management of periprosthetic hip and knee joint infections with a known sinus tract—a single-center experience

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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.

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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
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 recorded before the two-stage revision, 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 may 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 healthcare 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
| Patient (#{}) | Hip (H)/Knee(K) | Gender | Age  | BMI  | ASA | CCI | Nondefinitive intervention | Type of intervention | Intervention specialty | 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 | 16/35 | Serratia marcescens | Corynebacterium striatum |
| 2            | K               | Female | 67   | 38   | 3   | 3   | No                          |                               | 140/239 | No growth | MSSA | Enterococcus faecalis |
| 3            | K               | Female | 62   | 49   | 3   | 3   | Yes                         | 1. I& D 2. I&D          | Nonarthroplasty orthopedist | 31/0.5 | 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 | 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 | MSSA |
| 8            | K               | Female | 50   | 40   | 3   | 2   | No                          |                               | 54/-    | MSSA | MRSA |
| 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 | MSSA |
| 13           | K               | Male   | 66   | 35   | 2   | 2   | No                          |                               | 118/8.4 | MSSA | MSSA |
| 14           | K               | Male   | 64   | 35   | 2   | 2   | Yes                         | 1. I&D                      | Nonarthroplasty orthopedist | 62/15.3 | MSSA | 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   | MSSA | No growth |
| 17           | K               | Male   | 60   | 24   | 3   | 7   | No                          |                               | n/a (RA pt) | No growth | MSSA | Staphylococcus lugdunensis |
| 18           | K               | Male   | 52   | 32   | 2   | 1   | No                          |                               | 8/0.5   | MSSA | No growth |
| 19           | K               | Female | 62   | 41   | 3   | 3   | Yes                         | 1. Local wound care/wound vac with resection | Wound care specialist | 87/21.1 | No growth | Staphylococcus epidermidis |
| 20           | H               | Female | 72   | 35   | 3   | 6   | Yes                         | 1. I&D 2. I&D 3. I&D with resection | Nonarthroplasty orthopedist | 53/1.7  | MSSA | No growth |
| 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 | MSSA | MSSA |
| 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    | MSSA | MSSA |
| 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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