□ CASE REPORT □

Combined *Legionella* and *Escherichia Coli* Lung Infection after a Tsunami Disaster

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Abstract

Pulmonary infection after a tsunami is often polymicrobial and tends to form chronic pyogenic lung disease, necrotizing pneumonia, and empyemas. We report a combined pulmonary infection of *Legionella* and multiple antibiotic-resistant *Escherichia coli* in a previously well 75-year-old woman following immersion in tsunami waters 1 km inland from the Pacific coastline following the Tohoku Region Pacific Coast Earthquake of 2011. She needed drainage several times and the long-term use of multiple antibiotics according to the type of bacteria found and antibiotic susceptibility. We should be mindful of infections caused by multiple pathogens in the environment in Japan as a consequence of a tsunami disaster.

Key words: tsunami, *Legionella*, *Escherichia coli*, near-drowning, lung abscess

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Introduction

Many thousands of people were injured or killed by the Tohoku Region Pacific Coast Earthquake, and most by the tsunami which impacted a broad area of the Pacific coast. Although an increasing number of patients visited medical institutions in this area, most of the facilities treating the tsunami victims were also struck by the earthquake and/or tsunami and were unable to perform full laboratory examinations including bacteriological studies for several days to several weeks after the earthquake. We are finding it difficult to assess the impact of diseases or infections related to the earthquake and tsunami due to the chaos following the earthquake.

Our hospital, which is 16 km from the closest coastline impacted by the tsunami, was also damaged by the earthquake. Fortunately, however, the hospital was able to recover basic functions within a week of the earthquake. We herein describe a case with *Legionella* pneumonia and *Escherichia coli* (*E. coli*) lung abscess which developed after immersion in tsunami waters, and was refractory to treatment. We decided to share the details of this case with numerous medical facilities in this area with the hope to shed

light on other possible similar cases.

Case Report

A 75-year-old woman, who is a March 11, 2011 tsunami victim, was referred to our department because of fever and increasing pulmonary effusion despite treatment with antibiotics on March 22, 2011. She underwent surgery for gastric ulcer and pancreatic cancer at the age of 30 and 50, respectively. She had not been suffering from chronic diseases, except for osteoporosis.

On March 11, she was at home when the tsunami engulfed her house; she aspirated large amounts of water and mud, and became unconscious. Her house is located about one kilometer inland from the coastline in the town of Yamamoto within Miyagi prefecture, and between the coastline and her house there are paddy fields, a river, and a train station. Also, a nursing home close to the sea shore and a sewage canal, which is connected to a sewage facility, were located between the patient's house and the coastline.

The patient regained consciousness the following day, and was sent to a shelter after being rescued. She was sent to our hospital on March 17 because she complained of a general feeling of sickness. Her consciousness was almost clear

Figure 1. Chest X-ray on admission to our hospital. Infiltrations and atelectasis in right middle and lower lung field were observed.

at admission. There were no wounds on her body. Her vital signs were as follows: body temperature 39.6°C, heart rate 115 bpm, respiratory rate 40 times per minutes, and blood pressure 120/75 mmHg. SpO₂ was maintained at 96% by 6 L/min of oxygen through a reservoir face mask. She had a productive cough, inspiratory crackles, and a decrease in respiratory sound in the right chest on auscultation. WBC was 8,600/ μ L, and CRP increased to 21.36 mg/dL. Mild increases in AST and LDH, and mild decreases in Na and K, were observed. On chest X-ray, infiltrations and atelectasis in right middle and lower lung field were observed (Fig. 1). Since her urine was positive for *Legionella pneumophila* antigen by Binax NOW[®] (Inverness Medical Japan Co., Ltd. Tokyo), intravenous infusion of pazufloxacin (PZFX) was started. We were unable to perform microbiological examination on admission because of the damage to our hospital caused by the earthquake. Her body temperature temporarily decreased to 37°C, and then increased to 38°C in a few days and persisted. On March 25, we performed a drainage procedure for her right chest pleural effusion, which was observed on CT (Fig. 2). The test results of the pleural effusion were as follows: cell count 200/ μ L, mononuclear cells 100/ μ L, PMN 100/ μ L, pH 8.0, protein 3.6 g/dL, LDH 1,177 IU/L, and adenosine deaminase 45.9 U/L. The pleural effusion was also positive for *Legionella pneumophila* antigen. No other bacterium was detected from the microbiological study of the pleural effusion. The chest tube was removed at the end of March because it was no longer necessary to drain effusion. PZFX was continued until the first week of April for the *Legionella* pneumonia/pleurisy.

Despite the use of PZFX and the drainage, a high fever continued. Since we observed an increase in the low attenuation area in the right lung consolidation on CT, we performed a CT-guided puncture on the low attenuation area in the right lung in early April, and tens of milliliters of pus were aspirated. *E. coli* was cultured from the pus. Thus, we initiated cefmetazole and clindamycin treatment, and cefmetazole was replaced by meropenem because the *E. coli*

was resistant to penicillins, expanded-spectrum cephalosporins, aztreonam, levofloxacin, and trimethoprim-sulfamethoxazole, but not to carbapenems and aminoglycosides. A week after the puncture, her body temperature returned to normal. Meropenem was continued until early May (Fig. 3). She is now undergoing rehabilitation following her long bed stay.

Discussion

Infection after near-drowning, including that associated with tsunami waters, is often polymicrobial and tends to form chronic pyogenic lung disease, necrotizing pneumonia, and empyemas, and needs the long-term use of multiple antibiotics and sometimes drainage (1). The case reported here was a combined infection of *Legionella* and *E. coli*, and she developed necrotizing pneumonia, which meets the above-mentioned accepted notion. In the reported tsunami victims of the Sumatra-Andaman earthquake in 2004, 7 of 16 pulmonary infection cases with microbiological examination were polymicrobial, and 8 of 13 patients with a detailed description had empyema or cavity formation (2-5). Reported microbes involved in the Sumatra-Andaman earthquake of 2004 were combinations of *Burkholderia pseudomallei*, a Gram-negative bacterium which causes melioidosis in endemic areas such as in Thailand and northern Australia, *Klebsiella* species, *Pseudomonas* species, *E. coli*, *Enterobacter* species, *Acinetobacter baumannii*, *Staphylococcus aureus*, *Nocardia* species, *Salmonella typhi*, *Mycobacterium tuberculosis*, and *Candida* species (2-5). In Japan, we do not see patients with *Burkholderia pseudomallei* infection, and it is rare to see those with *Salmonella typhi* or *Mycobacterium tuberculosis* infections, although patients with *E. coli* and other enteric bacteria are common in Japan and tropical regions. Furthermore, there was no report of a *Legionella* infection following the tsunami of the Sumatra-Andaman earthquake in 2004. Although the pattern of disease is similar in both regions, pathogens involved in the disease may differ according to the region.

We detected *Legionella* antigen from the urine and pleural effusion of the patient using an immunochromatographic assay. Specificity of the positive antigenuria by this method is reported to be more than 99% (6). Data concerning the pleural effusion, such as a relatively high pH, relatively high percentage of mononucleated cells, mild increase in adenosine deaminase, in addition to the positive *Legionella* antigen, are compatible with those of previously reported cases of Legionnaire's disease rather than empyema (7). Thus, we diagnosed that the patient had *Legionella* pneumonia/pleurisy. *Legionella* is found in moist soil and water in lakes, rivers, swamps, and hot springs. It is also found in artificial water facilities, such as air conditioning systems, water cooling towers, hot water baths, fountains, water heaters, showers, and humidifiers. The incubation period for Legionnaire's disease after normal exposure is reported to be 2 to 10 days, with median values of 4 to 6 days (8). The possi-

Figure 2. Chest CT of March 25. Pleural effusion in the right chest with pleural thickening and low attenuation area inside the right lower lobe consolidation were observed. We performed drainage on the pleural effusion at the end of March and puncture on the low attenuation area in the right lower lobe consolidation in early April.

Figure 3. Clinical course. Arrow ① indicates the drainage to the pleural effusion at the end of March, and arrow ② indicates the drainage to the abscess inside the right lower lobe in early April. On follow-up CT in mid-April, both the pleural effusion and the abscess had disappeared, although her fever remained until mid-May.

bility of this patient having contracted *Legionella* infection before the tsunami, or while she was in the shelter, cannot be excluded. She had no host-side risk factor, such as cigarette smoking, chronic heart or lung disease, diabetes mellitus, end-stage renal failure, or an immunosuppressed state, except for her age. She had not traveled to a hot spring or a place with risks before the tsunami. Furthermore, while she was living in the shelter, no one in the shelter was infected with *Legionella*. Thus, the possibility of having contracted *Legionella* infection before or after the tsunami is low. Although a case with *Legionella pneumophila* infection after near-drowning has been reported, a case of near-drowning in seawater or in tsunami waters has not been reported (9). Further, inhibitory effect of seawater on the growth of *Legionella pneumophila* has been reported (10). The patient was engulfed by the tsunami 1 km inland from the seashore. Thus, the tsunami did not comprise simple seawater. In this region, it is necessary to be mindful of the occurrence of potentially severe *Legionella* infection after a tsunami.

It is not uncommon to see polymicrobial and enteric bacteria-induced lung abscess after near-drowning or after immersion in tsunami waters. It may be caused by enteric bacteria residing in seawater, environmental water, and soil. In this case, it was *E. coli* with extended-spectrum beta-lactamase and other types of antibiotic resistance. In the Sumatra-Andaman earthquake of 2004, a high percentage of resistant bacterial infection was reported (11). There are several possibilities why infection was associated with resistant bacteria. In most cases after disasters, microbiological study may be performed after the initiation of antibiotic administration like this case. It is possible that drug-resistant bacteria were selected before the microbiological study. It has been reported that resistant enteric bacteria are increasing in environmental soil, probably because of uncontrolled use of antibiotics in farm animals, although it has not been reported whether these bacteria were extended-spectrum beta-lactamase type resistant bacteria (12). Furthermore, there is a report that resistant enteric bacteria were observed in sewage facility and increased in the high-temperature season, which indicates the possibility for the transfer of plasmids with a resistant gene between bacteria in sewage facility (13). In the present case, a nursing home and a sewage canal, which is connected to a sewage facility, were located between the patient's house and the coastline. It is possible that there were highly resistant bacteria in this area because of the sewage canal and associated facility. In any case, our situation requires that we need to treat patients with pyogenic disease while considering the possibility of infection with resistant bacteria.

In soil and environmental water, there are more varieties of bacteria and fungi including *Pseudomonas* species, *Mycobacterium* species, and *Aspergillus* species, which induce a

slower development of infectious disease (14). We need to follow the victims of the tsunami in case of development of these infections after surviving acute infections.

The authors state that they have no Conflict of Interest (COI).

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