IDENTIFICATION OF LIPOHEMARTHROSIS WITH POINT-OF-CARE EMERGENCY ULTRASONOGRAPHY: CASE REPORT AND BRIEF LITERATURE REVIEW

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Abstract—Background: Traumatic knee pain is a common complaint in the emergency department (ED). Conventional radiographs are often ordered as the initial screening study, but might not be readily available or always identify significant fractures. Ultrasonography has been shown to be useful in the evaluation of knee fractures not identified by radiography. Objectives: To discuss and briefly review the literature regarding the use of suprapatellar bursal ultrasonography to detect lipohemarthrosis (LH) as a surrogate marker for an intraarticular knee fracture. Case Report: A 37-year-old man presented to the ED after a traumatic knee injury. Bedside ultrasonography demonstrated the characteristic triple layer sign of LH, raising the suspicion for an intraarticular fracture. The diagnosis was later confirmed with radiography and computed tomography (CT). Conclusions: The sono
graphic finding of LH may be used as a sensitive surrogate marker for intraarticular knee fracture in the ED. Ultrasonography can be considered as an adjunct modality in ED patients with suspicion for fracture and negative knee radiographs. © 2013 Elsevier Inc.

Keywords—lipohemarthrosis; intraarticular knee fracture; suprapatellar bursa; ultrasonography; emergency physician

INTRODUCTION

Traumatic knee pain is a common complaint in emergency department (ED) patients, accounting for up to 532,000 visits in the United States annually (1). Evaluation is, in part, focused on distinguishing significant fractures, which might require urgent or immediate treatment, from muscular and ligamentous injuries. Plain radiographs looking for direct evidence of fracture or indirect evidence of injury, such as lipohemarthrosis (LH), are often the test of choice. However, when used alone for the evaluation of acute knee trauma, plain radiographs can miss up to 21% of fractures (2,3). Unrecognized fractures not only increase morbidity, but also account for a significant portion of malpractice claims (4). Sonography of the knee is reported to facilitate the evaluation of knee injuries, including fractures, particularly when radiographs are normal or unavailable (5,6). To our knowledge this is the first reported case of emergency physician (EP), point-of-care knee sonography to diagnose an intraarticular knee fracture by the identification of LH.

CASE REPORT

A 37-year-old man with no medical history presented to the ED reporting pain and swelling to his left knee. He had fallen from a 4-foot ladder the day before presentation. Physical examination demonstrated normal vital signs, a left lower extremity with intact neurologic and vascular systems, suprapatellar swelling with effusion, and tenderness to palpation of both medial and lateral joint lines, as well as the proximal tibia. Range of motion about the knee was painful and limited to 0 to 45 degrees. There was mild laxity with valgus stress compared with
the contralateral extremity. Anterior-posterior, lateral, and oblique radiographs of the knee were ordered but could not be performed due to equipment failure.

Given the high clinical suspicion for a fracture and the delay in radiograph availability, a bedside ultrasound was performed by the EP. The patient was placed in the supine position with the knee extended. The suprapatellar bursa was scanned along axial and sagittal planes using a 13.0 to 5.0 MHz compact linear transducer (GE Logiq-e). A triple layer sign was identified showing the clear separation and layering of marrow fat, plasma, and blood cells within the bursal space, confirming the suspicion for an intraarticular fracture (Figure 1). Several hours later, the radiographs of the knee were obtained (Figure 2) and detailed an intraarticular tibial plateau fracture and associated fracture of the fibular head. A computed tomography (CT) scan of the knee revealed a comminuted, impacted bicondylar tibial plateau fracture, Schatzker grade 5 (Figure 3). The patient’s knee was wrapped in a bulky Jones dressing and placed in a knee immobilizer. The patient was instructed to remain non-weight-bearing on his affected extremity and was given prompt orthopedic follow-up. He underwent open reduction and internal fixation of his fracture later that week.

**DISCUSSION**

LH, the presence of blood and fat in the joint cavity, has been recognized in the literature as a reliable sign of an intraarticular fracture (5,7–10). First described by Kling in 1929, it is caused by fracture of the marrow-containing bone and the subsequent release of marrow fat into the joint space (7). LH was traditionally identified as a fat-fluid level on horizontal cross-table lateral radiographs of the knee. On CT, magnetic resonance imaging (MRI), and ultrasound, it can appear as either a fluid-fluid level composed of two layers, fat and blood, or a double fluid level with three layers consisting of fat, serum, and blood cells (5,6,11,12). On ultrasonography, the anterior

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**Figure 1.** Sagittal sonogram of the suprapatellar bursa demonstrating a three-layered effusion. Note the anechoic spheres of fat within the anterior layer. (a) Fat (b) Serum (c) Blood cells. **Anterior cortex of the distal femur.**

**Figure 2.** Lateral radiograph of the knee. LH is not seen in this image. Note, however, that this not a cross-table lateral X-ray, which is the optimal view for identifying LH.

**Figure 3.** Sagittal computed tomography image of the knee demonstrating tibial plateau fractures and a double-layered suprapatellar effusion. (a) Fat (b) Blood.
layer of fat appears hyperechoic and is composed of many spherical, anechoic fat globules. It is followed by an anechoic layer of serum and a posterior, more echogenic layer of clotting blood cells (13,14).

LH seen on radiographs has a low sensitivity but high specificity for detecting an intraarticular knee fracture. One series demonstrated that 65% of patients with intraarticular fractures did not have fat-fluid levels on X-ray studies, while all patients with LH visible on radiographs were found to have intraarticular fractures (10). Both CT and MRI, which are used to confirm the presence of a fracture when radiographs are negative, also reliably depict LH (6,11). However, these modalities might not be readily available and are impractical for evaluating all patients with knee trauma.

Ultrasoundography is a noninvasive, portable, and cost-effective imaging modality. Several studies have demonstrated its utility for identifying LH in patients who had intraarticular knee fractures confirmed with radiographs or CT (13,14). Bonnefoy et al. studied the diagnostic accuracy of sonography for the detection of knee LH and its efficacy as an indicator of an intraarticular fracture (5). Forty-eight patients with clinical suspicion for knee fracture were evaluated with anterior-posterior and lateral radiographs, ultrasonography performed by radiologists and CT within 48 h of knee trauma. Using CT as the gold standard, ultrasonography was more sensitive for detecting LH than radiographs (97% vs. 55%). Furthermore, when LH was used as an indicator of intraarticular fracture, sonography had a higher sensitivity and specificity for diagnosing fracture compared with plain radiography (94% vs. 84% and 94% vs. 88%, respectively) (5). These findings not only suggest that ultrasound is an extremely useful modality for the detection of LH, but also imply that the presence of LH on ultrasoundography is a highly sensitive marker of intraarticular fracture.

One limitation of ultrasound is that the timing of the ultrasound examination seems to affect the ability to detect LH. In both an in vitro and clinical study, Bianchi et al. demonstrated that LH takes time to develop its characteristic sonographic appearance (14). Their in vitro study involved sonography of a blood and oil mixture both immediately and then 30 min after mixing of the two substances. Two layers were visible on the initial images, and three layers were present after 30 min. The clinical component of their study involved ultrasoundography of seven patients with intraarticular knee fractures demonstrated on radiographs either 20 min or 3 h after knee immobilization. The investigators were able to only see a two-layered effusion in the six patients scanned after 20 min, while a three-layered effusion was clearly seen in the patient scanned after 3 h of immobilization (14). In the study discussed by Bonnefoy et al., two patients with an intraarticular fracture confirmed on CT did not have LH on ultrasound imaging (5). Interestingly, these patients had their sonograms performed 1 and 2 h after knee trauma, respectively, which might not have provided enough time for LH to develop (5).

In addition to the timing of the ultrasound examination, there are several other things to keep in mind when using sonography to identify LH. First, when imaging the suprapatellar bursa, it is important not to confuse the fat layer seen in LH with the suprapatellar fat pad, which lies anterior to the bursa and posterior to the quadriceps tendon. The two can be distinguished by manual squeezing of the joint, which in the case of LH mixes the various layers of the effusion and blurs the fat-fluid level (15). Secondly, infrapatellar fat pad rupture has been known to cause LH (16). In cases where the fat pad has been traumatically ruptured, distinction from fracture using LH can be problematic. The incidence of isolated traumatic infrapatellar fat pad rupture is unknown, but presumed to be low. Patients with LH on ultrasound should obtain additional imaging to evaluate for an underlying fracture.

CONCLUSION

This case demonstrates the use of ultrasoundography by an EP to detect LH for the evaluation and accurate diagnosis of an intraarticular knee fracture in the ED. Earlier studies have shown that the sonographic finding of LH is a highly sensitive predictor of intraarticular knee fractures. Further research is needed to clarify the required experience for satisfactory performance of this kind of sonography and to determine whether this method is useful and can reliably identify fractures missed on radiographs in the ED setting.

REFERENCES