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Ruptured or Dissected Popliteal Cyst in Patients with Calf Symptoms

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= 국문초록 =

장딴지 증상을 호소하는 환자에서 합병 슬와낭

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목적: 장딴지 부위의 통증, 종창, 종괴 등은 류마티스 질환을 비롯한 다양한 원인에 의해서 발생하며 합병 슬와낭(파열 또는 절개)은 심부 정맥 혈전증과 증상이 유사하여 정확한 진단이 요구된다. 본 연구는 장딴지 증상을 호소하는 환자에서 원인 질환과 함께 합병 슬와낭의 빈도와 특성을 알아보고자 하였다.

방법: 2002년 1월부터 2006년 12월 까지 장딴지 증상을 호소하여 근골격계 초음파, 도플러 초음파, 자기공명영상 촬영을 시행한 197명의 환자를 대상으로 의무 기록을 후향적으로 조사하였다.

결과: 대상 환자 197명은 102건의 도플러 초음파, 49건의 근골격계 초음파, 46건의 자기공명영상 검사를 시행 받았다. 장딴지 증상의 원인 질환으로는 혈전증(58/197, 29.4%) 봉와직염(14/197, 7.1%), 합병 슬와낭(12/197, 6.1%), 종양(12/197, 6.1%), 아킬레스건 파열(11/197, 5.6%), 안쪽 갈래 장딴지 근육 파열(10/197, 5.1%), 근육 탈출(3/197, 1.5%)등이 진단되었다. 12명의 합병 슬와낭 중 6명은 종괴를 호소하였으며 나머지 6명은 통증을 동반한 종창을 호소하였다. 12명 중 3명은 심부 정맥 혈전증 의심하에 도플러 초음파를 우선적으로 시행하였다. 합병 슬와낭은 안쪽 갈래 장딴지 근육과 얕은 근막 사이(12/12. 100%), 피하 지방 내부(3/12, 25%), 안쪽 장딴지 근육 내부(2/12, 17%)에 위치하였다. 합병 슬와낭 12 명 중 3명은 류마티스관절염을 앓고 있었다.

결론: 본 연구를 통해 장딴지 증상을 호소하는 환자에서 합병 슬와낭의 빈도가 6.1%로 조사되었으며 장딴지 증상을 호소하는 환자에서 합병 슬와낭과 이외에 다양한 원인 질환을 고려해야 함을

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알 수 있었다.

Key Words: Calf symptom, Complicated popliteal cyst, Magnetic resonance imaging, Ultrasonography

INTRODUCTION

Calf symptoms such as pain, swelling, and mass formation can develop in a variety of conditions, including deep vein thrombosis (DVT), ruptured or dissected popliteal cyst, or tear of a muscle or tendon such the medial head of the gastrocnemius, Achilles tendon, or plantaris tendon (1-3). Lymphedema, neoplasm, hemorrhage, S1 radiculopathy, panniculitis, vasculitis, and focal myositis, can also manifest as nonspecific calf symptoms (4-8). Differential diagnosis of calf symptoms can be made through careful documentation of the medical history, physical examination, and appropriate radiologic studies. However, the presentation of symptoms and signs may overlap, and, because treatment differs between disorders that manifest clinically as calf symptoms, appropriate diagnosis is important. Ultrasonography (US) and magnetic resonance imaging (MRI) are useful techniques in the assessment of patients with calf symptoms (1-3). US is the preferred method of diagnosis for calf symptoms because it is less expensive and simpler than MRI. Doppler US is the technique of choice for the diagnosis of DVT (9). Popliteal cyst is an enlargement of the gastrocnemius-semimembranosus bursa at its communication with the knee joint (10). A dissected or ruptured popliteal cyst can present with calf symptoms, such as pain, swelling, and mass, and with compartment syndrome, entrapment neuropathy, infection, or clinical manifestations that mimic thrombophlebitis (pseudothrombophlebitis) (11-14). Popliteal cyst may extend or rupture into any direction, but most commonly inferomedially (15). Clinically, it is important to distinguish between DVT and a complicated popliteal cyst because misdiagnosis of a ruptured or dissected Baker cyst as DVT may lead to unnecessary anticoagulation treatment and because delayed diagnosis of DVT can lead to serious complications such as pulmonary embolism and death. The incidence of a popliteal cyst in patients with symptoms of acute DVT has been reported rarely (4,16,17). The aim of this study was to investigate the incidence and characteristics of complicated popliteal cyst in patients treated in one center.

MATERIALS AND METHODS

1. Patients

We reviewed 197 consecutive patients who underwent radiologic evaluation for calf symptoms by US of the musculoskeletal system, Doppler US, or MRI to determine the underlying etiology from January 2002 through December 2006. The medical records of these patients were also reviewed. Patients with varicose veins, history of direct trauma to the calf, or operation on the calf area were excluded. This study was approved by our institutional review board.

2. Imaging protocols, diagnostic criteria, and imaging analysis

The US evaluation was performed by an experienced musculoskeletal radiologist using a 17-5 MHz linear array transducer (IU22, Philips Medical Systems, Bathell, WA). MRI was performed on a 1.5 T magnetic resonance scanner (Intera, Philips Medical Systems, Bathell, WA) using a surface coil. The MRI protocol comprised a sagittal spin echo T2-weighted image (TR/TE, 4,200/100), proton density-weighted image (TR/TE, 2,000/36), fat-suppressed T2-weighted image (TR/TE, 3,200/70), coronal spin echo T2- and proton density-weighted image, and axial spin echo T2-weighted image. The T1-weighted fat-suppressed spin-echo se-

quence was obtained after intravenous injection of 0.2 mL/kg gadopentetate (Magnevist, Schering, Berlin, Germany) (TR/TE, 617/12). The parameters of the routine knee MRI were: 3～4 mm slice thickness, 0.2 mm interval, a 512×512 matrix, 2 NEX, and 16 cm field of view.

Images were reviewed retrospectively by one experienced musculoskeletal radiologist. The diagnosis of a dissected popliteal cyst was made by the findings of a leaking cyst and cystic extension into the fascial planes between the muscles of the posterior compartment or between the fascia and adjacent muscles or in intramuscular location. A ruptured popliteal cyst was defined as soft tissue extravasation of fluid content with ill-defined high signal intensity around the popliteal cyst with surrounding inflammation. The diagnosis of DVT was made based on findings including no compressibility of the vein, the presence of echogenic material, and the absence of flow signal inside the vein on Doppler imaging. DVT was also diagnosed when MRI showed intermediate to low signal intensity in the involved vein with or without associated muscle and subcutaneous edema. Arterial thrombosis was defined as intermediate to low signal intensity in the involved artery and no enhancement of the lumen after gadolinium administration on MRI. Thrombophlebitis in the calf was defined as hypoechoic thrombosis within the superficial vein with increased echogenicity of the surrounding fat plane on US and low to intermediate signal intensity of thrombosis within the superficial vein and surrounding subcutaneous edema on MRI. The definition of rupture of the tendon and muscle determined by US and MRI was based on the findings of discontinuity of the affected tendon and muscle with alteration of the textural echogenicity and signal intensity. The diagnosis of subcutaneous fat necrosis was based on the findings suggested by Fernando et al (18). Hemangioma was defined as a serpentine area of high signal intensity mass corresponding to slow flowing blood and high signal intensity of fat overgrowth with or without phleboliths on MRI.

RESULTS

Patients presenting with calf symptoms were evaluated by various physicians, including a rheumatologist, orthopedic surgeon, general surgeon, emergency medicine physician, and rehabilitation physician. Of the 197 consecutive patients, 49 were examined using US of the musculoskeletal system (mean ages 43 years, range 9～76 years), 102 were examined using Doppler US (mean ages 57 years, range 15～85 years), and 46 were examined using MRI (mean ages 49 years, range 18～83 years). Six patients were evaluated with more than one of three radiologoical studies. Three patients were evaluated with MRI and US. Another three pa-

Table 1. Causes of calf symptoms

	Doppler US	US	MRI
Subcutaneous lesions (28)			
Cellulitis	3	3	8
Fat necrosis		3	
Panniculitis		2	
Non-specific lesion		9	
Musculotendinous lesions (23)			
Achilles tendon rupture		9	2
Tennis leg (1*)		3	8
Muscle herniation		2	1
Vascular lesions (59)			
DVT	46	1	1
SVT	5†	3	1
Arterial thrombosis (1*)	1		1
Venous insufficiency	1		
Tumor (13) (1*)		3	10
Popliteal cyst (15) (3*)	3	3	9 (1‡)
Miscellaneous lesions (10)	5	1	4
Idiopathic (52)	43	7	2
Total	107	49	47

*the number of patients evaluated with combined diagnostic modalities. †Five patients had both SVT and DVT. ‡One patient had both hemangioma and popliteal cyst

US: ultrasonography, MRI: magnetic resonance imaging, DVT: deep vein thrombosis, SVT: superficial vein thrombosis

tients were evaluated with MRI and Doppler US. All 102 patients evaluated with Doppler US had complained of either pain or swelling. Among the 49 patients evaluated with US of the musculoskeletal system, thirty-one patients complained of pain or swelling and the remaining 18 patients presented with a mass. Among the 46 patients evaluated with MRI, twenty-seven patients complained of pain or swelling and the remaining 19 patients showed a mass. Fifty-eight of the 197 patients (29.4%) were diagnosed with thrombosis, and of these, 48 diagnoses (24.4%) were confirmed as DVT, making it the most common cause of calf symptoms (Table 1). Nine patients (4.6%) were diagnosed with superficial vein thrombosis (SVT), one (0.5%) with arterial thrombosis, and one with venous insufficiency; five patients with SVT had coexisting DVT. Of the nine patients with SVT, five were diagnosed with Doppler US, three with US, and one with MRI. Six of the nine patients with SVT had greater saphenous vein thrombosis, two had thrombosis in the lesser saphenous vein, and one had thrombosis in both the greater and lesser saphenous veins One patient had popliteal artery thrombosis, which was diagnosed using US, MRI, and angiography. Evaluation of calf symptoms showed that four of the 58 patients (6.9%) with thrombosis also had coexisting cancer including one each with non-Hodgkin's lymphoma (T cell), gall bladder cancer with bone metastasis, cervical cancer, and bladder cancer with liver metastasis. The patient with T cell lymphoma also had a pulmonary thromboembolism. Twelve of the 197 patients (6.1%) were diagnosed with a complicated popliteal cyst (Table 2). The diagnosis was made by Doppler US in three patients, by US in three, and by MRI in nine; two patients (16.7%) were evaluated with both MRI and Doppler US. Six of the 12 patients complained mainly of mass and the other six reported painful swelling. Three of the 12 patients with a popliteal cyst were evaluated initially by Doppler US under suspicion of DVT. Ten of the 12 patients had a dissected and ruptured popliteal cyst (Figure 1, 2); and the other two had only a ruptured popliteal cyst. In all 12 patients, the cyst was located in the space between the medial head of the gastrocnemius and superficial fascia (Figure 1, 2). In three patients, the cyst was located in subcutaneous tissue (Figure 1), and in two patients, it was located intramuscularly within medial head of the gastrocnemius (Figure 2). Hemorrhage in a complicated popliteal cyst

Table 2. Characteristics of the complicated popliteal cysts

Patient number	Age/sex	D or R	Presenting symptoms	Extension of popliteal cyst	Meniscus tear	Cartilage abnormality	Joint effusion	Radiologic study	Underlying disease
1	67/F	DR	mass	G-F	NA	NA	Yes	US	
2	69/F	DR	pain	G-F, SC	No	Yes	Yes	MRI	
3	46/F	DR	pain	G-F, IM, SC	No	No	Yes	Doppler US, MRI	RA
4	56/F	DR	pain	G-F	MM, LM	Yes	Yes	MRI	
5	72/F	DR	pain	G-F, IM	MM	Yes	Yes	Doppler US, MRI	RA
6	57/M	R	pain	G-F	MM	No	Yes	US, MRI	
7	20/M	DR	mass	G-F	No	No	Yes	MRI	
8	70/M	DR	mass	G-F	MM	Yes	Yes	MRI	
9	65/F	DR	pain	G-F	NA	NA	NA	Doppler US	RA
10	66/M	DR	mass	G-F, SC	No	No	Yes	MRI	
11	56/F	DR	mass	G-F	NA	NA	Yes	US	
12	73/F	R	mass	G-F	MM	No	Yes	MRI	

D: dissection, R: rupture, G: gastrocnemius, G-F: space between the medial head of the gastrocnemius and superficial fascia; NA: not available, SC: subcutaneous, IM: intramuscular, RA: rheumatoid arthritis, MM: medial meniscus, LM: lateral meniscus

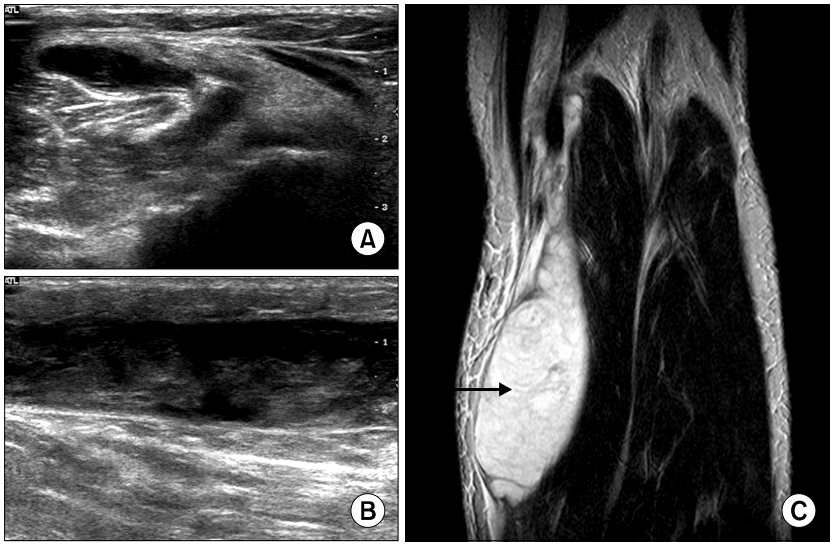

Fig. 1. A 46-year-old woman with rheumatoid arthritis and ruptured and dissected baker cyst. Ultrasonogram shows typical location of the baker cyst in the space between the medial head of the gastrocnemius and semembranosus (A). Anechoic dissected baker cyst with internal synovial proliferation demonstrates in the space between the medial head gastrocneiums and superficial fascia (B). Coronal fat suppressed T2-weighted MR image show high signal intensity of baker cyst with rupture and dissection into the space between the medial head gastrocnemius and superficial fascia. There is an extension into the subcutaneous tissue layer (C, arrow).

was observed in three of the twelve patients. Five of the nine patients evaluated with MRI had a torn meniscus involving the posterior horn of the medial meniscus; one patient also had a lateral meniscus tear. Four of the nine patients evaluated with MRI had a cartilage abnormality. Eleven of the 12 patients with a popliteal cyst had knee joint effusion. Three of these 12 patients had rheumatoid arthritis and showed exuberant synovial proliferation within the popliteal cyst on US and MRI. We found 28 patients (28/197, 14.2%) with subcutaneous lesions involving cellulitis (14 patients), fat necrosis (three), panniculitis (two), and non-specific subcutaneous lesions (nine). One patient was diagnosed with subcutaneous fat necrosis and two with panniculitis by biopsy. Eleven patients (11/197, 5.6%) were diagnosed with a partial or complete rupture of the Achilles tendon. In nine patients, the rupture was exercise related and in one patient, symptoms occurred after walking. In one 70-year-old patient, the rupture occurred after standing. Ten patients (10/197, 5.1%) had a partial or total rupture of the medial head of the gastrocnemius muscle, and all had complained of calf pain. Three patients (3/197, 1.5%) had muscle herniation involving the peroneus longus muscle in two patients and peroneus brevis muscle in one patient. A tumor was diagnosed in 12 of the 197 patients (6.1%); five patients had a hemangioma, two patients had a vascular tumor, and one patient each had a neuroma, dermatofibroma, neurofibroma, lipoma, or epidermoid cyst. Three patients with hemangioma were diagnosed through tissue biopsy and two were confirmed by the typical radiologic appearance such as phleboliths within the hemangioma. The location of the hemangioma was subcutaneous in three patients and intramuscular in two patients. Miscellaneous abnormalities included lymphedema in five patients, and in one patient each intramuscular granuloma, nodular muscular sarcoidosis, eosinophilic

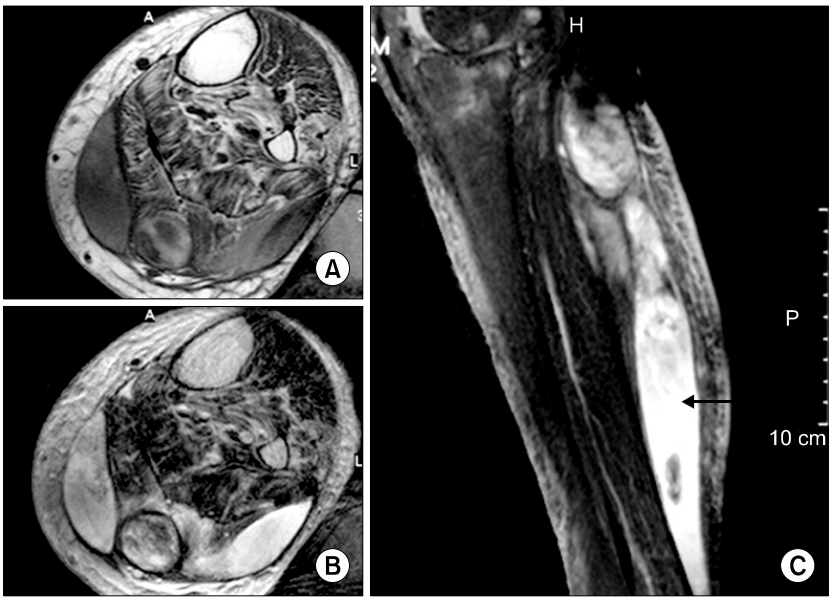

Fig. 2. A-72-year old woman with rheumatoid arthritis and ruptured and dissected baker cyst. Axial T1-weighted MR image (A), T2-weighted image (B), and coronal sagittal fat-suppressed image (C) show ruptured and dissected baker cyst, appearing with heterogeneous high signal intensity due to internal synovial proliferation and hemorrhage within the gastrocnemius muscle and space between the superficial fascia and the both head of the gastrocnemius muscle (arrow).

myositis, intramuscular hematoma, and Limb-Girdle muscular dystrophy. Eight patients had bilateral calf symptoms caused by DVT in three patients and in one patient each lipoma, fat necrosis, nodular sarcoidosis, eosinophilic myositis, and Limb-girdle muscular dystrophy. There were no specific abnormal findings in 52 patients (52/197, 26.4%), and these were defined as idiopathic.

DISCUSSION

Our data demonstrate that DVT was the most common cause of calf symptoms and complicated popliteal cyst with inferior extension should be considered in the differential diagnosis of patients with calf symptoms. A variety of diseases can cause calf symptoms. Sometimes it is imperative to make a definitive diagnosis of calf symptoms through radiologic investigations, such as sonography, MRI, venography, or computed tomography. A few studies have reported on the causes of calf symptoms based on only evaluation using calf sonography or Doppler US (4,16,17). However, MRI can well demonstrate soft tissue abnormalities than other imaging methods. Our analysis included patients with calf symptoms who were evaluated using US, Doppler US, and MRI, and we confirmed the causes of calf symptoms based on anatomy. Our data showing that DVT was the most common cause of calf symptoms was consistent with a few previous studies (4,16,17). An enlarged or complicated popliteal cyst can compress an adjacent vein and may cause symptoms that mimic venous thrombosis (pseudothrombophlebitis) of the lower extremity (19,20). In our patients, the incidence of a ruptured popliteal cyst in patients who underwent Doppler US to detect DVT was 3% (3/102), which is similar to that reported by Volteas et al(34/1,000, 3%)(16), but higher than that reported by Lansfeld et al (10/3,072, 0.3%) (17). US

is a useful radiologic tool to diagnose calf symptoms. The incidence of a ruptured popliteal cyst in patients examined with US was 6% (3/49) in our study, which is higher than the 2% (3/125) reported by Sato et al (4). The most common complication of popliteal cyst is rupture or dissection into the calf (17). Katz et al. reported that dissecting cysts are more common than ruptured cysts (21). However, 12 of our patients had a ruptured cyst and 10 had both a ruptured and dissecting cyst. This discrepancy might relate to differences in the radiologic evaluation. Katz et al evaluated their patients with arthrography (21). During arthrography, the injected dye can distend an otherwise normal bursa and falsely produce a cyst or cyst rupture, which may reduce the sensitivity when differentiating a cyst rupture from dissection. Knee arthrography is no longer used, but has been replaced by MRI. MRI or US of the musculoskeletal system is better than arthrography for diagnosing a ruptured or dissected popliteal cyst. This probably explains why the incidence of ruptured popliteal cyst was higher in our study than in the study by Katz et al (21). Popliteal cyst can extend in any direction, but most commonly in the inferomedial or posterior directions (15). In our patients, dissection into the space between the medial head of the gastrocnemius muscle and superficial fascia was the most common direction. It is presumed that a popliteal cyst tends to extend into the space presenting the least resistance, and the plane between the medial head of the gastrocnemius muscle and superficial fascia is a weak space. Fang et al. reported three patients with intramuscular dissection of a popliteal cyst; the dissection extended into the medial head of the gastrocnemius in two patients and into the vastus medialis muscle in the other patient (15). Two of our patients exhibited a dissected popliteal cyst located within the gastrocnemius muscle. There are three mechanisms by which popliteal cysts develop: (1) accumulation of fluid in a noncommunicating bursa; (2) posterior herniation of the joint capsule because of increased intraarticular pressure; and (3) distention of a bursa by fluid originating in a diseased knee joint (22). Eleven of the 12 patients had knee joint effusion, and one patient who was not evaluated for the presence of knee joint effusion had rheumatoid arthritis. We believe that that accumulation of fluid in a noncommunicating bursa was not responsible for the development of a complicated popliteal cyst in our patients. Inflammatory joint diseases such as rheumatoid arthritis, psoriatic arthritis, reactive arthritis, and systemic lupus erythematosus may be accompanied by a complicated popliteal cyst (4, 23-25). Three of the 12 patients with a complicated popliteal cyst had rheumatoid arthritis, but no other inflammatory knee joint diseases were identified. Miller et al. reported that effusion, a meniscal tear, and degenerative arthropathy are associated with the presence of a popliteal cyst (26). They suggested that degenerative arthropathy includes cartilage thinning, abnormal signal intensity within cartilage, osteophytes, subchondral low signal-intensity sclerosis, or subchondral fibrocystic change (26). However, Marti-Bonmati et al. reported that popliteal cyst is not related to the presence of cartilage lesions (27). Rupp et al. suggested that a tear of the posterior horn of the medial meniscus is the pathologic change most often associated with a popliteal cyst and that medial meniscal posterior horn lesions might cause cysts by producing synovitis (28). In our study, five of nine patients (56%) with a complicated popliteal cyst had a medial meniscus posterior horn tear. A dissecting popliteal cyst, which may indicate malfunction, may occur after knee arthroplasty, although none of our patients had a history of knee arthroplasty (29). Ecchymosis inferior to the malleolus or in the foot has been reported to be associated with rupture of a popliteal cyst (30). In our study, ecchymosis on the foot was observed in one patient with a complicated popliteal cyst. Because bruising and ecchymosis can occur after the appearance of pain and swelling in Achilles tendon rupture, the differential diagnosis between DVT and a complicated popliteal cyst is necessary. One of the 11 patients with Achilles tendon rupture had ecchymosis in the calf

area. A muscle hernia is defined as a focal protrusion of muscle tissue through a fascial defect (31). It is common in the middle and lower third of the leg and most often involves tibialis anterior (31). Herniation of peroneus longus, peroneus brevis, and gastrocnemius which can cause calf symptoms has also been reported (32-34). Muscle hernia is usually asymptomatic, but it may present with cramping or pain after prolonged activity, mass, or swelling (35). All three patients with muscle hernia presented with mass in our study. A tumor in the calf usually presents with mass (1). Five patients had hemangioma, making it the most common tumor in our patients. All five reported symptoms of mass. Two of the five had MRI or simple X-ray findings indicative of hemangioma with associated phleboliths making tissue biopsy unnecessary to diagnose the hemangioma. Phleboliths within the soft tissue mass are diagnostic, but are not common (36). The differential diagnosis of any subcutaneous abnormalities demonstrated by US includes a wide range of diseases such as cellulitis, fat necrosis, panniculitis, lipomas hemangiomas, and subcutaneous panniculitis-like T cell lymphoma (37-39). The etiology of subcutaneous fat necrosis is still unknown, but it is thought to be associated with trauma (40). One of our patients exhibited subcutaneous fat necrosis related to blunt trauma of the leg caused by a car accident 10 months before the onset of necrosis. Some autoimmune rheumatologic diseases can present with calf symptoms, and the origin of the pain may be related to a complicated popliteal cyst, DVT, vasculitis, or focal myositis (7,8,25). Three of our patients with rheumatoid arthritis presented with calf symptoms secondary to a complicated popliteal cyst, and one patient with systemic lupus erythematosus had antiphospholipid antibody syndrome complicated with DVT. Our study also included a patient with an unusual case of eosinophilic polymyositis bilaterally in the calf muscles, which caused severe and painful calf swelling simulating acute posterior compartment syndrome. Nodular muscular sarcoidosis of the calf muscles has been reported rarely (41). One of our patients presented with a bilateral palpable mass in the calf secondary to nodular muscular sarcoidosis. None of our patients had a complicated bilateral popliteal cyst.

There are several limitations of our study. The number of enrolled patients was small and the study was retrospective, which may have limited the collection of detailed clinical data about symptoms, physical findings, and laboratory results. In some patients, the suspicious mass lacked pathologic proof. Most of the patients were evaluated with only one radiologic study. The reliability of US is operator dependent, although sonographic diagnosis of a popliteal cyst with or without complication is straightforward. Despite these limitations, our data suggest that the differential diagnosis of calf symptoms can be made easily through careful history taking, physical examination, and appropriate radiologic studies. Our data also suggest that a complicated popliteal cyst with inferior extension should be considered in the differential diagnosis of patients with calf symptoms.

CONCLUSION

Our present study demonstrates that calf symptoms can occur in a variety of conditions and also suggests that complicated popliteal cyst with inferior extension should be considered in the differential diagnosis of patients with calf symptoms.

REFERENCES

1) Constantinou M, Vicenzino B. Differential diagnosis of a soft tissue mass in the calf. J Orthop Sports Phys Ther 2005;35:88-94.
2) Kane D, Balint PV, Gibney R, Bresnihan B, Sturrock RD. Differential diagnosis of calf pain with musculoskeletal ultrasound imaging. Ann Rheum Dis 2004;63:11-4.
3) Jamadar DA, Jacobson JA, Theisen SE, Theisen SE, Ebrahim F, Kalume-Brigido M. Sonography of the painful calf: differential considerations. Am J

Roentgenol 2002;179:709-16.
4) Sato O, Kondoh K, Iyori K, Kimura H. Midcalf ultrasonography for the diagnosis of ruptured Baker's cysts. Surg Today 2001;31:410-3.
5) Khan SY, Hilton-Jones D, Rigby SP. A swollen calf. Lancet 2005;365:1662.
6) Cho KH, Lee DY, Kim CW. Erythema induratum of Bazin. Int J Dermatol 1996;35:802-8.
7) Khellaf M, Hamidou M, Pagnoux C, Michel M, Brisseau JM, Chevallier X, et al. Vasculitis restricted to the lower limbs: a clinical and histopathological study. Ann Rheum Dis 2006;66:554-6.
8) Christopoulos C, Savva S, Pylarinou S, Diakakis A, Papavassiliou E, Economopoulos P. Localised gastrocnemius myositis in Crohn's disease. Clin Rheumatol 2003;22:143-5.
9) Gaitini D. Current approaches and controversial issues in the diagnosis of deep vein thrombosis via duplex Doppler ultrasound. J Clin Ultrasound 2006;34:289-7.
10) Wigley RD. Popliteal cysts: variations on a theme of Baker. Semin Arthritis Rheum 1982;12:1-10.
11) Handy JR. Popliteal cysts in adults: a review. Semin Arthritis Rheum 2001;31:108-8.
12) Scott WN, Jacobs B, Lockshin MD. Posterior compartment syndrome resulting from a dissecting popliteal cyst. Clin Orthop 1977;122:189-92.
13) Nakano KK. Entrapment neuropathy from Baker's cyst. JAMA 1978;239:135.
14) Tashjian RZ, Nickisch F, Dennison D. Ruptured septic popliteal cyst associated with psoriatic arthritis. Orthopedics 2004;27:231-3.
15) Fang CS, McCarthy CL, McNally EG. Intramuscular dissection of Baker's cysts: report on three cases. Skeletal Radiol 2004;33:367-71.
16) Volteas SK, Labropoulos N, Leon M, Kalodiki E, Nicolaides AN. Incidence of ruptured Baker's cyst among patients with symptoms of deep vein thrombosis. Br J Surg 1997;84:342.
17) Langsfeld M, Matteson B, Johnson W, Wascher D, Goodnough J, Weinstein E. Baker's cysts mimicking the symptoms of deep vein thrombosis: diagnosis with venous duplex scanning. J Vasc Surg 1997;25:658-62.
18) Fernando RA, Somers S, Edmonson RD, Sidhu PS. Subcutaneous fat necrosis: hypoechoic appearance on sonography. J Ultrasound Med 2003;22:1387-90.
19) Hench PK, Reid RT, Reames PM. Dissecting popliteal cyst simulating thrombophlebitis. Ann Int Med 1966;64:1259-64.
20) Kilcoyne RF, Imray TJ, Stewart ET. Ruptured Baker's cyst simulating acute thrombophlebitis. JAMA 1978;240:1517-8.
21) Katz RS, Zizic TM, Arnold WP, Stevens MB. The pseudothrombophlebitis syndrome. Medicine 1977;56: 151-64.
22) Liebling MR. Editorial response: Why a duck?--Or for that matter, why a cyst? Clin Infect Dis 1999;29: 279-80.
23) Tashjian RZ, Nickisch F, Dennison D. Ruptured septic popliteal cyst associated with psoriatic arthritis. Orthopedics 2004;27:231-3.
24) Ozgocmen S, Kaya A, Kocakoc E, Kamanli A, Ardicoglu O, Ozkurt-Zengin F. Rupture of Baker's cyst producing pseudothrombophlebitis in a patient with Reiter's syndrome. Kaohsiung J Med Sci 2004;27:231-3.
25) Reilly PA, Maddison PJ. Painful, swollen calf in a patient with SLE. Br J Rheumatol 1987;26:319-20.
26) Miller TT, Staron RB, Koenigsberg T, Levin TL, Feldman F. MR imaging of Baker cysts: association with internal derangement, effusion, and degenerative arthropathy. Radiology 1996;201:247-50.
27) Marti-Bonmati L, Molla E, Dosda R, Casillas C, Ferrer P. MR imaging of Baker cysts -prevalence and relation to internal derangements of the knee. MAGMA 2000;10:205-10.
28) Rupp S, Seil R, Jochum P, Kohn D. Popliteal cysts in adults. Prevalence, associated intraarticular lesions, and results after arthroscopic treatment. Am J Sports Med 2000;30:112-5.
29) Dirschl DR, Lachiewicz PF. Dissecting popliteal cyst as the presenting symptom of a malfunctioning total knee arthroplasty. Report of four cases. J Arthroplasty 1992;7:37-41.
30) von Schroeder HP, Ameli FM, Piazza D, Lossing AG. Ruptured Baker's cyst causes ecchymosis of the foot. A differential clinical sign. J Bone Joint Surg Br 1993;75:316-7.
31) Simon HE, Sacchet HA. Muscle hernias of the leg. Review of literature and report of twelve cases. Am J Surg 1945;67:87-9.
32) Braunstein JT, Crues JV 3rd. Magnetic resonance imaging of hereditary hernias of the peroneus longus muscle. Skeletal Radiol 1995;24:601-4.
33) Sherry RH. Herniation of peroneus brevis muscle: report of a case. Bull Hosp Dis 1942;3:69-72.
34) Alhadeff J, Lee CK. Gastrocnemius muscle herniation at the knee causing peroneal nerve compression resembling sciatica. Spine 1995;20:612-4.

35) Beggs I. Sonography of muscle hernias. Am J Roentgenol 2003;180:395-9.
36) Morris SJ, Adams H. Case report: paediatric intramuscular haemangiomata-don't overlook the phlebolith! Br J Radiol 1995;68:208-11.
37) Bloem JL. Imaging of soft tissue tumors. J Belge Radiol 1992;75:265-73.
38) Sidhu PS, Rich PM. Sonographic detection and characterization of musculoskeletal and subcutaneous tissue abnormalities in sickle cell disease. Br J Radiol 1999;72:9-17.
39) Hung GD, Chen YH, Chen DY, Lan JL. Subcutaneous panniculitis-like T-cell lymphoma presenting with hemophagocytic lymphohistiocytosis and skin lesions with characteristic high-resolution ultrasonographic findings. Clin Rheumatol 2007;26:775-8.
40) Tillman C, Holst R, Svedman C. Traumatic fat necrosis: a case report. Acta Derm Venereol 2003;83: 227-8 .
41) Guo M, Lemos L, Baliga M. Nodular sarcoid myositis of skeletal muscle diagnosed by fine needle aspiration biopsy. A case report. Acta Cytol 1999;43: 1171-6.