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## Major article

## Lessons learned from earthquake-related tuberculosis exposures in a community shelter, Japan, 2011

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## Key Words:

Interferon- $\gamma$  release assay  
Contact investigation  
Natural disaster

**Background:** Refugees and displaced populations after natural disasters have been vulnerable to tuberculosis. We report an active pulmonary tuberculosis case at a shelter and the subsequent contact investigation and review lessons learned from the 2011 Great East Japan Earthquake.

**Methods:** The contact investigation was conducted to identify latent tuberculosis infection among a total of 95 contact persons, including 78 evacuees at the shelter, who were exposed to the index tuberculosis patient. The association between exposure time of contacts to a patient with active tuberculosis and results of interferon- $\gamma$  release assay (IGRA) was also examined.

**Results:** IGRA was positive in 9 (12.3%) of 73 evacuees at the shelter. Contacts who were exposed to active tuberculosis for more than 25 days were significantly more likely to be IGRA positive, compared with contacts exposed for less than 20 days. All of the 4 evacuees with latent tuberculosis infection who initiated treatment completed the regimen successfully.

**Conclusion:** When a disaster strikes and many people are living in shelters, it is essential for health care personnel to first suspect tuberculosis and implement prevention and control in collaboration with referral hospitals and public health centers.

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The Japanese national surveillance system has reported the occurrence of infectious diseases such as tetanus and legionellosis and outbreaks such as influenza and norovirus gastroenteritis following the 2011 Great East Japan Earthquake and subsequent tsunami.<sup>1</sup> Refugees and displaced populations after natural disasters have been vulnerable to tuberculosis (TB).<sup>2,3</sup> We experienced and described TB cases and contact investigations after the Japan Earthquake that were associated with evacuees at a shelter, an infected disaster volunteer, and among health care personnel providing care to patients in hospital rooms without the ability to provide negative pressure.<sup>4-6</sup> We report here another case of active pulmonary TB at a shelter and the subsequent contact investigation

after the Japan earthquake. We also review lessons learned from TB contact investigations after the Japan earthquake.

## METHODS

The index case was a 77-year-old man with liver dysfunction who was referred and admitted to our hospital in the middle of June after the Great East Japan Earthquake on March 11, 2011. He stayed at a shelter with his family and other evacuees from March 11 to April 10 (1 month) because his house had been destroyed by the tsunami prior to returning to his home. The patient reported cough, sputum production, and appetite loss from the end of March. He had anorexia, weight loss, and pollakiuria from April and visited a urologic clinic. He also reported fever from the end of May for which he saw a general practitioner who referred him to a general hospital for detailed evaluation. He had a previous history of a gastric ulcer and prostatic hypertrophy, but no history of tuberculosis infection or immunologic abnormalities. This study

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**Table 1**Results of interferon- $\gamma$  release assay and tuberculin skin test in contact investigation for the index case by age

| Age, y | IGRA (n)        |          |          | TST (n)         |          |          |
|--------|-----------------|----------|----------|-----------------|----------|----------|
|        | Contacts tested | Negative | Positive | Contacts tested | Negative | Positive |
| 0-9    | 0               | 0        | 0        | 8               | 0        | 8        |
| 10-19  | 4               | 4        | 0        | 1               | 1        | 0        |
| 20-29  | 5               | 5        | 0        | 0               | 0        | 0        |
| 30-39  | 8               | 8        | 0        | 0               | 0        | 0        |
| 40-49  | 8               | 8        | 0        | 0               | 0        | 0        |
| 50-59  | 17              | 16       | 1        | 0               | 0        | 0        |
| 60-69  | 17              | 16       | 1        | 0               | 0        | 0        |
| 70-79  | 16              | 11       | 5        | 0               | 0        | 0        |
| 80-89  | 9               | 6        | 3        | 0               | 0        | 0        |
| 90-99  | 1               | 1        | 0        | 0               | 0        | 0        |
| Total  | 85              | 75       | 10       | 9               | 1        | 8        |

IGRA, interferon- $\gamma$  release assay; TST, tuberculin skin test.NOTE. IGRA results were evaluated according to the Japanese guideline for using the QuantiFERON-TB Gold In-Tube.<sup>8</sup>

was approved by the Ethics Committee of Miyagi Cardiovascular and Respiratory Center, Kurihara, Japan.

A chest radiograph revealed extensive infiltrative shadows in both lungs. Acid fast bacilli (AFB) were observed by sputum smear and was graded Gaffky 9 (grade 3+ on the World Health Organization scale). *Mycobacterium tuberculosis* complex was detected by polymerase chain reaction. As a result of his detailed examination, he was diagnosed as pulmonary TB and transferred to the TB ward where he was placed in a negative-pressure single room. The patient was treated with a 3-drug regimen of isoniazid, rifampin, and ethambutol. Pyrazinamide was not used because of liver dysfunction. Sputum culture yielded *M tuberculosis*, and antimycobacterial susceptibility testing revealed that the strain was susceptible to isoniazid, rifampicin, ethambutol, streptomycin, and ethionamide. He improved and was discharged in August after sputum smears were repeatedly negative for AFB. He continued to receive directly observed treatment at an outpatient clinic but died of congestive heart failure in September.

Gathering contacts' information was challenging in the shelter after the earthquake. A contact investigation was conducted to identify latent tuberculosis infection (LTBI) among a total of 95 contact persons who were exposed to this TB patient, including 78 evacuees at the shelter, 9 family members, 4 health care providers, 2 shelter volunteers, and 2 carpenters. Although exposed children aged under 5 years were assigned high priority for investigation, there is lack of evidence about the performance of interferon- $\gamma$  release assay (IGRA) in children.<sup>7</sup> In this investigation, LTBI in 9 contacts (an infant and children  $\leq 10$  years of age) was determined by tuberculin skin test (TST), and LTBI in 85 contacts (children aged  $> 10$  years and adults) was done by the whole-blood IGRA using QuantiFERON-TB Gold In-Tube (QFT-3G) (Cellestis; Chadstone, Victoria, Australia) from June to September 2011 (2-5 months after the last possible exposure). IGRA results were evaluated according to the Japanese guideline.<sup>8</sup> The association between exposure time of contacts to a patient with active tuberculosis and results of IGRA was also examined for 80 of the 85 contacts tested with IGRA. TST or IGRA was not available for one contact because he was a patient with a terminal disease (ie, cholangiocarcinoma).

## RESULTS

Eight (88.9%) of the 9 child contacts tested were TST positive, although they had received bacille Calmette-Guérin (BCG) vaccination. Ten (11.8%) of the 85 adult contacts tested were IGRA positive (Table 1). Eight (18.6%) of the 43 contacts who were exposed to

**Table 2**Association between exposure time of contacts to the index case and results of interferon- $\gamma$  release assay

|                              | IGRA (n) |          |     |
|------------------------------|----------|----------|-----|
|                              | Negative | Positive | All |
| Exposure time $\leq 20$ days | 36       | 1        | 37  |
| Exposure time $\geq 25$ days | 35       | 8        | 43  |
| All                          | 71       | 9        | 80  |

IGRA, interferon- $\gamma$  release assay.NOTE. IGRA-positive rate in exposure time  $\geq 25$  days versus  $\leq 20$  days (8/43 vs 1/37, respectively,  $P = .0077$ , Fisher test).**Table 3**

Review of earthquake-related tuberculosis exposures and contact investigations, Japan, 2011

| Source description |        |           |              |                 |                    |                          |            |
|--------------------|--------|-----------|--------------|-----------------|--------------------|--------------------------|------------|
| Age                | Gender | Type      | Sputum smear | No. of contacts | No. of IGRA tested | No. of IGRA positive (%) | Reference  |
| 70s                | Male   | Evacuee   | 3+           | 95              | 85                 | 10 (11.8)                | This study |
| 80s                | Female | Evacuee   | 1+           | 62              | 57                 | 9 (15.8)                 | 4          |
| 30s                | Female | Volunteer | 1+           | 72              | 59                 | 6 (10.2)                 | 5          |

IGRA, interferon- $\gamma$  release assay.

active TB for more than 25 days were IGRA positive, whereas only 1 (2.7%) of the 37 contacts who were exposed to active TB for less than 20 days were IGRA positive ( $P = .0077$ , Fisher test, 2-tailed; Table 2). For TST- or IGRA-positive contacts, medical examination and chest radiography were performed, but there were no findings characteristic of pulmonary TB. After physicians explained risks and benefits to contacts, the prophylactic treatment of LTBI was instituted for 4 contacts (4 evacuees), and the others received follow-up chest radiography. Children contacts who were weakly TST positive received follow-up chest radiography because they had a BCG vaccination. All of the 4 contacts with LTBI who initiated treatment completed the regimen successfully. As of January 2013, there have been no active TB cases observed among contacts. Table 3 reviews earthquake-related TB exposures and contact investigations.

## DISCUSSION

The tsunami just after the Japan earthquake claimed many lives in a moment, and survivors were often obliged to reside in shelters.<sup>9</sup> General physicians had an important role in medical care for evacuees with chronic conditions. Older TB patients often visit general physicians with an atypical presentation of TB, including lower prevalence of fever, sweating, hemoptysis, cavitary disease, lower levels of serum albumin and blood leukocytes, higher prevalence of dyspnea, and concomitant conditions such as cardiovascular disorders, chronic obstructive pulmonary disease, diabetes, and malignancies.<sup>10</sup> The older TB patient in this case had atypical presentation, and the physician at initial medical examination did not suspect TB, which may have delayed the time to TB diagnosis and resulted in TB spread in the shelter. It would be difficult for untrained shelter staff to screen older persons for the presence of TB, especially if they present with atypical symptoms. To maintain physicians' competence in prevention, diagnosis, and treatment of TB, continuous medical education and training should focus on general physicians rather than pulmonologist or infectious diseases physicians. It is essential for health care personnel supporting shelters to first suspect TB in persons with consistent symptoms and accelerate rapid diagnosis and treatment of TB in collaboration with referral hospitals where AFB testing and chest radiography are available. Patients with known or suspected TB should be

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