



Ultrasound in Emergency Medicine

POINT-OF-CARE ULTRASOUND AND THE SEPTIC PROSTHETIC HIP JOINT

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□ Abstract—Septic joints can have an insidious onset and are difficult to diagnosis. Diagnosis can be more complicated in the setting of a distant prosthetic joint. Plain films and inflammatory markers are not specific and magnetic resonance imaging (MRI) is not a timely test in the emergency department. Computed tomography (CT) scan is quick and useful to evaluate for bony changes or signs of inflammation, but lacks the details of MRI, and the prosthetic joint may cause significant artifact. Point-of-care ultrasound (POCUS) is often used in the pediatric population to evaluate for an effusion when there is a concern for a septic native hip joint and is finding a role in adult emergency medicine to evaluate for an effusion in painful native adult hip joints. Even so, ultrasound is not currently included in diagnostic algorithms for diagnosing prosthetic hip joint infections (PJIs). POCUS is, however, readily available in the emergency department. We present a case where POCUS aided in identifying a periprosthetic synovitis and changed the course of the patient's management from previous physical therapy to an investigation toward the final diagnosis of a septic prosthetic hip joint. © 2019 Elsevier Inc. All rights reserved.

INTRODUCTION

Prosthetic joints are among the most common operations performed internationally, and are a reliable intervention to help relieve joint pain and to allow for greater mobility (1,2). Unfortunately, patients with prosthetic joints are at increased risk for developing a joint

infection. Approximately 0.5–2.0% of patients after hip replacement experience a prosthetic hip joint infection (PJI). Infection risk increases after revision surgery (5%), and can be as high as 15–40% after reimplantations (2). Additionally, the risk of PJIs increases after a systemic infection. Specifically, studies have shown that > 40% of patients with prosthetic joint replacements developed a PJI after documented *Staphylococcus aureus* bacteremia (3).

In patients with PJIs, presenting symptoms can be vague. In chronic cases, 89% of patients present with joint dysfunction, 74% present with pain, and 33% present with erythema. Only 9% of patients will present with sepsis (2). Risk factors for hip revision due to PJIs include diabetes, male sex, obesity, dementia, femur fracture, previous septic arthritis, and revision and lateral surgical approach (4).

The diagnosis of PJIs is not straightforward. A major criterion for diagnosis of PJIs requires aspiration of synovial fluid. Serum laboratory testing, including C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR), can be part of minor criteria to lend support to a diagnosis of PJI. CRP is considered elevated acutely if >100 mg/dL or chronically if >10 mg/dL; ESR is not useful acutely, but considered elevated if >30 mm/h for chronic PJIs (5).

Plain radiographs can evaluate for acute fracture, loosening of hardware, concurrent joint disease, or osteomyelitis, but are also often normal and not diagnostic for a septic joint. CT or MRI scans can detect effusions and

inflammation in joints that maybe otherwise be missed on physical examination. The hip joint is a particularly challenging area to assess for an effusion on physical examination (compared to the knee for example). POCUS is used in the pediatric population to diagnose a hip effusion and aid in the bedside evaluation for a septic joint (6,7). The gold standard for diagnosis of a septic joint is synovial fluid culture, which is obtained through arthrocentesis. Hip arthrocentesis is commonly performed with x-ray guidance by interventional radiologists or by orthopedic surgeons, and is not a procedure traditionally done by emergency physicians. POCUS allows for a dynamic evaluation for periprosthetic fluid and potentially needle aspiration of the joint. Additionally, emergency physicians have successfully used POCUS to obtain joint fluid in native hips (8). POCUS is not currently included in protocols for diagnosis of prosthetic septic joints (2,9,10). As such, providers may not be aware of its utility to visualize a periprosthetic fluid collection to suggest a septic effusion in a prosthetic joint. We present a case where POCUS helped play a pivotal role in furthering the diagnostic evaluation of a painful prosthetic joint by elevating the concern for infection.

CASE REPORT

A 74-year-old male with a history of hypertension, obesity, and hip osteoarthritis status post a right total hip arthroplasty (more than 2 years prior) presents with a chief complaint of right hip pain. Four months prior to presentation, he was diagnosed with an infected foot ulcer complicated by methicillin susceptible *Staphylococcus aureus* (MSSA) bacteremia, and he completed a course of i.v. antibiotics.

The patient stated that while undergoing treatment for his foot, he had a mechanical fall onto his right knee 3 months ago leading to right knee pain. His knee was treated with physical therapy and he feels this aggravated his right prosthetic hip. His right hip pain gradually progressed and he is now requiring crutches to ambulate, as he is no longer able to bear weight on the joint. He was seen in an orthopedic clinic for his hip symptoms, where plain films showed appropriate alignment and functioning hardware. The diagnosis was thought to be a strained hip flexor, as his pain worsened with hip flexion. He continued physical therapy for his knee and hip with mild improvement in range of motion but continued to require crutches secondary to hip pain with weight bearing. He denies recent fever, chills, nausea, vomiting, or skin changes.

The physical examination is notable for an overall well-appearing obese male who is afebrile and has normal vital signs. The right hip has well-healed surgical incisions without overlying ecchymosis or erythema. The

hip is nontender to palpation. There is a small amount of anterior hip swelling and he has markedly limited active and passive range of motion due to pain. Evaluation included serial plain films of the right hip and pelvis, which showed no changes from prior studies.

POCUS at the site of right hip pain showed a hypochoic area overlying the prosthesis–bone junction (Figure 1) that does not migrate with hip rotation. Laboratory results were notable for no leukocytosis, but elevated CRP of 66 mg/L and ESR of 78 mm/h. Interventional radiology x-ray–guided aspiration of the joint grew MSSA. MRI showed florid synovitis around the right hip prosthesis (correlating with ultrasound images) without any associated fracture. As an outpatient, he was taken to the operating room by orthopedics for a washout and revision of the right total hip arthroplasty, and discharged on i.v. antibiotics.

Ultrasound Technique

To perform a diagnostic ultrasound of the hip joint, place the patient in the supine position, with hip exposed. Place curvilinear probe over affected hip with transducer orientation aligned transverse, in short axis to the femur and identify the femoral nerve/artery/vein. Rotate the medial aspect of the probe superomedially toward the umbilicus just below level of inguinal ligament (Figure 2) to identify the femoral head and neck (Figure 3) (8,11). In a native hip, a distance of 0.7 cm or more, or 2 mm asymmetry to the contralateral asymptomatic hip, from the femoral neck to the capsule (see location A-A in Figure 3) identifies an effusion (12).

DISCUSSION

Septic arthritis, can present in subtle ways particularly in prosthetic joints or when chronic. Although uncommon,

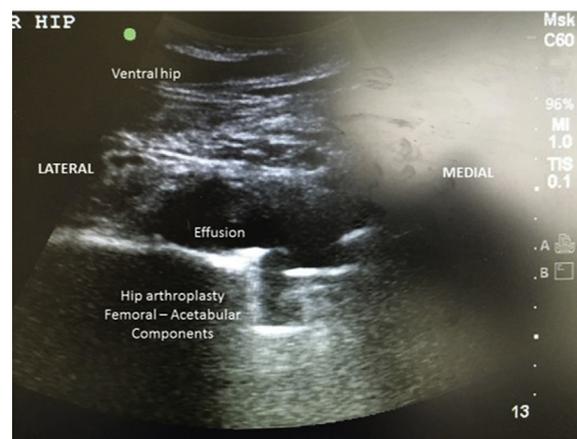


Figure 1. Ultrasound with curvilinear probe showing hip arthroplasty and overlying hypochoic effusion.



Figure 2. Photo of probe position on patient to assess the hip joint.

infection of a replacement is a potentially devastating complication with pain, poor function, decreased quality of life, and even death. There is a broad differential for hip pain with an underlying prosthesis, including dislocation, aseptic loosening, periprosthetic fracture, tendon rupture, tendonopathy, bursitis, and strained muscles (13). Consider the diagnosis of a septic joint in patients presenting with a single painful joint, even in the absence of systemic symptoms. Risk factors for PJI include male sex, body mass index of >30, diabetics, prior revision, and history of bacteremia (3,4). In the presented case, this patient had risk factors of being male, obese, and a history of bacteremia. His replacement had occurred more than 2 years prior to his PJI, the timing of which accounts for about 38% of PJIs (4). Evaluation for a septic joint may include complete blood count, CRP, ESR, plain films, and advanced imaging, such as CT and MRI (14). POCUS can be added to these options, particularly in the emergency department where availability, artifact, cost, and timeliness make other advanced imaging prohibitive. Visualization of fluid by ultrasound can also prevent unnecessary “dry” aspirations and joint contamination. Other case reports have illustrated the role of POCUS in the emergency department for pediatric and adult native hips (6–8,15). Here we present a case where POCUS too can be utilized with prosthetic hip joints to evaluate for an effusion. To the authors’ knowledge, there is no standardized measurement of the amount of fluid for prosthetic joints, where capsule thickness can exhibit surgical changes; however, in MRI studies, periarticular inflammation, sinus tracts, and pseudocapsular expansion with fluid collections are noted as telltale signs of PJIs to prompt next steps (9,16). It is important to be aware that particularly in chronic PJIs, there may be no periarticular inflammation, so lack of fluid on ultrasound does not rule out a joint infection (16). If periprosthetic fluid is

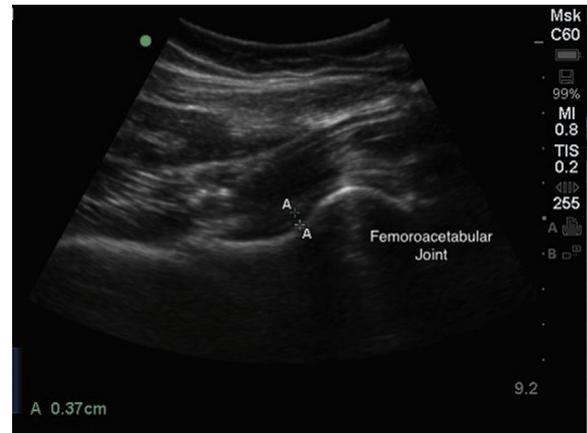


Figure 3. Normal native hip, A-A annotation denoting normal capsule at femoral neck.

identified, as with native pediatric and adult hips, this can prompt obtaining the gold standard arthrocentesis to evaluate for PJIs (1).

WHY SHOULD AN EMERGENCY PHYSICIAN BE AWARE OF THIS?

Prosthetic hip infections are difficult to identify through history and physical examination methods. POCUS is a noninvasive tool that can be used at bedside in the emergency department to evaluate for hip joint effusions in native pediatric and adult joints, and also may facilitate the diagnosis of a septic prosthetic hip joint by identifying periprosthetic fluid to prompt ordering serum laboratory tests and a diagnostic arthrocentesis. Diagnosis is important, as a septic prosthetic joint can lead to loosening of the prosthesis, systemic infection, impairment of functional status, and mortality. Treatment requires an operative washout and revision in addition to antibiotics (2,4). POCUS is utilized to evaluate painful native hips in both pediatric and adult patients and may also be a useful tool to evaluate pain in a prosthetic hip joint (6–8).

REFERENCES

1. Osmon DR, Berbari EF, Berendt AR, et al. Diagnosis and management of prosthetic joint infection: clinical practice guidelines by the Infectious Diseases Society of America. *Clin Infect Dis* 2013;56:e1–25.
2. Zajonz D, Wuthe L, Tiepolt S, et al. Diagnostic work-up strategy for periprosthetic joint infections after total hip and knee arthroplasty: a 12-year experience on 320 consecutive cases. *Patient Saf Surg* 2015;9:20.
3. Tande AJ, Palraj BR, Osmon DR, et al. Clinical presentation, risk factors, and outcomes of hematogenous prosthetic joint infection in patients with *Staphylococcus aureus* bacteremia. *Am J Med* 2016;129:221. e211–20.
4. Lenguerrand E, Whitehouse MR, Beswick AD, et al. Risk factors associated with revision for prosthetic joint infection after hip replacement: a prospective observational cohort study. *Lancet Infect Dis* 2018;18:1004–14.

5. Parvizi J, Tan TL, Goswami K, et al. The 2018 definition of periprosthetic hip and knee infection: an evidence-based and validated criteria. *J Arthroplasty* 2018;33:1309–1314. doi:10.1016/j.arth.2018.05.002.
6. Garrison J, Nguyen M, Marin JR. Emergency department point-of-care hip ultrasound and its role in the diagnosis of septic hip arthritis: a case report. *Pediatr Emerg Care* 2016;32:555–7.
7. Plumb J, Mallin M, Bolte RG. The role of ultrasound in the emergency department evaluation of the acutely painful pediatric hip. *Pediatr Emerg Care* 2015;31:54–8. quiz 59–61.
8. Minardi JJ, Lander OM. Septic hip arthritis: diagnosis and arthrocentesis using bedside ultrasound. *J Emerg Med* 2012;43:316–8.
9. Lohmann CH, Rampal S, Lohrengel M, Singh G. Imaging in periprosthetic assessment: an orthopaedic perspective. *EFORT Open Rev* 2017;2:117–25.
10. Volpe L, Indelli PF, Latella L, Poli P, Yakupoglu J, Marcucci M. Periprosthetic joint infections: a clinical practice algorithm. *Joints* 2014;2:169–74.
11. Martinoli C, Garello I, Marchetti A, et al. Hip ultrasound. *Eur J Radiol* 2012;81:3824–31.
12. Koski JM, Anttila PJ, Isomaki HA. Ultrasonography of the adult hip joint. *Scand J Rheumatol* 1989;18:113–7.
13. Burton JH, Fortuna TJ. Joints and bursae. In: Tintinalli JE, Stapczynski JS, Ma OJ, Yealy DM, Meckler GD, Cline DM, eds. *Tintinalli's Emergency Medicine: A Comprehensive Study Guide*. 8th ed. New York: McGraw-Hill Education; 2016:1927–35.
14. Hariharan P, Kabrhel C. Sensitivity of erythrocyte sedimentation rate and C-reactive protein for the exclusion of septic arthritis in emergency department patients. *J Emerg Med* 2011;40:428–31.
15. Cruz CI, Vieira RL, Mannix RC, Monuteaux MC, Levy JA. Point-of-care hip ultrasound in a pediatric emergency department. *Am J Emerg Med* 2018;36:1174–7.
16. Amanatullah D, Dennis D, Oltra EG, et al. Hip and knee section, diagnosis, definitions: proceedings of international consensus on orthopedic infections. *J Arthroplasty* 2019;34(2S):S329–37.