Surgical (Over) Treatment of Pediatric Lyme Arthritis: A Need for Faster *Borrelia* Testing

Jaclyn Aleksandra Konopka, Hayley Anne Sacks[1], Pablo Castaneda[2], Cordelia Wheeler Carter
[1]NYU Langone Orthopaedics, [2]NYU Orthopaedic Hospital

INTRODUCTION:

Lyme arthritis in the pediatric population has been previously described in endemic regions, particularly in the rural Northeast. However, differences between urban and rural populations are not well characterized. Furthermore, delay in diagnosis of Lyme arthritis and the similarity in symptoms between Lyme arthritis and septic arthritis result in some patients undergoing surgical treatment to treat presumptive septic arthritis. This is instead of medical management with an outpatient course of oral antibiotics - the standard of care for Lyme arthritis. The aim of this study is to (1) characterize Lyme arthritis in an exclusively urban population and (2) determine what factors predispose patients with Lyme arthritis to the unnecessary risks and costs of surgical treatment.

METHODS: We performed a retrospective review of children treated for Lyme arthritis at a single academic urban medical institution in New York City between 2016 and 2021. Inclusion criteria were age less than or equal to 18 years, involvement of a major joint, and positive Lyme serology and/or PCR testing. Demographic and clinical data were collected. Patients treated operatively with surgical irrigation and debridement (I&D) were compared to those treated without surgery using Mann-Whitney U and Chi-Squared tests

RESULTS:

106 children were diagnosed with Lyme arthritis over five years, with 80.2% of cases affecting the knee. Demographic data are summarized in **Table 1.** The mean age was 9.5 years, and 61.3% were male. Most patients were Caucasian, with private insurance, and lived in socioeconomically affluent neighborhoods.

Ten patients (9.4%) underwent surgical treatment for suspected septic knee arthritis; all had negative joint fluid cultures at long-term follow-up. **Table 2** demonstrates the clinical characteristics of the cohort. None of the operative patients were febrile at presentation. The operative group was more likely than the non-operative group to have an elevated heart rate (109.5 ± 8.2 versus 95.4 ± 22.1 BPM, $p = 0.03$), white blood cell count (12.27 ± 3.5 versus 9.1 ± 3.1, $p = 0.004$), C-reactive protein level (46.8 ± 26.8 versus 26.4 ± 30.2 mg/L, $p = 0.009$), erythrocyte sedimentation level (59.2 ± 32.2 versus 38.2 ± 28.6 mm/hr, $p = 0.03$), and synovial cell count (75,693.8 ± 26,778.3 versus 42,082.1 ± 24,939.5 leukocytes/mL, $p = 0.002$). Patients were also more likely to undergo surgery if they presented to the emergency department (50.0% versus 29.2%) or urgent care (30.0% versus 19.8%) than to an outpatient office (10.0% versus 50.0) (**Table 3**, $p = 0.03$). The average time for a Lyme test result to become available was 43.5 hours. For those undergoing irrigation and debridement, surgery Lyme tests resulted on average 8.7 hours after the surgical start time.

DISCUSSION AND CONCLUSION:

Although Lyme disease is typically associated with rural, wooded areas in the Northeast, Lyme arthritis nonetheless occurs commonly in the pediatric population in the urban setting as well. White, male children from high socioeconomic status backgrounds are most likely to present with Lyme arthritis in the urban setting. Unnecessary surgical treatment remains common for Lyme arthritis in pediatric patients in both urban and rural regions. 10% of pediatric patients with Lyme arthritis underwent surgery for presumed septic arthritis at our institution. Patients who were indicated for surgery, despite ultimate Lyme diagnosis, had a higher heart rate, white blood cell count, erythrocyte sedimentation level, C-reactive protein level, and synovial cell count. Patients who underwent surgical treatment were also more likely to present in the emergency department setting. Lyme tests resulted on average more than 40 hours from their time of collection, and patients who underwent surgery, on average, had a Lyme test result that was more than 8 hours after the surgical start time. A faster turnaround time on Lyme testing may allow surgeons to definitively diagnose Lyme disease before proceeding to the operating room for treatment of presumptive septic arthritis, suggesting the need for a more efficient diagnostic test.

Table 1
Demographic Variables

	Percent or Mean (SD)			
	All Patients (N = 106)	**Non-Operative (N = 96)**	**Operative (N = 10)**	**P value**
Sex *(male)*	61.3%	62.5%	50.0%	0.44
Age *(years)*	9.52 (3.61)	9.53 (3.74)	9.4 (2.12)	0.80
Race				
White	71.7%	69.8%	90.0%	0.50
Black	1.9%	2.1%	0.0%	
Asian	5.7%	5.2%	10.0%	
Other	4.7%	5.2%	0.0%	
Not Recorded	16.0%	17.7%	0.0%	
Type of Insurance				
Private	70.8%	70.8%	70.0%	0.08
Public	21.7%	20.8%	30.0%	
Note	7.5%	8.3%	0.0%	
Average Income in Home Neighborhood				
< $50,000	10.4%	10.4%	10.0%	0.67
$50,000-$100,000	41.5%	42.7%	30.0%	
>$100,000	46.2%	44.8%	60.0%	

Table 2
Clinical Characteristics

	Percent or Mean (SD)			
	All Patients (N = 106)	**Non-Operative (N = 96)**	**Operative (N = 10)**	**P value**
Laterality *(Right)*	54.7%	54.2%	70.0%	0.62
Joint Involved				
Shoulder	0.9%	0.9%	0.0%	0.98
Elbow	2.8%	3.1%	0.0%	
Wrist	0.9%	0.9%	0.0%	
Finger	0.9%	0.9%	0.0%	
Hip	4.7%	5.2%	0.0%	
Knee	80.2%	88.5%	90.0%	
Ankle	2.8%	3.1%	0.0%	
Toe	0.9%	0.9%	0.0%	
Multiple	5.7%	5.2%	10.0%	
Positive Effusion	95.3%	95.8%	90.0%	0.56
Vital Signs				
Systolic BP *(mmHg)*	110.4 (11.8)	109.5 (11.8)	118.5 (8.1)	**0.04***
Diastolic BP *(mmHg)*	65.6 (9.1)	64.2 (9.2)	68.0 (7.1)	0.25
Temperature *(C)*	36.8 (0.3)	36.8 (0.3)	37.1 (0.3)	**0.02***
Heart Rate *(BPM)*	100.3 (19.5)	95.4 (22.1)	109.5 (8.2)	**0.03***
Respiratory Rate *(BPM)*	20.3 (1.9)	21.2 (2.3)	19.6 (1.5)	0.68
Oxygen Saturation *(%)*	99.0 (1.5)	98.8 (1.3)	99.1 (1.7)	**0.03***
Labs				
WBC *(x 10 cells/L)*	9.4 (3.3)	9.1 (3.1)	12.27 (3.5)	**0.004***
CRP *(mg/L)*	28.7 (30.4)	26.4 (30.2)	46.8 (26.8)	**0.009***
ESR *(mm/hr)*	40.4 (29.6)	38.2 (28.6)	59.2 (32.2)	**0.03***
Synovial Cell Count *(leukocytes/mL)*	47,351.5 (27,843.4)	42,082.1 (24,939.5)	75,693.8 (26,778.3)	**0.002***
Synovial Neutrophil Count *(%)*	81.2 (11.9)	81.4 (12.2)	78.5 (0.71)	0.55

Table 3
Primary Service and Location at Initial Presentation

	Percent or Mean (SD)			
	All Patients (N = 106)	**Non-Operative (N = 96)**	**Operative (N = 10)**	**P value**
Primary Service				
Emergency Medicine	22.6%	20.2%	37.5%	0.90
Family Medicine	1.0%	1.1%	0.0%	
Orthopaedic Surgery	53.9%	54.3%	50.0%	
Pediatric ID	1.0%	1.1%	0.0%	
Pediatric Rheumatology	2.9%	3.2%	0.0%	
General Pediatrics	18.6%	19.1%	12.5%	
Location				
Emergency Department	31.7%	29.2%	50.0%	**0.03***
Inpatient Unit	1.9%	1.0%	10.0%	
Outpatient Clinic	47.1%	50.0%	10.0%	
Urgent Care	21.2%	19.8%	30.0%	

ID = infectious disease, * indicates a p < 0.05