

## Case Study

# Klebsiella Pneumoniae sepsis deteriorated by uncontrolled underlying disease in a decontamination worker in Fukushima, Japan

Toyoaki Sawano<sup>1</sup>, Masaharu Tsubokura<sup>2</sup>, Claire Leppold<sup>3</sup>, Akihiko Ozaki<sup>4</sup>, Sho Fujioka<sup>5</sup>, Tsuyoshi Nemoto<sup>6</sup>, Shigeaki Kato<sup>7</sup>, Tomoyoshi Oikawa<sup>8</sup> and Yukio Kanazawa<sup>5</sup>

<sup>1</sup>Department of Postgraduate Education, Minamisoma Municipal General Hospital, <sup>2</sup>Division of Social Communication System for Advanced Clinical Research, Institute of Medical Science, University of Tokyo, <sup>3</sup>Department of Research, Minamisoma Municipal General Hospital, <sup>4</sup>Department of Surgery, Minamisoma Municipal General Hospital, <sup>5</sup>Department of Gastroenterology, Minamisoma Municipal General Hospital, <sup>6</sup>Department of Internal Medicine, Minamisoma Municipal General Hospital, <sup>7</sup>Department of Internal Medicine, Soma Central Hospital and <sup>8</sup>Department of Neurosurgery, Minamisoma Municipal General Hospital

**Abstract: Objectives:** Patients with underlying conditions are at a higher risk of developing sepsis, a systematic response to infection, which has a high mortality rate. After the March 2011 Fukushima Daiichi nuclear power plant accident, there has been an influx of migrant decontamination workers; however, little is known about their health status.

**Case:** A Japanese 55-year-old male decontamination worker, who had several underlying diseases, was transferred to our hospital in cardiopulmonary arrest. He had a history of diabetes mellitus and hypertension and a past history of tuberculosis. Control of underlying conditions was poor, with HbA1c of 13.8% at presentation. He was diagnosed with pneumonia-induced bacteremia and sepsis due to *Klebsiella pneumoniae*. Although spontaneous circulation returned in emergency room, he died a day after admission.

**Conclusion:** The poor control of underlying diseases seen in this patient could have been influenced by his recent job transfer and engagement in decontamination work and additionally related to his socioeconomic status (SES). This case highlights the need for further research to elucidate the underlying diseases, working conditions, and SES of this population.

(J Occup Health 2016; 58: 320-322)

doi: 10.1539/joh.15-0292-CS

**Key words:** Sepsis, *Klebsiella pneumoniae*, Fukushima Daiichi nuclear power plant accident, Decontamination work, Socioeconomic status

## Introduction

Sepsis is defined as a systemic response to a confirmed or suspected infection including pneumonia, intra-abdominal infection, and urinary tract infection<sup>1)</sup>, with the presence of systemic inflammatory response syndrome. Although several antisepsis treatments have been established such as early goal-directed therapy<sup>2)</sup>, the risk of mortality due to severe sepsis and septic shock remains high<sup>3)</sup>. In terms of prophylaxis, it is imperative to control underlying diseases such as diabetes mellitus<sup>4)</sup>, alcoholism<sup>5)</sup>, and chronic obstructive pulmonary disease<sup>1)</sup>, which are known to enhance the incidence of sepsis. *Klebsiella pneumoniae* is a rare sepsis-causing bacteria, but it is well known for its severe outcomes with high mortality<sup>6,7)</sup>. Bacteremia caused by *K. pneumoniae* is seen more, and with a poorer prognosis<sup>8)</sup>, in patients with underlying diseases because of potential deterioration of the immune system<sup>6,9,10)</sup>. Therefore, control of underlying diseases is highly important to reduce the mortality due to sepsis caused by *K. pneumoniae*.

In the long-term radioactive decontamination work in Fukushima, maintaining the health of decontamination workers is essential. The March 2011 Fukushima Daiichi nuclear power plant accident caused widespread radioac-

Received November 1, 2015; Accepted February 7, 2016

Published online in J-STAGE April 22, 2016

Correspondence to: T Sawano, Department of Postgraduate education, Minamisoma Municipal General Hospital, 2-54-6 Takami-cho, Haramachi-ku, Minamisoma, Fukushima 975-0033, Japan (e-mail: playi ng-soccer\_is\_fun@msn.com)

tive contamination, a health hazard for the residents of Fukushima. To reduce the level of radiation exposure to the residents, decontamination work has been extensively implemented in affected areas<sup>11,12</sup>). Decontamination workers are engaged in physically difficult jobs that impose wearing protective equipment, carrying heavy loads, and working on elevated infrastructures such as roofs. Health maintenance of these workers is important; nevertheless, little information is available on their health and underlying diseases.

We present here the case of a 55-year-old male decontamination worker who was admitted to our hospital and eventually died from sepsis due to *K. pneumoniae*. Further examination revealed that he had multiple underlying diseases, indicating that the risk of bacterial infection could be high among the presumed 15,000-20,000 decontamination workers in Fukushima prefecture. The present case highlights the importance of health maintenance of decontamination workers and the need to identify the risks they may face.

### Case Presentation

A 55-year-old man was transported to our emergency room following cardiopulmonary arrest.

Eight days before admission, he moved to Minamisoma city to begin the decontamination work. Six days before admission, he developed flu-like symptoms. Oral intake gradually decreased, and a coworker attempted to bring him to the hospital on admission day. During transfer, he lost consciousness. He was immediately brought to a nearby fire station and was found to be in cardiopulmonary arrest. Thereby, he was transported to our hospital with cardiopulmonary resuscitation.

The following was clarified from our medical records. He had a history of insulin-dependent diabetes mellitus, recently indicated hypertension, and past history of tuberculosis. While details of his health condition before engagement in decontamination work were not available because of lack of hospital history, potentially owing to settling in an unfamiliar place, his health condition may have worsened after starting work. He originated from outside Fukushima prefecture, lived alone in a dormitory, and had an income of 2.5-3 million yen per year [mean Japanese male income was 5.1 million yen in 2014<sup>13</sup>], and he did not complete high school. In Minamisoma city, decontamination workers are managed as per the following working conditions: 8 hours of work per day, 5 days a week, with a 1-hour break per day. Workers must wear long-sleeved shirts, long pants, and paper masks to prevent external or internal radio-contamination. These conditions are strictly enforced by employers following governmental regulations for radiological protection for decontamination work<sup>14</sup>). Our patient drank more than 60 g of ethanol per day and had a 25-year history of tobacco

smoking one pack a day but had stopped for the treatment of tuberculosis at the age of 45 years.

On arrival to the hospital, we found him in cardiopulmonary arrest: asystole and not breathing. Three milligrams of adrenaline and 1 mg of atropine were intravenously administered with high-flow oxygen administered under intubation. Twenty-seven minutes after arrival to the hospital, spontaneous circulation was restored. On examination in the emergency room, the body temperature was 37.6°C, blood pressure was 96/62 mmHg, pulse was 135 bpm, and oxygen saturation was 98% while being administered oxygen (15 L) from a ventilator. Results of a laboratory examination of blood revealed the following: pH 6.62, partial pressure of oxygen 57.5 mmHg, partial pressure of carbon dioxide 154 mmHg, white cell count 11900 cells/ $\mu$ L, C-reactive protein levels 26.98 mg/dL, HbA1c 13.8%, blood glucose 584 mg/dL, urea nitrogen 76.4 mg/dL, creatinine 3.07 mg/dL, and positively for hepatitis C virus antibody. Computed tomography showed disseminated shadow and air bronchogram on the bilateral lung field.

No evidence of active tuberculosis was found from the cultures of gastric juice and sputum and from interferon-gamma release assay. *K. pneumoniae* was positive in two sets of blood cultures. The patient was diagnosed with pneumonia-induced bacteremia and sepsis. Despite post resuscitation care using a ventilator and vasopressor, he died a day after admission.

### Discussion

We present a case of sepsis due to *K. pneumoniae*, resulting in death.

Control of underlying diseases, which may have adverse effects on the immune system, is significant in reducing the mortality risk inherent to sepsis<sup>1</sup>). In the present case, the patient had history of diabetes mellitus, and his blood glucose control was extremely poor, with HbA1c of 13.8%. In addition, he had untreated hypertension and hepatitis C virus infection with a past medical history of tuberculosis. From these conditions, he should have been regarded as a high-risk candidate for developing severe bacterial infections before his development of sepsis.

The poor control of underlying diseases seen in this patient could have been influenced by the patient's recent job transfer in which he left his family behind to begin decontamination work in addition to his working environment. Additionally, socioeconomic status (SES), measurable by level of education, income, and occupation, of this patient was low. In general, most decontamination workers are migrant workers, and they live alone in unfamiliar areas. It has previously been reported that in low-SES patients, the incidence of hypertension<sup>15,16</sup>), arteriosclerosis<sup>17</sup>), cardiovascular disease<sup>18</sup>), and stroke<sup>19</sup>) is high, and hospitalization caused by bacterial infection is more

frequent than in higher SES patients<sup>20</sup>.

Although it is impossible to draw a conclusion from only one case, individuals engaged in decontamination work appear more likely to have low SES and poorly controlled underlying diseases. It is unclear at this moment whether the observed bacteremia resulted from poor baseline health or poor working environment. Given the short working duration as a decontamination worker and low SES, the bacteremia observed in this case may be associated with his underlying health rather than working environment. However, this case may not represent all decontamination workers, and further research is warranted in this area to understand the baseline characteristics of health in decontamination workers and the possible influence of their SES.

In conclusion, our case was a 55-year-old man with poorly controlled underlying diseases, who eventually died from sepsis due to *K. pneumoniae*. His recent job transfer and engagement in decontamination work could have caused the deterioration of underlying conditions. To improve the health of decontamination workers, there is a need for further research addressing the underlying diseases, working conditions, and SES of this population.

*Conflict of Interest:* None declared.

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