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Teletriage for patients with traumatic finger injury directing emergency medical transportation services to appropriate hospitals: A pilot project in Nagoya City, Japan

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ABSTRACT

Introduction: Emergency medical technicians in Japan have experienced difficulties in identifying hospitals that will accept patients with severe finger injuries. We developed and managed a system named Interactive Teletriage using mobile phone photos to aid efficient patient transportation. The aim of this study was to investigate features related to the transportation of patients with severe finger injuries and to evaluate the feasibility of this system.

Materials and methods: We prospectively analysed data from the medical association of Aichi Prefecture and the Nagoya City Fire Department in Japan. We investigated features related to the transportation of 474 patients with severe finger injuries in Nagoya from 2010 to 2013: 100 in 2010, 134 in 2011, 125 in 2012, and 115 in 2013. We began using Teletriage in August 2011 and compared the periods before and after its implementation.

Results: The time of injury showed two different peaks from 09:00 to 11:00 h and at 13:00 h. The number of patients injured during each weekday was generally the same, while cases on Saturdays and Sundays reflected 70% and 47% of the weekday average, respectively. Of the 474 patients, 395 (83%) were accepted to hospitals after 3 or fewer requests for admission: 160 of 202 (79.2%) before and 235 of 272 (86.4%) after Teletriage, constituting a significant increase ($p = 0.039$). Furthermore, the number of patients who required 4 or more requests significantly decreased after implementation of Teletriage ($p = 0.039$): 42 patients (20.8%) before and 37 (13.6%) after Teletriage. Our data showed that as the number of requests until final determination increased, the transportation period increased. Furthermore, the mean transportation period significantly decreased from 22.3 min before to 18.1 min after Teletriage ($p = 0.021$). As the number of requests until final determination increased, the proportion of patients transported to Level I and II hospitals decreased; conversely, the proportion of patients transported to Level III, IV, and V hospitals increased.

Conclusions: Our results indicated that the implementation of Teletriage has the potential to ease the problem of emergency medical transportation for those with severe finger injuries.

Introduction

Severe finger injuries such as amputation, degloving injury, and arterial injury are not only emergency conditions but also require technically challenging operations that may include microsurgery [1–4]. Because the primary treatment can directly affect the final function of the hand, a swift, accurate evaluation to determine whether or not patients should be transported to a highly specialised hospital is needed [5–9].

The system of emergency medical services and pre-hospital rescue in Japan is different from that in the United States [10–12]. In the United States, the Medical Priority Dispatch System (MPDS) operates in many places. Japan has no systematic triage protocol like the MPDS [13]. Japanese emergency medical technicians (EMTs) need to evaluate the condition of patients and transport them to appropriate hospitals by themselves. However, the number of highly specialised medical facilities is limited, and it is often difficult for EMTs to properly evaluate and convey accurate information to the hospitals before acceptance of

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patients. This situation, unfortunately, is typical in the Japanese medical system. In addition, there is no law in Japan corresponding to the Emergency Medical Treatment and Active Labor Act (EMTALA) of the United States, which may punish hospitals for turning patients away from an emergency department. Therefore, many hospitals in Japan refuse to accept patients with a severe finger injury. This has been a nationwide problem, especially in urban areas, where there are many hospitals but also many patients [10].

To address this problem, we developed a system that incorporates timely direct communication and mobile phone photos to aid in the smooth transport of patients with severe finger injury to appropriate hospitals. We named the system Interactive Teletriage. The purpose of this study was to investigate features related to the transportation of patients with severe finger injuries in the city of Nagoya from 2010 to 2013. We began managing patient transportation using Interactive Teletriage in August 2011 and subsequently evaluated the system by comparing results before and after its implementation.

Patients and methods

Nagoya, in Aichi Prefecture, is the largest city in central Japan with a population of 2.27 million people and an area of 326.43 km^2. It is the fourth most populous city in Japan [14]. This study was based on an ongoing prospective analysis of data from the medical association of Aichi Prefecture and the Nagoya City Fire Department. Herein, we report on our investigation of features related to the transportation of patients with severe finger injuries in Nagoya from 2010 to 2013, including periods before and after implementation of Interactive Teletriage, our system for managing emergency transportation. This study consisted of 100 patients in 2010, 134 patients in 2011, 125 patients in 2012, and 115 patients in 2013. The evaluation included the number of patients managed by the Teletriage system, time of injury, day of the week injured, number of requests for the admission to the hospitals until final determination, and mean transportation period as well as classification level of hospital according to the number of requests. We compared the periods before and after the implementation of Teletriage.

When responding to a finger injury, emergency medical services adopted Teletriage when it was difficult for them to determine whether the patient should be transported to a highly specialised hospital. After reaching the patient at the accident scene or shortly thereafter in the ambulance before leaving, the EMTs took digital photos of the injured fingers and called us while simultaneously sending the photographs by Then, we assessed the necessity for highly specialised treatment such as performing revascularisation, provided authoritative information, and directed the ambulance to the most appropriate hospital. In turn, the EMTs called the recommended hospitals and their doctors directly following our advice. We may have also accepted the patient depending on the circumstances. The individuals assessing and providing the information were hand surgery specialists in the Department of Hand Surgery, Nagoya University Graduate School of Medicine. We used mobile phones that could transmit and receive images with a 3.2 megapixel digital camera. Before Teletriage program initiation, we collaborated with EMTs to establish the protocol. Doctors from the Department of Hand Surgery then provided training to EMTs, giving specific details on how to most effectively photograph the injury. Our protocol stipulated taking photos on site giving views of the palmar and dorsal sides with the patient's fingers spread as much as possible (Fig. 1).

We conducted a questionnaire survey that was distributed to all hospitals within Aichi Prefecture in 2012. The questionnaire items were: (1) the number of medical doctors (orthopaedic surgeons, plastic surgeons, vascular surgeons, and anaesthesiologists); (2) the number of specialists in hand surgery; (3) the number of microsurgical operations and replantations performed in 2011; (4) the number of occupational therapists; and (5) the ability to perform emergency operations for severe finger injuries. Based on this survey, we classified hospitals into levels from I to V. Level I hospitals provided the highest level of surgical care to patients with severe finger injury. Level I and II hospitals were able to accept severe finger injury patients any time of any day. They were officially authorised as "Hand Surgery Educational Facilities" by the Japanese Society for Surgery of the Hand. Level I, but not Level II, hospitals performed more than 50 operations which included microsurgery in 1 year and had two or more hand surgery specialists as well as occupational therapists. Levels III and IV hospitals were able to accept patients with severe finger injuries in some cases. Level III hospitals had at least one hand surgery specialist, but Level IV hospitals had none. Level V hospitals were unable to accept patients with severe finger injuries.

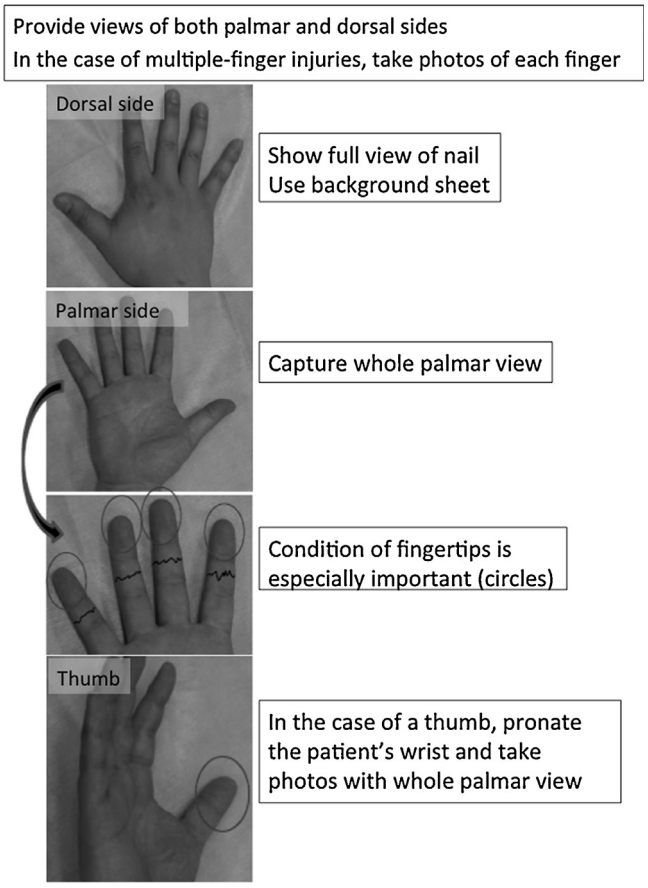

Fig. 1. Our protocol for taking digital photos.

Data were summarised using descriptive statistics. The comparison between before and after Teletriage of number of requests to the hospitals until final determination and patients with emergency conditions was done by χ^2 analysis. The mean transportation period before and after implementation of Teletriage was assessed using the Mann-Whitney U test. Statistical significance was set at $p < 0.05$. IBM SPSS software version 20 (IBM Corp., Armonk, NY) was used for statistical analysis.

Results

The Teletriage system was employed for 45 patients beginning in August 2011. The time of injury showed two different peaks