Low Yield of Microbiologic Studies on Pleural Fluid Specimens*

Terrance W. Barnes, MD; Eric J. Olson, MD, FCCP; Timothy I. Morgenthaler, MD, FCCP; Randall S. Edson, MD; Paul A. Decker, MS; and Jay H. Ryu, MD, FCCP

Background: **It is generally recommended that pleural fluid samples from pleural effusions of unknown cause be cultured for bacteria, mycobacteria, and fungi. However, the utility of this practice has been not been adequately assessed.**
Design: **Retrospective review.**
Setting: **Tertiary care, referral medical center.**
Patients: **Five hundred twenty-five patients undergoing diagnostic thoracentesis at Mayo Medical Center, Rochester, MN, over a 12-month period from July 1, 2001, to June 30, 2002.**
Interventions: **None.**
Measurements and results: **Among 525 patients undergoing diagnostic thoracenteses, 476 patients (91%) had one or more cultures performed on their pleural fluid specimens. Thirty-nine positive results (3.0% of 1,320 cultures) occurred in 35 of these 476 patients (7.4%). After excluding likely contaminants, true pathogens were identified in only 19 of 1,320 pleural fluid cultures (1.4%) belonging to 15 patients (3.2% of those who had cultures performed on their pleural fluid specimen). These positive results included 2.3% of aerobic bacterial, 1.2% of anaerobic bacterial, 1.4% of fungal, and 0% of mycobacterial cultures. Microbiologic smears performed on these pleural fluid samples included 357 Gram stains, 109 fungal smears (potassium hydroxide), and 232 acid-fast smears with positive yields of 2.5%, 0%, and 0%, respectively. These positive findings represented 1.3% of all smears performed. Of the specimens obtained from outpatient thoracenteses, only one had a true-positive result (0.8%). Only 1.1% (four specimens) of the cultures performed on free-flowing effusions demonstrated true pathogens; three of these four specimens grew fungi.**
Conclusions: **The positive yield of microbiologic smears and cultures on pleural fluid specimens is low, particularly in the outpatient setting and in patients with free-flowing effusions. Microbiologic testing of pleural fluid specimens should be ordered more selectively.**
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Key words: bacterial culture; empyema; fungal culture; pleural effusion; thoracentesis

Abbreviations: AFB = acid-fast bacilli; CHF = congestive heart failure; CI = confidence interval; LDH = lactate dehydrogenase

Analysis of pleural fluid obtained via thoracentesis is a valuable procedure in determining the cause of pleural effusions. The most common causes of pleural effusions include congestive heart failure (CHF), malignancy, and infection. It is generally recommended that microbiologic cultures and smears be performed on pleural fluid obtained by thoracentesis.[1–4] Although the yield of pleural fluid cultures in specific pleuropulmonary infections has been studied, very little information exists on the overall yield of these pleural fluid cultures performed at the time of diagnostic thoracenteses. Our aim was to assess the frequency of positive results from pleural fluid cultures and to identify factors associated with these positive results.

Materials and Methods

A computer-assisted search of medical records was performed to identify all subjects listed as having undergone thoracentesis.

*From the Divisions of Pulmonary and Critical Care Medicine (Drs. Barnes, Olson, Morgenthaler, and Ryu), Infectious Diseases (Dr. Edson), and Biostatistics (Mr. Decker), Mayo Clinic, Rochester, MN.
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Correspondence to: Jay H. Ryu, MD, FCCP, Division of Pulmonary and Critical Care Medicine, Desk East 18, Mayo Clinic, 200 First St SW, Rochester, MN 55905; e-mail: ryu.jay@mayo.edu

In addition, a search was performed through the Laboratory Medicine computer database in identifying those subjects whose body fluid was assayed for protein or lactate dehydrogenase (LDH [normal serum value, 122 to 222 U/L]), two common tests performed on pleural fluid specimens. We identified 538 subjects undergoing their initial diagnostic or combined diagnostic and therapeutic thoracentesis at Mayo Medical Center over a 12-month period from July 1, 2001, to June 30, 2002. Thirteen patients who did not consent for their records to be reviewed were excluded from the analysis. The medical records from the remaining 525 patients were examined to ensure the diagnostic nature of the thoracentesis procedure. The following clinical data were abstracted: age, sex, clinical findings, laboratory test results, radiologic findings, final diagnosis, treatment, and outcome. We specifically identified those patients that had received antibiotics at any time within the 7 days prior to their thoracentesis. A pleural effusion was considered "loculated" if any imaging study (radiograph, CT, or ultrasound) clearly demonstrated septations or illustrated that the effusion was not free flowing. Fever was defined as any body temperature ≥ 38.5°C that was documented in the medical record within 24 h of the time the thoracentesis was performed.

Microbiologic samples were collected and processed according to well-established, published guidelines.[5] Microbiologic cultures and smears from pleural fluid from each patient were recorded along with respective results. We analyzed pleural fluid data pertaining only to the initial diagnostic thoracentesis and excluded those related to repeat procedures. Isolates were considered contaminants if they are typically not associated with empyema (*ie*, coagulase-negative staphylococcus) and/or recovered from patients with no clinical evidence of infection or with alternative diagnoses that explained their illness. The underlying cause of the pleural effusion was based on the clinician's diagnosis documented in the medical records, unless there was strong evidence suggesting another diagnosis.

Data are summarized using median, range for continuous variables, and frequency, percentage for categorical variables. Comparisons of true-positive vs negative and false-positive results in regard to associated demographic features were performed using an exact test for categorical variables and the two-sample rank-sum test for continuous variables. In all cases, two-tailed p values ≤ 0.05 were considered statistically significant.

Results

Among 525 patients undergoing diagnostic thoracenteses, 476 patients (91%) had one or more cultures performed on their pleural fluid specimens: aerobic bacterial (n = 469), anaerobic bacterial (n = 335), fungal (n = 277), mycobacterial (n = 227), viral (n = 5), actinomyces (n = 3), Legionella (n = 3), and mycoplasma (n = 1) cultures (Table 1).

Thirty-nine positive results occurred in 35 of these 476 patients (7.4%). These 39 positive results represented 3.0% of all 1,320 cultures that were performed (Table 2); however, 20 of these 39 positive results (51%) were contaminants. Thus, true pathogens were identified in only 19 of 1,320 pleural fluid cultures (1.4%), including 11 of 469 aerobic bacterial (2.3%), 4 of 335 anaerobic bacterial (1.2%), 4 of 277 fungal (1.4%), and 0 of 227 mycobacterial cultures (0%). These 19 positive results for pathogens belonged to 15 patients or 3.2% of those who had cultures performed on their pleural fluid specimens. Three patients had more than one pathogen in their culture results.

Microbiologic smears performed on these pleural fluid samples included 357 Gram stains, 109 fungal smears (potassium hydroxide), and 232 smears for acid-fast bacilli (AFB) [Table 3]. Positive results were noted in 2.5%, 0%, and 0% of Gram stain, fungal, and AFB smears, respectively. These positive findings represented 1.3% of all microbiologic smears performed. Among the nine positive Gram

Table 1—*Cultures Performed on 476 Pleural Fluid Specimens*

Culture Type	No.	Positive, No.	True-Positive, No. (%)
Aerobic bacterial	469	26	11 (2.3)
Anaerobic bacterial	335	6	4 (1.2)
Fungal	277	6	4 (1.4)
Mycobacterial	227	1	0 (0)
Viral	5	0	0 (0)
Actinomyces	3	0	0 (0)
Legionella	3	0	0 (0)
Mycoplasma	1	0	0 (0)
Total	1,320	39	19 (1.4)*

*These 19 true-positive results are from 15 patients.

Table 2—*List of Positive Pleural Fluid Culture Results*

Isolates	Total	True Pathogens
Aerobic bacterial (n = 469)		
Staphylococcus, coagulase-negative	10	0
Staphylococcus aureus	4	4
Streptococcus viridans	4	2
β-Hemolytic Group F streptococcus	1	1
β-Hemolytic Group A streptococcus	1	1
S viridans and *Hemophilus influenzae*	1	1
Streptococcus pneumoniae	1	1
Lactobacillus	1	1
Hemophilus influenzae, β-lactamase negative	1	0
Chryseobacterium	1	0
Corynebacterium	1	0
Anaerobic bacterial (n = 335)		
Multiple species	2	2
Prevotella nigrescens	1	1
Bacteriodes fragilis	1	1
Propionibacterium acnes	2	0
Fungal (n = 277)		
Cryptococcus neoformans	1	1
Coccidiodes immitis	1	1
Candida albicans	2	2
Penicillium	1	0
Geotrichum	1	0
Mycobacterial (n = 227)		
Mycobacterium gordonae	1	0