

Microbiological Profile of Prosthetic Joint Infections in Orthopaedic Oncology

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INTRODUCTION: Periprosthetic joint infections (PJI) are a devastating complication after reconstruction with megaprosthesis in orthopaedic oncology. PJI severity is further compounded by the unique immunologic considerations in oncology—chronic immunodeficiency, systemic and radiation therapy, increased surgical complexity—as well as tumor-microbiome interactions that may put patients at increased risk. Despite significant efforts to characterize the microbiologic profile of PJI in traditional joint arthroplasty, data is lacking for oncologic patients with megaprosthesis. The objective of this study was to characterize causative microorganisms and time-to-positivity (TTP) of PJI in oncologic patients at our institution, with subanalyses for cancer type and primary tumor characteristics.

METHODS: A retrospective review of our institutional megaprosthesis database was conducted. We reviewed tissue and fluid cultures for patients diagnosed with PJI—defined using the 2011 Musculoskeletal Infection Society criteria—between the years 2000 and 2022. All positive causative microorganisms, including the number of samples, specimen type, identified pathogen, and TTP, were recorded and assessed, along with basic oncologic data. Median and interquartile ranges were used to describe continuous variables, and comparisons were made using the Mann-Whitney U test.

RESULTS: We included 75 patients diagnosed with megaprosthesis PJIs (Table 1). Patients primarily consisted of those with a McPherson host grade B (84%) and metastatic bone disease (85%), and half of patients received prior radiation therapy (Table 1). PJI classification of acute versus chronic PJI was relatively balanced (42% vs. 57%), and in most cases, patients underwent proximal (31%) or distal (41%) femur replacement (Table 2). The six most prevalent pathogens isolated in cultures were *Staphylococcus epidermidis* (n=63), *Staphylococcus aureus* (n=48), *Enterococcus spp.* (n=35), *Streptococcus spp.* (n=32), *Coagulase negative staphylococcus* (n=21) and *Gram-negative rods* (n=20) (Figure 1). Differences in microorganism prevalence were observed between primary vs. metastatic bone disease (Figure 2A), bone vs. soft tissue sarcoma (Figure 2B), and bone tumor histology (Figure 2C). TTP varied among microorganisms and differed significantly (p <0.05) between gram-positive vs. gram-negative bacteria (Figure 3A), culture origin (bone, soft tissue, or synovial fluid) (Figure 3B), and culture method (broth only vs. broth and solid media) (Figure 3C). Of the more common pathogens, *Streptococcus epidermidis*, *Streptococcus lugdunensis*, *Fingoldia magna*, and *Corynebacterium* had the longest TTPs (Figure 4). TTP varied widely among microorganism species (Table 3).

DISCUSSION AND CONCLUSION: While the causative microorganisms in oncologic PJI were broadly similar to those in traditional joint arthroplasty literature, there are pointed differences in prevalence and TTP by subpopulation. These differences may be the result of cancer-driven microbiome disruptions in oncologic patients. Cultures in megaprosthesis PJI should be held for at least two weeks if positivity is not achieved sooner. Further investigation is needed to understand the mechanisms behind these differences to provide prompt, individualized, and targeted antimicrobial therapy for this at-risk population.

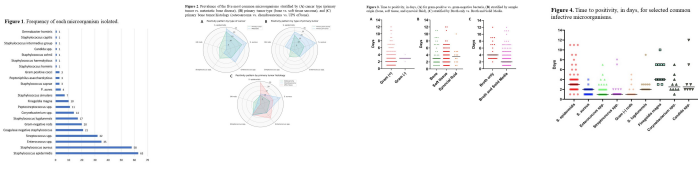
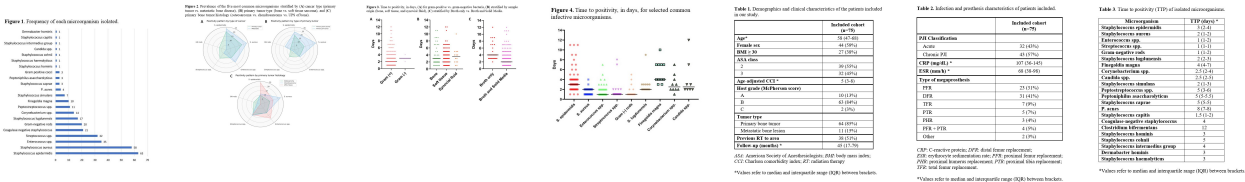


Table 1. Demographics and clinical characteristics of patients included in the study	
Characteristic	Frequency (n)
Age*	60 (80%)
Gender	48 (64%)
McPherson host grade	63 (84%)
Metastatic bone disease	64 (85%)
Primary tumor site	31 (41%)
Distal femur replacement	31 (41%)
Proximal femur replacement	44 (59%)
Prior radiation therapy	37 (49%)
Acute vs. chronic PJI	32 (42%)

Table 2. Infection and pathogen characteristics of patients included in the study	
Characteristic	Frequency (n)
PJI Classification	32 (42%)
Acute	32 (42%)
Chronic	43 (57%)
Culture origin	63 (84%)
Broth only	32 (42%)
Broth and solid media	31 (41%)
Type of organism	63 (84%)
Gram-positive	32 (42%)
Gram-negative	31 (41%)
Pathogen	63 (84%)
Staphylococcus epidermidis	63 (84%)
Staphylococcus aureus	48 (64%)
Enterococcus spp.	35 (47%)
Streptococcus spp.	32 (42%)
Coagulase negative staphylococcus	21 (28%)
Gram-negative rods	20 (27%)

Table 3. Time to positivity (TTP) of isolated microorganisms	
Microorganism	TTP (days)
<i>Staphylococcus epidermidis</i>	10.0
<i>Staphylococcus aureus</i>	10.0
<i>Enterococcus spp.</i>	10.0
<i>Streptococcus spp.</i>	10.0
<i>Coagulase negative staphylococcus</i>	10.0
<i>Gram-negative rods</i>	10.0
<i>Streptococcus epidermidis</i>	10.0
<i>Streptococcus lugdunensis</i>	10.0
<i>Fingoldia magna</i>	10.0
<i>Corynebacterium</i>	10.0

*Values refer to median and interquartile range (IQR) between brackets.