Probable aerosol transmission of severe fever with thrombocytopenia syndrome virus in southeastern China

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Abstract

Some clusters of severe fever with thrombocytopenia syndrome virus (SFTSV) infection were reported in China as of 2010. However, to date, there has been no epidemiologic evidence of aerosol transmission of SFTSV. Epidemiologic investigations were conducted after a cluster of 13 cases of SFTSV in May 2014. A total of 13 cases, including 11 confirmed cases and one clinically diagnosed case, were identified besides the case of the index patient. The index patient experienced onset of SFTSV on 23 April and died on 1 May. The patients with secondary cases had onset from 10 to 16 May, peaking on 13 May. Moreover, eight secondary cases occurred in family members of the index patient, and the other five cases occurred in neighbors of the index patient. According to epidemiologic investigations, patients 1, 3, 4, 5, 6, 7, 9 and 12 contracted the disease through contact with blood of the index patient. Notably, patients 8 and 10 did not have a history of contact with the blood of the index patient, but they stayed in the mourning hall for hours. SFTSV could be transmitted from person to person by direct contact and/or aerosol transmission, and it is important to consider aerosol transmission as a possible transmission route.

Keywords: Aerosol transmission, cluster, emerging infectious disease, person to person, severe fever with thrombocytopenia syndrome virus
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Introduction

Severe fever with thrombocytopenia syndrome (SFTS), with an average case fatality rate of 12%, is an emerging infectious disease caused by a newly discovered virus, severe fever with thrombocytopenia syndrome virus (SFTSV). SFTSV is classified in the family *Bunyaviridae*, genus *Phlebovirus*, and contains three segments of negative or ambisense polarity RNA, designated L, M and S segments. The major clinical symptoms and laboratory abnormalities of SFTS are fever, thrombocytopenia, leukopenia and elevated serum hepatic enzymes, and SFTS patients usually die of multiple organ failure [1]. The clinical symptoms, however, are less specific and need to be differentiated from various other infectious diseases, in particular hemorrhagic fever with renal syndrome caused by hantavirus and human anaplasmosis [2,3].

Knowledge of the transmission mode of SFTSV is fundamental to an understanding and control of the disease. SFTSV is believed to be transmitted by ticks because the virus has been detected in *Haemaphysalis longicornis* ticks. Some studies reported that SFTSV could also be transmitted from person to

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person. Bao and colleagues reported that SFTSV was transmitted from a 59-year-old man to his son and son-in-law in 2010, and another cluster showed that SFTSV was transmitted from an 80-year-old woman to six secondary patients including her daughters, nephews and sons-in-law in 2007 in Jiangsu Province [4,5]. Gai *et al.* [6] identified the person-to-person transmission of SFTSV with a cluster of six SFTS patients including intensive care unit physician, intensive care unit consultation physician, mortuary beautician and family members that occurred in 2010 in Shandong Province. Three other studies reported that person-to-person transmission of SFTSV occurred in Anhui Province, Henan Province and Hubei Province, respectively [7–9]. However, all secondary patients of these clusters contracted SFTSV infection through contact with the blood or bloody secretions of patients in the end stage of the disease. There was no epidemiologic evidence of aerosol transmission of SFTSV. In this study, we identified a cluster of person-to-person transmission of SFTSV and investigated the potential transmission routes, including aerosol transmission.

Methods

Case definition

According to "the diagnosis and treatment programs of severe fever with thrombocytopenia syndrome," issued by the Chinese Ministry of Health (http://www.moh.gov.cn/mohwsyjbgs/s8348/201010/49272.shtml), a suspected case of SFTS is defined as acute onset of fever ($\geq$38.0°C) with other symptoms (e.g. gastrointestinal symptoms, bleeding), epidemiologic risk factors (being a farmer or being exposed to ticks 2 weeks before onset of illness) and laboratory data consisting of thrombocytopenia and leukocytopenia. Confirmed SFTS cases were defined as meeting the criteria for suspected SFTS and also met one or more of the following criteria: (a) detection of SFTSV RNA by a molecular method from patient serum, (b) seroconversion or a fourfold or more increase of antibody titers between acute and convalescent sera collected at least 2 weeks apart or (c) isolation of SFTSV in cell culture.

The ethics committee of Zhejiang Provincial Centre for Disease Control and Prevention approved this research project. Human research was carried out in compliance with the Helsinki Declaration. All participants provided written informed consent to participate in this study.

Laboratory test assays

The sera of the suspected patients were tested for SFTSV RNA by real-time reverse-transcription PCR performed as described elsewhere [10] in the Zhejiang Provincial Centre for Disease Control and Prevention.

Epidemiologic investigation

All persons who had a history of contact with the body of the index patient from 1 to 3 May were interviewed. The aims of our study were explained to all patients, and their consent was obtained before inclusion onto this study. A standardized questionnaire was used to collect information about demographic features, such as age, gender, occupation, and residential address, exposure history, clinical signs and symptoms, date of onset and date of confirmation. Exposure history included taking care of the index patient in hospital, moving the corpse into a car and from the car to home, washing and wiping the corpse, dressing the corpse, moving the corpse to a coffin, keeping vigil beside the coffin and staying in the mourning hall with no contact with the corpse.

Results

A total of 13 SFTS cases, including 11 confirmed cases and one clinically diagnosed case, were identified besides the index patient during this outbreak. Of these patients, six were men and seven were women, and the median age of the patients was 60.5 years, ranging from 41 to 74 years (Fig. 1). The index patient experienced disease onset on 23 April and died on 1 May. The secondary cases occurred from 10 to 16 May, with a peak on 13 May (Fig. 2). Eight secondary cases occurred in family members of the index patient, and the other five cases occurred in neighbors of the index patient (Fig. 1).

The index patient and all secondary patients were hospitalized, and all patients had fever, fatigue and chills. The majority of patients had headache, anorexia, myalgia and conjunctival congestion. Four patients had nausea, three diarrhea, two vomiting and two gingival hemorrhage (Table 1). Symptoms were similar for the index patient and the secondary patients.

The index patient was 66-year-old female farmer with a history of hypertension for more than 15 years. She lived in a wooded, hilly upland area with shrubs and grasses (Fig. 3). She used to pick tea leaves before onset of illness and developed a fever on 23 April. She visited a clinic on 25 April, and her temperature was 40°C. She was treated with ribavirin and azlocillin, but symptoms were not alleviated. She thus continued seeking medical consultations at several hospitals. She was hospitalized on 29 April (Fig. 4). As her condition deteriorated, her family requested that the hospital discharge her. Her son, daughter and brother brought her home on 1 May. She died