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Complications - Infection

Diagnosing Infection in the Setting of Periprosthetic Fractures

Roshan P. Shah, MD [a, *], Darren R. Plummer, MD, MBA [a], Mario Moric, MS [a], Scott M. Sporer, MD [a, b], Brett R. Levine, MD [a], Craig J. Della Valle, MD [a]

[a] Department of Orthopaedic Surgery, Rush University Medical Center, Chicago, Illinois
[b] Department of Orthopaedic Surgery, Joint Replacement Institute, Central Dupage Hospital, Illinois

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ABSTRACT

Background: The diagnosis of periprosthetic joint infection is particularly challenging in patients with periprosthetic fractures. The purpose of this study was to investigate the utility of commonly used diagnostic tests for periprosthetic joint infection in patients with a periprosthetic fracture.
Methods: Of 121 patients treated with a periprosthetic fracture (97 hips, 24 knees, mean age: 72.9), 14 (11.6%) met Musculoskeletal Infection Society criteria for infection. Diagnostic variables were evaluated using logistic regression models for the prediction of infection and receiver operating characteristics curves.
Results: The synovial white blood cell (WBC) count and differential were the best diagnostic tests, with good test performance (area under the curve, 84%) and optimal cutoffs of 2707 WBC/uL and 77% polymorphonuclear cells. The erythrocyte sedimentation rate and C-reactive protein were found to have overall lower test performance but remained relatively sensitive at standard cutoff values of 30 mm/h and 10 mg/L, respectively.
Conclusion: The synovial fluid WBC count and differential are the best tests with optimal cutoff values that are similar to those used for patients without a periprosthetic fracture.
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Periprosthetic joint infection (PJI) and periprosthetic fracture are individually devastating events to arthroplasty patients. They can occur concomitantly, with a reported rate of chronic infection of 10.3% of periprosthetic fractures in one series (21 infections in 204 periprosthetic hip fractures) [1]. Successful treatment of these fractures requires knowing that a deep infection exists, as treatment will be different if PJI is present.

Diagnosis of PJI in the setting of periprosthetic fracture can be particularly challenging given the need for surgical intervention in a short time frame and concerns that recent trauma may elevate serum and synovial fluid markers which are commonly used for the diagnosis of PJI [1-4]. In most patients requiring a revision, serum erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) and intraoperative frozen section analysis can help diagnose PJI. In contrast, the reliability of these tests has been questioned in the setting of periprosthetic fractures [1-3]. Aspirations for culture and biomarker evaluation are options; however, these can delay diagnosis for several days, which is undesirable for patients waiting for fracture treatment.

Prior work has suggested the utility of the synovial fluid white blood cell (WBC) count and differential for diagnosis of PJI [5]; however, the utility of these tests in the setting of a periprosthetic fracture has not previously been specifically analyzed. Hence, the purpose of this study was to investigate the utility of commonly used diagnostic tests for PJI in patients with periprosthetic fractures and determine optimal cutoff values for the synovial fluid WBC and differential.

Methods

After institutional review board approval, we identified 121 patients (97 hips, 24 knees) with periprosthetic fractures treated operatively by 3 surgeons between 2002 and 2013; a subset of these patients have been analyzed previously as part of prior work on the diagnosis of PJI [5-7]. Mean age of the cohort was 72.9 (range, 34-94) years and included 93 females (77%). On average, fracture occurred 4.8 years after the index surgery, with a range of 7 days to 30.2 years.

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* Reprint requests: Roshan P. Shah, MD, Department of Orthopedic Surgery, Columbia University, 622 West 168th Street, PH-11, New York, NY 10032-3720.

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Table 1
Mean Values of Test Measures Between Infected and Not-Infected Groups.

Test Measure	Infected (N = 14)	Not Infected (N = 107)	*P* Value
ESR (mm/h)	55.4 (20-90)	35.4 (5-79)	<.01
CRP (mg/L)	49.8 (1-207)	28.0 (0.5-197)	.1
WBC count (/uL)	12,186 (2707-53,845)	2473 (30-15,570)	<.001
%PMNs	87.6 (77-98)	57.8 (2-100)	<.001

ESR, erythrocyte sedimentation rate; CRP, C-reactive protein; WBC, white blood cell; %PMNs, percent polymorphonuclear leukocytes.

Fourteen (11.6%) patients met Musculoskeletal Infection Society criteria for PJI [1]. Preoperative or intraoperative synovial fluid WBC count and percent polymorphonuclear leukocytes (%PMNs), preoperative ESR and CRP values, and synovial fluid culture results were compared between patients who did and did not meet Musculoskeletal Infection Society criteria for PJI.

Normally distributed univariate data were analyzed using *t* tests. Diagnostic variables were evaluated using logistic regression models for the prediction of infection. Youden's J statistic was used

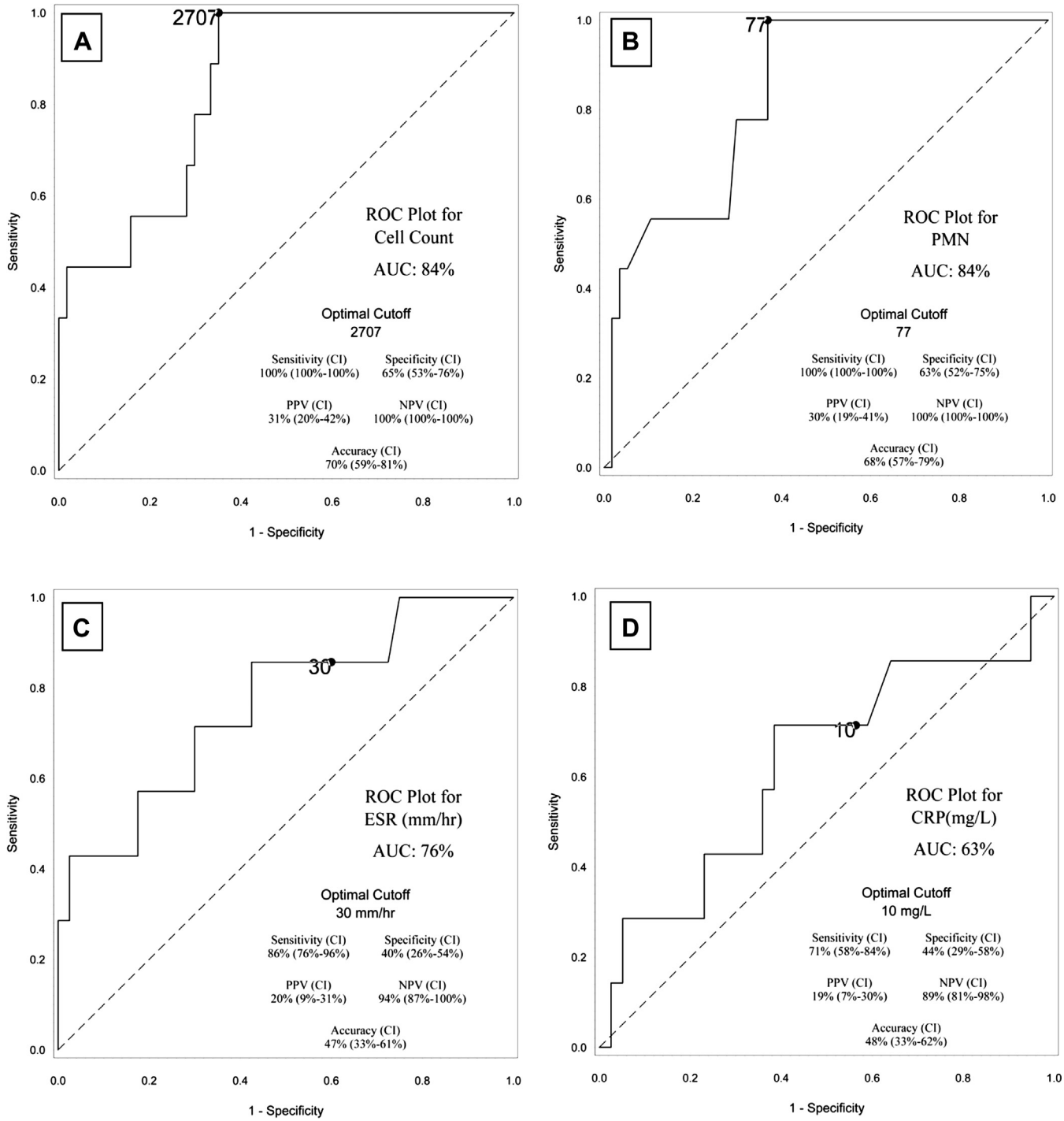

Fig. 1. ROC curves for white blood cell count (A, cells/uL), %PMNs (B), ESR (C, mm/h), and CRP (D, mg/L). AUC, area under the curve; ROC, receiver operating characteristic; %PMNs, percent polymorphonuclear leukocytes; ESR, erythrocyte sedimentation rate; CRP, C-reactive protein; PPV, positive predictive value; NPV, negative predictive value.

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