The Spectrum of Chronic Osteomyelitis In Children

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ABSTRACT

Background: While the majority of pediatric osteomyelitis cases are acute in nature, a significant subset present with prolonged symptoms often associated with substantial morbidity. Little data exist to guide clinicians in the management of these infections. We sought to describe the epidemiology, clinical features and management of chronic osteomyelitis in children.

Methods: We reviewed hospital admissions with an ICD10 code for chronic osteomyelitis from 2011-2018 at Texas Children's Hospital. Cases were included if symptoms lasted >28 days on presentation. Patients diagnosed with chronic recurrent multifocal osteomyelitis were excluded. Cases were classified as those 1) associated with a contiguous focus (CoF), 2) associated with penetrating or open trauma, 3) orthopedic hardware associated, 4) post-acute chronic osteomyelitis (PACO, those occurring after >28 days of therapy for acute osteomyelitis) and 5) primary hematogenous chronic osteomyelitis (PHCO, those with 28 days of symptoms without other clear risk factors).

Results: 114 cases met inclusion criteria. The median patient age is 11.8 years and 35.9% patients had underlying comorbidities. 67.5% of patients underwent a surgical procedure. Cases were diverse in terms of pathogenesis (**Figure 1**). A microbiologic etiology was identified in 72.8% of cases and was polymicrobial in 20.2% of cases; *Staphylococcus aureus* was the single most common etiology (**Figure 2**). CoF infection was more often associated with polymicrobial etiology with or without *Pseudomonas* (P<0.001) and disease of the foot. PACO was caused by *S. aureus* in 95% of cases (p<0.001, **Figure 3**). The overall median duration of total therapy was 210 days. 41% were discharged from hospital on OPAT with or without later transition to oral antibiotics. 26.3% of patients had persistent signs/symptoms at time of last follow-up of which 46% experienced repeat hospital admission/surgery. There was no association between duration of intravenous therapy and persistent functional limitations.

Conclusions: Children with chronic osteomyelitis represent a diverse group both in terms of pathogenesis and microbiology. Pathogenesis and clinical presentation can provide clues to microbiologic etiology. Prolonged intravenous therapy does not appear to improve functional outcomes in chronic osteomyelitis.

AIMS

1. **Define the contemporary microbiology and epidemiology of chronic osteomyelitis (CO) in children.**
2. **To evaluate associations between microbiology, clinical presentations and treatment outcomes in pediatric CO.**

INTRODUCTION

- Osteomyelitis is among the most common serious infections of childhood.
- *S. aureus* is the most common cause of acute hematogenous osteoarticular infection (OAI) in children accounting for up to 76% of culture positive cases (*Feigin and Cherry's Textbook of Pediatric Infectious Diseases*, 7th Edition 2013).
- While most pediatric osteomyelitis presents acutely, a small subset experience a prolonged duration of symptoms often associated with substantial morbidity.
- There are a relative paucity of data regarding the epidemiology and optimal management of chronic osteomyelitis (CO) in children.
- We sought to describe the epidemiology, microbiology and clinical management of CO among pediatric patients in a tertiary children's hospital.

PATIENTS AND METHODS

Patients. Cases were initially identified based on hospitalizations at Texas Children's Hospital (Houston, TX) from Jan 1, 2011- Dec 31, 2018 associated with an ICD10 codes (M86.4-6) for chronic osteomyelitis
Inclusion Criteria: 1) Symptoms > 28 days on presentation OR
2) Signs / symptoms of chronic infection persisting after ≥ 4 weeks of directed therapy for acute osteomyelitis along with:
a). Radiographic evidence of sequestrum or permeative lucencies
b). New or worsening drainage, swelling, erythema, pain or loss of function
c). Readmission for the management of osteomyelitis
Exclusions: Chronic recurrent multifocal osteomyelitis

PATIENTS AND METHODS

Definitions. Patients were classified into mutually exclusive categories.
1). Those associated with a contiguous focus (CoF) of infection
2). Those associated with penetrating or open trauma
3). Those associated with indwelling orthopedic hardware
4). Post-Acute Chronic Osteomyelitis (PACO): Those with a clearly documented preceding acute osteomyelitis
5). Primary hematogenous chronic osteomyelitis (PHCO): those with ≥ 28 days of symptoms at presentation without other clear risk factors.
Treatment failure was regarded as persistent signs/symptoms at last follow-up.

RESULTS

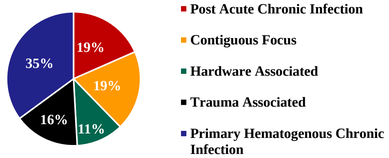
- During the study period, 279 encounters were associated with ICD10 codes for CO. 114 non-duplicate cases met inclusion criteria (**Table 1**).
- The categories of CO are displayed in **Figure 1**.
- The microbiology was diverse & 21% were polymicrobial **(Figure 2**).
- CoF infection was more often associated with polymicrobial etiology, *Pseudomonas* (P<0.001) and disease of the foot and pelvis (**Figure 3, 4**).
- PACO was due to *S. aureus* in 95% of cases (p<0.001, **Figure 3**) with most patients being otherwise healthy (**Figure 4**).

Table 1. General Characteristics of Patients

	N=114 (%)
Median Age, years (IQR)*	11.8 (6.2-14.4)
Medical Comorbidities	41 (35.9)
Duration of Symptoms on Presentation, days	122 (60-244)
Most Common Sites of Disease	
Femur	28 (24.6)
Tibia	23 (20.2)
Feet/Toes	21 (18.4)
Pelvis	14 (12.3)
Fever on Admission	33 (28.9)
Drainage	36 (31.6)
Local Inflammation	83 (72.8)
WBC at Admission, x10^3 cells/mm3	8.8 (6.9-12.2)
CRP at Admission, mg/dl	1.3 (0.5-3.3)
ESR at Admission, mm/hr	28 (10-60)
MRI Performed	93 (81.6)
Surgery Performed	77 (67.5)
# of Surgical Procedures	2 (1-3)

*All continuous variables expressed as medians with interquartile ranges (IQR)

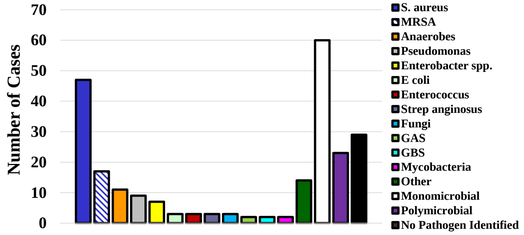
Figure 1. Categories of Chronic Osteomyelitis



RESULTS

- Treatment regimens varied across groups (**Figure 5**)
- Signs/symptoms of chronic osteomyelitis persisted in 26% of patients at time of last follow-up and were more common in patients with neurologic comorbidities and/or decubiti (**Table 2**).
- Overall, the median duration of therapy was 210 days. There was no association with duration of therapy and treatment success (**Table 2** and **Figure 6**).

Figure 2. Most Common Organisms Identified in Chronic Osteomyelitis†



†Individual species included if ≥ 2 cases; reported species not mutually exclusive

Figure 3. Organisms by Category of Osteomyelitis

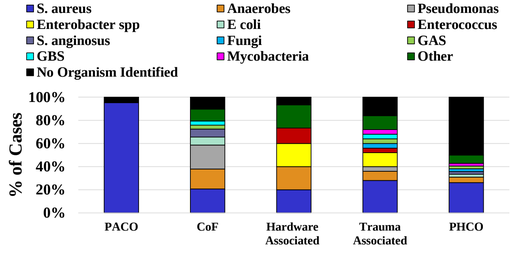
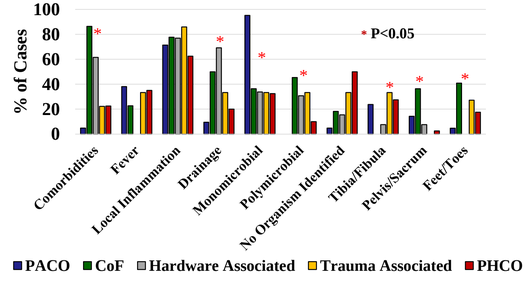


Figure 4. Presentation by Category of Chronic Osteomyelitis



RESULTS

Figure 5. Treatment Characteristics, Outcome by Category of Chronic Osteomyelitis

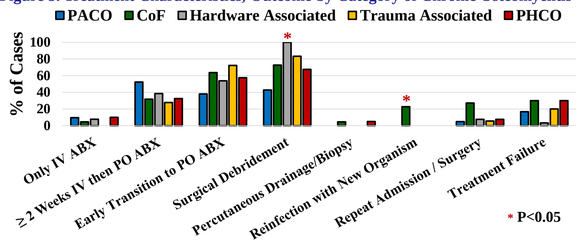
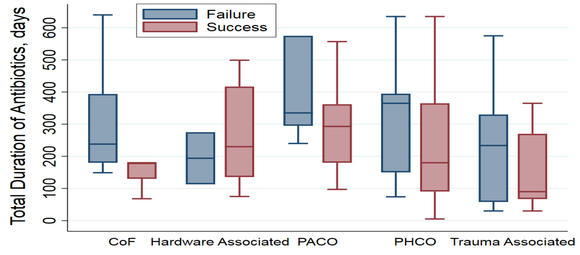


Table 5. Comparisons of Cases With Resolution of Symptoms

	Treatment Failure, n=30	Treatment Success, n=84	P Value
Age, years	12.7 (6-14.9)	11.6 (6.2-14.1)	0.36
Neurologic Comorbidities	12 (40)	9 (10.7)	0.001
Decubiti Present	9 (30)	8 (9.5)	0.01
Disease of Pelvis/Sacrum	7 (23.3)	8 (9.5)	0.06
Surgery Performed	25 (83.3)	55 (65.4)	0.1
Discharge on PO Antibiotics	18 (60)	50 (59.5)	1
Duration of IV Antibiotics	21 (5-42)	10 (4-37)	0.37
Duration of Total Antibiotics, d	295 (180-394)	180 (97-356)	0.03
Treatment > 120 days**	25/30 (83.3)	54/73 (73.9)	0.4
S. aureus	10 (33.3)	44 (52.4)	0.09
Anaerobes	5 (16.7)	7 (8.30	0.29
Pseudomonas	4 (13.3)	4 (4.7)	0.2

**120 days represents the bottom quartile of total treatment duration in the study group

Figure 6. Relationship Between Category of Disease, Treatment Duration



CONCLUSIONS

- *S. aureus* is the most common cause of CO in children, although the microbiology is diverse. Pathogenesis may provide clues to etiology.
- Poor outcome is associated with the presence of decubiti, neurologic comorbidities.
- Prolonged antibiotics may not necessarily increase rates of treatment success.
- Prospective studies are needed to better understand optimal management of pediatric patients with chronic osteomyelitis