Clin Orthop Relat Res (2011) 469:2992–2994
DOI 10.1007/s11999-011-2102-9

Clinical Orthopaedics and Related Research®
A Publication of The Association of Bone and Joint Surgeons®

SYMPOSIUM: PAPERS PRESENTED AT THE 2010 MEETING OF THE MUSCULOSKELETAL INFECTION SOCIETY

New Definition for Periprosthetic Joint Infection

From the Workgroup of the Musculoskeletal Infection Society

Javad Parvizi MD, Benjamin Zmistowski BS, Elie F. Berbari MD, Thomas W. Bauer MD, PhD, Bryan D. Springer MD, Craig J. Della Valle MD, Kevin L. Garvin MD, Michael A. Mont MD, Montri D. Wongworawat MD, Charalampos G. Zalavras MD

Published online: 22 September 2011

Introduction

Periprosthetic joint infection (PJI) is one of the most challenging and frequent complications after lower-extremity joint (hip and knee) arthroplasty. However, there is no single accepted set of diagnostic criteria for PJI. Various definitions have been proposed; however, none have been widely adopted. Furthermore, some of these definitions disagree with each other [14]. Therefore, a workgroup convened by the Musculoskeletal Infection Society (MSIS) analyzed the available evidence to propose a new definition for PJI. A summary of recommendations of those in attendance at a premeeting workshop of the 21st Annual Meeting of the MSIS on August 4, 2011, pertaining to the definition of PJI is outlined below. Existing published data on the definition of PJI was discussed by e-mail in the preceding 6 months by the executive members of the MSIS and a group of experts with known interest in this field. The intention of this proposal is to have a "gold standard" definition for PJI that can be universally adopted by all physicians, surveillance authorities (including the Centers for Disease Control, medical and surgical journals, the medicolegal community), and all involved in management of PJI. The panel acknowledged, in certain low-grade

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All ICMJE Conflict of Interest Forms for authors and *Clinical Orthopaedics and Related Research* editors and board members are on file with the publication and can be viewed on request.

J. Parvizi (✉), B. Zmistowski
The Rothman Institute of Orthopaedics at Thomas Jefferson University Hospital, 925 Chestnut Street, 5th Floor, Philadelphia, PA 19107, USA
e-mail: research@rothmaninstitute.com

E. F. Berbari
Division of Infectious Diseases, Mayo Clinic, Rochester, MN, USA

T. W. Bauer
Department of Anatomic Pathology, The Cleveland Clinic Foundation, Cleveland, OH, USA

B. D. Springer
Department of Orthopaedic Surgery, OrthoCarolina Hip and Knee Center, Charlotte, NC, USA

C. J. Della Valle
Department of Orthopaedic Surgery, Rush University Medical Center, Chicago, IL, USA

K. L. Garvin
Department of Orthopaedics, University of Nebraska Medical Center, Omaha, NE, USA

M. A. Mont
Center for Joint Preservation and Replacement, Rubin Institute for Advanced Orthopedics, Sinai Hospital of Baltimore, Baltimore, MD, USA

M. D. Wongworawat
Department of Orthopaedic Surgery, Loma Linda University Medical Center, Loma Linda, CA, USA

C. G. Zalavras
Department of Orthopaedic Surgery, University of Southern California, LAC+USC Medical Center, Los Angeles, CA, USA

infections (ie, Propionibacterium acnes), several of these criteria may not be routinely met despite the presence of PJI. Using this definition, clinicians can be confident in their diagnosis and therefore provide appropriate treatment. Additionally, adoption of this definition for research purposes will allow for consistency between studies and potential improvement of the quality of the published body of evidence.

Definition of Periprosthetic Joint Infection

Based on the proposed criteria, definite PJI exists when:

(1) There is a sinus tract communicating with the prosthesis; or
(2) A pathogen is isolated by culture from at least two separate tissue or fluid samples obtained from the affected prosthetic joint; or
(3) Four of the following six criteria exist:
    (a) Elevated serum erythrocyte sedimentation rate (ESR) and serum C-reactive protein (CRP) concentration,
    (b) Elevated synovial leukocyte count,
    (c) Elevated synovial neutrophil percentage (PMN%),
    (d) Presence of purulence in the affected joint,
    (e) Isolation of a microorganism in one culture of periprosthetic tissue or fluid, or
    (f) Greater than five neutrophils per high-power field in five high-power fields observed from histologic analysis of periprosthetic tissue at ×400 magnification.

PJI may be present if fewer than four of these criteria are met.

Considerations

Microbiologic Testing

It is imperative that tissue for culture be obtained from representative periprosthetic tissue or fluid. To limit the risk of contamination, each sample should be taken with separate, sterile instruments. The definition of phenotypically identical organisms should be based on phenotypic similarities and in vitro antimicrobial susceptibility testing since confirmation of genetic identity is not routinely performed on clinical isolates. We recommend that at least three and no more than five periprosthetic specimen culture samples are taken and incubated in an aerobic and anaerobic environment. Fungal and mycobacterial cultures should not be performed routinely and reserved to higher-risk scenarios. The time of culture incubation has not been standardized yet. Isolation of a single low-virulence pathogen such as coagulase-negative Staphylococcus, P. acnes, or Corynebacteria in the absence of other criteria is not believed to represent a definite infection. Isolation of a single virulent organism such as S. aureus may represent a PJI. Furthermore, recent evidence has identified that certain tests, such as Gram stain, of periprosthetic tissue or fluid are not sensitive in diagnosing PJI [7].

Serum Tests

Based on previous publications, an ESR of greater than 30 mm/hour and a CRP of greater than 10 mg/L would represent elevated levels [11, 15]. However, it is important to note there are variations in measuring these markers between laboratories. Furthermore, the level of these serum markers is affected by age, sex, and medical comorbidities of the patient. It has also been reported these markers can be elevated for approximately 30 to 60 days in the immediate postoperative period [3, 9].

Synovial Tests

Multiple studies have provided thresholds for synovial leukocyte count and PMN% in the differential. In the chronically infected knee arthroplasty, these values have been reported from 1100 to 4000 cells/μL and 64% to 69%, respectively [5, 8, 16]. In patients with acute infections, the levels of synovial cell count and PMN% are much higher (approximately 20,000 cells/μL and 89%, respectively). Acute infections are defined as less than 3 months from index surgery or from the onset of symptoms [1]. The levels of synovial cell count and PMN% in the infected hip arthroplasty are not well delineated. A sole study has provided a threshold of 3000 cells/μL for leukocytes and 80% for PMN% for the infected hip arthroplasty [15]. None of these studies have included patients with underlying inflammatory arthropathies and related diseases. Current research is proceeding to provide more definitive thresholds for all patients.

Histology

Examination of periprosthetic tissues for evidence of neutrophils has been traditionally conducted by specially trained musculoskeletal pathologists. Histologic examination consequently may be operator dependent. It is therefore incumbent on surgeons to ensure their pathologists are in agreement with the diagnostic criteria for PJI. When examining for the presence of neutrophils, the histopathologist

should disregard neutrophils entrapped in superficial fibrin or adherent to endothelium or small veins. Also, caution should be exercised in analyzing this test in cases where elevated neutrophil count might be expected, such as recent periprosthetic fractures or inflammatory arthropathy.

Future Developments

This proposed definition was based on current evidence supporting the role of various tests in diagnosis of PJI that are available in the literature. We recognize there are numerous other tests currently being evaluated, including measurement of CRP from the synovial fluid [12], synovial leukocyte esterase [13], sonication of explanted prosthetics [17], and molecular techniques such as PCR [10] and other molecular markers such as IL-6 [2, 4, 6]. As these or other techniques become validated and widely available, the currently proposed definition may require modification.

Acknowledgments We thank the following individuals for their involvement and invaluable input throughout the development of this document: Robert Barrack MD, Keith Berend MD, Sandra Berrios-Torres (from Centers for Disease Control and Prevention), Kevin Bozic MD, John Esterhai MD, Ryan Fagan (from Centers for Disease Control and Prevention), Thomas Fehring MD, Terry Gioe MD, Teresa Horan (from Centers for Disease Control and Prevention), Steven Kurtz PhD, Bas Masri MD, Arvind Nana MD, Douglas Osmon MD, John Segreti MD, and Mark Spangehl MD.

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