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### Tertiary Intensive Care to Victims Repatriated to Europe After the 2004 Tsunami disaster

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Individuals evacuated following the 2004 tsunami disaster sustained traumatic injuries to the head, chest and limbs that were contaminated with highly resistant bacteria. Transferred patients from disaster areas should be isolated until their microbial flora are identified, as they may introduce new and unusual pathogens into an intensive care unit (ICU). Aggressive debridement, together with vacuum-assisted closure for the interim, broad antimicrobial coverage and psychoemotional intervention, were cornerstones of the successful management of the evacuated tsunami victims.

#### Introduction

On December 26, 2004, a giant earthquake shocked Southeast Asia, triggering deadly flood waves (tsunami) across the Indian Ocean. More than 310,000 people were reported dead and millions left destitute. Shortly thereafter, European governments repatriated the most severely injured tourists using Medical Evacuation ("MedEvac") aircrafts. Upon arrival in Europe, patients were distributed to various medical centers. One cohort of severely injured patients was admitted to the Cologne-Merheim Medical Center (CMMC) in Germany for further surgical and intensive care unit (ICU) treatment (Maegele et al. 2005; Maegele et al. 2006).

#### Triage and Air Transfer

Following the tsunami, European governments quickly organized airlifts to evacuate injured citizens from the disaster area. Their strategy was to evacuate patients with minor injuries first, simultaneously providing capacity to care for more severely injured and hospitalized patients, who were unable to reach the airport for evacuation. Following the establishment of first-aid and collecting points at evacuation airports, "scout" teams were formed to search for injured tourists. Initial surveys along the coasts quickly indicated that only dead bodies remained at and near the seashore, and thus the ongoing search focused primarily on local hospitals in which victims had received first-aid and treatment focusing on basic stabilization of cardio-respiratory functions, wound management and infection control.

Upon triage at the collecting point, patients with minor injuries were airlifted via regular or ambulance aircraft. Critically ill patients were evacuated by Airbus A310 MRT MedEvac aircraft following stabilization of vital functions (Zylka-Mehnhorn 2005). Within a short time, approximately 2,500 uninjured tourists and tourists with minor injuries, as well as 300 more severely injured tourists from various countries, were evacuated. Upon arrival after the 15-hour MedEvac flight from Phuket to the Cologne, Germany, military airport, one cohort of severely injured patients was taken directly to the CMMC for further surgical and ICU treatment. No deaths were reported en route.

#### Major Problem: Contaminated Wounds and Uncommon Respiratory Infections

The predominant pattern of injury in the tsunami victims consisted of multiple large-scale, soft-tissue wounds (range: 2x3 cm – 60x60 cm) in the lower extremities (88%), upper extremities (29%) and head (18%) (see figure 1, page 12). Additional injuries included thoracic trauma with hemothorax and serial rib fractures (41%) and peripheral bone fractures (47%), both open and closed.

A major problem associated with wound management in these patients was significant contamination. Microbiological assessment identified not only a variety of common isolates (*Pseudomonas* 54%, *Enterobacteriaceae* 36%, *Aeromonas* spp. 27%), but also uncommon isolates, which were often multi-resistant (multi-resistant *Acinetobacter* and ESBL-positive *E. coli*, 18% each). The process of near-drowning in seawater involves the aspiration of immersion fluids, as well as marine debris, into the respiratory tract, thus providing intrapulmonary inoculation of bacteria and inducing pneumonitis and pneumonia. All our patients showed radiological and clinical signs of pneumonitis upon arrival, and respiratory tract specimens contained a high rate of multi-resistant *Acinetobacter* species, as well as methicillin-resistant *Staphylococcus aureus* (MRSA),

Aeromonas hydrophilia, Pseudomonas species and Candida albicans. Table 1 on page 25 summarizes causative pathogens and locations from which they had been identified.

Wound management focused on aggressive and repetitive debridement, including removal of devitalized tissues. In two cases, amputations were inevitable. Between initial wound surgery and delayed secondary closure, with or without skin grafting, wounds were protected using VAC® therapy (Vacuum Assisted Closure®/ V.A.C. Vakuumpquellen, KCI Therapie Geräte, Höchststadt, Germany) (Argenta and Morykwas 1997; Joseph et al. 2000; Mullner et al. 1997).

Our initial choice of anti-infective therapy was a combination of a potent quinolone with clindamycin. This strategy is commonly followed in our facility for infection of unknown origin and generally corresponds to the guidelines of the Paul-Ehrlich Society for Chemotherapy (Bodman and Vogel 2001). This approach covered major pathogens that could initially be expected in our incoming patients (Lim 2005). Anti-infective management was immediately adopted according to incoming results from microbiology and resistance patterns (see table 1, page 25).

#### **Psychoemotional Aftermath**

The full impact of the tidal wave on the mental health of survivors is still unknown (Miller 2005). In February 2005, the World Health Organization (WHO) estimated that up to 50% of the five million people affected by the tsunami would experience moderate to severe psychological distress. Approximately 5-10% would develop more persistent problems, e.g. depression, posttraumatic stress disorder (PTSD) or other anxiety disorders unlikely to resolve without intervention.

Among all patients and relatives that were treated in our facility, clinical symptoms of posttraumatic psychological stress response were noted. All patients treated in our hospital had suffered loss of at least one relative, and two mothers of our cohort lost both of their children. Major complaints included nightmares, emotional detachment, sleep difficulties, flashbacks, headaches and intrusive thoughts based upon individual experiences during the disaster. Psychoemotional responses further comprised distress about injuries sustained, dissociation, optical, acoustical and olfactory intrusions and, in some cases, agitation.

To cover the psychoemotional trauma associated with the disaster, non-governmental organizations (NGOs) and their local partners undertook efforts to assure initial psychological support already at the scene of the tsunami, in particular for children who, in part, suffered the loss of both parents.

Upon arrival in Germany, psychological care for the evacuees was continued directly at the airport by disaster intervention teams and emergency pastors, coordinated by *Nachsorge, Opfer- und Angehörigenhilfe* (NOAH), a special division of the Federal Office for Civil Protection and Disaster Management (*Bundesamt für Bevölkerungsschutz und Katastrophenhilfe*, or BKK). This support network also introduced telephone hotlines, assembled (together with airline companies) passenger lists of the less severely injured patients who were evacuated on regular flights and distributed educational pamphlets on typical clinical signs of posttraumatic stress syndrome to each arriving victim, indicating when to consult professional support. Upon federal request, the Department of Psychotrauma of the University of Heidelberg assembled a comprehensive list of 400 qualified psychotherapists offering immediate support nationwide when needed. These materials are intended to be preserved or further developed for future disasters, and the foundation of a nationwide and independent Institute for Psychotrauma is being discussed (Bühning 2005). Psychotherapeutic support for patients and relatives treated in the Cologne-Merheim Medical Center was provided by the department's psychotherapeutic intervention team, consisting of three qualified and experienced psychotraumatologists, available 24/7 upon request.

#### **Summary / Conclusion**

A pattern of severe, large-scale, soft-tissue damage including high-level contamination was common to all tsunami victims evacuated to our medical facility. Microbiological assessment identified common aquatic pathogens, but also an unusually high rate of multi-resistant strains that may spread easily among patients treated in local hospitals. Strict isolation and broad microbiological assessment is recommended for infection control in patients arriving from those areas. For optimum treatment, tight collaboration between surgeons, intensivists and microbiologists is mandatory. In addition, care for the physical needs of disaster victims needs to be balanced with care for the patients' emotional needs. Thus, a network of psychological support is an essential component in disaster management. Using this holistic, body-and-mind approach to critical care, our hospital was successful in treating the severely injured tsunami victims, preventing the spread of unusual microbes throughout our hospital and setting the stage for our patients' long-term healing process following one of the biggest natural disasters of our time.

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