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Clinical Experience With a Coordinated Multidisciplinary Approach to Treating Prosthetic Joint Infection

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ABSTRACT

The successful treatment of prosthetic joint infection (PJI) is difficult, requiring coordination across multiple specialties. In 2017, we formed a collaboration between our infectious disease clinicians and our orthopaedic arthroplasty surgeons in an effort to optimize care, accommodate patients, and expedite clinical decision-making in the treatment of PJI. The model consisted of combined infectious disease and arthroplasty clinics, standardized lab results, and planned staged revision procedures. We named this the arthroplasty infection service. Our early experience with a defined multidisciplinary approach to PJI was positive. Although the impact of the arthroplasty infection service on PJI outcomes is yet to be determined, we believe this is a step forward in the management of this complex patient population. With an increasing burden of PJI in the United States, this model could be emulated at many institutions that regularly treat these challenging cases.

Introduction

Prosthetic joint infection (PJI) is a devastating complication for patients and orthopaedic arthroplasty surgeons. Nearly 15% of revision hip arthroplasties and 25% of revision knee arthroplasties are secondary to PJI [1-3]. The economic burden is considerable, with a projected 1.62 billion dollars to be spent on revision surgeries, antibiotics, pain control, and prolonged rehabilitation for PJI in 2020 [4]. Although the standard of care for PJI depends on multiple factors, strong collaboration between infectious disease (ID) specialists and orthopaedic arthroplasty surgeons is critical to success. In 2017, we implemented a new clinical model, the arthroplasty infection service (AIS), to enhance coordination of care between our ID physicians and orthopaedic arthroplasty surgeons for patients with PJI. This consisted of combined ID and arthroplasty clinics, standardized lab testing, and planned staged revision procedures.

Office tip

Combined ID and arthroplasty clinic

The key feature of the AIS is a thrice weekly combined ID and arthroplasty clinic. All patients with confirmed or suspected PJI are scheduled during this clinic if possible. During the visit, the patient is evaluated by the arthroplasty surgeon and ID specialist. After discussion between the providers, the surgeon and/or ID specialist returns to the patient's room to discuss recommendations and the proposed treatment plan. Patients are given the opportunity to ask questions and receive additional input from both providers.

Before institution of the AIS, patients frequently missed ID appointments. In reviewing all patients treated for PJI by one of our arthroplasty surgeons before institution of the AIS from 2014 to 2017 and all patients treated after from 2017 to 2019, the incidence of missed ID appointments decreased from 40.6% (13/32) to 25.0% (6/24). Within the same sample of patients, the average total round trip mileage for clinical follow-up decreased from 446 to 277 miles. Given that travel is painful in the setting of PJI, this decrease is not insignificant and coincides with current initiatives to advance patient-directed care. Patients and their family members benefitted from reduction in travel costs and time away from work. Patients

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also appreciated the clarity of treatment plans afforded by the combined model, which eliminated the potential for conflicting final recommendations from the ID and arthroplasty teams.

From an arthroplasty surgeon's perspective, immediate ID input was invaluable for recognition of potential contaminants, diagnosis of chronic infections with less-virulent organisms such as *Cutibacterium acnes* and coagulase-negative *Staphylococci*, and treatment of fungal and atypical bacterial infections [5]. ID input also increased the feasibility of transitioning select patients to oral antibiotics in accordance with the growing evidence for PJI treatment with linezolid, quinolones, and rifampin [6-8]. They also provided expert recommendations regarding the timing of antibiotic holidays before staged procedures and indications for long-term suppressive antibiotics. Among patients already on long-term antibiotics, the ID specialists appreciated surgical input in determining whether to attempt an antibiotic holiday or continue suppressive treatment indefinitely. Among patients at a high risk of failure with additional surgical interventions due to bone loss or medical comorbidities, antibiotic holidays were approached cautiously to minimize risk of reinfection requiring return to the OR. The arthroplasty surgeon's input in this shared decision-making process furthered the ID physicians understanding of different spacer types, goals of surgery, the anticipated morbidity associated with additional revisions, and feasibility of hardware removal vs retention of components. ID specialists also benefitted from meeting patients in a preoperative clinic environment rather than the postoperative ward where medications and surgical recovery interfered with information gathering and provider gestalt assessment. They also appreciated the improved continuity of patient care and reduction in missed appointments. Before the institution of the AIS, patients in challenging circumstances expressed being forced to choose between surgical and ID follow-up. In most situations, they chose to see their surgeon. This contributed to the 40% rate of missed appointments seen among our patients before the AIS, which represents a major obstacle in effective ID management of PJI and a substantial loss of revenue for the ID provider.

Finally, and perhaps most importantly, the shared clinic reinforced relationships between providers. Working together in the clinic facilitated the exchange of ideas between services, resulting in new solutions to patient care, innovative research hypotheses, and combined journal clubs. It also enhanced education for trainees by providing increased exposure to collaborating specialties.

Standardized lab testing

A protocol for routine lab draws was instituted and streamlined for all patients in the AIS including weekly complete blood count and basic metabolic panel/complete metabolic panel draws. During the combined clinic, both the ID and arthroplasty surgical teams reviewed weekly labs obtained from all patients. This provided vital screening for antibiotic toxicity and key information regarding the effectiveness of antibiotic treatment and timing of future procedures.

Coordination regarding the necessity and timing of labs resulted in a decrease in errant blood draws. There were 5 incidences of missed or duplicated labs among 24 patients treated for PJI by one of our arthroplasty surgeons in the interval before the institution of the AIS. There were no incidences of errant labs among 32 patients treated after. Patients appreciated fewer needle sticks and less time wasted obtaining repeat labs.

Coordinated staged revision procedures

Before undergoing staged revision procedures, all patients were seen in the AIS clinic for a preoperative appointment. The appropriateness and timing for staged revision was discussed and agreed upon by both providers. A final operative plan was established with input from the patient, ID specialist, and arthroplasty surgeon.

Our arthroplasty surgeons noted the value of having ID input before surgery. They directed the use of specific antibiotics to be mixed in the cement, particularly in cases of drug-resistant organisms or antibiotic allergies. They identified cases that would benefit from securing frozen sections and periprosthetic tissue samples in addition to intraoperative cultures. They followed the results of these studies and ensured that no patients discharged before establishment of an ID plan. In some cases, they were able to develop a postoperative antibiotic plan before surgery, eliminating the need for inpatient ID consult so long as the intraoperative findings and surgery proceeded as planned. In instances when ID treatment plans were initiated in the hospital, the inpatient ID team would contact the outpatient ID provider to coordinate care and maintain a coherent treatment plan. This increase in efficiency and continuity of care benefited patients, given that the ID physicians were already familiar with their case.

Discussion

Despite advances in preoperative and postoperative preventive measures as well as intraoperative techniques, the incidence of PJI remains between 1% and 2% of primary arthroplasties [9-11]. Kapadia et al [12] speculate that this is due to increasing rates of diabetes, morbid obesity, and other comorbidities that increase the risk of PJI and subsequently offset advances in PJI prevention. Beam and Osmon [13] highlight other challenges impeding treating of PJI, including biofilm formation and antibiotic resistance. Given the impact on the patient's functional recovery, economic burden, and projected increase in total joint arthroplasties, every aspect of PJI prevention, diagnosis, and treatment demands attention [4]. Combined treatment models such as the AIS represent one area for potential improvement by encouraging effective and efficient treatment. In a recent study by Goodson et al [14], implementation of a fast-track PJI protocol managed by an orthopaedic-specific ID physician resulted in shorter hospital stays with no differences noted in rates of 90-day complications, reimplantation rates, or 12-month survival. Their findings highlight additional potential advantages of established multidisciplinary treatment teams for PJI. Ferry et al [15] described a nationwide system in France with 24 dedicated centers for treating bone and joint infections including PJI. Over the course of 4 years, they saw a substantial rise in the incidence of case discussions and meetings between orthopaedists, ID physicians, and microbiologists. They concluded that the shared model enhanced PJI management, education, and research.

The proper treatment of PJI requires consideration of multiple factors including time since surgery, patient comorbidities, baseline functional status, the acuity of symptom onset, the quality of the local tissue and presence of a sinus tract, the presumed infectious source, and the suspected virulence of the infectious organism. Multiple treatment options add to the complexity. These include long-term suppressive antibiotics, irrigation and debridement ± liner exchange, single-stage revision, 2-stage revision, and salvage procedures (eg, Girdlestone resection, arthrodesis, amputation). Although the goal of infectious cure is desired, functional outcomes and risks of treatment-related complication must also be considered. Guidelines and treatment algorithms provide direction, but ultimately, recommendations must be tailored on a case-by-case basis. The treatment plan must also rapidly adjust to changes in symptoms, examination findings, and/or labs, given the unpredictable nature of PJI. Delays in altering care due to slow communication among providers may lengthen required treatment periods, or worse, result in recurrent deep infections. Given the 50% mortality

rate reported at 4.7 years after recurrent PJI [16], the importance of efficient communication and combined decision-making between arthroplasty surgeons and ID specialists cannot be understated.

The point of this article was to describe a novel approach in treating PJI. Although we experienced multiple positive effects of increased collaboration between our ID and surgical teams, the ultimate goal of the AIS is to promote early identification and effective treatment of PJI. Future studies are needed to evaluate the impact of this model on eradication of infection and other outcomes in PJI. In addition, we are fortunate to treat patients at a large tertiary referral center, which accommodates dedicated ID practices for orthopaedic patients. This model may be ineffective at smaller practices where the volume is inadequate to justify regular ID clinics. In these cases, virtual visits may provide a practical alternative. The patient can be seen in person at the provider's location with the other provider joining via telemedicine. We recommend scheduling these patients at the start of the day to minimize interference with clinic workflow.

Summary

The early impact of an integrated multidisciplinary approach for treating PJI is positive. We saw increased attendance in ID clinic appointments, improved timing of labs, and advances in perioperative planning. We believe this is a step forward in the treatment of this complex population and coincides with current initiatives to advance patient-directed care. With an increasing burden of PJI, the AIS model could be instituted at many centers that regularly treat this challenging patient population.

Conflict of interest

The authors declare there are no conflicts of interest.

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