The International Activities in Taiwan by the Joint Burn Care Assistance Team of Physicians from Japan Medical Association and Three Medical Societies

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Introduction

Cross-border medical support activities began with the Committee of Five, the predecessor of the International Committee of the Red Cross, which was established in 1863.[1] In Japan, in addition to the Japanese Red Cross Society, the Japan Medical Association Team (JMAT)[2,3] is relied on for medical support in disaster-affected areas. JMAT was active in providing aid in the aftermath of the Great East Japan Earthquake, which struck on March 11, 2011.

Around 8 pm on June 27, 2015, a dust explosion occurred at a water park called Formosa Fun Coast in New Taipei City, Taiwan, when flammable colored powder used at an event exploded. On June 30, the number of burn patients totaled 498 (ultimately there were 499 patients), of which 398 were hospitalized. Of these, 277 were intensive care patients and the average burn coverage was reported to be 44% of total body surface area.

At the request of the Taiwan Medical Association (TMA) and the NGO Taiwan Root Medical Peace Corps (TRMPC), the Japan Medical Association (JMA) dispatched six burn experts recommended by the Japanese Society of Intensive Care Medicine (JSICM), the Japan Association for Acute Medicine (JAAM), and the Japanese Society for Burn Injuries (JSBI). This Joint Burn Care Assistance Team of Physicians by JMA and Three Medical Societies was in Taiwan for the four days from Sunday, July 12 to Wednesday, July 15, 2015 to collaborate with the Taiwanese government, especially Taiwan's Ministry of Health and Welfare, in assisting with burn treatment. This report discusses the activities of the team in Taiwan.

Preparations Leading Up to Burn Treatment Support

On June 30, JSICM began considering transporting burn patients by air to intensive care units in Japan. By July 7, JMA had coordinated with the TMA and Taiwan's Ministry of Foreign Affairs, and had also brought together the JSICM, JAAM and JSBI to select six members

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Fig. 1 Coordination with Taiwan Medical Association and Taiwan's Ministry of Foreign Affairs
The Joint Burn Care Assistance Team's visit to Taiwan was carried out in collaboration with the Taiwan Medical Association (TMA) and Taiwan's Ministry of Foreign Affairs. The need to set up a medical system for emergencies, such as wide-area disasters was discussed. In addition, it was confirmed that there is the need to establish legislation through collaboration between the TMA and JMA for emergency medical support systems.

for the team and set the procedures for sending the team. The four days from July 12 to July 15 were designated for activities, with the members serving as advisors on burn treatment but not providing direct medical treatment.

At 10:30 am on July 12, the members met at the Chubu Centrair International Airport in Nagoya, shared information on the current status of burn treatment in Taiwan, and confirmed the guidelines for their activities. On arriving at the Taiwan Taoyuan International Airport on China Airlines, representatives from Taiwan's Ministry of Foreign Affairs and the TRMPC and reporters from many news outlets were waiting. The team then went to Taiwan's Ministry of Health and Welfare and received information about the burn treatment following the water park accident in New Taipei City. The Ministry and the TRMPC explained the support system and schedule for the team's stay in Taiwan (**Fig. 1**). The current status of the 498 burn patents (the final count was 499) was also reviewed (**Table 1**).

Table 1 Number of burn victims in Formosa Fun Coast dust explosion accident

Burn patients (no.)	498
ICU (no.)	277
General ward (no.)	160
Discharge	60
Burn area average (%)	44

This is the breakdown of the injured as announced by Taiwan's Ministry of Health and Welfare on June 30, 2015. Initially, 277 patients were in intensive care units. Subsequently, one more person was added and the number of injured was revised to 499. The average burn coverage was about 44%. Of these, 11 people (2.2%) had died as of August 13, 2015, which is an extremely high rescue rate.

Visits to Hospitals in Taiwan

On July 13, the team visited the Tri-Service General Hospital and the Shin Kong Wu Ho-Su Memorial Hospital, followed by the Cheng Hsin General Hospital on July 14 and the Linkuo Chang Gung Memorial Hospital and Cathay General Hospital on July 15. The team visited the five hospitals in total that the Taiwan's Ministry of Health and Welfare had readied for their arrival, and shared information on treatment.

Each hospital had prepared presentations on severe cases that had been difficult to manage. They shared patient information and discussed treatment and management (**Fig. 2**). Subse-

Fig. 2 Presentations and discussions on severe symptoms
This is an image of discussions of cases at the Shin Kong Wu Ho-Su Memorial Hospital on July 13, 2015. The situation was tense as the patient's symptoms were extremely severe. In addition to presentations on cases of severe burns using computer projections and discussions of treatment guidelines, the team visited the rooms of patients with severe injuries and reviewed treatment guidelines on an individual basis in conjunction with the symptoms in each case.

Fig. 4 Tour of operating room and specific advice on operations
At the Cheng Hsin General Hospital on July 14, 2015, the team discussed surgical guidelines in the operating room. Debridement of burn wounds, cleaning of wounds and infection management were discussed in full to arrive at management guidelines.

quently, the team went on hospital rounds for the burn center (**Fig. 3**), the critical care unit, and the hospital wards and toured the operating rooms (**Fig. 4**), and then thoroughly discussed the management and treatment guidelines for each patient in terms of the management of the burn wound, consciousness, breathing, circulation, infection, nutrition, regeneration and rehabilitation. The team recognized the advanced

Fig. 3 Making the rounds of the burn management unit
This is a picture of the team making the rounds of the burn center and the beds in the intensive care unit at the Tri-Service General Hospital on July 13, 2015. The treatment guidelines for individuals were discussed in conjunction with their symptoms, and treatment information was shared.

burn treatment available at each hospital and tried to share good treatment guidelines among them. The team gave computer presentations of the burn treatment guidelines used in Japan, infection management and skin grafting with artificial dermis and cultured epidermal autograft (CEA), and then discussed these approaches at each hospital.

All of the hospitals that the team visited were treating more burn patients than normally expected, given this emergency situation resulting in a large number of burn patients. They all faced difficulties in ensuring a sufficient number of health care providers, treatment centers for whole-body management, local wound management and infection prevention.

Taiwan's Medical Volunteer System

Regarding medical manpower, retired doctors and doctors who had started their own practices returned to the medical center as medical volunteers to help with the treatment. In addition to these volunteers in Taiwan, if the dispatch of doctors and nurses from Japan were possible, the burden on critical care doctors could be reduced. It was determined that transporting burn patients to Japan, as considered by the JSICM, was not applicable due to the high standard of treatment in Taiwan and the strong desire and expectations of patients and their families to be treated in their own country, as well as the risks associated with wide-area transport.

Bedside Discussions on Whole-body Management

All of the five hospitals used the same approach to whole-body management as Japan uses in its burn treatment. However, not all of the doctors treating patients with multiple burns were experienced in burn treatment. The team was thus able to serve as intermediaries between doctors specializing in burn treatment and doctors with other specialties.

First, the team gave a presentation on the effective use of dexmedetomidine (DEX) for pain relief and mitigation, and shared information on the relationship between pain management and maintaining immunity. DEX[4,5] is an $\alpha 2$ adrenoreceptor agonist widely used in Japan during the intensive care phase. In addition to a sedative effect via the locus ceruleus, DEX is effective in easing pain in the trunk of the body. The team discussed the effect DEX could have in easing sympathicotonia, as well as stabilizing circulation.

As regards respiratory care, the dust explosion caused by the corn starch used in the colored powder resulted directly in airway burns, lung injuries and accompanying respiratory infections in some patients. The inhalation burn injury[6] caused by the dust explosion required attention and careful follow-up. As a result of the respiratory tract injuries caused by burning corn starch adhering to the trachea, extracorporeal membrane oxygenation (ECMO) was introduced. There have been cases in which patients could be removed from ECMO. There were over 20 cases in each hospital of patients requiring artificial respirators for pulmonary edema as a result of this kind of airway burn and mass transfusions required to manage extensive burns.

In cardiovascular management, there was a general understanding about the difficulty of managing the initial transfusions in the many symptoms present when burns cover more than 40% of the body. The team discussed management guidelines for fluid therapy in the case of severe inflammation, as seen with sepsis and burns, including an approach to restoring fluid balance using pulse pressure variation (PPV) and stroke volume variation (SVV) for waveform analysis of pulse waves,[7-9] and circulation management through ultrasound scans. In addition, we discussed treatment guidelines for cases in which cardiac tamponade and large-volume pleural effusion, which can occur with transfusions in extensive burns, function as restrictive factors for the heart and thus impede circulation. In confirming these individual cases, treatment guidelines were discussed at the bedside and treatment guidelines were shared.

Management of Burn Wounds

Even 16 days after patients had first received the burns, there were several cases in which debridement of the burn wounds was not yet complete. Since the objective was to save the lives of the many patients with extensive burns, an approach was used in which debridement in a small area was carried out over several days and repeated while the patient was under general anesthesia. There were several severe cases, which were required escharotomies due to circumferential deep burns.

At each hospital, the team explained the general process for burn treatment, the target time for completion of debridement, wound treatment, methods for cleaning wounds, and the use of topical agents, and shared information on treatment management. The team also gave presentations using computers on the use of cultured epidermal autograft (CEA) combined with auto 6 to 1 meshed split thickness skin graft called hybrid method in Japan. In these presentations, the method using CEA, which is not yet approved in Taiwan, the "sandwich" method in which artificial dermis and autologous skin are combined, negative pressure wound therapy, and a method using silver sulfadiazine were discussed, and treatment guidelines were shared.

Management of Infection and Sepsis

There were cases in which local infection and respiratory tract infections resulted in sepsis. In addition to enteric bacteria, pathogenic bacteria such as *Acinetobacter baumannii*, Methicillin-resistant *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Candida* spp. were causing problems, and multi-drug-resistant *Acineobacter* infections were confirmed in particularly high numbers. The team shared information about the status of the management of multi-drug-resistant bacteria in Japan and effective monitoring of bactericide blood concentration levels, as well as

the effectiveness of measuring plasma (1→3)-β-D-glucan[10] in managing fungi and the appropriate use of antifungal agents.

Coordination with Taiwan's Ministry of Health and Welfare

After visiting the hospitals, the team stopped by the Ministry of Health and Welfare every day to report on the status of burn management at the hospitals and share information on its activities. The Ministry considered the use of CEA, which was approved for manufacture by Japan's Ministry of Health, Labour and Welfare as Japan's first human cell/tissue-engineered medical device (product name: JACE®, Japan Tissue Engineering Co., Ltd., Japan)[11] on October 29, 2007. In addition to describing the characteristics of CEA and the pros and cons of its use, the team provided specific information on whole-body management, such as the exact skin grafting methods for burns (burn management using artificial dermis and CEA that has been preserved), optimizing debridement, wound management using negative pressure wound therapy, methods for cleaning wounds, infection and sepsis management, and pain management and mitigation. Files of the presentations given by the team were provided to the Ministry of Health and Welfare and the respective hospitals via the TRMPC.

In Closing

The Joint Burn Care Assistance Team's work in Taiwan confirmed the need for medical collaboration between Taiwan and Japan in accidents resulting in multiple casualties. The visits to the five representative hospitals—the Tri-Service General Hospital, the Shin Kong Wu Ho-Su Memorial Hospital, the Cheng Hsin General Hospital, the Linkuo Chang Gung Memorial Hospital and Cathay General Hospital—affirmed the effectiveness of treatment collaborations in emergency situations. The team informed the JMA and Taiwan's Ministry of Health and Welfare of the need to establish a mutual support system in both countries to respond to multi-casualty events in Taiwan and Japan. Discussions with medical professionals from Taiwan's Ministry of Foreign Affairs, Ministry of Health and Welfare, the TMA, the TRMPC and others (**Fig. 1**) demonstrated the importance of medical interaction between the two countries.

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