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Complications - Infection

Recurrent Periprosthetic Joint Infection After Irrigation and Debridement With Component Retention Is Most Often Due to Identical Organisms

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ABSTRACT

Background: Irrigation and debridement with prosthetic retention (I&D) is an oft-utilized treatment option for PJI, despite its known limited success. While it is known that nearly half of all patients treated with I&D have recurrent infection, the organism persistence between infection events remains unreported. In addition, identifying those cases in which I&D routinely failed to eradicate the infection (not simply prevent recurrent infection) may allow improved patient selection for this less morbid procedure—a difficult task to date.

Methods: Using an institutional database, 146 patients (153 joints) undergoing I&D between April 2000 and July 2013 were identified. There were 60 hips (40%). The overall success rate of I&D in this group was 52% (80/153). The failure group was limited to those patients with growth on culture at both initial failure and recurrent failure (46 cases). Analyses were performed to identify potential predictors of failed I&D and organism persistence in those cases.

Results: In the study group, 83.7% (36/43) of cases failed with the same organism. Knees with failed I&D had an organism persistence of 92.3% (24/26) compared with 70.5% (12/17; $P = .09$) for the hip. Patients initially infected with *Staphylococcus aureus* (specifically methicillin-resistant [13/13]) had a higher risk of persistent PJI (96%; 24/25) compared to other organisms (66.7%; 12/18; $P = .01$).

Conclusion: I&D had a success rate of approximately 50% and typically failed due to organism persistence rather than a new infection. Given that persistent infection was most common in knees and *S aureus*, I&D should have a limited role in treating PJI, especially in these cases.

Rarely is a total joint arthroplasty unsuccessful in managing debilitating end-stage hip or knee arthritis [1-3]. However, the arthroplasty surgeon is always cognizant of the risk of periprosthetic joint infection (PJI). While it remains an uncommon complication, PJI is a devastating complication requiring surgical intervention, long-term antibiotics, and may lead to impaired joint function and decreased activity tolerance [4-6]. With the increasing burden, PJI is placing on the arthroplasty community; substantial efforts, including research, have been devoted to further understanding this pathology. This research has shown a significant relationship between the development of PJI and mortality [7,8]. In addition, many patients diagnosed with PJI ultimately require multiple surgical interventions, increasing the burden on the medical community and delaying a successful return to daily activities for the patient [9-12].

Two-stage exchange, consisting of thorough irrigation and debridement with complete resection of the prosthetic and any surrounding cement and insertion of an antibiotic-loaded cement spacer followed by reimplantation 6-12 weeks later, has become the defacto "gold-standard" for treating PJI [6,13,14]. In attempts to minimize the morbidity associated with prolonged nonfunctioning joint mobility and significant bone loss associated with 2-stage exchange, irrigation and debridement of the joint with prosthetic retention and exchange of modular components (I&D) is an often

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utilized procedure, especially in acute onset of infectious symptoms. Unfortunately, this approach is associated with less than 50% likelihood of permanent infection eradication [15-19].

An improved understanding of the characteristics of I&D failure will allow targeted use of this less morbid PJI treatment. A review of patients treated with 2-stage exchange showed that when recurrent infection occurred, it was more often with a new infecting organism rather than persistent infection [20]. It is unknown if this pattern holds for I&D, specifically is failure of I&D a failure to eradicate the pathogen (as might be expected) or a failure to prevent a new infection in a high-risk patient (as is the case with 2-stage exchange).

Therefore, this study aims to determine (1) the incidence of organism persistence in cases of failed I&D and (2) identify predictors of organism persistence. Such understanding may allow for targeted use of I&D when it is most effective of eradicating PJI.

Patients and Methods

After approval from the local institutional review board, a retrospective analysis of irrigation and debridement was undertaken. This retrospective analysis included all patients undergoing irrigation and debridement with modular component exchange and retention of fixed components for treatment of PJI of the hip or knee between April 2000 and January 2013.

One hundred and fifty-three joints in 146 patients who underwent the aforementioned treatment were identified. Ninety-three (60.8%; 93/153) of these were knees. Sixty-one (39.9%; 61/153) were male, and the cohort had an average age of 64.1 (range: 32-94) years. Most of these (72.5%; 111/153) were following primary total joint arthroplasty. However, 13.1% (20/153) and 14.3% (22/153) were following prior revision and completed 2-stage exchange, respectively. Seven patients (4.8%; 7/146) underwent 2 irrigation and debridements. Four were in contralateral knees (1 simultaneous I&D), 1 requiring simultaneous contralateral hip I&D, and 2 were repeat knee I&D after prior failed debridements. To further categorize these cases, an attempt to diagnose PJI retrospectively using the Musculoskeletal Infection Society's (MSIS) definition of PJI was performed [21]. More than 80% (123/153) of the cases in this cohort fulfilled the MSIS criteria for PJI. Data regarding timing from index surgery, comorbidities, and culture results were collected for these patients as well (Table 1). Cases included in this analysis had a minimum of 2 years before investigation of any further surgical management.

First, patients requiring a return to the operating room for repeat surgical management for PJI after I&D were identified and classified as a recurrent PJI. These failures were investigated further for any predictive patterns of failure based on infecting organism, characteristics of infection, timing of failure, and demographic variables. Patients not requiring any further surgical management were considered to be successfully managed with I&D alone. Second, the study cohort was formed from those identified as failures (recurrent PJI), and the offending pathogen causing the recurrent infection was identified from preoperative aspiration and/or operative cultures. This finding was then compared with the original infecting organism to determine the proportion of cases that failed due to identical organisms. For this analysis, infections were considered to be persistent when phenotypically identical pathogens were found at both the time of initial I&D and at the time of subsequent surgery. As it is not possible to determine organism persistence in the setting of negative cultures, cases in which cultures were negative at either surgery were excluded from the study cohort. Patients deemed to have recurrent PJI due to identical organisms were classified as persistent PJI.

To determine predictors of persistent PJI after I&D vs infection with a new pathogen, the study cohort was used to compare the 2

Table 1
Demographics of the Entire Cohort, Success vs Failed Groups, and Persistent vs New Failed Irrigation and Debridement.

	Entire Cohort (n = 153)	Success (n = 80)	Failed (n = 73)	*P* Value	Persistent (n = 36)	New (n = 7)	*P* Value
Age (y)	64.1	64.4	63.9	.85	64.1	62.3	.75
Male gender (%)	61 (39.8%)	35 (43.8%)	26 (35.6%)	.33	11 (30.6%)	4 (57.1%)	.21
BMI (kg/m^2)	33.4	33.1	33.8	.59	32.4	33.7	.77
Index surgery							
Primary	111 (72.5%)	56 (70%)	55 (75.3%)	.18	28 (77.8%)	5 (71.4%)	.65
Revision	20 (13.1%)	7 (8.8%)	13 (17.8%)		6 (16.7%)	2 (28.6%)	
Reimplantation	22 (14.3%)	17 (21.2%)	5 (6.8%)		2 (5.6%)	0	
Joint (%)							
Hip	60 (39.2%)	34 (42.5%)	26 (35.6%)	.41	12 (33.3%)	5 (71.4%)	.09
Knee	93 (60.8%)	46 (57.5%)	47 (64.4%)		24 (66.6%)	2 (28.6%)	
Time From Index Surgery (d)	422.7	240.9	621.9	.002	727.5	287	.31
CCI	1.39	1.14	1.68	.08	1.86	1.29	.49
Comorbidities							
Diabetes	26 (17.0%)	13 (16.3%)	13 (17.8%)	.83	5 (13.9%)	1 (14.3%)	.98
Rheumatoid	7 (4.6%)	2 (2.5%)	5 (6.8%)	.26	4 (11.1%)	0	.83
Hypothyroid	17 (11.1%)	10 (12.5%)	7 (9.6%)	.61	3 (8.3%)	0	.43
MSIS+ (%)	123 (80.4%)	60 (75%)	63 (86.3%)	.10	35 (97.2%)	7 (100%)	1.00
Intra-articular purulence	71 (46.4%)	33 (41.3%)	38 (52.1%)	.19	20 (55.6%)	4 (57.1%)	1.00
Infecting organism							
MSSA	32 (21%)	12 (15%)	20 (27.4%)	.81	11 (30.6%)	1 (14.3%)	.02
MRSA	33 (22%)	18 (22.5%)	15 (20.5%)		13 (36.1%)	0	
Streptococcus	11 (7.2%)	7 (8.8%)	4 (5.5%)		2 (5.6%)	1 (14.3%)	
CNS	16 (10.5%)	9 (11.3%)	7 (9.6%)		5 (13.9%)	1 (14.3%)	
Gram negative	9 (5.9%)	4 (5%)	5 (6.8%)		1 (2.8%)	2 (28.6%)	
Fungal	2 (1.3%)	1 (1.3%)	1 (1.4%)		0	1 (14.3%)	
Polymicrobial	18 (11.8%)	10 (12.5%)	8 (10.9%)		4	1	
Enterococcus	3 (2.0%)	2 (2.5%)	1 (1.4%)		0	0	
Culture negative	28 (18.3%)	16 (20%)	12 (16.4%)		N/A	N/A	
Cultures not taken	1 (0.6%)	1 (1.3%)	0		N/A	N/A	
Time to failure (d)	N/A	N/A	201.5		189.5	185.7	0.98

n, number; BMI, body mass index; CCI, Charlson Comorbidity Index; MSSA, methicillin-sensitive *Staphylococcus aureus*; MRSA, methicillin-resistant *Staphylococcus aureus*; CNS, coagulase-negative Staphylococcus; N/A, not applicable.