Metachronous Periprosthetic Joint Infection in Patients with Multiple Arthroplasties at Index Infection

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Introduction

Periprosthetic joint infection (PJI) is a devastating complication of one of the most successful surgeries in medicine. About 1% to 2% of patients will develop PJI after primary total hip arthroplasty (THA) or primary total knee arthroplasty (TKA) [1]. The 5-year patient survival rate of THA PJI is estimated to be worse than that of common cancers, such as breast cancer [2]. The burden of this disease is likely to increase exponentially as the population ages and the number of patients undergoing total joint arthroplasties increases in the future [3].

Most devastating is what Murray et al deem as metachronous periprosthetic joint infection (MPJI) in which patients are surgically treated for an initial PJI and then develop a subsequent PJI at a second site [4]. The incidence of MPJI has been estimated to be between 6.3% and 20% [5-6]. There has been a discordance in the risk factors for MPJI, as reported in several existing studies. Most evidence has supported rheumatoid arthritis, sepsis or systemic inflammatory response syndrome at the time of initial PJI, MRSA-positive intraoperative cultures, more than 3 stages of resection arthroplasty, longer length of hospitalization, and an index knee prosthesis as the likely risk factors.

Aims and Objectives

The objective of our study is to determine (1) MPJI incidence, (2), time to MPJI, (3) MPJI risk factors, (4) organism profile, and (5) the relationship of index PJI and laterality of MPJI.

Methods

This retrospective study was conducted at a single tertiary referral center with 11 fellowship-trained surgeons. After IRB approval, 1654 patients with PJI of a total hip or knee arthroplasty (2013–2022) were identified using billing codes. Diagnosis was confirmed via the 2018 MSIS criteria. Patients with additional arthroplasties at the time of index PJI were classified by laterality. Only those with ≥2 years of follow-up were included; synchronous PJIs (<10 days apart) were excluded.

Demographic data, medical comorbidities, arthroplasty details, and interim procedures were collected. All positive cultures within six months of PJI were recorded, including non-prosthetic infections. PJI timing was categorized as acute (<4 weeks), subacute (4 weeks–12 months), or chronic (>12 months). Culture data were stratified by pathogen relatedness and biofilm propensity. Surgical treatment was at the surgeon's discretion, with routine infectious disease consultation.

Outcomes were classified as eradication, non-eradication (requiring antibiotic suppression or spacer), or failure (fusion, Girdlestone, or amputation). Recurrent infection was defined as a new infection ≥6 months after eradication. MPJI cases were compared to non-MPJI cases.

Categorical variables were analyzed as percentages. Continuous variables were analyzed as means and standard deviations. Comparisons were carried out using a *Chi*-square test or Fisher's exact test with significance set at alpha 0.05.

Results

Variable	Single PJI (n = 196)	MPJI (n = 9)	P-value
Male/Female	90/106	3/6	0.45[3]
Age, mean, y	62.88 ± 11.52	57.05 ± 13.72	0.14[1]
BMI, mean, kg/m2 (SD)	33.9 ± 8.5	37.9 ± 9.6	0.17[1]
ASA Status at index PJI surgery (SD)	2.8 ± 0.56	2.7 ± 0.44	0.57[1]
Hypertension, n. (%)	153 (80%)	8 (88%)	0.43[3]
Type 2 diabetes mellitus, n. (%)	57 (30%)	2 (22%)	0.65[3]
Renal insufficiency, n. (%)	29 (15%)	0	0.21[3]
Existing ASCVD, n. (%)	66 (34%)	4 (44%)	0.5[3]
Heart failure, n. (%)	17 (8%)	1 (11%)	0.8[3]
Atrial fibrillation, n. (%)	41 (21%)	1 (11%)	0.47[3]
COPD, n. (%)	25 (13%)	2 (22%)	0.41[3]
Asthma, n. (%)	31 (16%)	4 (44%)	**0.02**[3]
Cirrhosis, n. (%)	8 (4%)	0	0.53[3]
History of DVT, n. (%)	44 (23%)	1 (11%)	0.42[3]
Depression or anxiety, n. (%)	78 (41%)	5 (55%)	0.34[3]
Malignancy, n. (%)	45 (23%)	3 (33%)	0.47[3]
Thyroid disease, n. (%)	52 (27%)	2 (22%)	0.77[3]
Rheumatoid arthritis, n. (%)	17 (8%)	3 (33%)	**0.014**[3]
Seronegative spondyloarthropathy, n. (%)	6 (3%)	1 (11%)	0.19[3]
Immunosuppressant use, n. (%)[a]	22 (11%)	3 (33%)	**0.047**[3]
Alcohol abuse, n. (%)	12 (6.3%)	1 (11%)	0.54[3]
Current tobacco use, n. (%)	23 (12%)	2 (22%)	0.34[3]

Table 2. Characteristics of patients with single and second-site PJI
BMI, body mass index; ASA, american society of anesthesiologists; ASCVD, atherosclerotic cardiovascular disease; COPD, chronic obstructive pulmonary disease; DVT, deep vein thrombosis.
[a] Immunosuppressants include corticosteroids, disease-modifying anti-rheumatic drugs, and biologics
[1]Unequal variance two sample t-test; [2]Fisher Exact p-value; [3]Chi-Square p-value

Acknowledgements

Special thanks to my OUWB classmate, Daniel Nikolaidis and Corewell Health orthopedic surgery fellow, Dr. Andrew Steffensmeier. Additional thanks to our principal investigators, Dr. Robert Runner and Dr. Mark Karadsheh.

Conclusions

Patients who have host risk factors for MPJI would likely benefit from regular follow up as well as patient education on early signs of infection. The risk of MPJI is increased in patients who have asthma, rheumatoid arthritis and taking immunosuppressive medications. Finally, surgeons should familiarize themselves with the identified risk factors for MPJI when discussing risks and benefits associated with revision procedures.

References

[1] Ayoade F, Li DD, Mabrouk A, Todd JR. Periprosthetic Joint Infection. StatPearls, Treasure Island (FL): StatPearls Publishing; 2024.

[2] Natsuhara KM, Shelton TJ, Meehan JP, Lum ZC. Mortality During Total Hip Periprosthetic Joint Infection. J Arthroplasty 2019;34:S337–42. https://doi.org/10.1016/j.arth.2018.12.024.

[3] Zmistowski B, Karam JA, Durinka JB, Casper DS, Parvizi J. Periprosthetic joint infection increases the risk of one-year mortality. J Bone Joint Surg Am 2013;95:2177–84. https://doi.org/10.2106/JBJS.L.00789.

[4] Singh JA, Yu S, Chen L, Cleveland JD. Rates of Total Joint Replacement in the United States: Future Projections to 2020-2040 Using the National Inpatient Sample. J Rheumatol 2019;46:1134–40. https://doi.org/10.3899/jrheum.170990.

[5] Murray RP, Bourne MH, Fitzgerald RH. Metachronous infections in patients who have had more than one total joint arthroplasty. J Bone Joint Surg Am 1991;73:1469–74.

[6] Clesham K, Hughes AJ, O' hEireamhoin S, Fleming C, Murphy CG. Second-site prosthetic joint infection in patients with multiple prosthetic joints. Eur J Orthop Surg Traumatol 2018;28:1369–74. https://doi.org/10.1007/s00590-018-2189-8.