A Surgical Opportunist- *Enterobacter* Bone and Joint Infection

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INTRODUCTION: Surgical site infections associated with orthopaedic procedures are a major source of morbidity and burden on patients and the healthcare system. *Enterobacter* species are bacteria that often have inherent resistance to cefazolin, a common antibiotic for peri-operative surgical prophylaxis. Therefore, patients may be at higher risk for *Enterobacter* infections compared to other organisms following surgical procedures. The characteristics and outcomes of patients suffering from *Enterobacter* bone and joint infection is a current gap in the clinical literature.

METHODS: This was a retrospective observational study approved by the University of Texas Southwestern Medical Center Institutional Review Board (#STU20250396). A cohort of thirty patients with musculoskeletal infections that had positive cultures for *Enterobacter* species (n=15 bone, n=15 joint) from a 5-year period (2019-2024) with at least one year of follow up were reviewed. Baseline demographic, surgical, microbiological, treatment, and outcomes data were recorded. If a preceding surgery was documented within one year prior to *Enterobacter* infection at the same site, time from prior surgery to infection was documented.

RESULTS SECTION: Demographically (**Table 1)**, patients suffering from *Enterobacter* musculoskeletal infection were majority male (80%), overweight (median BMI of 29.3), and with functional limitations/illness at baseline (93% with ASA III-IV, 63% with diabetes, and 23% with end-stage renal disease). *Enterobacter* infections were most often found at the foot and ankle (53%) followed by shoulder (20%) and knee (20%) (**Fig. 1A**). The majority of *Enterobacter* infections were associated with preceding surgery at the same anatomic site (mean post-surgical time to infection 95 +/- 71.6 days) (**Fig. 1B**). Cefazolin was documented as peri-operative prophylaxis in at least 46% of these cases. Microbiologically, infections were polymicrobial in 43% of cases. 37% of *Enterobacter* isolates were resistant to one or more antibiotic classes. Culture source (n=34 as some cases had multiple positive types of cultures) were bone (44%), soft tissue (26%), and synovial fluid (29%). Regarding treatment, patients received surgical debridement for *Enterobacter* infection in 29 of 30 cases. All patients received antibiotics and 10% received antibiotics for more than six weeks. Patients had an average ESR of 91.1 +/- 38.8 and CRP of 51.9 +/- 39.7 at the time of infection. Following treatment, inflammatory markers decreased to 38.6 +/- 35.6 and 21.6 +/- 25.0 for ESR and CRP, respectively. For outcomes (**Table 2**), 80% of patients required re-admission due to complications at the same anatomic site. Documented culture-positive relapse of *Enterobacter* occurred in 17% of patients. 13% of patients required amputation of the *Enterobacter*-infected site. In this cohort, no patients died resulting from complications of *Enterobacter* bone and joint infection.

DISCUSSION: *Enterobacter* infection was preceded by surgery in 73% of bone and joint infection cases. More than a third of cases were drug-resistant and more than half were monomicrobial (only due to *Enterobacter*). Outcomes were relatively poor with a majority of patients requiring re-admission and 13% ultimately requiring amputation. However, culture-positive relapse of the infection was appreciated in only 17% of patients, suggesting that there may have been other reasons for this sick-at-baseline population to do poorly following surgery. The data are limited as an observational and retrospective study; future work will compare *Enterobacter* musculoskeletal infections to a matched non-*Enterobacter* cohort.

SIGNIFICANCE/CLINICAL RELEVANCE: The majority of *Enterobacter* bone and joint infections were associated with prior surgery. While outcomes were poor for patients with *Enterobacter* musculoskeletal infection, frank infectious relapse was only appreciated in less than a quarter of patients, suggesting that these opportunistic bacteria may be a reflection of poor host health rather than the driver of negative outcomes.

IMAGES AND TABLES:

Table 1. Demographics

Characteristic	Number (%)
Sex	
Male	24 (80%)
Female	6 (20%)
Median Age (years)	65 +/- 11.3
Median BMI	29.3 +/- 6
Ethnicity	
Hispanic/Latino	7 (23.3%)
Non-Hispanic/Latino	23 (76.7%)
Race	
White	19 (63.3%)
Black	11 (36.7%)
Asian	0 (0%)
Other	0 (0%)
Smoking History	
Active	4 (13.3%)
Former	14 (46.7%)
Non-Smoker	12 (40%)
ASA Score (n=28)	
I-II	2 (7.1%)
III-IV	26 (92.9%)
Co-morbidities	
Diabetes	19 (63.3%)
ESRD/Dialysis	7 (23.3%)
Cirrhosis	2 (6.7%)
IV Drug Use	2 (6.7%)

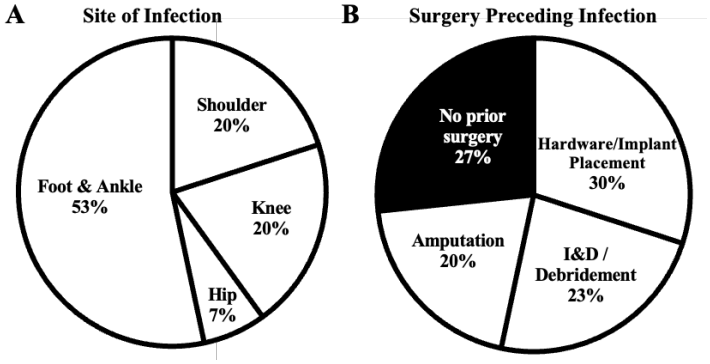

Figure 1. A) Anatomic site of *Enterobacter* infection (n=30) and B) type of surgery prior to infection (n=22)

Table 2. Clinical Outcomes

Characteristic	Number (%)
Post-debridement re-admission for complications	24 (80%)
Enterobacter relapse	5 (16.7%)
Amputation needed after debridement	4 (13.3%)
Death in follow-up period	2 (6.7%)
Death related to *Enterobacter*	0 (0%)