

A Victim of the Great East Japan Earthquake Identified with the Preserved Medical Samples of Her Deceased Mother

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On March 11, 2011, a magnitude 9.0 earthquake and huge tsunami occurred near the Pacific coast of northeast Japan, in which more than 18,000 people died or went missing and more than 120,000 buildings were destroyed. In Taro district, one of the areas struck hardest by the tsunami, a middle-aged woman was found deceased in the rubble. Generally, a family physician can recognize victims based on their appearance; the place where they were found; their home or work address; their belongings; the identifying marks on their clothes; their dental charts; and their living biological parents, children, or multiple siblings through DNA analysis. However, in this case, the middle-aged woman remained the area's sole unidentified person for months, because her appearance was different, her body was slightly swollen, and she was missing some teeth. The district's medical and dental facilities were destroyed and almost all medical records and dental charts lost. Fortunately, a family physician who had worked in the district for many years survived the disaster, and was available to provide background information about the victim, her family, and their relationship. He recalled the existence of tissue samples of her mother who had died several years earlier. Subsequently, the individual was identified through the DNA analysis of her blood and mother's tissue samples. As demonstrated in the case, appropriately managed medical information and samples from previously deceased relatives can aid disaster victim identification. The destruction caused by the Great East Japan Earthquake forms our investigation's background.

Keywords: disaster; DNA analysis; identification of victim; medical records; tsunami

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Introduction

On March 11, 2011, a magnitude 9.0 earthquake occurred near the Pacific coast of northeast Japan. About 30 minutes later, a huge tsunami struck the coastal region, resulting in 18,449 dead or missing persons and the complete destruction of 121,739 buildings (National Police Agency of Japan 2016).

Prior to the disaster, Taro district had a population of 4,434 people within an area of 101 km² (Kuroda 2011). The district, part of the Iwate prefecture, was one of the hardest struck areas by the tsunami (Fig. 1). The 19-m-high tsunami destroyed the center of Taro, including the district's only medical clinic, resulting in 181 dead or missing persons. In general, a family physician can recognize deceased disaster victims from their appearance; the place where they were found; their home or work address; their belongings; the identifying marks on their clothes; their dental chart and teeth; and their living biological parents, children, or multiple siblings through DNA analysis. This paper's first author (Dr. K) worked in Taro from 2001 through 2012, and was

the only physician since 2007. The tsunami completely inundated his clinic and also the sole dental clinic of the town, resulting in a loss of almost all medical records and dental charts. A total of 141 corpses were found throughout the Taro district, and all but one were identified within several days after their finding. This article examines the case of the sole unidentified person.

Case Report

Identifying the sole unidentified disaster victim in the district

The individual in question was a middle-aged woman (Ms. X) who was found deceased in the rubble in March 2011. Written consent for publication was obtained from all the authors and the patients' kin. Further, according to the Ethics Committee of Tohoku University Graduate School of Medicine, ethical approval was not required for this case. In March 2011, a postmortem examination was performed and the cause of death was diagnosed as suffocation due to pressure from a large quantity of seawater. She was 148 cm in height, of medium build, had some teeth

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Fig. 1. Tsunami in Taro district on March 11, 2011. Huge tsunami overcame the 10 m height embankment (white arrow) and destroyed the center of the district repeatedly. Next tsunami followed (black arrow). Ms. X was found under the rubble at the white star area. This image reproduced with permissions from Mr. T. Torii.

missing, and had a slightly swollen round face. She had no personal belongings or any identifying markings on her clothes. A blood sample was taken for DNA analysis and her dental chart was obtained.

There were several inquiries about missing persons near where Ms. X was found. Finally, there were two possible candidates (referred to as “Ms. A” and “Ms. B” henceforth) (Fig. 2). Ms. X was not Ms. A as determined by DNA analysis between Ms. X and Ms. A’s living daughter. Ms. B was in her fifties with no marriage history and no child, and except for one sister living in another prefecture, her parents and siblings had passed away several years ago. Japanese police did not undertake DNA analysis of Ms. X’s blood sample to compare with Ms. B’s sister because it would not provide conclusive evidence of her identity - a parent or a child of the victim has half of her DNA surely, but siblings may not have half of them. DNA analysis using her sister’s sample would have been inconclusive and was therefore not performed. In addition, it was impossible to obtain any physical reference samples for Ms. B, such as those of her hair or nails, because her house was completely destroyed in the disaster.

In April 2011, the prefectural criminal investigation laboratory conducted a visual comparison of her face with past photographs provided by Ms. B’s sister. The identification division of the police agency collated her fingerprints with those on paper documents held on record in the town office that were probably written by Ms. B. However, the comparison could not conclusively identify that Ms. X was Ms. B. Subsequently, Ms. X was sent to the city office as an unidentified body and then cremated.

Action: identification of the case

At the beginning of June, as the sister of Ms. B thought the unidentified individual must be Ms. B, she called Dr. K for advice on how to identify the body conclusively. Dr. K recalled that he used to be the family physician of Ms. B’s mother and had performed endoscopic stomach biopsies on

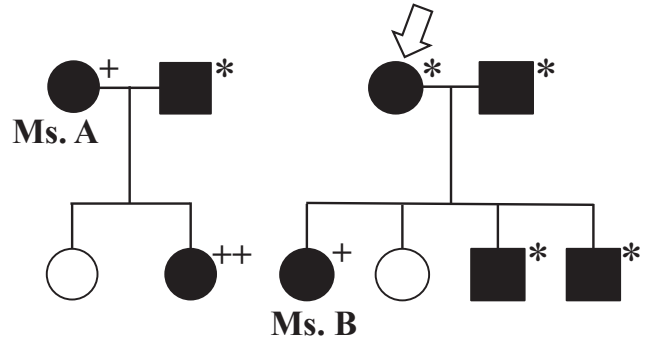


Fig. 2. Ms. A and Ms. B were candidates for Ms. X.

Black and white symbols represent persons that have passed away and those that are still alive, respectively. Ms. A had one living daughter. Ms. B had one older sister, but no living parents or children. The biopsy samples of Ms. B’s mother (indicated by the arrow) were subjected to DNA analysis using short tandem repeat typing. In the figure, “*” represents the persons who died of diseases before 2011, “+” the people who died or went missing in the 2011 tsunami, and “++” the individual who died in the 2011 tsunami, and whose corpse was identified.

the mother several years ago. He further remembered that the records of these biopsies were in a medical examination laboratory, which was in a region that had not been affected by the disaster. He identified three subsequent biopsy samples from Ms. B’s mother, which had been obtained on November in 2005 and were stored at the laboratory. The biopsy samples had been diagnosed as tubular adenocarcinoma of the stomach, but the mother refused to have surgery, and died in August 2006.

Dr. K immediately informed the police that medical samples of Ms. B’s “real mother” were stored in the laboratory. Ms. B’s sister, the police, and the laboratory exchanged written consent for DNA analysis on June 2011. The prefectural criminal investigation laboratory performed DNA analysis in order to determine parentage between Ms. X and Ms. B’s mother. Although the samples were small, ten loci from among the 15 available from a short tandem repeats (STRs) examination were able to be analyzed, and all ten loci matched between Ms. X and Ms. B’s mother. According to each compatible allele frequency in Japanese, the probability of such a match was 1 in 1.63 million (Yoshida et al. 2005). Other circumstantial evidence included body build, clothes and place where the body was found, all of which were consistent with the results of the DNA analysis. Thus, it was concluded that Ms. X was Ms. B. In June 2011, her cremated remains were returned to her family.

Discussion

Ms. B’s was one of the 15,894 corpses found after the Great East Japan Earthquake, 15,824 of which were found in three prefectures: Iwate, Miyagi and Fukushima (Ezawa et al. 2016). Among these three prefectures, 13,956 (88.6%) people were identified by the characteristics of

their body build and/or belongings, 1,250 (7.9%) were identified by dental evidence, 173 (1.1%) by DNA analysis using past samples, and 373 (2.4%) by their fingerprints. An additional 2,806 (17.8%) people were identified by using DNA analysis to determine their parentage. As of September 9, 2016, 72 (0.5%) corpses remain unidentified (Ezawa et al. 2016). This case was the only one in which a corpse was identified using the tissue samples of a relative who had died several years earlier. The Interpol Disaster Victim Identification Guide (Interpol 2013) recommends that antemortem DNA reference samples should be limited to first-degree relatives. As this case shows, even if all first-degree relatives have already passed away, there may still be tissue samples of these relatives that can be used to identify the victim.

One important feature of this case was that the family doctor knew almost all of the inhabitants in the area and had survived the tsunami himself. He was in a unique position to recall the clinical history of the victim's family, and played a key role in the identification. He had worked as the sole physician in the district for ten years before the disaster, treating outpatients, from newborns to individuals aged 103 years old, and inpatients, including nursing home residents, and conducting home and school visits for ensuring public health. He was living with his family as a civilian in the district. Hence, he loved the district and its inhabitants and could recall their history. If he had died during the disaster, Ms. X might have remained unidentified.

This shows that if the medical information of a victim and their family is preserved, and if their relationship is clarified, it may be possible to identify the victim through DNA sampling, even if both the victim and their relatives

are dead. Samples of deceased relatives might contribute to identification of such persons when combined with properly managed medical information. At present, we do not have a specific strategy in place to preserve medical records. However, we will strive to ensure that the records are stored in the safety zones so that they remain safe and medical information about the families of disaster victims is available even in the event of a disaster.

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Conflict of Interest

The authors declare no conflict of interest.

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