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Patella Fracture Identified Using Point-of-care Ultrasound

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Abstract: A 49-year-old female fell from standing. Her right knee extended into the air. She had acute right knee pain preventing weight-bearing. Her knee was most comfortable fully-extended. She could not flex it due to pain, nor extend it against resistance. Tenderness and a horizontal defect were noted over the anterior knee. Bedside ultrasound demonstrated a horizontally-fractured patella (confirmed on X-ray) with intact femoral and patellar tendons. She was put in a knee immobilizer and underwent surgery, with return to full function and activities. Ultrasound can identify patella fractures and help with early evaluation, management, and specialty referral, as well as ordering more-focused imaging. In one study, POCUS (point-of-care ultrasound) for patella fracture had 95% sensitivity, 63% specificity, 86% positive predictive value, and 83% negative predictive value. The dynamic nature of ultrasound allows a ruptured patella (87% sensitivity) or quadriceps tendon (100% sensitivity) to be excluded with high certainty.

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Introduction

Ultrasound is an increasingly-important tool to evaluate musculoskeletal conditions. Ultrasound can identify fractures, muscle tears, fluid collections, gas within tissue, and foreign bodies (Bonnefoy et al., 2006; Yesilaras et al., 2014). This case describes the use of ultrasound in diagnosing a suspected patellar fracture and excluding alternative or concomitant diagnoses of patellar tendon or quadriceps tendon rupture.

Case report

A 49-year-old female with no past medical history presented after a slip and fall from standing on a wet kitchen floor. Her right knee extended into the air, and she had acute-onset right knee pain preventing weight-bearing. Her knee was most comfortable in full extension; she could not flex it due to pain. She could not extend her knee against resistance. Pain and a horizontal defect were noted over the anterior knee. Bedside ultrasound demonstrated a horizontally-fractured patella, with intact femoral and patellar tendons (Figures 1 and 2). The fracture was confirmed on X-ray (Figures 3 and 4). The patient was put in a knee immobilizer and referred to Orthopedic Surgery. She underwent surgery, with return to full function and activities.

Discussion

Patella fractures can occur through indirect (forceful extension) or direct (e.g. sports trauma, knee hitting dashboard) mechanisms. Most require surgery; non-operative treatment may be reasonable when there is an intact extensor mechanism and

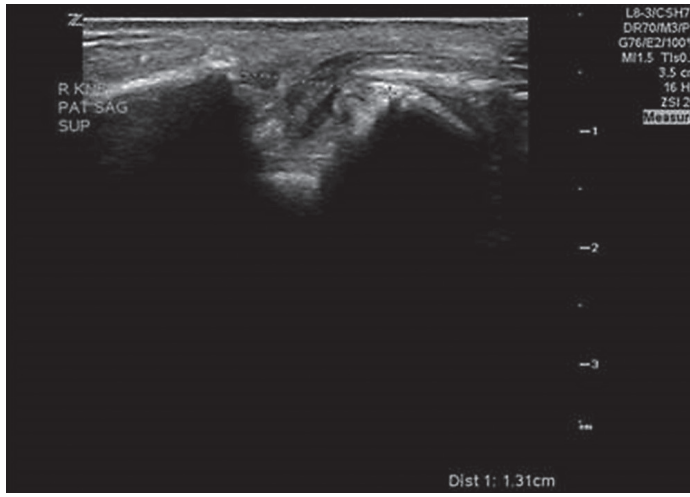

Figure 1 – Ultrasonographic image of the right patella using a linear L8-3 probe (Zonare Z One Pro Ultrasound System) in the sagittal plane overlying the patella demonstrates a 1.31 cm patellar cortex disruption superior-inferiorly.

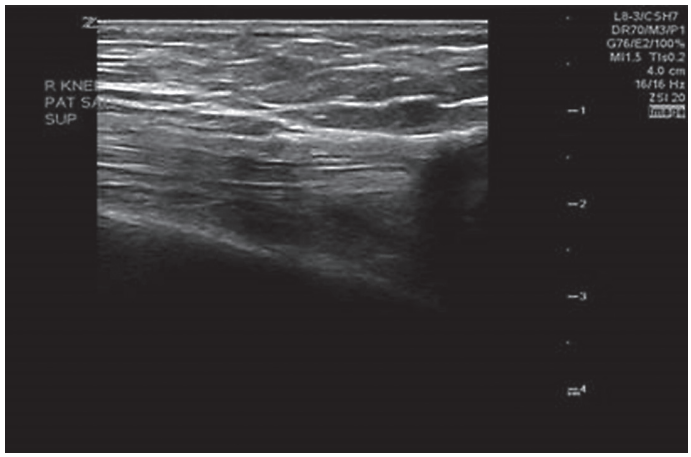

Figure 2 – Ultrasonographic sagittal-view image using a linear L8-3 probe (Zonare Z One Pro Ultrasound System) demonstrating intact right quadriceps tendon and no knee effusion.

Figure 3 – Lateral X-ray demonstrating mid-patella transverse fracture.

minimal intra-articular step-off (Solaro et al., 2011). Although plain film X-ray imaging is an excellent modality for identifying fractures, point-of-care ultrasound (POCUS) can be advantageous in fracture diagnosis and management. POCUS allows for earlier diagnosis, expectation-setting, and referral to a surgical specialist (if needed). POCUS can also inform more-focused imaging; for example, the provider can order patellar views (e.g. "sunrise" view) and tell the Radiologist to focus specifically on the patella. Additionally, POCUS can give the patient the psychological comfort of having objective evidence to support their chief complaint at an earlier time. Compared with CT (computed tomography) or MR (magnetic resonance), ultrasound is less costly (Bonnefoy et al., 2006). Ultrasound can dynamically visualize the patellar

Figure 4 – Oblique X-ray demonstrating mid-patella transverse fracture.

tendon and quadriceps tendon to assess for rupture as an alternate cause of symptoms or a concurrent injury (Bianchi et al., 1994; Warden et al., 2007). Lastly, ultrasound has increased practicality for its ability to be used in locations without access to X-rays (e.g. wilderness, high school sports events).

Using a high-frequency linear transducer, a patella fracture can be identified as a disturbance in what would usually be a continuous bright line at the meeting point of the bone and soft tissue. A fracture can also be identified with POCUS as a hypoechoic collection, which is often indicative of a hematoma in the fracture space (Carter et al., 2016). Finally, ultrasound identification of lipohemarthrosis (synovial effusion with an echogenic layer of fat above the hypo/anechoic fluid [i.e. fat-fluid level]) suggests fracture, though this is a rare finding in patella fractures, and more-often associated with distal femur or tibial plateau fractures (Costa et al., 2007).

For POCUS to be a viable substitution for or complement to plain film imaging, it must have a high sensitivity and specificity. In one study of 27 patients with knee trauma, Aljamil (2014) noted 19 with positive X-rays by sunrise view. Of those, POCUS identified 18 fractures (sensitivity = 95%). Of 8 patients with negative X-ray results, POCUS identified 5 patella fractures (specificity = 63%). In this population, the positive predictive value of an ultrasound was 86% and negative predictive value was 83.3%.

One condition that can contribute to a lower specificity and positive predictive value is a bipartite patella, which occurs in about 2% of the population (Weaver,

1977). A bipartite patella is characterized by an unfused accessory ossification center; the two separate sections are connected by thick fibrous tissue. Because of this division in the patella, a bipartite patella can be confused with a patella fracture. However, a bipartite patella has smooth edges at the separation points and higher-than-normal patella volume (with a bipartite patella, the sum of the true patella volume and that of the smaller section is greater than what would be expected of a normal patella) (Blankstein et al., 2001). Patients with a suspected patella fracture discovered by ultrasound should be asked if they are known to have a bipartite patella.

In sum, ultrasound is useful for identifying patella fractures and can help with early evaluation, management, and specialty referral, as well as ordering more-focused imaging. In a patient who is low-risk (by mechanism and physical examination) for patella fracture, a negative ultrasound can be reassuring no fracture is present. In addition, the dynamic nature of ultrasound allows a ruptured patella (87% sensitivity) (Bianchi et al., 1994) or quadriceps tendon (100% sensitivity) (Warden et al., 2007) to be excluded with high certainty.

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