

Anti-anaerobic antibiotic use is associated with lower hospital readmission rates in adults treated for known or suspected pleural empyema

Benjamin S. Avner, MD, PHD¹, Zeena Qiryaqoz¹, Justin Mak¹, James Le¹, Anush Ginosyan¹, and Cuyler Huffman, MS²

¹Western Michigan University Homer Stryker MD School of Medicine, Department of Internal Medicine

²Western Michigan University Homer Stryker MD School of Medicine, Department of Biomedical Sciences



Abstract

Background: No prevailing consensus exists on appropriate antibiotic choice, route, and duration in the treatment of bacterial pleural empyema after appropriate source control. Professional society guidelines identify a wide range of antibiotic durations, and generally recommend an antibiotic with broad-spectrum activity against anaerobes, while noting the lack of quality data. Here we address the question of whether antibiotic management of empyema is associated with hospital readmission rate.

Methods: We performed a retrospective chart review analysis of adult inpatients who had pleural drainage, via either chest tube or surgical intervention, for known or suspected empyema. 355 of the patients identified through an ICD-based electronic search string met inclusion criteria of drainage of an exudative pleural effusion, and we had follow-up data for 339 patients. The date of drainage was used to define the start date of antibiotics for our analysis. We identified whether the patients were readmitted to the hospital within 30 days of discharge and used clinical notes to determine whether empyema was the cause of readmission. We compared readmission rates with regard to 1) use of antibiotics with broad activity against anaerobes, 2) total antibiotic duration, and 3) IV antibiotic duration. Mann-Whitney U test with Bonferroni multiplicity adjustment was used to compare outcomes. As an additional post-hoc comparison, anti-anaerobic duration was dichotomized and populations were compared by χ^2 test with multiplicity adjustment.

Results: 1) A longer course of an anti-anaerobic antibiotic (β -lactam/ β -lactamase inhibitor combination, carbapenem, clindamycin, metronidazole, or moxifloxacin) was associated with lower 30-day empyema-specific and all-cause readmission rates. This association remained significant among the subgroup of patients treated with nonsurgical chest tube drainage. 2) Longer total antibiotic duration was associated with lower empyema-specific 30-day readmission rates, with a non-significant trend towards lower all-cause 30-day readmission. 3) IV antibiotic duration was not associated with a difference in 30-day readmission.

Conclusions: Our data support routine use of anti-anaerobic antibiotics in the treatment of pleural empyema. However, our study casts doubt on the benefits of extended IV rather than oral antibiotics in the treatment of empyema. This represents a target for future investigation with the aim of limiting excessive use of IV antibiotics.

Background & Objectives

- Pleural infection/empyema requires prompt drainage + antibiotics^{1,2}
- Knowledge gap^{3,4}: What kind of antibiotics, and for how long?
- Estimates of anaerobic bacteria frequency in pleural infections: 11-76%^{1,2,5,6}
- Limited data support shorter antibiotic course in certain adults w/ empyema⁷

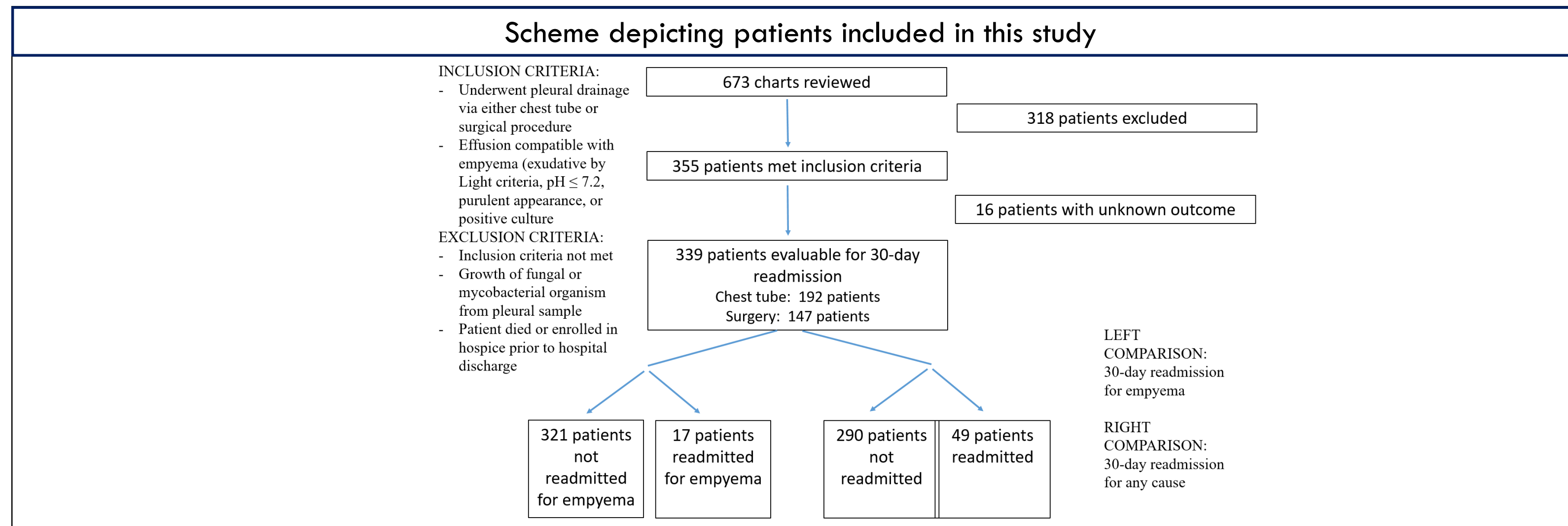
- **Objective: Determine patient outcomes with respect to antibiotics administered after pleural drainage in the treatment of known or suspected empyema**

- Study design: Retrospective case-control analysis (chart review)
- Outcome variables
 - Empyema-specific readmission within 30 days (Y vs N)
 - Any readmission within 30 days (Y vs N)

Comparisons between groups

- 1) Anti-anaerobic antibiotic duration
 - 1a) ≥ 3 days of anti-anaerobic antibiotic vs. < 3 days
- 2) Total antibiotic duration
- 3) IV antibiotic duration

Results



Demographic information for included patients	
Demographic	
Mean age	58.63
Male sex	206 (61.8%)
Diabetes	86 (25.4%)
Lung disease (asthma, COPD, or bronchiectasis)	120 (35.5%)
GFR ≤ 60	63 (18.6%)
ICU admission	132 (39.1%)
Positive pleural fluid culture	171 (50.6%)
Drainage via chest tube alone without surgery	192 (56.8%)
Type of anti-anaerobic antibiotics	None or < 3 d: 125 (35.2%) β -lactam based: 102 (28.7%) Non- β -lactam based: 81 (22.8%) Switched from BLB to NBLB: 27 (7.6%) Switched from NBLB to BLB: 20 (5.6%)

Longer durations of anti-anaerobic and total antibiotic use were associated with lower readmission rates						
	No 30-day readmission for empyema (n = 321)	30-day readmission for empyema (n = 17)	p-value	No 30-day readmission, any cause (n = 290)	30-day readmission, any cause (n = 49)	p-value
Anti-anaerobic antibiotic duration	Median 8 d IQR 0 – 17	Median 2 d IQR 0 – 3	0.003	Median 8.5 d IQR 0 – 17	Median 2 d IQR 0 – 11	0.003
Total antibiotic duration	Median 17 d IQR 11 – 28	Median 13 d IQR 6 – 15	0.010	Median 17 d IQR 11 – 28	Median 14 d IQR 9 – 21	NS
IV antibiotic duration	Median 7 d IQR 4 – 16	Median 8 d IQR 3 – 15	NS	Median 7 d IQR 4 – 16	Median 9 d IQR 5 – 18	NS

Association between anti-anaerobic antibiotics and lower readmission rates was significant among the subgroup with chest tube (nonsurgical) pleural drainage						
CHEST TUBE GROUP	No 30-day readmission for empyema (n = 180)	30-day readmission for empyema (n = 12)	p-value	No 30-day readmission, any cause (n = 162)	30-day readmission, any cause (n = 30)	p-value
Anti-anaerobic antibiotic duration	Median 8.5 d IQR 0 – 19	Median 0.5 d IQR 0 – 2.5	0.002	Median 9 d IQR 0 – 19	Median 1.5 d IQR 0 – 5	0.001
SURGERY GROUP	No 30-day readmission for empyema (n = 141)	30-day readmission for empyema (n = 5)	p-value	No 30-day readmission, any cause (n = 128)	30-day readmission, any cause (n = 19)	p-value
Anti-anaerobic antibiotic duration	Median 8 d IQR 0 – 16	Median 3 d IQR 2 – 6	NS	Median 7.5 d IQR 0 – 16	Median 6 d IQR 0 – 15	NS

Patients receiving fewer than 3 days of anti-anaerobic antibiotics were more likely to be readmitted			
	Fewer than 3 days anti-anaerobic antibiotics	At least 3 days anti-anaerobic antibiotics	p-value
30-day empyema-specific readmission: NO	107 (90.7%)	214 (97.3%)	
30-day empyema-specific readmission: YES	11 (9.3%)	6 (2.7%)	0.008
30-day all-cause readmission: NO	93 (78.2%)	197 (89.5%)	
30-day all-cause readmission: YES	26 (21.8%)	23 (10.5%)	0.004

Summary & Conclusions

- Marked association between anti-anaerobic antibiotic duration and lower risk of readmission within 30 days
- Remained significant in subgroup treated with chest tube
 - We support recommendations³ for **empiric anti-anaerobic** therapy in empyema
- Longer total antibiotic duration associated with lower readmission rates for empyema
 - Suggests **benefit of antibiotic duration** at least 3 weeks
- No association between IV antibiotic duration and readmission rates
 - Suggests empyema can be treated successfully with **oral** rather than IV antibiotics

Future Directions

- Additional retrospective direction: Larger analysis of benefit of empiric anti-anaerobic antibiotics depending upon organism(s) in pleural cultures
- Prospective studies needed to confirm results
- Direct comparison of a short vs long course of IV antibiotics (with same total antibiotic duration)
- Comparison of different (prespecified) total lengths of antibiotics, e.g. 2-3 vs 4-6 weeks

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