Medial meniscus vacuum phenomenon in association with ACL rupture
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Section: Musculoskeletal system
Area of Interest: Musculoskeletal joint
Procedure: Diagnostic procedure
Procedure: Normal variants
Imaging Technique: MR
Special Focus: Trauma Motility Case Type: Clinical Cases
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Patient: 55 years, male

Clinical History:

A 55 years old gentleman presented to Accident and Emergency department with right knee pain and swelling after a twisting injury to the right knee which he sustained while he was playing golf. On examination he had joint effusion with restriction of the knee extension and positive anterior drawer test.

Imaging Findings:

The right knee radiograph showed joint effusion and tri-compartmental degenerative changes.

The MRI right knee was initially reported by a senior musculoskeletal resident who reported ACL rupture, tri-compartmental degenerative changes with posterior horn medial meniscal root avulsion tear. This meniscal tear was subsequently reported by a musculoskeletal consultant radiologist as air-fluid level within the degenerated meniscus in keeping with a vacuum phenomenon.

Discussion:

Background:

“Vacuum Phenomenon” (VP) is the term for a gas accumulation, mainly of nitrogen, in a closed joint which is liberated from surrounding tissues secondary to a negative pressure created within the joint after applying traction force [1-3]. This phenomenon is usually observed in patients with spondylosis and spinal disc degenerative disease on CT [3].

Resnick reported this gaseous collection in 2-3% in all patients and 20% of elderly patients with degenerative intervertebral disc disease [4]. However, this could also be seen in different spinal and intervertebral disc diseases such as vertebral osteomyelitis, Schmorl nodule formation, vertebral collapse with osteonecrosis [3]. A few cases of this phenomenon have also been reported in temporo-mandibular joint with or without any discernable disease [5, 6]. Sakamoto reported 1.3% (12 cases) VP within the total of 914 consecutive three Tesla MRI scans from 875 patients (524 men; mean age, 35 years). Half of the 12 cases resembled a meniscal tear. These were better appreciated on Gradient-recalled echo (GRE) localizer images, with 3D SPACE images being the next most effective [7]. Same appearances were also observed in a case report within the lateral compartment in a patient who
sustained a lateral tibial plateau fracture [8].

Imaging Perspective:

VP can be seen on the radiograph as an air density but more readily depicted on the CT with gas attenuating values ranging from -800 to -400 Hounsfield Units [5, 9]. On MRI, the gas collection appears as low signal on both T1 and T2 weighted sequences, similar to MRI signal of calcium deposition and fibrous tissue which makes the diagnosis of this phenomenon challenging.

Outcome:

Vacuum phenomenon is rather a presentation of an underlying disease or condition such as degeneration or trauma. Therefore, the treatment should be directed towards the underlying cause of this phenomenon.

Teaching Point:

VP within the knee is a rare entity which could be seen in both traumatic and non-traumatic scenarios such as degeneration. This phenomenon could mimic meniscal tear; therefore, radiologists should be aware of its radiological presentation in order to avoid erroneous radiological diagnosis and subsequently unnecessary surgical intervention.

**Differential Diagnosis List:** Medial meniscus vacuum phenomenon with ACL rupture, Meniscal root tear, Discoid meniscus, Chondrocalcinosis

**Final Diagnosis:** Medial meniscus vacuum phenomenon with ACL rupture

**References:**

Figure 1

Description: AP view of the right knee.
Radiograph of a 55-year-old man which demonstrates degenerative arthropathy. **Origin:** Department of Radiology. Royal Derby Hospital, UK

Description: Lateral view of the right knee radiograph of a 55-year-old man which demonstrates degenerative arthropathy. **Origin:** Department of Radiology. Royal Derby Hospital, UK
Description: Sagittal T2 weighted image demonstrates air-fluid level within the medial meniscus posterior horn of the right knee in keeping with vacuum phenomenon (red arrow). The knee was scanned in the supine position. Origin: Radiology Department. The Royal Derby Hospital, UK.
**Description:** Sagittal T2 weighted image demonstrates ACL rupture with marked osteoarthropathy.

**Origin:** Radiology Department. The Royal Derby Hospital, UK.
Description: Patient’s right knee MRI imaging demonstrates air-fluid level within the posterior medial meniscal horn in keeping with vacuum phenomenon (arrows). The patient was scanned in supine position. Origin: Department of Radiology, Royal Derby Hospital, UK