Assessment and management of post-traumatic haemarthrosis of the knee

Traumatic haemarthrosis of the knee poses significant diagnostic difficulty in the acute phase. Orthopaedic follow up is essential. An update of current recommended practice is provided, and the pros and cons of arthroscopy and magnetic resonance imaging are discussed.

The term haemarthrosis refers to the presence of blood within the joint capsule. The causes can be divided broadly into two categories: traumatic and non-traumatic. This article deals exclusively with traumatic haemarthrosis of the knee joint, providing guidance for assessment and management in the acute phase, typically starting in the emergency department.

Acute traumatic knee injury can be a result of either contact or non-contact injury, with an incidence of approximately 4.7 per 10 000 population (Sarimo et al, 2002). Haemarthrosis usually develops within 2–6 hours of injury, but may take up to 24 hours to appear. The major causes of traumatic haemarthrosis of the knee are sports-related incidents, road traffic accidents and recreational incidents. The most common type of sport leading to knee injury in the UK is football followed by rugby. Generally, this type of injury is at least twice as common in men and the demographics are shown in *Table 1*.

The key to effective management of traumatic haemarthrosis is to understand its significance. The most common significant causative lesion found in the absence of fracture is that of rupture of the anterior cruciate ligament. Other causes are listed in *Table 2*. A summary of the distribution of the commoner causes is shown in *Table 3*.

Table 1. Demographics of acute traumatic haemarthrosis

Male:female	2.9:1 (range 1.9–4:1)
Sports	40%
Road traffic accident	10%
Other, e.g. recreational	50%

Table 2. Causes of acute traumatic haemarthrosis

Intra-articular fracture: patella, tibial condyle, femoral condyle, tibial plateau
Anterior or posterior cruciate ligament rupture
Osteochondral fracture
Peripheral meniscal tear
Lateral dislocation of the patella
Minor trauma in the presence of coexisting coagulation disorder: haemophilia or warfarin interactions

Diagnosis

When confronted with an acutely swollen knee following trauma, a focused history and physical examination (although this may be difficult in the acute setting) are required initially. The history should attempt to elicit the mechanism of injury as well as any pre-existing joint pathology, the time taken for an effusion to accumulate, and the delay between injury and loss of function. In the course of sporting activity, the patient is usually unable to continue playing in the presence of a haemarthrosis and is retired from the game, being carried off the field. Patients will often report hearing a 'pop' or feeling a 'snap' inside their knee, especially with anterior cruciate ligament rupture, which typically occurs after non-contact deceleration or hyperextension. The history, particularly in subacute presenta-

Table 3. Distribution of differing injuries diagnosed from the presentation of acute haemarthrosis of the knee in an unselected population

	Percentage range (total 1181 patients)	Calculated average percentages
Anterior cruciate ligament rupture	17–75	33.8
Patellar dislocation	4–23	10.2
Medial collateral rupture	14–25	14.9
Meniscal tear	8–50	20.4
Posterior cruciate ligament rupture	1–11	3.7
Osteochondral defect	8–29	16.7
Idiopathic, capsular or synovial tear	18–36	31.7

From Noyes et al (1980); Jain et al (1983); Casteleyn et al (1988); Jones and Allum (1989); Sarimo et al (2002); Ansari et al (2004)

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tions, should include enquiry about 'locking' (the inability to fully extend the leg owing to a mechanical block) and 'giving way' (instability).

Examination should be as thorough as the patient can tolerate. It should include inspection of the overlying skin, looking for external signs of trauma such as bruising or lacerations and the position of the knee at rest. The overlying skin should be felt for temperature. A haemarthrosis often has a doughy feel, with local warmth. The size of the effusion can be estimated by performing a 'patellar tap', positive in the presence of a moderate effusion, and 'the bulge test', positive even with a small effusion. A careful and systematic assessment should be made for tenderness in the knee, to include the medial and lateral joint lines, the tibial and femoral condyles, the origins and insertions of the collateral ligaments, the popliteal fossa, the patella and the patella tendon. The ipsilateral hip and ankle as well as the contralateral knee should also be examined routinely. Distal neurovascular status should always be checked and documented in all knee injuries.

The active and passive range of movement should be ascertained and followed by tests for ligamentous instability. The collateral ligaments should be tested using the adduction/abduction stress tests with the knee in full extension and 30° of flexion. The traditional 'anterior drawer' test (knee at 90° flexion) for anterior translation of the tibia on the femur is often misleading in the presence of haemarthrosis, and the Lachman test (knee at 20° flexion) has a higher specificity for anterior cruciate ligament injury in the unanaesthetized patient. The Lachman test, in experienced hands and in the anaesthetized patient, has a high positive predictive value (Casteleyn et al, 1988), whereas the pivot shift test (also known as the dynamic subluxation provocation test) has a very low false negative rate (Jones and Allum, 1989). The combination of the two is useful in determining whether an anterior cruciate ligament tear is partial or complete. Patellar dislocation can also cause a haemarthrosis and, therefore, a patellar apprehension test should be performed. These tests are described in detail by Apley (Solomon et al, 2005) and Baker (1992).

Examination should be followed by plain radiographs of the knee in anteroposterior and horizontal beam projections. Careful attention should be paid to any evidence of a lipohaemarthrosis, represented on the horizontal beam lateral film by a 'fluid level'. This is visible as a black region (fat) above a whiter fluid level (blood). It is caused by an intra-articular fracture, leading to the release of blood and bone marrow fat into the joint space.

A specific search should be made for any mild undisplaced crack fractures in the femoral condyles, tibial plateau, interspinous region and patella.

Arthrocentesis is not indicated unless the diagnosis is in doubt, especially when there is a possibility of septic arthritis. Arthrocentesis must be performed under strict aseptic conditions as there is a small but significant risk of introducing infection into the knee. The presence of blood in the aspirate of an obvious haemarthrosis does not alter the management of the condition, is uncomfortable for the patient and the processing of the sample is not financially insignificant (Ansari et al, 2004). The main indications for arthrocentesis in the case of obvious and tense haemarthrosis are a fixed flexion deformity or the need for pain relief because of the distension of the joint capsule. However, re-accumulation is common and any associated pain is best treated with compression and analgesics. If arthrocentesis is performed then any aspirate should be sent for culture and biochemical evaluation, including evaluation of the presence of fat globules which is an indication of osteochondral fracture (Lee et al, 1989).

Management

After thorough assessment and evaluation the patient should have a compression bandage placed around the affected knee which should then be immobilized with a straight-leg immobilizer. An alternative is the use of a well-applied Robert Jones dressing; traditionally three layers each of alternating wool and crepe extending approximately 6 inches (15 cm) above and below the knee (Brodell et al, 1986). The patient should be given crutches and isometric quadriceps exercises, anti-inflammatory medication (if not contraindicated) and not allowed to bear weight until review in the orthopaedic clinic. Isolated soft tissue injuries can safely be treated with rest, ice, compression and elevation (RICE) (Patel and Haddad, 2007). The patient should not be placed in a plaster of Paris cylinder without a confirmed diagnosis (Ansari et al, 2004).

On first presentation in the emergency department it is common for the correct diagnosis of the pathology behind the haemarthrosis to be unrecognized (Noyes et al, 1980); even complete anterior cruciate ligament rupture can evade diagnosis at first presentation (Jain et al, 1983). Planned review of the patient is, therefore, essential. Even after careful assessment on initial presentation, the clinical history and physical examination are unreliable in about a third of cases in predicting the need for operative intervention (Casteleyn et al, 1988). It is much easier to ascertain the diagnosis at assessment in the clinic within 1 week of presentation, because of the reduction in the swelling about the knee. At this point expectant treatment or further investigations such as magnetic resonance imaging or arthroscopy should be considered (*Table 4*).

There is a continuing debate about the need for surgery in rupture of the anterior cruciate ligament. The goal of anterior cruciate ligament reconstruction is to prevent further damage to knee-stabilizing structures and to delay progression to osteoarthritis within the joint (Haddad and Oussedik, 2004). Repair of acute rupture of the anterior cruciate ligament can lead to arthrofibro-

Table 4. Basic principles of haemarthrosis management in the knee
Routine plain film radiography
Selective arthrocentesis
Orthopaedic referral or follow up in all cases
Further evaluation with either magnetic resonance imaging or arthroscopy

sis and so a delay before operation has been suggested (Shelbourne et al, 1991). It is common practice in the UK to operate in the sub-acute setting in young athletes or sportspeople once a full range of motion is restored (Kapoor et al, 2004). In other patients the decision about whether or not to operate depends on the personal and medical circumstances of each patient. The mere presence of a ruptured anterior cruciate ligament is not necessarily an indication for surgery. The majority of UK-based knee surgeons would not operate even for chronic anterior cruciate ligament deficiency in patients over the age of 45 years (Kapoor et al, 2004).

Arthroscopic examination

There are varying views about whether or not patients with an acute traumatic haemarthrosis of the knee should be admitted and undergo arthroscopy as soon as possible. Maffulli et al (1993) looked at athletes and, in this subgroup, suggested that arthroscopy is mandatory because of the high incidence of ligamentous injury and the difficulty in visualizing ligamentous defects after time has passed. This, in their opinion, is an indication for arthroscopy so as to accurately diagnose injury, even if immediate corrective surgery is not performed, and to enable appropriate follow up. Similarly, Jones and Allum (1989), in their prospective study of the general population attending a UK district general hospital, concluded that in the under 35-year age group routine examination under anaesthesia and arthroscopy should be performed because of the high incidence of anterior cruciate ligament injuries. Jones and Allum (1989) and others cite both Gillquist et al (1977) and DeHaven (1983) who promote arthroscopy for all cases of haemarthrosis.

Noyes et al (1980) advocated a 'wait and see' approach, and highlighted that the presence of major collateral ligament or capsular tears contraindicate arthroscopy because of the possibility of compression of popliteal structures by extravasation of irrigation fluid. A more recent study (Sarimo et al, 2002) strongly advocates that all patients should have accurate diagnosis by non-invasive means. Their reasoning is that most orthopaedic surgeons are relatively conservative in their treatment approach in the acute phase, only operating for meniscal tears and articular loose bodies. Their therapeutic arthroscopy rate was only around 14%, suggesting that magnetic resonance imaging is better for most patients, avoiding unnecessary general anaesthetic and invasion of the joint. They advocated that all cases of traumatic haemarthrosis should be reviewed by an orthopaedic surgeon so as to decide whether an acute operation was necessary or not. Harilainen (1990) found a therapeutic procedure was performed in only 44% of cases (66% including acute anterior cruciate ligament reconstructions).

Magnetic resonance imaging

Although the established complication rate of a diagnostic arthroscopy is low at less than 2.1% (Sherman et al, 1986), and many of these complications are minor or clinically insignificant, it remains an invasive and expensive procedure. For these reasons magnetic resonance imaging has become a useful tool in the assessment of knee injuries. Different forms of magnetic resonance imaging have been assessed in their accuracy compared to arthroscopy. Magnetic resonance imaging is a very useful diagnostic tool for further evaluation of a lipohaemarthrosis (Schick et al, 2003), suspected meniscal injury (Huysse and Verstraete, 2008) and possible traumatic chondral lesions (Kuikka et al, 2006). Non-orthogonal magnetic resonance imaging has a specificity and sensitivity of 100% in the detection of partial and complete anterior cruciate ligament rupture (Vellet et al, 1989).

Magnetic resonance imaging has been shown to be as good as diagnostic arthroscopy in determining the need for further therapeutic intervention in the acutely traumatized knee (Quinn and Brown, 1991). Prospective studies have shown that in the case of equivocal clinical findings a negative magnetic resonance imaging can reliably exclude injuries needing surgical interventions: magnetic resonance imaging has 100% sensitivity and 71% specificity in identifying those knees requiring surgery (Munshi et al, 2000).

Using magnetic resonance imaging as an early diagnostic tool in acute knee haemarthrosis obviates the need for arthroscopy in up to 42% of unselected patients (Bui-Mansfield et al, 1997) and 22% in those equivocal cases where the diagnosis remains clinically elusive (Munshi et al, 2000). The timing of imaging is very important and a delay of at least 2 weeks is advised for clarity; the need for this type of imaging should, therefore, be assessed by the orthopaedic team (Patel and Haddad, 2007).

Conclusions

All patients with an acute traumatic haemarthrosis of the knee joint require referral for orthopaedic surgical advice. However, distinction should be made between those under the age of 35 years, who are more likely to have a ligamentous and/or meniscal injury, and those older patients who are unlikely to benefit from arthroscopy.

Currently it appears reasonable for all presenting patients to undergo magnetic resonance imaging scanning as a diagnostic procedure if locally available. This is useful diagnostically and also as a guide for reconstructive surgery should this later be deemed necessary. In the

active younger or athletic population, arthroscopy should be performed in those patients without a definitively negative magnetic resonance imaging scan. Invasive diagnostic studies such as arthroscopy are not indicated for patients where the pathology is obvious on magnetic resonance imaging scanning, and conservative treatment only is indicated. BJHM

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KEY POINTS

- Haemarthrosis of the knee has multiple causes.
- Intra-articular fracture should always be excluded initially.
- Orthopaedic follow up is always indicated.
- Magnetic resonance imaging facilitates non-invasive diagnosis.