Improving Bacterial Identification in Pediatric Acute Hematogenous Osteomyelitis

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Abstract

Background: Our institution implemented an acute hematogenous osteomyelitis (AHO) guideline in September 2013 to standardize treatment for pediatric AHO using evidence-based recommendations. One goal of the guideline is to increase bacterial identification, allowing for directed antibiotic use. The guideline supports early biopsy and blood culture, with utilization of polymerase chain reaction (PCR) testing in the setting of negative cultures.

Data on the effect of pre-biopsy antibiotics on bacterial yield is varied and nearly absent among pediatric populations. Our guideline holds antibiotic administration until after biopsy for stable patients because the effect of antibiotic administration on bacterial yield was uncertain. This report describes the effect of the AHO guideline on bacterial identification and the influence of pre-biopsy antibiotics on bacterial yield.

Methods: This is a single-site, retrospective study of patients hospitalized January 1, 2009 to December 31, 2015 with uncomplicated AHO, defined as acute onset bone or joint infection in healthy children age 6 months-18 years, and identified using ICD diagnosis codes. Methods for bacterial testing are described in Figure 1. Variables were collected describing demographics, diagnosis, and treatment.

Results: Ninety-four cases met inclusion criteria; 54 pre and 40 post- guideline. The overall rate of bacterial identification by culture and PCR increased significantly from 44% to 70% (p=0.024). Details are described in Figure 2. Among cases with a biopsy, bacterial yield was higher in those with pre-biopsy antibiotics at 83% (19/23) versus 35% (17/49) in patients with post-biopsy antibiotics (p <0.001). This group also had a higher median initial CRP of 6.4mg/L compared with 2.9mg/L. The timing of antibiotics (< or > 24 hours) before biopsy did not affect bacterial yield.

Conclusions: Implementation of the AHO guideline has increased the rate of bacterial identification. Timing of antibiotics did not affect bacterial yield. A higher acuity and burden of disease likely explains increased bacterial yield in the group with pre-biopsy antibiotics. This supports evidence that specimens from biopsy can yield positive results, even in the presence of prior antibiotic treatment.

Introduction

Our institution, created a multidisciplinary guideline to impact diagnosis and treatment of AHO in pediatric patients. The guideline recommends early blood culture and biopsy culture prior to antibiotic administration when possible. Additionally, it recommends PCR testing in the presence of negative blood and biopsy cultures.

- Select Aims of Guideline:
  - Increase the utilization of diagnostic testing for targeted antibiotic management
  - Increase bacterial yield
- Study Objectives:
  - To evaluate the impact of creating and implementing an evidence-based guideline on bacterial yield.
  - To determine the effect of antibiotics prior to focal culture on bacterial yield.

Results

Figure 1: Bacterial Identification Pathway

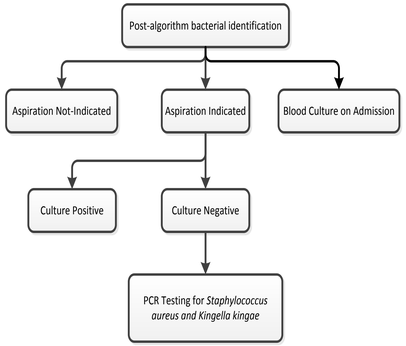
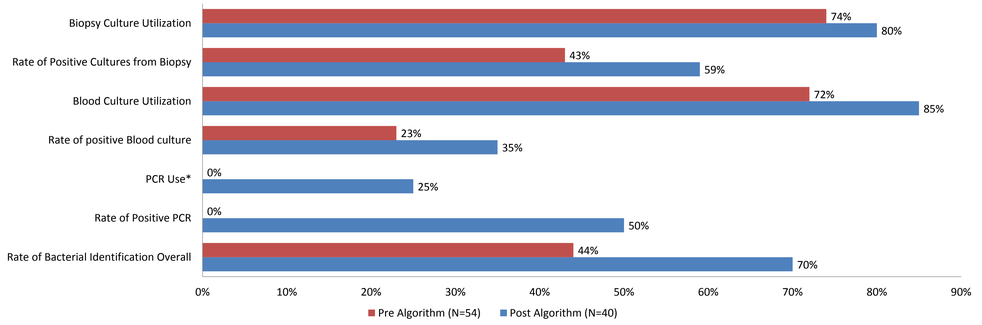


Table 1. Analysis by Guideline Implementation and Antibiotic Timing

	Total Population (n=94)	Pre Guideline (n=54)	Post Guideline (n=40)	P-value
LOS (median)	4.7	4.5	5.0	0.134
Age(median years)	6.3	6.2	6.4	0.479
Days of Symptoms	4	5	3.75	0.316
Use of biopsy culture before Antibiotics (among patients with biopsy)	68% (49/72)	73% (29/40)	63% (20/32)	0.516
Bacterial identification (by blood and focal cultures, or PCR)	55% (52)	44% (24)	70% (28)	0.024

	Biopsy culture Collected Prior to Antibiotics (n=49)	Antibiotics Prior to Biopsy culture (n=23)	P-value
Positive culture from biopsy	35% (17)	83% (19)	<0.001
First CRP (median)	2.9	6.4	0.780

Figure 2. Bacterial Identification Utilization and Positivity Rates Pre and Post Guideline



*Polymerase chain reaction (PCR) tests were not utilized prior to the guideline

Methods

- Study Design: Single-center, retrospective chart review based cohort study, Institutional Review Board approved
- Setting: 240-bed, freestanding children's hospital in Austin, Texas
- Inclusion criteria:
  - Patients admitted between January 2009-December 2015
  - Patients 6 months-18 years of age
  - ICD diagnosis code for AHO
  - Physical exam and/or history suggestive of AHO or septic joint
  - Fewer than 14 days of signs and symptoms
- Exclusion criteria:
  - Patients > 18 years of age
  - Evidence of sepsis or hemodynamic instability
  - Contiguous osteomyelitis (penetrating trauma or fracture)
  - Complicated osteomyelitis including: multifocal, chronic, presence of abscess within the bone, head, face or orbital involvement, presence of orthopedic device or prosthesis, post-operative wound
  - History of the following disease states: Bone or cartilage disorder, congenital or acquired bone disease, immunodeficiency, type I or II diabetes, sickle cell disease, chronic sinusitis, sacroiliitis, fasciitis, synovitis, arthropathy
- Variables: Basic demographics, blood culture utilization, biopsy culture utilization, PCR utilization, rate of biopsy culture before antibiotics, rate of positive cultures and PCR, length of stay, use of recommended diagnostic tests, readmission rate
- Statistic Analyses: Wilcox, Chi-squared, and Fisher's exact tests

Summary and Conclusion

- The utilization of a guideline for children with acute hematogenous osteomyelitis at our institution resulted in higher bacterial yield among these patients.
  - This increase was the result of increasing the utilization of all diagnostic testing and appropriate timing cultures and PCR tests.
- Administration of antibiotics before biopsy did not decrease bacterial yield.
  - The significant increase in yield among this group may be explained by the acuity of illness in those who were given antibiotics before biopsy.

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