Scand J Trauma Resusc Emerg Med 2005; **13**; 43-46

With editorial comments by Dr. David J. Dries,
Department of Surgery, University of Minnesota

Kerwin AJ, Frykberg ER, Schinco MA, Griffen MM, Murphy T, Tepas JJ.

The Effect of Early Spine Fixation on Non-Neurologic Outcome

J Trauma 2005; **58**: 15-21.

Introduction: It has been shown that spinal fracture fixation within 3 days can reduce the incidence of pneumonia, length of stay, number of ventilator days, and hospital charges Our institutional protocol calls for surgical stabilization of spinal fractures within 3 days of admission. We hypothesized that compliance with an early spinal fracture fixation protocol (within 3 days of admission) would improve non-neurologic outcome in patients with spinal fractures.

Methods: The trauma registry was queried for the period January 1988 through October 2001 to identify patients with spinal fractures requiring surgical stabilization. Patients were analyzed to determine the compliance with our protocol and to determine whether early spinal fixation can reduce the incidence of pneumonia, reduce length of stay, and reduce mortality.

Results: 1,741 patients with spinal fractures were identified. 299 (17.2%) required surgical stabilization. 174 (58.2%) had surgical stabilization within 3 days while 125 (41.8%) had surgical stabilization greater than 3 days from admission. There were no significant differences between the two groups with regards to age (37.9 versus 42.5), admission GCS (14.1 versus 13.9), or ISS (22 versus 20.8). The incidence of pneumonia was similar in both groups (21.8 versus 25.6%). The mortality was higher in the early group as compared with the late group (6.9 versus 2.5%), although it did not reach statistical significance. The hospital length of stay was significantly shorter (14.3 versus 21.1) for patients who had early spine fixation, however there was no statistically significant difference between the two groups with regards to intensive care unit length of stay (7.2 versus 7.9) or number of ventilator days (5.02 versus 1.9). Patients who were severely injured (ISS > 25) also had a significantly shorter hospital length of stay (19.6 versus 29.1) if they underwent early spinal fixation. Patients with thoracic spine injury and associated spinal cord injury had a significantly shorter HLOS (10.1 versus 30.5), ICULOS (2.3 versus 13.1), and lower incidence of pneumonia (6.5 versus 33.3%).

Conclusions: Reasonable compliance with an early spinal fracture fixation protocol produced some outcome improvements in non-neurologic outcome. Early spine stabilization reduced hospital length of stay in all patients. Patients with thoracic spine trauma and a spinal cord injury had the greatest benefit in reduction of morbidity, HLOS and ICULOS from early stabilization. There was a trend toward poorer outcome in some groups with early spine stabilization. A rigid protocol requiring early surgical spine stabilization in all patients does not appear justified. Although early spine stabilization should be performed whenever possible to reduce hospital length of stay, the timing of this procedure should be individualized to allow patients with the most severe physiologic derangements to be optimized preoperatively.

Key Words: Spinal fractures, Spinal cord injury, Surgery, Timing.

***Comments**: The concept of early stabilization of long bone fractures to lower the incidence of posttraumatic pulmonary and thomboembolic complications has been extrapolated to the treatment of spinal fractures (J Bone Joint Surg 1989; 71:336-340). A small number of large series have investigated the effect of early spine stabilization (Ann Surg 2001; 233:851-858; J Orthop Trauma 1996; 10:323-330). For the most part, data seems to support early stabilization of the spine as a strategy to reduce non-neurologic complications associated with acute care hospitalization. This large recent series, however, suggests that careful resuscitation may be important and that a global policy toward early spine stabilization may be deleterious in some cases. The authors come from a noted trauma center and include senior members of the American Association for the Surgery of Trauma.*

Patients with thoracic spine injuries and associated spinal cord injury had the greatest benefit from early stabilization. Here hospital and ICU length of stay were reduced as well as the incidence of pneumonia. This is consistent with other work, particularly a large series from the Memphis group. Patients with cervical spine injury associated with spinal cord injury did not demonstrate improved outcome. If the cervical spine was injured without associated spinal cord injury, resource consumption was reduced. This I presume is associated with opportunities provided by early mobilization.

This retrospective data set has a number of important flaws. First, a clear history of mobilization cannot be obtained. Second, the timing points for separation of early and late repair groups are arbitrary and it is not clear, in most cases, the reason for delay in surgical stabilization. Factors such as surgeon and operating room availability or availability of necessary equipment may artificially change the results obtained. Finally, the impact of surgeon and surgical technique are not assessed here.

Gonzalez D.

Crush Syndrome

Crit Care Med 2005; **33**: S34-S41.

The assessment, management, and treatment of the entrapped victim are critical skills needed to ensure a successful outcome. Individuals have been trapped in the "rubble" for even short periods of time only to succumb to predictable consequences of muscle compression injury. The clinician should be prepared to address issues of crush syndrome (including compartment syndrome) proactively and aggressively. The history of this disease is clear and well documented both in the military literature and in the earthquake rescue reviews. The key to management is managing and predicting clinical conditions before they present themselves. The potential exists in the urban environment (with the potential of building collapses) to have patients with crush syndrome that far exceed local medical capabilities should be part of modern disaster planning.

Key Words: Crush syndrome, Acute renal failure Rhabdomyolysis, Earthquake, Building collapse, Confined space.

***Comments**: This one of a group of reviews occasioned by a supplement to Critical Care Medicine describing issues pertinent to the care, disaster, terrorism and military conflict victims (Ren Fail 1997; 19:647-653; Prehosp Emerg Care 2002; 6:81-91). The crush syndrome is a characteristic component of blunt force trauma, which includes rhabdomyolysis, acute renal failure and myoglobinuria. Three criteria are noted in patients sustaining crush syndrome: 1) muscle mass involvement; 2) prolonged compression (from 20 minutes to 4-6 hours); and 3) local circulatory compromise.*

Muscle tissue destruction and the influx of myoglobin potassium and phosphorus into the circulation result in the classic picture of traumatic rhabdomyolysis and crush syndrome. Hypovolemic shock and hyperkalemia are frequently seen. This type of presentation is common in disasters such as earthquake, war settings, vehicular accidents and events involving pinning the victim under heavy objects. Clinical presentation is based on history of events and a high index of suspicion.

The commentary from the New York City Fire Department and The Urban Search and Rescue Team of New York advocates withholding resuscitation fluids from trauma victims before hemorrhage control if a radial pulse is detected. 250 mL aliquots of fluid for patients with loss of pulses are felt to be a better choice than massive fluid resuscitation given historically. In penetrating torso injury, the presence of a central pulse is adequate perfusion until definitive hemorrhage control is available. For infants, the brachial pulse is a more practical and consistent monitor for physical exam. Extensive intravascular fluid deficits may be anticipated. The potential for hypovolemia, arrhythmias and renal failure is high. Unfortunately, releasing compression on involved tissues coincides with proximal early signs and symptoms of the crush syndrome such as hypovolemia, shock, metabolic acidosis, arrhythmias, hyperkalemia, hypocalcemia and hyperphosphatemia.

Where resuscitation must be considered in a close space, a crush injury cocktail is recommended. This fluid includes normal saline with 1 amp of bicarbonate and 10 g of mannitol added to each liter. Urine should be alkalinized.

Noji EK.

Public Health Issues in Disasters

Crit Care Med 2005; **33**: S29-S33.

Objective: This article outlines a number of important areas in which public health can contribute to making overall disaster management more effective. This article discusses health effects of some of the more important sudden impact natural disasters and potential future threats (e.g., intentional or deliberately released biologic agents) and outlines the requirements for effective emergency medical and public health response to these events.

Findings: A number of issues underlie public health concerns after disasters occur. First is control of environment with management of water, sanitation, hygiene and vectors of disease. Adequate quantities of clean water and a system to discard excreta are early priorities. Development of emergency shelter must include the consideration that 3.5 m2 is the absolute minimum floor space per person in emergency shelters. In general, only when housing losses reach more than approximately 25% is there a need to find other forms of shelter. Other issues requiring acute management are avoidance of outbreaks of infectious disease, appropriate disposition of dead bodies, simple high benefit immunization programs (measles) and a nutrition program.

Conclusion: All natural disasters are unique in that each

affected region of the world has different social, economic, and health backgrounds. Some similarities exist, however, among the health effects of different natural disasters, which if recognized, can ensure that health and emergency medical relief and limited resources are well managed.

Key Words: Disasters, Natural, Earthquake, Flood Volcano, Tornado, Hurricane, Typhoon, Cyclones, Disaster epidemiology, Disaster medicine, Emergency, Mass casualty incident, Homeland security.

***Comments**: This report from The Centers for Disease Control and Prevention in Atlanta describes health problems arising in the setting of natural disasters. Interventions, supplies and personnel are described with roles for management (Pac Health Dialog 2002; 9:124-129).*

Without shame, I paraphrase the realities of natural disasters presented by this author (Prehospital Disaster Med 1999; 14:213-214):

- *The involved local population generally covers immediate lifesaving needs.*
- *Assistance provided in the setting of disaster must be based on impartial and complete evaluation of genuine needs. Local governments and agencies frequently address immediate needs rather than external relief organizations.*
- *Epidemics do not spontaneously occur after disasters and dead bodies do not lead to catastrophic outbreaks of exotic diseases. The key to preventing disease is optimal sanitation and public education (Scand J Infect Dis 2003; 35:110-113).*
- *Most people respond spontaneously and generously in a natural disaster.*
- *Members of affected populations find new strength during emergencies. These are not shocked and helpless individuals.*
- *Disasters strike hardest at most vulnerable groups such as the poor, women, children and the elderly.*
- *Temporary settlements should be the last alternative. Local upgrades of available housing are more effective.*

Grissom TE, Farmer JC.

The Provision of Sophisticated Critical Care Beyond the Hospital: Lessons from Physiology and Military Experiences that Apply to Civil Disaster Medical Response

Crit Care Med 2005; 33: S13-S21.

Objective: The provision of sophisticated medical care in an austere environment is challenging. During and after a mass casualty event, it is likely that critical care services will be needed beyond an intensive care unit (ICU) setting. The objective of this article is to explore existing ICU care systems such as military aeromedical transport that may be applicable to disaster medicine and to providing critical care outside of an ICU setting.

Findings: The U.S. Air Force Critical Care Aeromedical Transport (CCAT) Teams were developed in 1994 in response to an unmet military need for long-range air transport of critically ill and injured patients. This system has transported several thousand ICU patients and is an applicable model for the future development of extrahospital critical care capabilities needed during a disaster. Beyond the military, however, an international group of practitioners in prehospital ground and air medical transport have developed an extensive literature surrounding development of appropriate team composition and treatment strategies for complex problems in patients being moved from referring to receiving medical agencies. To provide this service effectively, transport programs have developed procedures for difficult aspects of critical care including airway management and vascular access. Similarly, practices for use of mechanical ventilation, fluid resuscitation, patient monitoring and drug administration have grown up to support providers functioning in the uncertain environment outside the traditional boundaries of the hospital intensive care unit. This prehospital literature and expertise developed may prove essential if critical care is taken outside the geographic boundaries of the hospital due to natural or manmade disaster.

Conclusion: The U.S. Air Force CCAT Team program, as well as many civilian critical care air ambulance services, provides a workable startling point for the development of disaster medical critical care response capabilities for disaster medical systems.

Key Words: Austere critical care, Intensive care unit air transport, Aeromedical evacuation, Portable intensive care unit, Disaster critical care.

***Comments**: Local, regional and national medical disaster response planning efforts have been directed at prehospital, first responder and emergency medicine infrastructure (N Engl J Med 1991; 324:815-821). Many locales and scenarios continue this approach. Most disaster planning has previously assumed that appropriate critical care will be available to casualties who are triaged, resuscitated and transported by first responder networks to hospital. Unfortunately, the lack of available of critical care may defeat preparation efforts of first responders (New Horiz 1998; 6:300-306).*

Medical disaster planning must acknowledge the premise that disaster critical care must be provided by the same personnel using the same general protocols as are routinely employed. What changes during a disaster are location, patient volume and the need for triage, chain of command and the potential need for self-preservation. Monitoring technologies must overcome limitations imposed by noise. Automated blood pressure monitors, measurement of oxygen saturation and end tidal CO_2 with limited electrocardiography may represent available monitoring. Ventilators must offer a range of tidal volumes, a limited number of modes and variable minute ventilation over a wide range of barometric pressure conditions. Infusion devices must be robust with extended battery life, pressure activated occlusion alarms and compact size. Point of care laboratory testing may be essential. Finally, a limited drug list must include provision for analgesia, sedation and the need for vasoconstriction or vasodilatation. Neuromuscular blockade is infrequently included unless crews are capable of intubation and advanced airway control.

A greater emphasis on personal protective gear will be required. For example, headwear may include helmets with face visors, and uniform choices may include Nomex, flame retardant gloves and hearing protection.

Supplemental Reading:

1. de Boer J, Dubouloz M (eds). Handbook of Disaster Medicine: Emergency Medicine in Mass Casualty Situations. Amsterdam, VSP, 2000.
2. Holleran RS (ed). Air & Surface Patient Transport: Principles & Practices, Third Edition. St. Louis, Mosby, 2003.
3. Hurd WW, Jernigan JG (eds). Aeromedical Evacuation: Management of Acute and Stabilized Patients. New York, Springer-Verlag, 2003.
4. Søreide E, Grande CM (eds). Prehopsital Trauma Care. New York, Marcel Dekker, Inc., 2001.
