SYNOVIAL RUPTURE OF THE KNEE JOINT

L. SOLOMON and L. BERMAN, JOHANNESBURG, SOUTH AFRICA

*From the Department of Orthopaedic Surgery and the Rheumatism and Arthritis Unit,
University of the Witwatersrand and Johannesburg Hospital*

Chronic herniation from the knee is a well recognised complication of arthritis, and numerous descriptions of this condition—usually called a “popliteal cyst” or “synovial cyst” of the calf—are in the literature. Acute synovial rupture, however, is much less readily diagnosed: the sudden onset of pain and swelling of the calf in a patient with rheumatoid disease is apt to be attributed to thrombophlebitis, and the true state of affairs may escape detection for weeks or months while ineffectual and potentially harmful treatment is applied.

In 1964 Dixon and Grant described six cases of acute rupture with extravasation of the joint contents between the muscles of the calf. Two further reports followed (Tait, Bach and Dixon 1965; Hall and Scott 1966), leading to a clearer understanding of this entity. Nevertheless, its precise differentiation from the various types of saccular herniation is still poorly appreciated and the relationship of all these conditions to the underlying pathology of the knee has not been completely elucidated.

TABLE I
UNDERLYING PATHOLOGY IN SYNOVIAL RUPTURE OF
THE KNEE IN TWENTY-TWO PATIENTS

Underlying pathology	Number of patients
Rheumatoid arthritis	14
Disseminated lupus erythematosus	1
Reiter's syndrome	1
Gout	2
Osteoarthritis	4
Total	22

TABLE II
THE DIFFERENT TYPES OF SYNOVIAL RUPTURE IN
TWENTY-TWO PATIENTS

Type of synovial rupture	Number of patients
Chronic saccular herniation	13
Acute saccular herniation	5
Acute capsular rupture with extravasation of joint contents into the calf	4
Total	22

In the present paper twenty-two cases of synovial herniation or of rupture are reported and an attempt is made to define the characteristics and rationalise the treatment of the various types of synovial rupture.

CLINICAL MATERIAL

Between January 1966 and December 1970, 823 patients attended the rheumatism and arthritis clinic, among whom twenty-two cases of synovial rupture of the knee were diagnosed (Table I). This figure does not include many examples of a “Baker's cyst”. Most ruptures occurred in patients with rheumatoid arthritis, but it is clear that any type of subacute or chronic synovitis of the knee may be complicated by joint herniation.

Thirteen patients had chronic “cysts” of the calf which had been present for a long time; three of them had both knees affected. The remaining nine patients presented during an acute episode of pain and swelling in the calf: five proved to have saccular herniation and four had capsular tears with diffuse extravasation of the joint contents into the leg (Table II).

It was only after about half the patients had been seen that it was recognised that there were three distinct clinical syndromes. These may best be illustrated by actual case histories from the series.

ILLUSTRATIVE CASE REPORTS

Case 1—A man of fifty-two years who had had sero-positive rheumatoid arthritis for fifteen years complained of increasing tightness and swelling of the calves. He had no precise recollection of the onset of these symptoms; he had simply become aware of the discomfort over a period of months. On examination he had the typical deformities of rheumatoid arthritis and low-grade synovitis of several joints including the knees. There was a fairly well defined, cystic mass in each calf; communication with the knee joint was demonstrated by cross-fluctuation and by the elicitation of a bruit in the popliteal fossa on compression of the calf. Contrast arthrography of the knees showed a large saccular herniation into each calf (Fig. 1). At operation the synovial sac was dissected free without difficulty and traced to its origin at the back of the joint. The opening in the capsule lay deep to the medial head of the gastrocnemius muscle; it was closed by suturing the musculo-tendinous belly into the margins of the hole. Histological examination of the sac showed proliferative folds of synovial membrane heavily infiltrated with inflammatory round cells. In one or two areas there was palisading of the connective tissue cells. The surface was covered with fibrinoid material (Figs. 2 and 3).

FIG. 1

FIG. 2

FIG. 3

Case 1—Figure 1 is an arthrograph showing the saccular herniation into the calf. Figures 2 and 3 are photomicrographs of the synovial pouch; in the low power view of the inner lining and wall of the synovial pouch (Fig. 2) there is much fibrin deposition on the surface and dense lymphocytic infiltration of the synovial membrane. (Haematoxylin and eosin, $\times 50$.) The high power view (Fig. 3) shows palisading of the histiocytes lining the synovial pouch. Note the underlying lymphocyte and plasma cell infiltration together with young blood vessel formation. (Haematoxylin and eosin, $\times 320$.)

FIG. 4

FIG. 5

FIG. 6

Case 2. Figure 4—A clinical photograph of the swollen calf in a patient with acute saccular herniation on the left. Figures 5 and 6—Antero-posterior and lateral arthrographs show the saccular herniation.

Case 2—A woman of fifty-two years had noticed pain and swelling of the left knee for a month or longer. No other joints were involved and generally she felt well. Suddenly one morning she suffered intense pain at the back of the knee and noticed that the calf was swollen. She consulted her doctor who suspected thrombophlebitis and started treatment with anticoagulants. When the swelling failed to subside, and indeed increased in size over the next week, he referred her for further investigation. Examination showed a tensely swollen calf (Fig. 4), with cross-fluctuation between calf and knee. There was no evidence of polyarthritis and the affected knee was only slightly swollen and had a full range of movement. Contrast arthrography outlined a large, well defined sac in the calf (Figs. 5 and 6). This was explored surgically and the large, thin-walled sac was traced to the back of the knee where it emerged deep to the medial head of the gastrocnemius.

Case 3—A fifty-year-old woman had had mild rheumatoid arthritis for two years. One morning on straightening the right knee rather sharply she suddenly felt a searing pain in the right calf. She was unable to tread firmly on this leg but nevertheless went to work. Being employed in the medical school, she consulted one or two people rather casually and it was only when she became aware of a marked swelling of the calf that she was properly examined. At this stage the leg was not only swollen, but showed all the signs of acute local inflammation. She was admitted to hospital with a diagnosis of thrombophlebitis. At this time, however, we had become aware of the association of synovitis of the knee and "pseudo-deep vein thrombosis" in patients with acute synovial rupture. Arthrography showed a diffuse extravasation of the contrast medium deep in the calf, quite unlike the saccular prolongations of the previous cases (Fig. 7). This we have come to recognise as the picture of acute rupture of the joint without the presence of a synovial pouch. No operation was carried out in this case. The patient was treated by bed-rest and the calf swelling subsided in eight days. There has been no recurrence of this episode.

DISCUSSION

The three clinical syndromes illustrated here have so much in common that the differences may not at first be apparent. In the first category are those patients with calf "cysts" which have been present for months or years without causing undue discomfort. Only when the sac starts to enlarge—perhaps during a flare-up of the underlying rheumatoid arthritis—does the patient complain of pain. The absence of any acute episode, the rather vague history and the presence of a thick-walled sac suggest that the hernia has developed gradually over a long period.

Case 2 represents a similar type of herniation but with an acute onset. In both, the sac communicates with the joint and is lined by the same synovial membrane.

The third syndrome is that of acute rupture of the joint capsule, the synovial contents spilling out under pressure between the muscle planes of the calf (Case 3). In these cases there is no true synovial sac.

The earliest description of joint herniation (using the term in its widest sense) is generally attributed to Adams (1840). However, it is William Baker's name that has come to be applied to the popliteal cysts associated with arthritis of the knee. In two papers (1877, 1885) he described ten cases of cystic swelling in the calf; in three of these he was able to demonstrate a true posterior herniation of the knee joint.

The typical Baker's cyst is a small postero-medial herniation associated with low-grade inflammation or simple hydrarthrosis of the joint; it may be no more than an enlargement of one of the communicating bursae around the knee joint (Wilson, Eyre-Brook and Francis 1938; Meyerdig and VanDemark 1943). Whether there is any essential difference between this condition and the large synovial "cysts" of the calf is still uncertain. The evidence from our own patients suggests that the difference, at least in morbid anatomical terms, is only one of degree, the calf "cysts" being distinguished by the sheer volume of the fluid and fibrinoid material which they so often contain. In one patient we have been able to show, by repeated contrast arthrography, all stages in the development of the hernia from a small Baker's cyst to a large Baker's cyst to a typical "giant synovial cyst" of the calf (Figs. 8 to 10). Two other patients in the present series have large calf "cysts" on one side and typical Baker's cysts on the other.

Perri, Rodnan and Mankin (1968) suggested that the large calf "cysts", too, are extensions of a communicating gastrocnemius-semimembranosus bursa; certainly in our patient in whom a saccular herniation appeared almost overnight (Case 2) this offers a reasonable explanation. It is inconceivable that so massive a herniation of the joint could occur as an acute phenomenon and still preserve an intact synovial sac. This point is further underlined by the fact that the true acute capsular ruptures which were explored surgically had no synovial sac but merely a thin connective tissue "pseudo-cyst" in the calf.

FIG. 7

Case 3—An arthrograph of an acute rupture of the knee. There is a diffuse extravasation of the contrast medium into the calf.

DIAGNOSIS

The symptoms of joint rupture so closely mimic those of thrombophlebitis that the condition has been called a pseudo-deep vein thrombosis. The local inflammatory reaction in the calf may be accompanied by a slight rise in temperature and pulse rate and a positive Homan's sign. The presence of chronic synovitis of the knee, however, should always raise the suspicion of synovial rupture, and further questioning may elicit the information that a previously swollen knee has suddenly become smaller. A fluid thrill may be obtained by compressing the calf; at other times this may be less obvious yet still discernible on auscultation over the popliteal fossa. Contrast arthrography was done routinely in our cases using 76 per cent Urographin. Fifteen or 20 millilitres of the contrast medium were injected into the knee under strict aseptic conditions. A tense effusion was aspirated first to avoid overdilatation of the joint. The suprapatellar pouch was emptied of fluid and compressed by a firm bandage. The knee was then exercised with the leg dependent for one minute before radiography. In most cases the rupture was revealed either as a well defined sac (Figs. 1, 5 and 6) or as a diffuse extrusion in the calf (Fig. 7). Once we were able to show a similar extension upwards into the thigh (Fig. 11).

Occasionally the capsular tear may be partly or completely sealed off by the overlying muscle and the sac becomes isolated from the joint. In two such cases in which routine arthrography failed to show up the tear, carbon dioxide arthrography successfully demonstrated the rupture (Fig. 12). Care should be taken in carrying out this procedure to avoid sudden distension and artificial rupture of the joint. Through a three-way tap the carbon dioxide is first run into a 20-millilitre syringe and then slowly injected into the joint. This is repeated until the syringe plunger detects the firm counter-thrust of the intra-articular pressure.

The firm diagnosis of synovial rupture does not, of course, exclude the possibility that thrombophlebitis may be present as well. Indeed, venography has shown that the popliteal

FIG. 8

FIG. 9

FIG. 10

Radiographs showing three stages in the development of a large synovial hernia.

vessels may be occluded by a large calf cyst (Ansell 1970), and deep vein thrombosis is therefore more likely in these patients than in others.

MORBID ANATOMY

In fourteen cases the ruptured joint was explored through the popliteal fossa. In twelve a diagnosis of saccular synovial herniation had been made before operation, and this was confirmed. Nine of the patients had rheumatoid arthritis; one had gout and two had osteoarthritis.

FIG. 11

FIG. 12

Figure 11—Radiograph showing extravasation of contrast medium proximally into the thigh. Figure 12—Carbon dioxide arthrography of the knee. The radiolucent gas appears outside the joint in the calf.

The hernial sac was usually freed from the surrounding structures without difficulty and was traced to a point deep to the medial head of the gastrocnemius where it became continuous with the synovial membrane of the joint. In patients with rheumatoid arthritis the sac always contained large quantities of fibrinoid material and the synovial lining showed the characteristic features of rheumatoid synovitis (Figs. 2 and 3).

Two of the patients with acute capsular rupture into the calf failed to improve with simple bed-rest, and operation was required. One had rheumatoid arthritis and the other had osteoarthritis of the knee. In each case a poorly defined fibrous "cyst" was discovered, closely adherent to the surrounding muscles. The patient with osteoarthritis showed a particularly interesting feature. He had been known to have moderately large Baker's cysts in the popliteal fossae. The left knee had been treated by intra-articular injection of steroids on three occasions. Two weeks after the third injection he suddenly suffered pain in the calf accompanied by marked diminution in the swelling of the knee. At operation a large haematoma was discovered deep to the gastrocnemius muscle. In the two cases of acute rupture too the tear in the capsule was found deep to the medial head of the gastrocnemius. Microscopic examination in these cases showed only inflamed fibrous tissue.

PATHOGENESIS

The cases presented here strongly suggest that there are at least two different types of capsular rupture—a large herniation of the intact synovial membrane into the leg and an acute rupture of the synovia with extrusion of its contents into the calf. A similar distinction was made by Dixon and Grant (1964), Tait, Bach and Dixon (1965) and Hall and Scott (1966).

Although joint rupture appears to be much more common in rheumatoid disease than in other types of arthritis we have encountered it in association with disseminated lupus erythematosus, osteoarthritis, Reiter's disease and gout; any chronic synovitis producing a tense effusion in the knee may result in a posterior capsular tear. This is quite understandable when one considers that the intra-articular pressure in the knee may rise to almost 500 millimetres of mercury with simple quadriceps contraction and to over 1,000 millimetres of mercury on active flexion of the joint (Dixon and Grant 1964). Why the joint should rupture deep to the medial head of gastrocnemius is still not understood: Dixon and Grant suggested that this is the weakest part of the capsule, the rest of the joint being enveloped by thick wads of muscle on both the extensor and flexor surfaces. The same authors were the first to observe that acute synovial rupture occurred in synovitis of fairly recent onset when muscular power was still good, whereas saccular synovial herniation was more likely in patients with long-standing disease. This is borne out in our patients; all those with acute synovial rupture had had swelling of the knee for less than two years.

TREATMENT

In our experience the large synovial "cyst" of the calf does not disappear spontaneously; surgical excision is needed in most cases because of the intense discomfort that develops with the gradual increase in size of the swelling.

Of four cases of acute synovial rupture, two settled completely with simple bed-rest for about a week. The remaining two required surgical decompression of the swollen calf. A review of the literature shows that most cases of acute rupture settle with conservative treatment; certainly there is no urgency to operate on these patients and only if bed-rest fails to relieve the tension in the calf need one resort to surgical decompression. When operation is undertaken, whether for a large synovial hernia or for acute rupture, the defect in the posterior capsule should always be repaired. Direct suture may not be possible but a firm closure of the opening is easily achieved by sewing the origin of the gastrocnemius muscle (usually the medial head) into the capsular tear. Fourteen knees in the present series were explored and repaired in this way; in none has there been a recurrence of the rupture.

The synovitis of the knee joint should be treated as well. It has been our practice in these cases to aspirate the joint and to inject a mixture of Depo-Medrone and nitrogen mustard once the popliteal wound has healed. If this fails to produce satisfactory improvement in the synovitis formal synovectomy should be done.

Active physiotherapy is important after operation. In none of our patients was knee movement lost after surgical repair of the posterior capsule.

The average length of stay in hospital of our patients was twenty-three days. Most of these patients had generalised rheumatoid arthritis and several of them required treatment of the systemic disease as well.

SUMMARY

1. Twenty-two cases of synovial rupture of the knee have been studied. This condition may complicate any chronic synovitis of the knee in which a tense intra-articular effusion is subjected to increased tension during flexion and extension of the joint.
2. Two types of rupture have been seen; a herniation of the synovial membrane into the popliteal fossa and down the leg, and an acute synovial tear with extravasation of joint contents between the muscle planes of the calf.

3. The diagnosis of this condition, the differentiation of the types of rupture and their treatment are discussed.
4. The acute rupture usually responds to simple bed-rest; the large synovial herniations often need removal and repair of the posterior capsule.

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