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ORIGINAL ARTICLE

Yoshinori Mikashima · Shigeki Momohara
Taisuke Tomatsu

The pathology and evaluation of surgical treatment in a ruptured giant popliteal/crural cyst associated with rheumatoid arthritis

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Abstract Popliteal cysts are often observed in patients with rheumatoid arthritis (RA), and giant cysts that extend from the popliteal to the crural region (popliteal/crural cysts) are occasionally encountered. We studied the background of popliteal/crural cysts and therapeutic results, and evaluated its etiologic factors and the effectiveness of surgical treatment. Nine knees of eight patients with popliteal/crural cyst secondary to RA, which was treated surgically because it resisted conservative treatment, and was followed up for 1 year or longer after surgery, were evaluated. The patients were five men and three women, with a mean age at surgery of 59.1 years and a mean duration of RA disease of 4.5 years. Only one male patient suffered pain in the bilateral joints. The mean level of erythrocyte sedimentation rate was 61.3 mm/h (range 3.9–100.2), the mean level of C-reactive protein was 3.6 (0.1–8.2) mg/dl, and the mean Lansbury index was 36.4 (12–61) at surgery. The cyst disappeared completely after surgery, and the postoperative course was uneventful in eight knees, but recurrence was observed in just one knee of the bilateral case. However, in this patient the cyst that recurred was not as large as the one before surgery, and it was eventually brought under control by subsequent outpatient medical management. Inflammatory reactions were suppressed, if temporarily, in all patients. The patients evaluated in this study showed the following characteristics: the male–female ratio of the patients was biased to males compared with that of RA patients in general; although knee joint damage was radiographically mild, marked symptoms of arthritis were observed in not only the knees but also other joints in all patients; and the disease could not be controlled effectively by medication. However, after surgical resection of the cysts, general as well as local signs of inflammation were mitigated, and surgery was considered to be very effective for the treatment of ruptured giant popliteal/crural cyst associated with RA.

Key words Popliteal/crural cyst · Rheumatoid arthritis (RA) · Surgery

Y. Mikashima (✉) · S. Momohara · T. Tomatsu
Department of Orthopedic Surgery, Institute of Rheumatology, Tokyo Women's Medical University, 10-22 Kawada-cho, Shinjuku-ku, Tokyo 162-0054, Japan
Tel. +81-3-5269-1711; Fax +81-3-5269-1726
e-mail: mikashima@mwb.biglobe.ne.jp

Introduction

Patients with rheumatoid arthritis (RA) are often known to develop cysts in the popliteal region. The cysts occasionally enlarge from the popliteal region to the posterior aspect of the calf, and are generally called popliteal/crural cysts.[1] They are usually treated conservatively by puncturing and fixation with a compression bandage, but they often show no response to such treatment or recur, and occasionally require surgical resection if they grow to immense dimensions. We have encountered cases of large ruptured giant popliteal/crural cysts associated with RA. In this study, the background of this disease and the effectiveness of surgical treatment were evaluated on the basis of clinical parameters including laboratory data and the Japanese Orthopaedic Association (JOA) score for RA knees, and the relevant literature is reviewed.

Patients and methods

Nine knees in eight patients with large cysts extending from the popliteal to the crural region that were considered to have occurred secondarily to RA and surgically treated at our department were evaluated (Table 1). The postoperative follow-up period was 1 year or longer in all patients with a mean of 29.6 (13–52) months. The gender distribution of the patients was five men (six knees) and three women (three knees). The mean age of the patients at surgery was 59.1 (51–67) years, and the mean duration of RA was 54.4 (12–98) months. The cysts were accompanied by symptoms of arthritis of the knee in all patients. At surgery

Table 1. Treatment of patients

Case no.	Age at surgery (years)	Sex	Surgery	Recurrence
1	58	M	Cystectomy	(−)
2 right	62	M	Cystectomy	(+)
2 left	62	M	Cystectomy + anterior synovectomy	(−)
3	57	M	Cystectomy + anterior synovectomy	(−)
4	62	M	Cystectomy + anterior synovectomy	(−)
5	58	M	Cystectomy	(−)
6	58	F	Cystectomy + anterior synovectomy	(−)
7	51	F	Cystectomy + anterior synovectomy	(−)
8	67	F	Cystectomy + anterior synovectomy	(−)

the mean level of the erythrocyte sedimentation rate (ESR) was 61.3 (3.9–100.2) mm/h, the mean level of C-reactive protein (CRP) was 3.6 (0.1–8.2) mg/dl, and the mean Lansbury index was 36.4 (12–61). The diagnosis was made by magnetic resonance imaging (MRI) in addition to clinical examinations, and some proliferation of the synovial membrane was noted in the knees of all patients. Swelling was noted in six of the nine knees, and range of movement (ROM) was restricted in only two of the nine knees. The mean preoperative JOA score was 67.7 (40–87). The postoperative follow-up period exceeded 1 year in all patients, with a mean of 29.6 (13–52) months.

Surgical procedures

Direct-view cyst resection from the popliteal/crural region was combined with arthroscopic synovectomy in six joints, and direct-view cyst resection was performed alone in three joints. Moderate or more severe proliferation of the synovial membrane (synovitis) was observed in all six joints that underwent anterior synovectomy. In the popliteal region, the cyst was located under the fascia of the medial head of the gastrocnemius muscle and the semimembranosus muscle/tendon, and had communication with the joint in six knees, but it had no communication with the joint or its communication could not be confirmed in three joints. In the crural region, the cyst was located under the fascia of the gastrocnemius muscle, extending between the muscle and muscle layers.

Results

The mean period after the patients noticed the cysts until they received surgery was relatively short, at 6.6 ± 4.1 months. The preoperative radiographic stage of the knee joint according to the Larsen scale[2] was stage I in one joint and stage II in eight joints. Joint damage was relatively mild in all joints and was not advanced in any joint even after 1 year postsurgery. The preoperative and postoperative states were compared with regard to the laboratory data, JOA score, and the presence or absence of recurrence. In laboratory data, the mean level of ESR was 62.2 ± 24.6 (27.8–100.2) mm/h preoperatively and 25.6 ± 18.8 (3.9–48.8) mm/h postoperatively, and the mean level of CRP was 4.4 ± 3.0 (0.7–8.2) mg/dl preoperatively and 1.0 ± 1.2 (0.1–3.3) mg/dl postoperatively, indicating marked mitigation of inflammatory reactions (Fig. 1). Regarding knee function, the mean JOA score markedly improved from 68.0 ± 16.5 (51–87) preoperatively to 93.1 ± 8.9 (78–100) postoperatively (Fig. 2). Concerning recurrence, eight knees showed uneventful courses without recurrence, but the cyst recurred in one knee joint of the man with bilateral disease 2 months after surgery. However, the cyst that recurred did not become as large as the one before surgery, and it eventually disappeared after treatment by alternative medication, aspiration of the cyst contents, and steroid injections. All patients expressed a high level of satisfaction with the outcome.

Fig. 1. Preoperative plain radiography (supine). On plain radiography preoperatively, the lesion was stage II on the Larsen scale, and slight narrowing of the articular gap was noted

Fig. 2. **a** Magnetic resonance imaging (MRI) revealed a mass (*arrows*) with homogeneous interior, the signal intensity of which was low in the T1-weighted mode (*left*) and high in the T2-weighted mode (*right*), from the medial head of the gastrocnemius muscle to the center of the crural region, in coronal scans. **b** MRI revealed a homogeneous mass (*arrows*) in sagittal scans in T1-weighted mode (*left*) and T2-weighted mode (*right*)

Representative cases

Case 1

A 58-year-old woman developed RA in 1993. She had been treated by a local physician since 1995 and received injections of gold preparations. She consulted our department on May 15, 1998, and was treated with oral prednisolone at 5 mg/day at first but serially thereafter with antirheumatic drugs including D-penicillamine, salazosulfapyridine, and bucillamine depending on the symptoms, and eventually with methotrexate. However, arthralgia around the bilateral knee joints was present at the initial examination, and the patient had noted gradual widening of swelling, particularly in the right popliteal region, since June 2000. Because the swelling extended from the popliteal region to the crural region, MRI was carried out in October 2000, and a giant cyst in the right popliteal/crural region was discovered. The patient was admitted to our department for surgery on January 17, 2001.

Physical findings on admission included mild swelling of the right knee joint, a ROM of the knee at 0° extension to 130° flexion, hydrarthrosis, and a JOA score of 65 points. An elastic, soft, tightly filled mass of about 10 × 20 cm was palpated from the medial head of the right gastrocnemius muscle to the center of the crural region. No adhesion to the skin was noted. Although the lesion was tender, there were no symptoms of nerve compression. On plain radiography, the lesion was stage II on the Larsen scale, and slight narrowing of the articular gap was noted (Fig. 1). Magnetic resonance imaging also revealed a mass with homogeneous interior, the signal intensity of which was low in the T1-weighted mode and high in the T2-weighted mode, from the medial head of the gastrocnemius muscle to the center of the crural region, on coronal and sagittal scans (Fig. 2a,b).

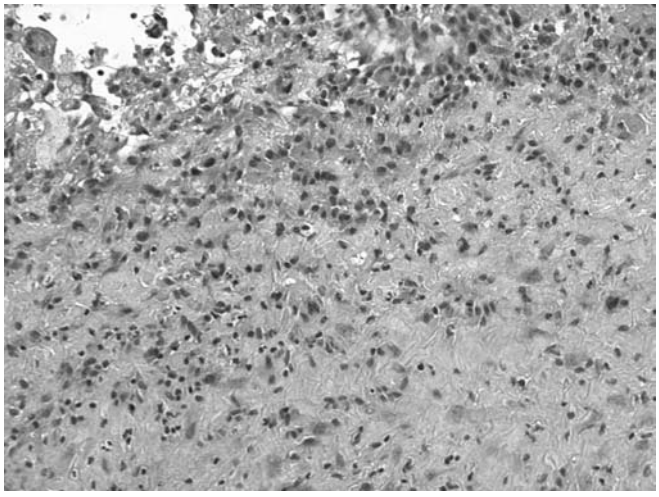

Fig. 3. On histopathological examination, marked fibrin deposition was observed in the cyst wall, and infiltration of inflammatory cells, which were primarily lymphocytes and plasma cells, was noted in the outer layer of the cyst wall. (H&E staining, ×200)

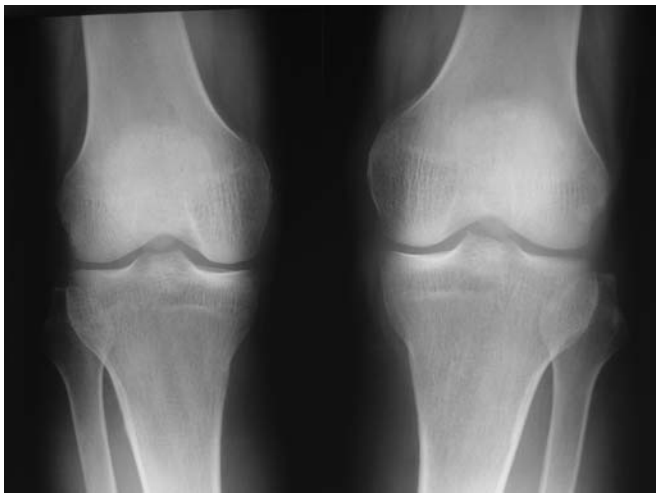

Fig. 4. Preoperative plain radiography (supine). On plain radiography preoperatively, the lesion was stage II on the Larsen scale, and slight narrowing of the articular gap was noted

On January 18, 2001, cyst resection and arthroscopic synovectomy of the right knee joint were carried out. The cyst was bilocular and present between the medial head of the gastrocnemius muscle and the semimembranosus muscle/tendon, and the upper chamber had communication with the articular cavity of the knee. The cyst did not adhere to the surrounding structures and was resected en bloc with the posterior articular capsule. The channel between the cyst and the knee was closed. On histopathological examination, marked fibrin deposition was observed in the cyst wall, and infiltration of inflammatory cells, which were primarily lymphocytes and plasma cells, was noted in the outer layer of the cyst wall (Fig. 3).

To date, 42 months after surgery, no recurrence of cyst or swelling of the knee has been noted. The ROM of the knee is also satisfactory at 0° extension and 130° flexion. The JOA score has improved to 85 points from the preoperative value of 65 points, and the patient expresses a high level of satisfaction.

Case 2

A 62-year-old man developed RA in 1999. He had been treated by a local physician since 1999 with salazosulfapyridine. He consulted our department on January 28, 2000, and was treated with oral prednisolone at 10 mg/day at first but serially thereafter with antirheumatic drugs including salazosulfapyridine and bucillamine, depending on the symptoms, and eventually with methotrexate. However, arthralgia around the bilateral knee joints was present at the initial examination, and the patient had noted gradual widening of swelling particularly in the bilateral popliteal regions since about February 2002. Because the swelling extended from the popliteal region to the crural region, MRI was carried out in March 2002, whereupon giant cysts in the bilateral popliteal/crural regions were visualized. The patient was admitted to our department for surgery on May 9, 2002.

Physical findings on admission included mild swelling of the bilateral knee joints, a ROM of the knees at 0° extension to 135° flexion (right knee) and at 0° extension to 130° flexion (left knee), hydrarthrosis, and JOA scores of 60 points (right knee) and 55 points (left knee). An elastic, soft, tightly filled mass of about 10 × 20 cm was palpated from the medial head of each gastrocnemius muscle to the center of the crural region. No adhesion to the skin was noted. Although the lesion was tender, there were no symptoms of nerve compression. On plain radiography the lesions were stage II on the Larsen scale, and slight narrowing of the articular gap was noted in each knee (Fig. 4). In each knee, MRI also revealed a mass with homogeneous interior, the signal intensity of which was low in the T1-weighted mode and high in the T2-weighted mode, from the medial head of the gastrocnemius muscle to the center of the crural region, on coronal and sagittal scans (Fig. 5a,b).

On January 18, 2001, cyst resection and arthroscopic synovectomy of the bilateral knee joints were carried out. In the both knees the cysts were multilocular and present between the medial head of the gastrocnemius muscle and the semimembranosus muscle/tendon, and the upper chamber had communication with the articular cavity of the knee. The cysts adhered to the surrounding structures in both knees, and were resected en bloc with the posterior articular capsule. The channels between the cyst and the knee were closed in the bilateral knees. On histopathological examination of the cysts of the bilateral knees, marked fibrin deposition was observed in the cyst wall, and infiltration of inflammatory cells, which were primarily lymphocytes and plasma cells, was noted in the outer layer of the cyst wall.

To date, 50 months after surgery, no recurrence of the cyst or swelling of the right knee has been noted, while 6 months after surgery recurrence of the cyst of the left knee was apparent. However, the recurrent cyst did not grow to the size of the cyst before surgery, and its size was reduced by subsequent outpatient medical management. The ROM of the knee is also satisfactory at 0° extension and 135°

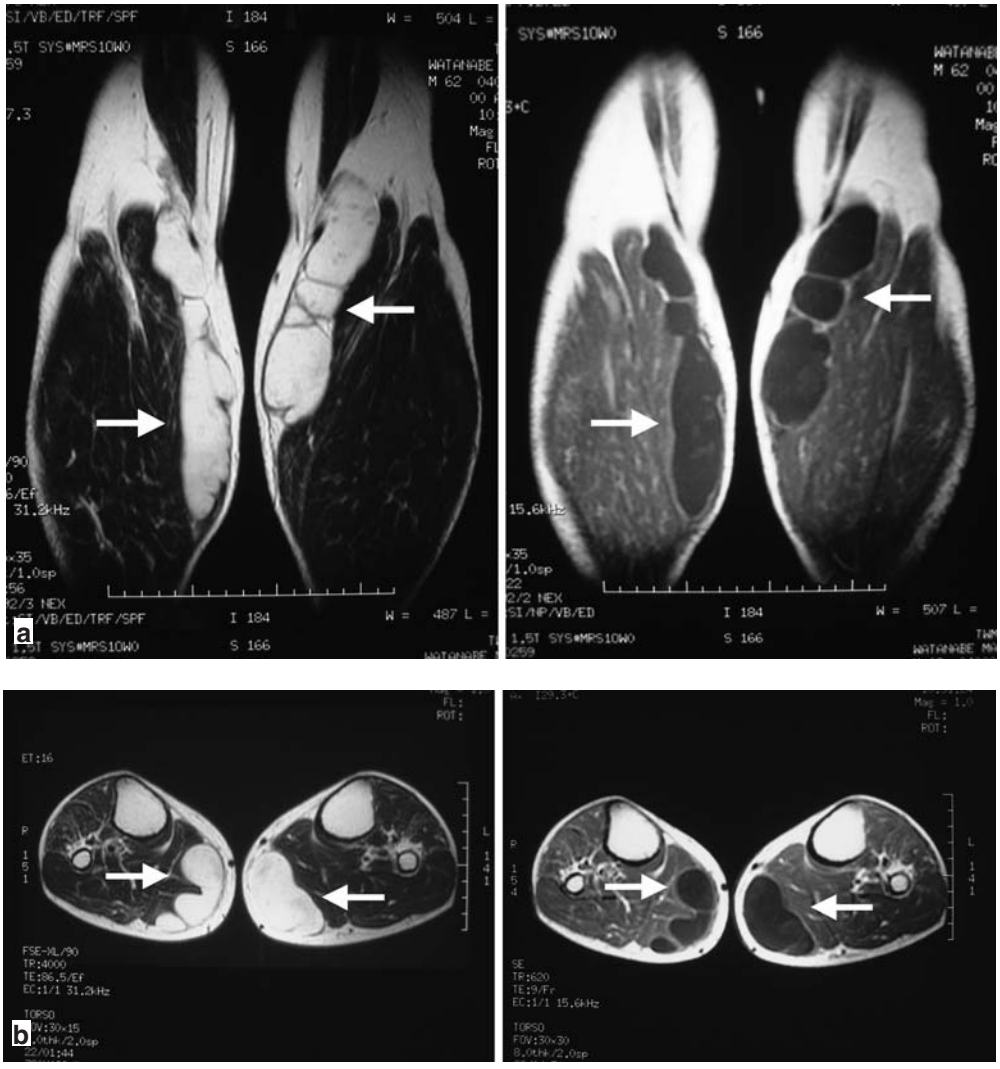

Fig. 5. **a** MRI revealed in coronal scans a mass with homogeneous interior (*arrows*), the signal intensity of which was low in the T1-weighted mode (*left*) and high in the T2-weighted mode (*right*), from the medial head of the gastrocnemius muscle to the center of the crural region. **b** MRI revealed a homogeneous mass (*arrows*) in sagittal scans. *Left*, T1-weighted mode; *right*, T2-weighted mode

flexion in both knees. The JOA score has improved to 85 points (right knee) and 80 points (left knee) from the preoperative values of 60 points (right knee) and 55 points (left knee), and the patient expresses a high level of satisfaction.

Discussion

Popliteal cyst has also been known as Baker's cyst since Baker presented the hypothesis in 1877 that the cyst is caused by posterior herniation of the synovial membrane of the knee due to a chronic increase in intra-articular pressure.[3] The disease may complicate osteoarthritis (OA) as well as RA of the knee. Subsequently, Wilson et al.[4] hypothesized in 1938 that popliteal cyst is an enlargement of the gastrocnemius-semimembranosus bursa in the posterior part of the knee due to chronic inflammation, and Hall and Scott[5] proposed in 1966 that cyst formation is caused by rupture of the posterior articular capsule due to a sudden increase in the intra-articular pressure of the knee.

Concerning popliteal/crural cyst in RA patients, many case reports have appeared since Kersley et al.[1] reported two cases in 1954, Matsumoto et al.[6] reported four Japanese cases in 1966, and Kirkham et al.[7] reported that popliteus bursa distension occurred, related to the anterolateral lower leg as rupture of lateral popliteal cysts in two RA cases. Recently, detection of asymptomatic popliteal/crural cysts has become possible due to the increased availability of MRI, and Kondo et al.[8] reported that cysts were observed in 7 (9.6%) of the 73 knees of RA patients who had some knee complaints and were classified as definite or above.

Regarding clinical symptoms, a mass appears in the popliteal and crural regions, swelling and pain occur, and Homan's sign occasionally becomes positive. Differential diagnoses include thrombotic phlebitis, phlegmon, lymphangitis, lipoma, hemangioma, aneurysm, and varices. Its distinction from thrombotic phlebitis is occasionally difficult.

As for the etiological mechanism of popliteal/crural cyst, Perri et al.[9] also suggested the following possibilities: (1) enlargement of the gastrocnemius-semimembranosus bursa, which has communication with the joint, (2) rupture of the posterior articular capsule and its transformation to a cyst in a chronic course, and (3) herniation of the posterior articular capsule due to a chronic increase in the intra-articular pressure. In our patients, none had a clear episode

suggestive of rupture of the articular capsule, communication with the articular capsule was confirmed intraoperatively on the medial side of the posterior articular capsule in the semimembranosus muscle/tendon in six of the nine joints, and pathological examination often showed cyst-like changes of the gastrocnemius-semimembranosus bursa in the cyst wall. These findings suggest that inflammation of the articular cavity due to RA increases articular effusion, that the resultant chronic increase in the intra-articular pressure causes herniation of the posterior articular capsule, and that the cyst enlarging into the crural region as synovitis due to RA further increases effusion in the bursa. Also, joint damage was mild in all patients, being only grade I or II according to Larsen's scale.[2] Magnetic resonance imaging and intraoperative findings suggest that joint damage did not progress, because inflammation extended to the posterior part of the knee despite proliferation of the synovial membrane in the joint.

Popliteal cyst often occurs near the semimembranosus muscle/tendon and the tendon of the medial head of the gastrocnemius muscle in OA. However, in our RA patients, popliteal/crural cysts were located in the popliteal region and on the medial side of the crural region, and extended into the crural region under the fascia on the medial side of the gastrocnemius muscle.

Popliteal/crural cyst is generally treated by surgical resection if it is symptomatic. In our investigation, no study has reported spontaneous healing in cyst treatment or the usefulness of recently developed biological preparations; in addition, novel antirheumatic agents may not be effective. Surgery should be selected when patients complain of swelling-related physical compression or circulatory disorder-related swelling of the lower limbs. Opinions concerning concomitant synovectomy by an anterior approach vary widely. Solmon and Berman[10] suggested that synovitis of the knee should be treated conservatively and that synovectomy should be selected if there is no improvement. In contrast, Pinder and Somerset[11] observed that anterior synovectomy should be performed concomitantly if severe synovectomy is present in the knee, because the recurrence rate is high after cyst resection alone. In our patients, cyst resection alone was performed posteriorly in three knees, and posterior cyst resection and anterior synovectomy were performed simultaneously in six knees that showed clear swelling of the knee. Although eight knees showed uneventful postoperative courses without recurrence, one knee showed recurrence of the cyst 2 months after surgery. In this patient, recurrence was observed after a combination of cyst resection and anterior synovectomy, but the cyst was considered not to have been removed completely, because it appeared multilocular on preoperative MRI and the border of the cyst with other tissues was unclear during surgery. However, the recurrent cyst did not grow to the size of the cyst that was present before surgery and its size was reduced by subsequent outpatient medical management, the patient expressing a high level of satisfaction.

Concerning the issue of whether open synovectomy or arthroscopic synovectomy is more effective, arthroscopic synovectomy is generally performed concomitantly with cyst resection. However, the results of this study do not support its usefulness; future investigation is needed. Regarding the treatment of a channel between the cyst and the knee, all examples were sutured and excised with these cases. It is considered better to suture the channel; however, the results of this study do not support its usefulness and again, further investigation is needed. Although Kanekasu et al.[12] advocated arthroscopic treatment by an anterior approach, we are of the opinion that posterior cyst resection is considered necessary if the cyst has attained a huge size, as in our patients.

We also evaluated the effectiveness of surgical treatment for popliteal/crural cyst on the basis of hematological findings including the CRP and ESR, JOA score, and the presence or absence of recurrence. The CRP, ESR, and JOA score all improved after cyst resection. Therefore, resection of synovial lesions in the bursa is considered to lead to improvements in the CRP and ESR. This suggests that surgical resection is extremely effective for treating popliteal/crural cyst complicating RA, especially when RA is poorly controlled.

In conclusion, men represented a higher percentage in the patients with giant popliteal/crural cyst complicating RA. Inflammation tended to be suppressed by surgery, and the degree of satisfaction of the patients after surgery was excellent. No progression of joint damage was observed in any of the patients after surgery. Although recurrence was noted in one of the nine knees, the size of the recurrent cyst was reduced by conservative treatment.

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