Diagnostic Accuracy of Various Modalities Relative to Open Bone Biopsy for Detection of Long Bone Posttraumatic Osteomyelitis

Vivek Chadayammuri, BS; Herbert Benoit; Jiandong Hao; Juan Quispe; Ji-Wan Kim, MD; Heather Young; Mark Hake, MD[1]; ***Cyril Mauffrey, MD, FACS, FRCS***
[1]University of Michigan, Ann Arbor, Michigan, United States

Purpose: Long bone posttraumatic osteomyelitis (PTOM) is a relatively common complication following surgical fixation of open fractures. Consensus is lacking as to ideal strategies for diagnostic evaluation of long bone PTOM. While open bone biopsy and culture is considered the "gold diagnostic standard," its cost and invasiveness are often prohibitive and have prompted the search for alternate diagnostic methods. The purpose of this study was to evaluate the sensitivity and specificity of various diagnostic modalities relative to open bone biopsy and culture for the detection of long bone PTOM.

Methods: A consecutive cohort of 159 adult patients presenting with long bone PTOM at our Level I trauma center between January 1, 2004 and December 31, 2013 were retrospectively identified. All included patients fulfilled diagnostic criteria for PTOM (as defined by the Centers for Disease Control and Prevention) that involved a long bone (femur, fibula, tibia, humerus, radius, and ulna). Patients with diabetic foot infection, septic arthritis, osteomyelitis of the spine/pelvis/hand, or insufficient medical records were excluded. Sensitivity and specificity of deep wound culture, soft-tissue histopathologic examination, and elevated levels of acute phase reactants (C-reactive protein [CRP], erythrocyte sedimentation rate [ESR], and leukocyte count [WBC]) were determined using findings of open bone biopsy and culture as a reference standard.

Results: The most common pathogen isolated on open bone culture was Staphylococci, contributing to 89 (57%) of 159 cases of long bone PTOM ($P < 0.001$). Relative to open bone biopsy and culture as the gold diagnostic standard, soft-tissue histopathology demonstrated a sensitivity of 69.8% (95% confidence interval [CI], 53.7-82.3%) and specificity of 38.9% (95% CI, 18.3-63.9%) for the detection of long bone PTOM. Deep wound culture exhibited a lower sensitivity of 66.0% (95% CI, 56.1-74.8%) and specificity of 28.1% (95% CI, 12.9-49.5%), a difference that was statistically significant ($P = 0.021$). Among inflammatory markers, elevated levels of CRP and ESR were equally sensitive for the detection of PTOM compared to open bone biopsy and culture, while WBC was significantly less sensitive (sensitivity, 33.2%; 95% CI, 25.3-43.7; $P < 0.001$).

Conclusion: Soft-tissue histopathologic examination, deep wound culture, and measurement of acute phase reactants are relatively poor substitutes for the diagnosis of long bone PTOM compared to open bone biopsy and culture. The accurate identification of causative pathogens underlying long bone PTOM is critical for diagnosis and choice of antibiotic treatment. Future studies investigating the use of higher-resolution diagnostic methods are merited.

See pages 401 - 442 for financial disclosure information.