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Risk of Periprosthetic Joint Infection in Patients With Multiple Arthroplasties

W. Parker Abblitt, MD *, Emily W. Chan, BA, Andrew A. Shinar, MD

Department of Orthopaedic Surgery, Vanderbilt University Medical Center, Medical Center East, Nashville, Tennessee

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ABSTRACT

Background: Risk of subsequent periprosthetic joint infection (PJI) in a second prosthetic joint following initial PJI has been shown to be 19%-20%. We sought to identify (1) the risk of developing a second PJI for our patients with multiple prosthetic joints and (2) the effect of bacteremia on development of a subsequent PJI.

Methods: We retrospectively reviewed all patients treated surgically for PJI by a single surgeon from 2003 to 2014. Time between initial and subsequent infection, bacteremia, and risk factors for PJI were identified.

Results: Of 167 patients treated for PJI, 76 had multiple prosthetic joints. Thirteen percent (10/76) developed a PJI in a second location. Excluding simultaneous infections, the rate was 8.3% (6/72), despite having a 57% incidence of immunosuppression, diabetes, renal failure, smoking, or steroid use. Average follow-up for patients with 1 PJI was 4.6 years (range 0.03-13.6). Seventy percent (7/10) of patients with multiple infections were bacteremic at the time of initial infection compared to 18.1% (12/66) of patients with a single infection ($P = .0004$). Excluding the 4 simultaneous infections (all bacteremic), the risk of developing an infection in a second joint was 20% if bacteremic and 5.2% if not bacteremic.

Conclusion: Our study identified the risk of developing a subsequent PJI to be one half of previous studies. Bacteremia at the time of PJI is an important factor for developing subsequent PJI. Multiple prosthetic joints may be less hazardous than previously thought for patients with PJI suggesting that suppressive antibiotics may only be necessary in cases with bacteremia.

Total joint arthroplasty (TJA) is one of the most successful surgeries in medicine with over 1.2 million hip and knee replacements performed in 2014 [1]. By 2030, that number is expected to exceed 3.4 million due to the growing and aging population [2]. The vast majority of patients undergoing TJA will experience excellent outcomes, yet failure of a TJA can be grievous.

Periprosthetic joint infections (PJI) are of particular interest; they are one of the most common modes for prosthetic joint failure, have devastating consequences with cost >$50,000 per episode, and have mortality rates as high as 2.5%-3% [3–5]. Currently, over 45% of patients who have one TJA go on to have a second joint replacement [6]. This population with multiple prosthetic joint replacements is likely to rise in the future. Other studies have demonstrated that remote infections have been shown to increase the risk of bacterial seeding and PJI [7–9]. Given these concerns, it is essential to establishing the risk of developing an additional, second infection of a coexisting prosthesis for patients diagnosed with initial PJI and to determine the role of bacteremia.

Murray et al [10] defined metachronous infection as an infection spread from one arthroplasty to a second, separate joint replacement. Their work estimated the risk of hematogenous spread to be 18% and also found no significant relationship with several risk factors for infection including rheumatoid arthritis and corticosteroid use. Further work by Luessenhop et al and Jafari et al demonstrated similar results with risk of 19% and 20% respectively but also suggested that rheumatoid arthritis may increase the risk of subsequent infection [11,12]. Bacteremia was mentioned in these studies, but it was not explicitly evaluated as part of the associated risk for development of a second synchronous or metachronous infection.

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* Reprint requests: W. Parker Abblitt, MD, Vanderbilt Orthopaedic Institute, Medical Center East, South Tower, Suite 4200, 1215 21st Ave. S., Nashville, TN 37232-8774.

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Table 1
MSIS Criteria for Periprosthetic Joint Infection.

Major Criteria	Minor Criteria
1. Sinus tract communicating with prosthesis 2. Pathogen isolated from fluid/tissue culture from 2 separate samples	1. CRP > 10 mg/L or ESR > 30 mm/h 2. Elevated synovial WBC • >1100 for knee • >3000 for hip 3. Elevated synovial PMN • >64% for knee • >80% for hip 4. Purulence in joint 5. Pathogen isolation from single culture 6. >5 PMN per HPF

CRP, C-reactive protein; ESR, erythrocyte sedimentation rate; WBC, white blood cell; MSIS, Musculoskeletal Infection Society; HPF, high power field; PMN, polymorphonuclear neutrophil.

Through this study, we sought to identify (1) the risk of developing a second PJI in a different location for our patient population with multiple prosthetic joints and (2) the effect of bacteremia on development of a subsequent PJI. We hypothesized that the risk of a second PJI infection in this population is lower than previous studies suggest and that bacteremia is a significant risk factor for the development of a second, distant infection of a coexisting prosthesis.

Materials and Methods

Our total joint database was used to identify patients treated for PJI by a single surgeon from 2003 to 2014. Periprosthetic infection was defined using Musculoskeletal Infection Society criteria (Table 1). One major criterion or at least 4 minor criteria were considered diagnostic of PJI. Inclusion criteria was set to include (1) patients treated for PJI from our joint database and (2) patients with multiple major TJAs at the time of treatment for PJI. Major joint arthroplasties were limited to include only shoulder, hip, and knee arthroplasties. Patients were excluded if (1) no second TJA was able to be identified in chart review or (2) the second joint replacement was performed after PJI. Medical records were used to select patients who met both inclusion and exclusion criteria. Clinical notes, operative reports, radiographic reports, and images were all used. We had prior approval of our institutional review board from this study.

A retrospective chart review was performed on all patients who met inclusion and exclusion criteria. Basic demographic data were collected including age, gender, and body mass index. General information on the joint arthroplasties was collected and included anatomic site (hip/knee/shoulder), laterality, and total number of joint replacements. Dates were recorded at initial infection, subsequent infection, and final patient follow-up at our institution. Final follow-up date was determined exclusively by appointments with the orthopedic, infectious disease, or rheumatology departments. Patient-specific factors were also collected. These included patient comorbidities (end stage renal disease, diabetes, or autoimmune disease), tobacco use, or immunosuppressive medication.

Detailed information regarding specifics of all PJIs was collected. Infectious organism at the time of both initial and subsequent infection was identified. Additionally, blood culture status at the time of initial hospitalization was reviewed and recorded. For our study, bacteremia was defined as one positive blood culture at the time of hospitalization for initial infection.

Patients were subdivided into 2 groups: those with simultaneous infections and those with metachronous infections. Simultaneous infections were defined by diagnosed second PJI <10 days. Basic statistical analysis was performed including Student's t-test for continuous variables and chi-squared test for categorical variables.

Results

Of 167 patients treated for PJI, 76 patients were identified to have multiple prosthetic joints at the time of initial infection. The average age of patients with multiple joint replacements was 63.4 years (range 36-84) and 40.8% (31/76) were male. The 76 patients had a total of 174 joint replacements.

Thirteen percent (10/76) of patients developed a PJI in a second location. Four of these patients presented with simultaneous infections. When simultaneous infections were eliminated, the rate of metachronous PJI was found to be 8.3% (6/72). Seven (70%) patients

Table 2
Patient Characteristics, Comorbidities, and Rate of Bacteremia for All Patients.

Variable	Single Joint PJI (n = 66)	All Multiple PJIs (n = 10)	*P*-Value	Metachronous PJI (n = 6)	Simultaneous PJI (n = 4)
Age	62.8	66.9	.295	68.0	64.8
Male gender	39.4%	50%	.525	33.3%	75%
BMI	33.3	31.1	.429	34.0	26.7
Months from first PJI	N/A	20.9		34.8	N/A
Number of joint replacements			.175		
2 arthroplasties	52 (78.8%)	7 (70.0%)		3 (50.0%)	4 (100%)
3 arthroplasties	11 (16.7%)	1 (10.0%)		1 (16.7%)	0 (0%)
4 arthroplasties	3 (4.5%)	2 (20.0%)		2 (33.3%)	0 (0%)
Second infection location					
Ipsilateral hip	–	0 (0%)		0 (0%)	0 (0%)
Ipsilateral knee	–	2 (20.0%)		1 (16.7%)	1 (25.0%)
Contralateral hip	–	1 (10.0%)		1 (16.7%)	0 (0%)
Contralateral knee	–	7 (70.0%)		4 (66.7%)	3 (75.0%)
Pertinent comorbidities					
Diabetes	17 (25.8%)	5 (50.0%)		3 (50.0%)	2 (50.0%)
Chronic renal failure	11 (16.7%)	1 (10.0%)		1 (16.7%)	0 (0%)
Tobacco use	11 (16.7%)	0 (0%)		0 (0%)	0 (0%)
Autoimmune disease	20 (30.3%)	2 (20.0%)		1 (16.7%)	1 (25.0%)
Immune modifying meds	9 (13.6%)	0 (0%)		0 (0%)	0 (0%)
Any comorbidity	40 (60.6%)	8 (80.0%)	.236	4 (66.7%)	2 (50.0%)
Bacteremic at initial infection	12 (18.1%)	7 (70.0%)	**.0004**	3 (50%)	4 (100.0%)
Average# surgeries related to infections	2.68	2.7		3.3	1.75

Bold value indicates statistical significance at *P*-value < .05.
BMI, body mass index; N/A, not applicable.