Isolation of *Legionella pneumophila* Serogroup 5 from Empyema Following Esophageal Perforation*

**Source of the Organism and Mode of Transmission**

Robert R. Muder, M.D.; Janet E. Stout, M.S.; and Ying C. Yee, M.S.

A patient undergoing esophageal dilatation for carcinoma of the esophagus suffered esophageal perforation and development of an empyema. Culture of pleural fluid yielded multiple organisms, including *Legionella pneumophila* serogroup 5. Epidemiologic investigation showed that the source of *L pneumophila* was a tap used by the nursing personnel to fill patients' water pitchers. Whole-cell restriction endonuclease analysis of DNA from the clinical and environmental isolates of *L pneumophila* serogroup 5 yielded identical patterns. Our findings suggest that *L pneumophila* was acquired by the patient at least 12 h prior to the procedure causing the esophageal perforation and empyema, suggesting that the organism can persist in an infectious form in the upper aerodigestive tract.

(CHEST 1992; 1601-03)

**DFA = direct fluorescent antibody**

Numerous reports have demonstrated a link between nosocomial *Legionella* infection and colonization of hospitals' water supplies with *L pneumophila*. Various investigators have postulated aerosolization from plumbing fixtures,* tap water contamination of respiratory therapy devices,* or aspiration of water* as potential mechanisms of pulmonary infection. In cases of nonpneumonic infection, direct acquisition of *Legionella* from water supplies by contamination of wounds has been convincingly demonstrated; however, in most cases of nosocomial legionellosis, the means of acquisition of the organism from the potable water supply remain unclear.

We present a case of polymicrobial empyema associated with isolation of *L pneumophila* serogroup 5 occurring after iatrogenic esophageal perforation.

**Materials and Methods**

Clinical specimens were plated on nonselective and selective media for the isolation of *Legionella* as previously described. Environmental culturing for *Legionella* was performed in all areas of the hospital where the patient may have been exposed to the hospital's water supply. Those areas included the inpatient unit to which he was admitted, the gastroenterology laboratory, and the operating suite. Sterile Dacron-tipped swabs were used to sample sink faucets and shower heads. Swabs were used to directly inoculate selective dye-containing agar plate media for isolation of *Legionella*.

Direct fluorescent antibody (DFA) staining was performed using a monoclonal antibody reagent (Genetic Systems) that reacts with all serogroups of *L pneumophila*. Serogroup-specific polyclonal reagents (SciMedX) were used for definitive identification and serogrouping. Determination of anti-Legionella antibodies was performed by enzyme-linked immunosorbent assay.

Whole-cell DNA restriction endonuclease analysis* of *L pneumophila* DNA was performed using the enzymes, EcoRI or HindIII (Toyobo, LTD.).

**Case Report**

A 73-year-old man presented with progressive dysphagia. He had a history of carcinoma of the esophagus diagnosed 6 months earlier, for which he had received radiation therapy. His subsequent course was complicated by severe dysphagia requiring multiple endoscopic dilatations and by the occurrence of chylous ascites controlled with...
diuretics and salt-poor albumin infusions. Six weeks prior to admission, the patient had received a course of penicillin G for presumed aspiration pneumonia involving the right middle lobe; no pleural effusion was noted. Medications at the time of admission included folate, thiamine, oxytocic-acetaminophen, and ranitidine.

On presentation the patient was cachectic, jaundiced, and afibrile. Diffuse rhonchi were present bilaterally. The liver was enlarged, with an irregular edge; no ascites were detected.

On the seventh day of hospitalization, the patient underwent rigid bronchoscopy and esophagoscopy. There was an obstructing esophageal mass at 27 cm, which was dilated to 28 French without difficulty. No endobronchial lesions were noted. Because of continued dysphagia, a nasogastric feeding tube was placed endoscopically two days later, and liquid tube feedings were begun. The patient continued to take liquids by mouth as well.

On the 14th day of hospitalization, the patient underwent endoscopy under general anesthesia, with dilatation to 51 French and placement of an esophageal prosthesis. An episode of hypoxemia and metabolic acidosis developed in the postanesthesia recovery area. The patient remained intubated and on ventilatory support; he was transferred to the intensive care unit. The next morning, he extubated himself; his respiratory status was stable on nasal oxygen. Intravenous therapy with cephaloridine, which had been begun before surgery, was continued.

The patient had no oral intake after surgery. On the second postoperative day, there were decreased breath sounds and a pleural rub at the right base. Radiography of the chest showed a new right pleural effusion (Fig 1A). No parenchymal infiltrates were seen, and none was detected on decubitus films or after tube drainage of the fluid (Fig 1B).

Tube thoracostomy yielded 500 ml of turbid yellow fluid. Gram stain showed Gram-negative coccii and Gram-positive rods, along with many polymorphonuclear leukocytes. Intravenous cefotaxime and pipercillin were initiated; on the following day, cefotaxime was discontinued, and tobramycin and metronidazole were added. Intravenous erythromycin (4 g/day) was added on the fifth postoperative day. The patient developed bilateral pulmonary infiltrates and progressive hypoxemia. He died on the seventh postoperative day.

Autopsy showed carcinoma of the midesophagus, with extensive mediastinal invasion. There was a transmural erosion of the esophageal wall 10.5 cm above the gastroesophageal junction. There was a purulent pleuritis of the right thoracic cavity and 300 ml of serosanguineous fluid in the left. Bilateral bronchopneumonia was present.

**RESULTS**

Culture of the pleural fluid obtained at thoracostomy yielded *L. pneumophila*, *Lactobacillus* sp, *Neisseria* sp, an *α*-hemolytic *Streptococcus*, *Enterococcus* sp, and coagulase-negative *Staphylococcus*. At autopsy, culture of material obtained from the right pleural cavity yielded *L. pneumophila*, *Candida krusei*, *C albicans*, and *Corynebacterium* sp. One colony of *L. pneumophila* was recovered from tissue taken from the left lung. All clinical isolates of *L. pneumophila* were identified as serogroup 5 by DFA staining with serogroup-specific antibody.

Monoclonal species-specific DFA testing of the initial specimen of pleural fluid was positive for *L. pneumophila*. Multiple tissue impression smears of right and left lung obtained at autopsy were prepared by cutting a fresh surface of formalin-fixed tissue. All were negative for *L. pneumophila* by DFA.

The patient's serum obtained at autopsy had IgG and IgM titers of less than 1:80 for *L. pneumophila* serogroup 1 to 6.

Of ten sites in the potable water system to which the patient had potential exposure, only one yielded *L. pneumophila*. The positive site was a tap on the inpatient unit from which the nurses filled the patients' water pitchers. The isolate was identified as belonging to serogroup 5 by DFA staining.

*Legionella pneumophila* isolated from the patient's pleural fluid and from the positive environmental site had identical whole-cell DNA restriction patterns after digestion with HindIII (Fig 2) and EcoRI. The pattern was distinct from that obtained with unrelated control isolates.

**DISCUSSION**

Esophageal perforation is a relatively frequent complication of palliative endoscopic intubation of esophageal malignancies, occurring after as many as 13 percent of such procedures. The occurrence of intrathoracic infection is a major contributor to morbidity and mortality. The bacterial flora of infections following esophageal perforation usually consists of organisms indigenous to the oropharynx and upper gastrointestinal tract. Our patient is unusual in that *L. pneumophila* was isolated in addition to flora common to the alimentary tract.

Serogroup 5 is a rare cause of *Legionella pneumonia*. We have conducted ongoing surveillance of the potable water system of our hospital for *L. pneumophila* since 1981, in conjunction with surveillance for the occurrence of nosocomial legionellosis. We have recovered both serogroup 1 and serogroup 5 organisms from the water supply;
serogroup 1 predominates, with serogroup 5 accounting for less than 20 percent of environmental isolates. Until the occurrence of infection in the patient we have described, all cases of \textit{L. pneumophila} infection acquired in this facility had been caused by serogroup 1 organisms.

We believe that our patient was exposed to \textit{L. pneumophila} serogroup 5 via contaminated drinking water prior to the endoscopic procedure that resulted in perforation for several reasons: (1) environmental surveillance for Legionella was performed within days after the pleural fluid was cultured, and \textit{L. pneumophila} serogroup 5 was recovered from only one site, the tap from which the nurses filled the patients' water pitchers; (2) although the pleural effusion was first noted in the intensive care unit, this unit and the operating rooms and postoperative recovery area are located in a different wing of the hospital from the medical-surgical floors, and this wing has a completely separate water supply; since the opening of this wing in 1988, there have been 90 isolates of \textit{L. pneumophila} recovered from the wing's water supply, and all have been serogroup 1; (3) the clinical and environmental serogroup 5 isolates were identical by restriction endonuclease analysis of whole-cell DNA; and (4) the patient had no oral or nasogastric intake beginning the evening before the procedure until the time of his death.

Although hospital water systems are a major source of nosocomial Legionella infection, the mode of transmission from the potable water is uncertain. Although there is considerable evidence that aspiration of pharyngeal organisms may play a predominant role,\cite{1} recovery of \textit{L. pneumophila} from the oropharynx of patients exposed to Legionella-containing water is difficult to demonstrate.\cite{2} It is uncertain whether this is due to the infrequency of such colonization or to the difficulty in isolating Legionella in the presence of oral flora. Alternatively, the \textit{L. pneumophila} may have persisted in the patients' stomach, since instillation of tap water into the stomach by gavage can result in Legionella pneumonia.\cite{3} The prior receipt of ranitidine by our patient may have promoted bacterial colonization by increasing gastric pH.\cite{4}

Our patient had no contact with the identified source of Legionella serogroup 5 for 12 h preceding the occurrence of the esophageal perforation that led to the pleural space infection. This suggests that \textit{L. pneumophila} can persist in an infectious form in the upper alimentary tract after ingestion of contaminated potable water. Aspiration of these organisms is a potential mechanism by which infection may occur; future studies of nosocomial legionellosis should consider aspiration as a means of transmission.

REFERENCES