synovitis			0.132
Present, n (%)	14 (82.4)	41 (95.3)	
Absent, n (%)	3 (17.6)	2 (4.7)	
Chondrocarcinosis			1.000
Present, n (%)	3 (17.6)	8 (18.6)	
Absent, n (%)	14 (82.4)	35 (81.4)	
Osteophytes			1.000
Present, n (%)	13 (76.5)	32 (74.4)	
Absent, n (%)	4 (23.5)	11 (25.6)	

[a]p-value by Chi-square/Fisher's exact test.

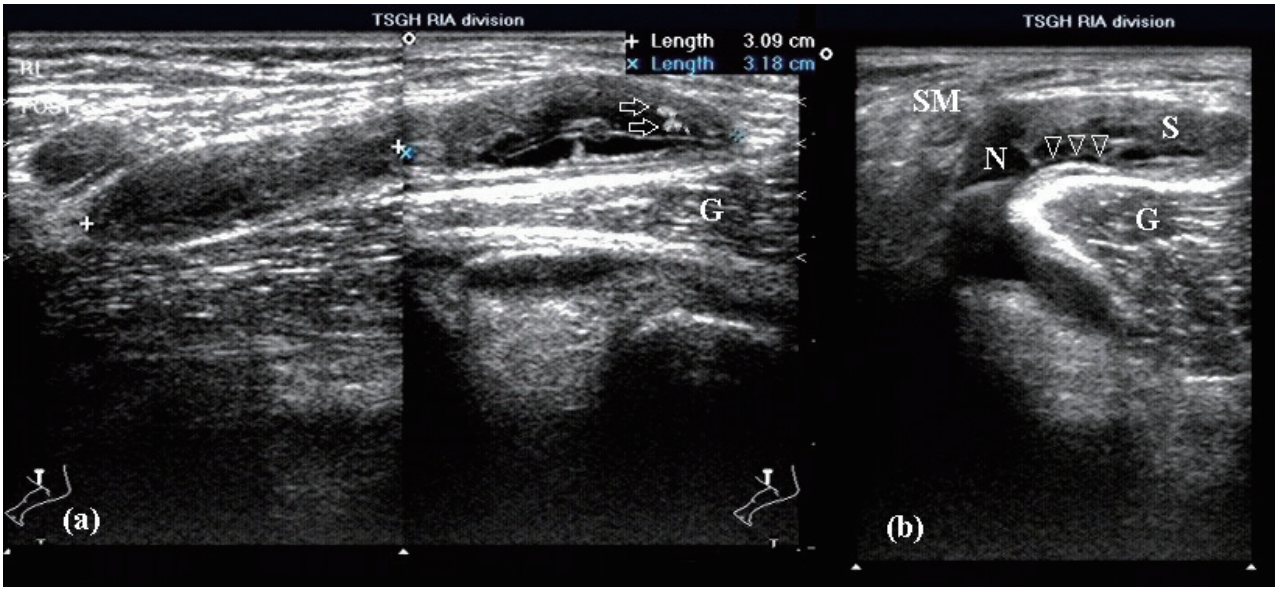

Figure 1. (a) Longitudinal sonogram of the typical appearance of a Baker's cyst in the popliteal fossa. The gastrocnemius muscle (G) is seen beneath the Baker's cyst. Hypoechoic fluid with a hyperechoic and floating spot (arrow) in the longitudinal ultrasound of the knee joint. (b) Transverse sonogram of a Baker's cyst located between the medial head of the gastrocnemius (G) and the semimembranosus (SM) muscles. The neck (N) was situated between the semimembranosus tendon (SM) medially and the medial head of the gastrocnemius (G) laterally. A septum (arrow head) was identified within the superficial portion (S).

and hypothyroidism[16]. The MUS findings in CPPD, seen mainly in the joints, include effusion, chondrocalcinosis, osteophytes, and Baker's cyst[14,17].

Baker's cyst is a common occurrence in patients with CPPD deposition disease[18]. However, it is difficult to diagnose Baker's cyst clinically without image guidance. Ultrasonography these days has largely replaced arthrography for the initial assessment of Baker's cyst. With ultrasonography, Baker's cysts are revealed as comprising three parts: the base, the superficial part, and the neck in the middle[19]. The neck lies between the medial head of the gastrocnemius and the semimembranosus tendon. Baker's cysts can be complicated by dissection, which usually occurs in a distal direction[20]. Cysts can rupture, and their fluid content can track into the fascial planes between the soleus and gastrocnemius muscles. This can cause inflammatory changes within the subcutaneous fat and muscles[21]. The clinical appearance of the leg in these cases can be very similar to that seen in cases of acute thrombophlebitis[22].

The incidence of Baker's cysts varies depending on the associated condition. A previous study demonstrated that 42% of patients with osteoarthritis had Baker's cysts that were detected by ultrasonography. Bilateral cysts were seen in 16% of the patients[23]. Up to 48% of patients with rheumatoid arthritis and up to 21.7% of those with gouty arthritis have been shown to have Baker's cysts[24,25]. In our study, Baker's cysts were seen in 28.3% of the knees.

Baker's cyst may be formed by the connection of a normal bursa (a normal lubricating fluid sac) with the knee joint or be caused by the herniation of the knee joint capsule out into the back of the knee. It is a common complication of chronic knee inflammation and joint effusion in a number of rheumatological conditions including RA[24]. Effusion causes increased intra-articular pressure,

which then forces the joint fluid through a weakened posteromedial joint capsule into the potential space of the gastrocnemio-semimembranosus bursa[25,26]. In our study, all Baker's cysts were accompanied by joint effusion.

On sonography, synovial hypertrophy in CPPD deposition disease appeared as a thickening of the synovial membrane [27]. Villous hypertrophy, as seen in the rheumatoid synovium, was not observed. A power Doppler demonstrates the increased microvascular flow in the synovial tissue, which is suggestive of active inflammation[27]. In our study, there were 14 (82.4%) patients with synovitis and a popliteal cyst. We found that there was no relationship between the occurrence of Baker's cysts and the presence of synovitis in CPPD deposition disease.

In chondrocalcinosis, calcium crystals (known also as CPPD or calcium pyrophosphate dihydrate crystals) accumulate in the cartilage of the joints, is frequently associated with pseudogout, osteoarthritis, and pseudo-osteoarthritis[28]. MUS is a very sensitive and specific technique for detecting chondrocalcinosis, which presents as bright stippled foci in the synovial fluid or around the articular region, a thin hyperechoic band parallel to the surface of the hyaline cartilage, and calcification of fibrocartilage[29,30]. In our study, there were 3 (17.3%) patients with chondrocalcinosis and a popliteal cyst. There was no relationship between the occurrence of Baker's cysts and the presence of chondrocalcinosis in patients with CPPD deposition disease.

CPPD deposition disease occurs frequently in the elderly as osteoarthritis is a common occurrence in this population. Clinical CPPD deposition disease typically resembles osteoarthritis, while acute inflammatory arthritis (pseudogout) is also a common presentation[31]. In our study, osteophytes were found in 13 (76.5%) patients with CPPD deposition disease. There was no relationship between the occurrence of Baker's cysts and the presence of osteophytes. The association between osteophytes and Baker's cysts implies that the altered biomechanics resulting from osteophytes may be enough to squeeze even normal amounts of fluid[32].

Conclusion

Baker's cysts are a common occurrence in patients with CPPD deposition disease, affecting 28% of this population. Baker's cysts can be accompanied by joint effusion, synovitis, chondrocalcinosis, and osteophytes. They can be accurately identified with the use of MUS. Baker's cyst should be considered a possible diagnosis in patients with a popliteal fossa swelling or lower leg pain.

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貝克氏囊腫在雙氫氧化焦磷酸鈣沈積疾病之臨床表現：骨骼肌肉超音波研究

戴舜邦[1] 盧俊吉[2] 陳政宏[2] 周雨青[3] 張棋楨[4]

[1]國軍高雄總醫院左營分院 內科部風濕免疫過敏科
[2]三軍總醫院 內科部風濕免疫過敏科
[3]國防醫學院公共衛生學系暨研究所
[4]台北醫學大學附設醫院 內科部風濕免疫過敏科

摘 要

藉由骨骼肌肉超音波，調查雙氫氧化焦磷酸鈣沈積疾病病患中，貝克氏囊腫的臨床表現。對於關節液抽吸分析後，60位診斷為雙氫氧化焦磷酸鈣沈積疾病病患，進行臨床與骨骼肌肉超音波的研究探討。分析貝克氏囊腫與變數如關節積液、滑膜炎、軟骨鈣化及骨刺的關係。藉由骨骼肌肉超音波，我們發現在60個膝關節中有17個(28.3%)貝克氏囊腫。關節積液、滑膜炎、軟骨鈣化及骨刺在膝關節偵測出來的數量(比例)分別是60個(100%)、55個(91.7%)、11個(18.3%)及45個(75.0%)。貝克氏囊腫的存在與否與關節積液、滑膜炎、軟骨鈣化及骨刺無明顯的關連性($p>0.05$)。貝克氏囊腫常見於雙氫氧化焦磷酸鈣沈積疾病的病患中(約28%)，而且它們常與關節積液、滑膜炎、軟骨鈣化及骨刺同時出現。貝克氏囊腫在臨床檢查中易被忽略，但是骨骼肌肉超音波可以準確性的診斷。因此，臨床醫師應常用骨骼肌肉超音波來診斷貝克氏囊腫。