Arthroplasty Today 8 (2021) 124–127

Contents lists available at ScienceDirect

Arthroplasty Today

journal homepage: http://www.arthroplastytoday.org/

Original research

Management of Periprosthetic Hip and Knee Joint Infections With a Known Sinus Tract—A Single-Center Experience

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ARTICLE INFO

Article history:
Received 16 August 2020
Received in revised form
31 January 2021
Accepted 14 February 2021
Available online xxx

Keywords:
Sinus tract
Periprosthetic joint infection
Revision arthroplasty
Hip arthroplasty
Knee arthroplasty

ABSTRACT

Background: Prosthetic joint infection (PJI) is a serious complication after total joint arthroplasty (TJA). A sinus tract communicating with a prosthetic joint is a major criterion defining PJI. Despite this fact, many patients presenting with a draining sinus tract undergo invasive procedures before initiation of two-stage revision arthroplasty. We hypothesized that many patients undergo nondefinitive procedures to treat the sinus tract, rather than undergoing definitive treatment of infection with two-stage revision.

Methods: A retrospective review of all cases of two-stage revision arthroplasty at Loyola University Medical Center between January 2004 and May 2018 was performed. Patients with infected TJA and periprosthetic sinus tract were included. Records were queried for laboratory values and prior procedures.

Results: We identified 160 patients who underwent two-stage revision for infection over the 14-year period. Of the 160 patients, 25 had a documented periprosthetic sinus tract before initiation of definitive revision arthroplasty and were included. Eleven (44.0%) had one or more procedures including interventional radiology drain placement, local wound care, or formal irrigation and debridement before definitive treatment. Forty-five percent of patients that underwent nondefinitive procedures before definitive surgery had either an erythrocyte sedimentation rate or C-reactive protein at normal or near-normal levels.

Conclusion: Many arthroplasty patients presenting with periprosthetic sinus tracts undergo nondefinitive procedures before definitive treatment. Inherent surgical risks of these procedures can increase the overall morbidity and mortality of these patients. Further effort is needed to educate surgeons regarding management of sinus tracts after TJA.

Introduction

Prosthetic joint infection (PJI) is a serious complication in patients undergoing total hip and knee arthroplasty. In 2011, the Musculoskeletal Infection Society (MSIS) identified a sinus tract communicating with a prosthetic joint as a definite indicator of chronic PJI [1]. The diagnostic criteria were revised in 2018, with the expansion of minor criteria, although the presence of a sinus tract remained a definitive major criterion indicating the presence of infection [2]. Two-stage reimplantation arthroplasty remains the "gold standard" for eradicating chronic PJI and managing this difficult complication [3–6]. Despite this fact, we observed that many patients presenting with a draining sinus tract undergo one or more invasive procedures before initiation of two-stage joint revision arthroplasty. These procedures may be performed by wound care specialists or surgical specialists outside orthopedic surgery, who may not be aware of the MSIS criteria. Such procedures can include simple irrigation and debridement (I&D), I&D with polyethylene exchange, interventional radiology (IR)-guided drain placement, local excision of sinus tracts, and others. We defined these procedures as nondefinitive based on the fact that they would not be expected to cure the infection, nor would they be expected to resolve the sinus tract permanently. The purpose of this study is to examine the frequency and type of intervention in patients presenting with a periprosthetic sinus tract to our

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https://doi.org/10.1016/j.artd.2021.02.012

academic medical center, before definitive diagnosis and treatment of PJI.

Methods

A retrospective review of all cases of two-stage joint revision arthroplasty at Loyola University Medical Center within the 14-year period of January 2004 to May 2018 was performed. Any patients with an infected knee or hip replacement and a documented periprosthetic sinus tract who underwent initial two-stage revision arthroplasty were included. Patient charts were queried for laboratory characteristics pertaining to the PJI as well as any prior invasive procedures or testing (Table 1). If available, preoperative inflammatory markers and preoperative aspiration microorganism were recorded before the two-stage revision, as well as intraoperatively collected microorganisms (Table 1). Aspirations were all done at our institution, with the exception of patients 14, 19, and 21, who had aspiration at an outside facility. We defined an invasive procedure as simple I&D, I&D with polyethylene exchange, IR-guided drain placement, and local excision of sinus tracts. Patients were excluded if the infection was within 90 days of the index arthroplasty procedure, or if it was found on further documentation review that the patients did not actually have a sinus tract. Descriptive statistics were calculated.

Results

One hundred sixty patients had an infection treated during the study period. We identified 39 patients who met the initial study criteria. After chart review, we excluded 14 patients who fit the exclusion criteria, leaving 25 patients who had a documented periprosthetic sinus tract at presentation and were included in the study. Eleven of the 25 patients (44.0%) had one or more invasive procedures, including IR drain placement, local wound care, or formal I&D with or without polyethylene exchange in the chronic PJI period before definitive treatment at our institution (Table 1). None of the procedures were performed for palliative reasons. Some of the nondefinitive procedures were performed at an outside facility, and some were performed at our institution before consultation of a joint replacement specialist. I&D was performed in 7 of 25 (40%) patients, and IR drain placement in 2 of 25 (8.0%). Two patients with chronic PJI underwent I&D with polyethylene exchange, but it was decided by the outside surgeon they were clinically unfit to tolerate two-stage revision surgery. However, at our institution, they were able to tolerate the procedure after consultation with medical subspecialists. Five of the 11 patients (45%) who underwent invasive procedures before definitive surgery unexpectedly had either an erythrocyte sedimentation rate (ESR) or C-reactive protein (CRP) at normal or near-normal levels. In addition, 7 of 25 (28%) patients ultimately had infection with a low-virulence organism [7], and 4 of 25 (16%) showed a culture-negative infection based on intraoperative cultures.

Discussion

Although overall complications after TJA are rare, PJI is a common reason for revision arthroplasty [8,9]. Despite a sinus tract or draining wound being considered a major criterion for PJI as determined by the MSIS and other collaborative evaluators, [1,2,10] many patients presenting to our institution undergo invasive and nondefinitive procedures before definitive two-stage revision arthroplasty. Our study found nearly 50% of patients underwent such procedures before being treated for the underlying PJI. While it is impossible to know the exact indications for these procedures, as they were performed outside our institution before presentation, the fact that these patients ultimately underwent two-stage revision suggests that they were performed because it was not recognized that a deeper infection was present.

The diagnosis of PJI remains challenging, especially in those patients presenting with minimal symptoms outside of a sinus tract or draining wound. We found that 45% of the patients who eventually underwent 2-stage revision arthroplasty presented with either an ESR or CRP that was normal or near normal, which could contribute to difficulties in making the initial PJI diagnosis. A recent study by Wang et al. showed a positive predictive value of 63.64% for ESR and 70.15% for CRP for detection of PJI, so it is possible that false-negative results of these tests can confound efforts at diagnosis [11], although an alternative explanation in our study population could be that patients with draining sinus tracts or draining wounds have lower levels of these markers. Larger studies could help define this relationship more clearly. The combined use of inflammatory markers can enhance the sensitivity of diagnosis, but some cases can still be difficult to detect [12].

Even when applying the new MSIS criteria, PJI caused by low-virulence organisms may not be detected [2]. The authors of the article describing these criteria caution that PJI may still be present, even in the absence of sufficient evidence to provide a definitive diagnosis [2]. Many of our patients presented before the new MSIS criteria were published, and so additional markers such as alpha defensin could help enhance the diagnosis, but these tests may not be readily available in all clinical settings. Newer testing, such as platelet count and volume [13], plasma viscosity [14], and advanced molecular techniques [15,16], may further enhance diagnostic accuracy in the future. Diagnostic difficulty can be further amplified by clinicians who do not regularly encounter PJI and may not be familiar enough with the MSIS criteria to recognize a sinus tract as diagnostic of infection. Efforts to educate community orthopedists, and surgeons in other specialties such as wound care and general surgery, may help to curb unnecessary complications of a missed diagnosis.

Treatment of PJI with I&D and retention of hardware has been associated with a high failure rate, and the success of this treatment only decreases with longer symptom duration, more time from index procedure, and the presence of a draining wound or sinus [17–20]. Forty percent of our patients underwent some form of I&D with or without poly exchange before their two-stage revision. Many of these patients had more than one I&D procedure, and these operations were often carried out by non–arthroplasty-trained specialists outside of tertiary care centers. In addition to burdening the PJI patient with additional operations, there is evidence of a higher rate of failed definitive revision joint arthroplasty in those patients with delayed infection diagnosis as well as in those treated with a limited prior single-stage polyethylene exchange [21–23]. In our series, these patients ultimately required transfer to a tertiary center for definitive management, adding to overall morbidity.

Finally, PJI can be a significant economic burden on the health-care system. The annual cost of infected revision arthroplasty cases on the US health system is projected to exceed US$1.5 billion by 2020 [24]. These extra costs accrue from more complicated operations, longer hospital stays, higher outpatient costs, and more frequent outpatient visits [25,26]. Nondefinitive operations before definitive treatment only increase this already heavy economic burden of the health-care system and physician resource utilization.

This study has limitations. First, it is the experience of a single institution, and as such, the results may not be applicable to a wider area. However, our hospital is in a major metropolitan area, and so the results should be useful on a more general basis. Second, the study is retrospective and has small numbers, which limits the

Table 1
Characteristics of patients presenting with sinus tracts

Patient (#)	Hip (H)/Knee(K)	Gender	Age	BMI	ASA	CCI	Nondefinitive intervention	Type of intervention	Intervention specialty	Inflammatory markers (ESR mm/h/CRP mg/dL)	Aspiration microorganism	Microorganism
1	K	Female	75	32	2	4	Yes	1. Wound excision/bursectomy 2. Repeat wound debridement	Plastic surgery	18/35	Serratia marcescens	*Corynebacterium striatum*
2	K	Female	67	38	3	3	No			140/239	No growth	MSSA
3	K	Female	62	49	3	3	Yes	1. I&D 2. I&D	Nonarthroplasty orthopedist	31/0.5	Enterococcus faecalis	*Enterococcus faecalis*
4	K	Female	63	35	3	3	Yes	1. Bedside Debridement 2. I&D with component exchange	1. Wound care specialist 2. Arthroplasty Orthopedist	111/9.9	MSSA	MSSA
5	H	Male	58	37	3	4	No			79/5.4	No growth	MSSA
6	K	Male	77	26	2	7	No			53/8.8	MSSA	MSSA
7	K	Male	52	44	3	4	No			72/3.7	Not done	MSSA
8	K	Female	50	40	3	2	No			54/-	Group D Enterococci	*Gemella morbillorum*
9	K	Female	81	38	3	8	Yes	1. I&D	Nonarthroplasty orthopedist	114/7.4	MSSA	MRSA
10	K	Male	59	30	2	1	Yes	1. I&D 2. I&D	Nonarthroplasty orthopedist	46/-	Not done	MRSA
11	K	Female	79	30	3	3	No			89/0.7	MSSA	MSSA
12	K	Female	64	38	3	4	No			62/5.8	Not done	*Escherichia coli*
13	K	Male	66	35	2	2	No			118/8.4	No growth	MRSA
14	K	Male	64	35	2	2	Yes	1. I&D	Nonarthroplasty orthopedist	62/15.3	No growth	MSSA
15	K	Female	59	42	3	3	No			86/4.1	MSSA	*Staphylococcus lugdunensis*
16	K	Female	61	32	3	2	No			-/2.6	No growth	No growth
17	K	Male	60	24	3	7	No			n/a (RA pt)	No growth	*Staphylococcus lugdunensis*
18	K	Male	52	32	2	1	No			8/0.5	No growth	No growth
19	K	Female	62	41	3	3	Yes	1. Local wound care/wound vac	Wound care specialist	87/21.1	*Staphylococcus epidermidis*	*Streptococcus canis*
20	H	Female	72	35	3	6	Yes	1. I&D 2. I&D 3. I&D with resection	Nonarthroplasty orthopedist	53/1.7	Not done	*Candida glabrata*
21	H	Male	49	32	3	1	Yes	1. Local wound care/wound vac 2. IR drain placement	1. Wound care specialist 2. Medicine	52/3.0	MSSA	*Staphylococcus epidermidis*
22	H	Male	57	31	3	7	Yes	1. IR drain placement	Medicine	16/1.0	No growth	*Staphylococcus epidermidis*
23	K	Female	51	40	2	3	Yes	1. I&D	Nonarthroplasty orthopedist	2/3.2	MSSA	MSSA
24	K	Female	74	25	2	4	No			67/4	No growth	No growth
25	K	Male	66	43	3	7	No			112/12.2	MSSA	MSSA

ASA, American Society of Anesthesiology Score; BMI, body mass index; CCI, Charlson Comorbidity Index; CRP, C-reactive protein; ESR, erythrocyte sedimentation rate; I&D, irrigation and debridement; IR, interventional radiology; MSSA, methicillin-sensitive *Staphylococcus aureus*; MRSA, methicillin-resistant *Staphylococcus aureus*.

power of its conclusions. Further study is needed, but we believe this information highlights the need for surgeons to be aware of the MSIS criteria. Finally, the small numbers make it impossible to track the outcomes of patients who had nondefinitive procedures compared with those who did not. Further study should address these outcomes.

Conclusion

A high number of patients undergoing total joint arthroplasty presenting to our institution with periprosthetic sinus tracts or wounds undergo potentially nondefinitive and costly invasive procedures before definitive two-stage revision arthroplasty. Inherent surgical risks of these procedures have the potential to increase the overall morbidity and mortality of these patients. Furthermore, the failure to recognize and treat the patient presenting with PJI in the early stages has the potential to affect the success of the definitive treatment negatively. Further intervention is needed to educate wound care and other nonarthroplasty specialists on how to manage chronic PJI patients with a known sinus tract before definitive revision or referral to a tertiary care center.

Conflicts of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this article.

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