During the study, 973 patients with a diagnosis of empyema thoracis were identified; 12 (1.23%) of these patients, including 9 men and 3 women, were infected with Salmonella species. The clinical characteristics of the 12 patients are summarized in the online Appendix Table (available from http://www.cdc.gov/ncidod/eid/vol11no09/05-0030_app.htm). The median age was 49 years; 1 patient was >65 years of age. Underlying diseases were present in all patients, including 7 with malignancy, 5 with gallstones, and 3 each with diabetes mellitus and chronic renal failure. Five patients had used antacids and 3 patients had received chemotherapy or steroids. Ten patients (83.3%) were immunocompromised and had a variety of illnesses, including malignancy, liver cirrhosis, and diabetes mellitus. Common symptoms were dyspnea (83.3%), fever (75%), and cough (50%). Analysis of pleural effusion showed a median leukocyte count of 25,600/µL, a lactate dehydrogenase level of 513 U/L, and a glucose level of 88 mg/dL. Gram staining was conducted on 3 patients’ pleural effusion but none of them showed positive results.

Twenty-three Salmonella isolates were recovered as the sole pathogen from various clinical specimens, including pleural effusion (15 isolates), blood (6 isolates), ascites (1 isolate), and aortic wall (1 isolate). Among the 12 patients with empyema thoracis, 4 had Salmonella enterica serotype Typhimurium (S. Typhimurium) and 1 had group C2 Salmonella during 1997–1999; 7 patients had Salmonella enterica serotype Choleraesuis (S. Choleraesuis) after 1998. All S. Typhimurium and group C2 Salmonella were isolated from pleural effusion specimens, but S. Choleraesuis was isolated from multiple extrapulmonary sites including blood, ascites, and aortic wall (Online Table). Although the number of study cases is limited, it may suggest that S. Choleraesuis is more invasive than 2 other Salmonella species.

Among the S. Choleraesuis isolates recovered from 7 patients, 2 were resistant to ampicillin and sulfamethoxazole-trimethoprim, 3 were resistant to chloramphenicol, 1 was resistant to ciprofloxacin, and all were susceptible to cefotaxime. All S. Typhimurium isolates were susceptible to sulfamethoxazole-trimethoprim, ciprofloxacin, and cefotaxime. Two of the 4 patients had isolates that were resistant to chloramphenicol, and 2 other patients had isolates that were resistant to ampicillin. The group C2 salmonella isolate was resistant to chloramphenicol only.

Among the 12 Salmonella isolates from patients with empyema thoracis, 9 were resistant to >1 commonly used antimicrobial. Treatment and outcome information was available for 11 of the 12 patients. All 11 patients received antimicrobials drugs (median duration 35 days); this therapy was appropriate in 9 of 11 patients. Six patients had thoracentesis, 2 had closed tube thoracostomy, and 1 had open drainage. One of the 4 patients with S. Typhimurium empyema who did not receive appropriate antimicrobial drugs died. In contrast, 4 (57%) of the 7 patients with S. Choleraesuis infection, including 1 who did not receive appropriate antimicrobial therapy, died. Another factor related to outcome was drainage. One (20%) of the 5 patients who underwent tube thoracostomy or thoracoscopy died, while 3 (50%) of the 6 patients who underwent thoracentesis died. All 3 of these patients had S. Choleraesuis.

Most (92%) of our patients were <65 years of age. These data indicate that Salmonella should be considered as a potential cause of thoracic empyema, even in younger patients, especially in the presence of malignancy or hepatobiliary disease. More than half of our patients had used antacids or had suffered from gallstones. This finding suggests that susceptibility to
Salmonella infection may be increased by alterations in the gastrointestinal tract, including decreased gastric acidity and chronic gastrointestinal disease. Leukocytosis was noted in 25% of patients. In fact, two thirds of the patients had a normal leukocyte count with immature leukocytes, which may be attributable to their relatively impaired cell-mediated immunity.

The predominant organism in this series was S. Choleraesuis, followed by S. Typhimurium. In Taiwan, the rate of resistance of S. Choleraesuis to ampicillin, chloramphenicol, or sulfamethoxazole-trimethoprim increased to approximately 90% for all 3 drugs and the rate of resistance to ciprofloxacin was from 7.7% to 59% (5–7). The resistance rate of S. Choleraesuis to ciprofloxacin in this study was similar to our previous report (7).

Nine of the 11 patients who completed follow-up information received appropriate antimicrobial drugs with drainage; however, 4 died. These 4 deaths (57%) were due to S. Choleraesuis-related empyema; 3 patients had underlying malignancy. Although appropriate antimicrobial drugs were used, our data suggest that more aggressive treatment with open drainage of the pleural effusion might have contributed to a better outcome than closed tube thoracostomy or simple thoracentesis alone. In contrast to S. Choleraesuis-related infection, all 4 patients with non–S. Choleraesuis-related thoracic empyema survived. One of these patients did not receive appropriate antimicrobial drug treatment, but did have adequate drainage with simple thoracentesis. This suggests adequate and aggressive drainage of pleural effusion may be as important as appropriate antimicrobial drugs. However, the overall death rate (36%) in this study was still higher than that of other reports (9). This might have been due to the high number of immunocompromised patients in this study.

In conclusion, thoracic empyema is a rare complication of nontyphoid Salmonella infection and is closely associated with an immunocompromised condition, even in patients <65 years of age. Higher rates of resistance and death were noted in patients with empyema thoracic caused by S. Choleraesuis. Early diagnosis, appropriate antimicrobial drug therapy, and aggressive drainage are necessary to improve the outcome of patients with thoracic empyema due to S. Choleraesuis.

Chih-Cheng Lai,* Li-Na Lee,* Po-Ren Hsueh,* Chong-Jen Yu,* and Pan-Chyr Yang*

*National Taiwan University Hospital, Taipei, Taiwan, Republic of China

References
1. Hohmann EL. Nontyphoid salmonellosis. Clin Infect Dis. 2001;32:263–9.
2. Chen KY, Hsueh PR, Liaw YS, Yang PC, Luh KT. A 10-year experience with bacteriologic of acute thoracic empyema: emphasis on Klebsiella pneumoniae in patients with diabetes mellitus. Chest. 2000;117:1685–9.
3. Samonis G, Maraki S, Kouroussis C, Mavroudis D, Georgoulas V. Salmonella enterica pneumonia in a patient with lung cancer. J Clin Microbiol. 2003;41:5820–2.
4. Biendo M, Laurans G, Thomas D, Dechehy O, Hamdad-Daoudi F, Canarelli B, et al. Regional dissemination of Salmonella enterica serotype Choleraesuis from pigs to humans, Taiwan. Emerg Infect Dis. 2003;9:360–9.
5. Chiu CH, Wu TL, Su LH, Chu C, Chia JH, Kuo AJ, et al. The emergence in Taiwan of fluoroquinolone resistance in Salmonella enterica serotype Choleraesuis. N Engl J Med. 2002;346:413–9.
6. Chiu CH, Su LH, Chu C. Salmonella enterica serotype Choleraesuis: epidemiology, pathogenesis, clinical disease, and treatment. Clin Microbiol Rev. 2004;17:311–22.
7. Hsueh PR, Teng LJ, Tseng SP, Chang CF, Wan JH, Yan JJ, et al. Ciprofloxacin-resistant Salmonella enterica Typhimurium and Choleraesuis from pigs to humans, Taiwan. Emerg Infect Dis. 2004;10:60–8.
8. National Committee for Clinical Laboratory Standards. 2003. Performance standards for antimicrobial disk susceptibility test; approved standards-eighth edition. M2-A8. Wayne (PA): The Committee.
9. Cohen JI, Bartlett JA, Corey GR. Extra-intestinal manifestations of Salmonella infection. Medicine (Baltimore). 1987;66:349–88.