Associations Between Microbiological Diagnoses and Clinical Outcomes in Children with Acute Hematogenous Osteomyelitis: A Retrospective Cohort Study

Madison Enderle, BS, Gina Gallizzi, MD, Nina R. Hu, BS, Alexandra B. Yonts, MD, Benjamin D. Martin, MD, Rana F. Hamdy, MD, MPH, MSCE

Children's National

THE GEORGE WASHINGTON UNIVERSITY
WASHINGTON, DC

BACKGROUND

- Acute hematogenous osteomyelitis (AHO) affects about 2-13 children per 100,000 in developed countries each year[1,2]
- *Staphylococcus aureus* is the most common causative pathogen of AHO and due to antibiotic resistant strains of this species, a microbial diagnosis is often desired
- Blood and bone cultures may identify causative pathogens and determine antibiotic susceptibilities but obtaining bone cultures carries risks
- The benefit to patients of having a pathogen identified is disputed and further research is required to address this question

OBJECTIVE

1) To determine if length of stay differs between culture-negative and culture-positive patients
2) To determine if odds of receiving 3 or more unique antibiotics differs between culture-negative and culture-positive patients

METHODS

- Included: under age 21 with a final clinician's diagnosis of AHO admitted to Children's National Hospital (CNH) from January 2010 – June 2020
- Excluded: patients with infections of bones of the head, hardware at the site, recent orthopedic surgery, or who were immunocompromised
- Data were retrospectively abstracted from medical records
- Baseline characteristics, treatment, and outcomes were described
- For culture-negative and culture-positive AHO patients, length of stay (LOS) and odds of receiving 3 or more unique antibiotics were compared using multiple linear regression and multiple logistic regression, respectively

RESULTS

- Of 367 included patients, 210 (57.2%) had at least one positive culture result, 151 patients (41.1%) had all negative cultures, and 6 (1.6%) patients had no blood, bone, nor synovial fluid cultures obtained
- About 83% of patients with positive culture were identified as having *S. aureus* infections
- Specifically, about 24% of identified pathogens were methicillin-resistant *S. aureus*

REFERENCES

1. Okubo Y, et al. Nationwide survey of pediatric acute osteomyelitis in the USA. *Journal of Pediatric Orthopedics B*. 2017.
2. Dartnell J, et al. Haematogenous acute and subacute paediatric osteomyelitis. *Journal of Bone and Joint Surgery - Series B*. 2012.

Figure 1. Baseline characteristics, treatment, and outcomes of pediatric patients with AHO admitted to CNH 2010-2021.

	Culture-positive	Culture-negative
	n = 210	n = 151
Age in years, mean (SE)	7.18 (0.33)	7.26 (0.47)
Age Under 5 Years	67 (31.1)	68 (45.0)
Peak CRP mg/mL, mean (SE)	11.99 (0.59)	7.02 (0.58)
Location*		
Lower Extremity	134 (63.8)	86 (57.0)
Upper Extremity	38 (18.1)	29 (19.2)
Pelvis	22 (10.5)	25 (16.6)
Spine	8 (3.8)	7 (4.6)
Scapula	4 (1.9)	2 (1.3)
Clavicle	3 (1.4)	2 (1.3)
Rib	4 (1.9)	-
Sternum	1 (0.5)	-
1+ Surgeries	145 (69.0%)	36 (23.8%)
3+ Unique Antibiotics Received	171 (81.4%)	65 (43.0%)
PICC Line	110 (52.4%)	57 (37.7%)
LOS in days, median (IQR)	7 (5,11)	4 (3,7)
Length IV Therapy in days, median (IQR)	16 (6,35)	6 (3,19)
Readmission	33 (15.7%)	29 (19.3%)
Recurrence	7 (3.3%)	4 (2.7%)

*Do not add to 100%. 4 patients had infections in more than one location.

CONCLUSIONS

- **In this population, being culture-negative was associated with shorter LOS and lower odds of receiving 3+ unique antibiotics**
- **Future studies should seek to distinguish between hospital onset and community onset infection**
- **Questions for future research:**
  - **Is receiving fewer antibiotics associated with use of broad-spectrum antibiotics?**
  - **Why are culture-negative patients culture-negative?**
  - **Do bone cultures benefit patients with negative blood cultures?**
  - **Do bone cultures benefit patients without abscesses requiring surgical management?**

Figure 2. Results of linear regression to determine if culture-negative pediatric AHO patients have different LOS than culture-positive pediatric AHO patients at CNH 2010-2021.

Crude and adjusted linear regression

	Crude Model B (SE), p-value	Adjusted Model B (SE), p-value
Culture-negative	-5.97 (2.53), 0.02	-6.45 (2.75), 0.02
Age	-	-1.02 (0.23), <0.01
Peak CRP	-	0.64 (0.15), <0.01
Surgery	-	-8.10 (2.71), <0.01

Post hoc analysis excluding patients 0.1 years and younger in crude and adjusted linear regression

	Crude Model B (SE), p-value	Adjusted Model B (SE), p-value
Culture-negative	-4.58 (1.19), <0.01	-2.66 (1.30), 0.04
Age	-	-0.15 (0.11), 0.20
Peak CRP	-	0.45 (0.07), <0.01
Surgery	-	-0.39 (1.29), 0.77

Figure 3. Results of logistic regression to determine if culture-negative pediatric AHO patients have different odds of being administered 3 or more unique antibiotics than culture-positive pediatric AHO patients at CNH 2010-2021.

Crude and adjusted logistic regression

	Crude Odds Ratio (95% CI)	Adjusted Odds Ratio (95% CI)
Culture-Negative	0.17 (0.11, 0.28)	0.20 (0.11, 0.34)
Age	-	0.99 (0.95, 1.04)
Peak CRP	-	1.05 (1.02, 1.09)
Surgery	-	0.92 (0.53, 1.58)

Post hoc analysis excluding patients 0.1 years and younger in crude and adjusted logistic regression

	Crude Odds Ratio (95% CI)	Adjusted Odds Ratio (95% CI)*
Culture-Negative	0.18 (0.11, 0.29)	0.20 (0.12, 0.35)
Age	-	1.00 (0.95, 1.05)
Peak CRP	-	1.05 (1.02, 1.09)
Surgery	-	0.93 (0.53, 1.62)