The acutely swollen knee.  
Part two – Management of traumatic pathology

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Abstract

The acutely swollen knee is a common presentation of knee pathology in the emergency department and the primary care setting, whether on board ship, in a Regimental Aid Post, or in a Medical Centre. The swollen knee has both traumatic and atraumatic (systemic) causes, all of which can be accurately diagnosed with an understanding of the underlying injury patterns and patho-anatomy. In Part 2 of this paper we consider the traumatic causes and also suggest a combined approach to managing an acutely swollen knee. The taking of a detailed history combined with thorough clinical examination will establish the diagnosis or at least the narrow differential diagnosis in the majority of cases. The use of specialist examination techniques, diagnostic imaging and arthrocentesis can further assist the clinician in confirming the correct diagnosis and thus prescribing the appropriate treatment. This review will endeavour to give a consensus of opinion and structured guidelines in the diagnosis and initial management of patients presenting with acute or recent onset swelling of the knee.

Introduction

A swollen knee or knee effusion is a common problem caused by accumulation of fluid in or around the knee joint. Knee effusions may due to traumatic or atraumatic causes. The most common traumatic causes are fractures, ligament injuries, and meniscal injuries. Atraumatic causes include arthritis, infection, crystal deposition, haematogenous and those resulting from tumours. Effusions can have different rates of onset due to different causes. Rapid swelling after injury usually indicates bleeding into the joint or haemarthrosis caused by a damaged and bleeding intrarticular structure, whereas rapid swelling without injury could indicate infection or crystal arthropathy. Delayed swelling with trauma could indicate meniscal injury or ligamentous sprain; an absence of trauma may indicate arthritis.

A detailed history combined with thorough clinical examination will establish the diagnosis or at least a narrow differential diagnosis in the majority of cases. The use of specialist examination techniques, diagnostic imaging and arthrocentesis can further assist the clinician in confirming the correct diagnosis and thus prescribing the correct treatment that the patient requires. The aim of this paper is to present a literature review so as to provide a consensus of opinion, along with structured guidelines for the diagnosis and initial management of patients presenting with acute or recent onset swelling of the knee following trauma. This paper must be read in conjunction with Part One in the previous issue of this journal (1).

A recent collaboration between a committee comprising orthopaedic surgeons and rheumatologists from the European Federation of National Associations of Orthopaedics and Traumatology (EORT) and The European League Against Rheumatism (EULAR) published a combined consensus definition of the acutely swollen knee which will be used in this paper (2). They concluded that the definition should be all patients newly presenting to a doctor with a history or examination finding suggesting onset of swelling (defined as an increase in volume) within a recent time (up to six weeks) in any anatomical structure of the knee, intra-articular or peril-articular. The term ‘acute’ in isolation for this review was felt to suggest an emergency and that the patient would need to be reviewed without delay. It was also deemed appropriate to include the term ‘recent onset swelling’ in order to be more encompassing of all types of knee effusion i.e. up to six weeks.
Figure 1 Clinical Photograph – Right Knee effusion

Epidemiology
Robust and well-structured epidemiological studies have not been conducted into the incidence and prevalence of the symptom of acute or recent onset of swelling of the knee. However, the lifetime prevalence of swelling of the knee has been reported as 27% in a British study (3) and 10% in a European study (4). Lifetime prevalence of knee symptoms is 54% in the same British study and 17% in a Scandinavian study (5).

Traumatic causes
Acute knee injuries should be assessed in the standard way by taking a detailed history of the traumatic event, combined with a thorough examination of the joint. In addition, the rest of the patient should be examined to exclude other injuries. Focused history questions should include the activity when the injury occurred, the mechanism of injury, contact or non-contact injury, speed of onset of knee swelling and whether the patient could bear weight following the injury. It is also important to enquire about ‘locking’ of the knee (inability to fully extend the knee due to a mechanical block) and giving way (instability).

The examination of the knee should be as thorough as the patient can tolerate. It is important to ensure that any wounds or lacerations found do not communicate with the knee joint itself, as this will necessitate urgent washout in an operating theatre. Examination findings should include size of the effusion, any obvious deformity, specific areas of ‘bony tenderness’ and ligamentous instability.

Traumatic knee effusions can be divided into those that develop rapidly following the injury (within the first few hours) and those that take several hours or even days to develop. The former is usually indicative of an acute haemarthrosis, which represents an acute intra-articular injury, either a ligamentous tear or fracture. The causes of haemarthrosis are summarised in Box 1.

Box 1 Causes of Acute Traumatic Knee Haemarthrosis

- ACL Rupture
- Peripheral meniscal tear
- Intra-articular fracture
- Patellar dislocation
- PCL Rupture

Fractures around the knee
History and Physical Examination
Patients with fractures around the knee commonly present with pain and swelling following direct or indirect trauma. The most commonly fractured bone is the patella, followed by the proximal tibia (6). Obvious deformities, ‘bony tenderness’ and bruising with a large and rapidly forming effusion are the typical symptoms and signs seen. The Ottawa Knee Rules have been developed to enable clinicians to screen patients with regard to the need for radiographic assessment after knee injury, and are summarised in Box 2 (6).

Box 2 Ottawa Knee Rules

A knee radiograph is recommended only for acute knee injury patients with one or more of the following:

- Age 55 or older
- Tenderness at the head of the fibula
- Isolated tenderness of the patella
- Inability to flex to 90 degrees
- Inability to bear weight, both immediately and in the Emergency Department.

Imaging
Plain radiographs will diagnose the majority of fractures. Radiographs may also show a lipo-haemarthrosis (a fat-fluid level on lateral radiograph). This is highly specific for the presence of a fracture around the knee joint, with a reported specificity of 88.6% (7). Therefore, in the presence of an acute lipo-haemarthrosis, when no fractures can be seen on plain radiographs, further imaging is indicated (usually a Computerised Tomography (CT) scan).

Treatment
The treatment of all fractures around the knee is beyond the scope of this review but can range from simple cast immobilisation to operative fixation.

Knee ligament injuries
History and Physical Examination
Knee ligament injuries are a common cause of traumatic knee effusion, with the most commonly injured ligament being the medial collateral ligament (MCL). The history is a key factor in diagnosing knee ligament injuries through
identification of the mechanism involved. The incidence of MCL injuries cannot be determined due to their wide spectrum of severity. MCL injuries occur in all age groups, but the majority are minor and may never actually be evaluated by a medical professional (8). An isolated varus force to the knee usually injuries the MCL. Most injuries to the MCL can be successfully treated non-operatively. The MCL is examined with a varus stress at 30 degrees of knee flexion.

Isolated injury to the Lateral Collateral Ligament (LCL) is extremely rare. LCL injury is normally in combination with other structural injuries to the joint, especially the postero-lateral ligament complex (PLC). This is most frequently injured in motor vehicle accidents and sports injuries. The most common mechanism of injury is one of excessive varus stress caused by a direct blow, or force, to a weight-bearing knee. Excessive external tibial rotation with or without hyperextension may also have a role in the mechanism of injury. The LCL is examined with a varus stress at 30 degrees of knee flexion.

Anterior cruciate ligament (ACL) injuries are the most common cause of a traumatic knee haemarthrosis. They usually occur as a result of a non-contact pivoting injury. There is still much debate about the management of ACL injuries (see below). The ACL is stressed with the Lachman test, which tests anterior-posterior stability of the tibia on the femur with the knee flexed at 30 degrees. Posterior cruciate ligament (PCL) injuries are significantly less common than ACL injuries. Mechanisms of injury include a fall onto a flexed knee, with the foot plantar-flexed, or a direct blow to the anterior tibia with a flexed knee (such as dashboard injury in a motor vehicle accident). They are normally the result of higher-energy trauma and may be complicated by concurrent injuries to the MCL, ACL or PLC. Most isolated PCL injuries can be successfully treated non-operatively but there should be a high index of suspicion of other knee ligament injuries. PLC injuries can be diagnosed with the dial test examination with the patient in a prone position. Greater than 10° of external rotation asymmetry at 30° knee flexion is consistent with an isolated PLC injury whereas greater than 10° of external rotation asymmetry at 30° and 90° of knee flexion is consistent with a combined PLC and PCL injury.

The assessing clinician should be aware of the high rate of vascular and neurological injuries associated with so-called knee dislocations or multiple injuries to knee ligaments. When examining an acutely injured knee it is often difficult to fully assess the competence of the ligaments due to pain. Once the knee swelling has improved it is important to reassess the patient’s range of movement and any pain or laxity when stressing ligaments.

**Imaging**
All patients presenting with an acute traumatic haemarthrosis should have plain radiographs taken to exclude a fracture around the knee. Magnetic Resonance Imaging (MRI) can be helpful when there is diagnostic uncertainty and a need to identify associated injuries.

**Treatment**
If a patient is able to bear weight, can achieve full extension and has minor swelling, then initial treatment should consist of rest, ice packs, compression and elevation (RICE). The patient should then be reviewed again within a week to reassess ligament stability. If not, or if there are any concerns, urgent referral to the nearest medical facility with an Emergency Department and X-ray facilities is advised.

**Anterior Cruciate Ligament (ACL) injuries**
It is well documented that ACL injuries are more common in a military population, with a reported annual incidence of 0.37% per person per year in the US military (9), compared with 0.05% (10) in a civilian population. The Lachman test is the most valid stability test for an ACL rupture with a sensitivity of 85% and a specificity of 95% (11). MRI has been assessed as a valid and safe non-invasive diagnostic tool for ACL injury, with reported sensitivity and specificity of 94% (12).

The treatment of ACL injuries should be tailored to the individual patient. Factors to be considered when determining treatment should include the patient’s activity level, presence of symptomatic instability, desire to return to activity and the presence of associated injuries. The aim of ACL reconstruction is to reduce symptomatic instability and to prevent further injuries to the knee. It is well documented that there is a strong association between ACL injury and the onset of early osteoarthritis (OA), with an incidence of about 50% at 20 years after injury (13). There is good evidence that ACL reconstruction does help to prevent further intra-articular injuries, such as meniscal tears, which are associated with increased incidence of OA (14). At present there is little evidence that an ACL reconstruction will reduce the risk of developing OA in the future.

In the majority of cases involving patients from the Royal Navy (RN) and Royal Marines (RM), ACL reconstruction should be considered, but patients should have a detailed discussion with an orthopaedic surgeon and be aware of the likely rehabilitation requirements. The provision of a robust physiotherapy regime pre- and post-surgery (or instead of) is an essential and integral part of this decision-making process.

**Meniscal injuries**

*History and Physical Examination*
Meniscal injuries are amongst the most commonly reported
knee problems. The mechanism of injury usually involves a twisting injury to a weight-bearing knee. Patients commonly complain of joint line pain, recurrent swelling and occasionally clicking or true locking (inability to fully extend the knee). When examining the knee it is important to look for swelling, joint line tenderness and the range of movement, especially the ability to fully extend the knee. If there is an inability to fully extend the knee then this is an indication for acute referral to the local orthopaedic service for evaluation of the knee and to exclude a displaced ‘bucket-handle’ tear of the meniscus. Various ‘special tests’ have been reported for the examination of meniscal injuries including the McMurray test. However, the McMurray test has a reported sensitivity and specificity of only 53% and 59% for detecting meniscal pathology (11). The most useful clinical test for meniscal injury is the Thessaly test, which is described in Box 3. Recent validation demonstrated a sensitivity of 90%, and specificity of 98% in detecting meniscal injury (15).

The clinician holds the patient’s outstretched hands for support, while the patient stands flat-footed with their knee flexed to 20 degrees and rotates their body and knee three times, internally and externally. The test is positive if symptoms are reproduced on rotation.

**Box 3 Thessaly’s test for meniscal tear**

**Imaging**

If there has been a history of an acute traumatic haemarthrosis, or the patient is unable to bear weight, then plain radiographs should be taken to exclude fractures around the knee. MRI of the knee can be helpful in confirming the diagnosis and has a reported sensitivity of 93.3% for detecting medial meniscal tears (79.3% for lateral) and a specificity of 88.4% (95.7% for lateral) (16). However, in older patients the results of the MRI scan should be carefully correlated with clinical findings; one study found a 36% reported incidence of meniscal tears in asymptomatic patients over the age of 45 (17).

**Treatment**

Treatment options for meniscal tears include meniscal repair and partial meniscectomy; in some cases no treatment is required. Meniscal repair is usually reserved for younger patients with a tear within the vascularised outer third of the meniscus. Repair of the meniscus in the non-vascularised zone is controversial (18). Where tears that are judged to be irreparable, partial meniscectomy reliably reduces or eliminates symptoms, but does result in an increased rate of early OA, particularly if large portions of the lateral meniscus are removed. Therefore, it is hypothesised that younger patients with meniscal tears in avascularised zones, especially in the lateral meniscus, may benefit from meniscal repair instead of partial resection. However, long-term studies are awaited on this controversial point.

The management of traumatic knee injuries is summarized in Box 4.

**Pre-shore/Pre Hospital management**

**History**: Acute onset of knee swelling with a history of trauma.

**Examination**: Pain and swelling, possible ‘bony tenderness’. Patient may or may not be able to weight bear.

**Treatment**: If patient is able to weight bear, achieve full extension and minor swelling then initial treatment should consist of rest, ice, compression and elevation. The patient should then be reviewed again within a week to re-assess. If not, or any concerns then an urgent referral to the nearest medical facility with an Emergency Department and X ray facilities is advised.

**Hospital management**

**History**: A detailed history of the traumatic event should be obtained including the mechanism of injury.

**Examination**: Should be as thorough as possible and include testing the range of motion, stability and any general or local tenderness.

**Radiographs**: If indicated, should identify any fracture or raise suspicion for further investigation.

**Imaging**: If plain radiographs are not definitive then computerised tomography (CT) can be used to further investigate.

**Treatment**: If any intra-articular fracture, suspicion of ligament rupture or meniscal injury then the patient should be referred to the orthopaedic service for further assessment and management.

**Box 4 Management of Traumatic Knee Swelling**

**A general approach to the acutely swollen knee**

Although this two-part article sought to clarify the differential diagnosis of the acutely swollen knee by considering traumatic and atraumatic causes separately, it is important to have a diagnostic approach that initially considers both and then refines the diagnosis by exclusion through history, clinical findings and special investigations. In Box 5 (19) a flow diagram is depicted that demonstrates the general approach to the acutely swollen knee reflecting the content of this two-part article. It is also useful to consider the EULAR/EFORT recommendations for assessment of the injured or swollen knee (1) as depicted in Box 6. Clinicians familiar with these two approaches should be able to confidently manage patients presenting with an acutely swollen knee, regardless of aetiology.
Clinical Box 5. Acute Knee Effusions: a Systematic Approach to Diagnosis and Examination of the Swollen Knee

**Injury**
- Pivot, Twisting, Audible "Pop" Instability
- Direct blow to knee, unable to weight bear
- Twisted knee while bearing weight or squatting

**No Injury**
- Initial Episode
  - Acute onset, IV Drug use, Immuno-compromised patient abnormal joint
- Recurrent
  - Multiple joint involvement, red, swollen painful joints: diuretic use; alcohol use
  - Multiple joints, prolonged morning stiffness.

**Physical Examination**
- Positive Lachman's and anterior drawer tests, positive pivot shift test
- Abrasion, ecchymosis, deformity, crepitus
- Joint line tenderness, positive McMurray's sign and Apley's test
- Fever, Joint warmth, erythema, stable ligaments.
- Erythema, Joint warmth and tenderness
- Warmth, tenderness, synovial thickening, stable ligaments

**Radiographs**
- Normal or Second Fracture
- Fracture
- Normal
- Normal or chondrocalcinosis
- Subchondral cysts, marginal erosions, osteopenia

**Arthrocentesis**
- Bloody
- Bloody, Fat globules
- Possibly Blood
- Decreased Glucose, Organisms on Gram stain, WBC count >50,000 per mm³, positive culture
- Urate crystals, calcium pyrophosphate crystals, negative gram stain and culture.
- Increased protein level, decreased glucose level, WBC count of 2,000 to 50,000 per mm³
- ACL Tear
- Fracture
- Meniscal tear
- Infectious Arthritis
- Gout, Pseudogout
- RA
Box 6. EULAR/EFORT Recommendations for the diagnosis and initial management of patients presenting with an acute or recent onset swelling of the knee

<table>
<thead>
<tr>
<th>Stage</th>
<th>Recommendation</th>
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<tbody>
<tr>
<td>Recognition</td>
<td>A patient presenting with acute swelling of the knee should undergo thorough clinical examination in order to confirm swelling.</td>
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<tr>
<td>Referral</td>
<td>Patients with a suspicion of septic arthritis or trauma with an onset of swelling within 12 hours should be referred immediately to a doctor experienced in musculoskeletal diseases.</td>
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<tr>
<td>History</td>
<td>Bone tumours are rare but patients with a suspicion of bone tumour should be referred to an orthopaedic surgeon within 1 week. Patients with a suspicion of inflammatory arthritis should be referred to a rheumatologist within 6 weeks. In addition to taking a conventional medical history (including previous and concomitant diseases and medication) specific information should be obtained about traumatic versus non-traumatic causes, the speed of onset, the characteristics of pain, first versus recurrent episodes, the presence of fever, the involvement of other joints and/or back and a recent history of infection.</td>
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<tr>
<td>Physical Exam</td>
<td>Physical examination of a patient presenting with an acute or recent onset swelling of the knee should first focus on the affected knee and should include the unaffected knee as well as an appropriate assessment of the other joints. A general physical examination should be performed on indication. The examination of the knee should include the localisation and characteristics of the swelling (intraarticular versus extra-articular), the detection of effusion, testing stability, general or local tenderness, skin temperature and appearance, the range of motion, and a muscular and neurovascular assessment.</td>
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<td>Laboratory tests</td>
<td>In patients presenting with an acute swollen knee of traumatic origin laboratory testing is not helpful in making a diagnosis. In patients presenting with an acute swollen knee of non-traumatic origin, normal acute phase reactants and normal white blood cell count may be helpful in decreasing the probability of inflammatory diseases including especially septic arthritis. Other laboratory tests should be performed on indication.</td>
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<tr>
<td>Joint fluid aspiration</td>
<td>In the diagnostic process of a patient presenting with an acute swollen knee joint fluid aspiration should be performed in patients suspected of having septic, crystal or inflammatory arthritis. Joint fluid should be examined macroscopically and microscopically for leukocytes, crystals and bacteria (Gram staining and culture). In cases of significant traumatic effusion without radiographic evidence of a fracture, aspiration of haemarthrosis can be performed as well. In case of suspicion of a tumour joint fluid aspiration should not be performed.</td>
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<tr>
<td>Imaging</td>
<td>In patients presenting with an acute swollen knee a plain x ray of the affected joint in two planes (preferably a weight-bearing anterior–posterior view) should be performed. In specific situations additional x rays may be helpful. Ultrasound (US) may be helpful in detecting joint effusion and synovial hypertrophy if clinical examination is doubtful. US, MRI and other imaging modalities may be helpful in detecting intra-articular and extra-articular structural abnormalities and should be performed on indication.</td>
</tr>
<tr>
<td>Procedures</td>
<td>In patients presenting with acute swelling of the knee, diagnostic arthroscopy is only recommended in exceptional cases (e.g., for a biopsy).</td>
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<tr>
<td>Diagnosis</td>
<td>On the basis of the procedures described thus far it should be attempted to make an appropriate diagnosis, which should be the basis for further therapeutic decisions. Meanwhile, general measures can be useful to relieve symptoms.</td>
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<tr>
<td>Initial management</td>
<td>General measures to relieve pain and swelling in patients presenting with an acute swollen knee should be tailored to the individual patient and may include partial or non-weight bearing advice, splints, cold packs, the prescription of simple analgesics and non-steroidal anti-inflammatory drugs if not contraindicated. Antibiotics should not be started before appropriate diagnostic sampling has been performed. Intra-articular steroids should not be administered unless an appropriate diagnosis has been made and contraindications have been ruled out.</td>
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Conclusion
The acutely swollen knee is a common presentation in primary and secondary care in both the civilian and military environment. However, with a generally younger and more active military population the incidence is probably much higher. This two-part article has endeavoured to present a review of the differential diagnoses and initial management of patients presenting with acute or recent onset swelling of the knee. The overarching aim is to raise awareness of these conditions and ultimately lead to earlier evaluation and treatment. We hope it will act a guide or aide-memoire to the medical professionals of the Royal Naval Medical Service wherever they may be providing care, particularly in equipping them with a general approach to the swollen knee that can lead to accurate and speedy diagnosis.

References


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