>> BY BRENT BRONSON, NREMT-P

The Cold Facts *of* Secondary Hypothermia

Hypothermia is a common finding among patients and often complicates the management of those with severe blunt or penetrating trauma. Although permissive hypothermia may be protective in anoxic brain injury following resuscitation from prehospital cardiac arrest,[1] secondary hypothermia associated with traumatic injuries and hemorrhagic shock can be fatal.

Hypothermia in the trauma patient is referred to as secondary hypothermia. It is caused by an underlying pathology that prevents the body from generating enough core heat. Body heat is generated as a result of oxygen consumption, which is pathologically reduced during conditions of shock and results in a decrease in core temperature.[2] Hypothermia is the third most serious condition in a trauma patient, ranking close to hypoxia and hypovolemia,[3]

SECONDARY HYPOTHERMIA IN TRAUMA PATIENTS WITH A CORE TEMPERATURE BELOW 95°F IS CONSIDERED A POOR PROGNOSTIC SIGN... IF UNDER 89.6°F IT IS LINKED TO 100% MORTALITY[2]

A core temperature less than 32° C (89.6° F) in trauma patients is associated with a 100% mortality rate and any decrease in temperature below 35° C (95° F) is a poor prognostic sign.[2] Trauma patients are susceptible to hypothermia from environmental exposures, extrication and transport, multisystem trauma, and extremes of age. Secondary hypothermia in trauma victims remains a common problem that occurs early during the resuscitative phase irrespective of the ambient environmental temperatures.

In a prehospital study of 302 injured patients, Helm et al[4] found that almost half were hypothermic. There was no correlation between the season of the year and the frequency of hypothermia. In 94 tracheally intubated patients brought to one regional trauma center, Luna et al[5] found that almost 2/3 of the patients had a core temperature of less than 36° C (96.8° F). Hypothermia was found to be a prehospital physiologic marker and an independent contributor to overall mortality in 2848 trauma patient admissions treated at the 31st Combat Support Hospital in Iraq over a 12-month period.[6]

The Lethal Triad

Hypothermia, acidosis, and coagulopathy constitute the "Lethal Triad" in trauma patients. This triad presents in a vicious cycle, known as the "bloody vicious cycle", that often cannot be interrupted. Patients frequently die due to "irreparable injuries".[2] As hemorrhagic shock overwhelms the body's compensatory responses, inadequate oxygen delivery results in anaerobic metabolism. The resulting acidosis leads to coagulopathy that is further compounded by the effects of hypothermia. Perhaps the most severe effect of hypothermia is its inhibitory effect on the enzymatic reaction rates of the coagulation cascade.[7] Because hypothermia can prolong clotting times, patients with massive injuries may also develop systemic clotting factor depletion and diffuse coagulopathy due to the body's continuous attempts to form clots at multiple injury sites.[2]

Current trauma care guidelines call for active efforts at preventing hypothermia.[8] These recommendations are based on studies that document the extraordinarily high association between hypothermia and mortality in trauma patients. Basic, effective interventions should be performed early in patient care to reduce further heat loss.

Skin temperature may be 10-15° C cooler than the core temperature in hypothermic patients. As a function of the second law of thermodynamics, heat flows from an area of higher temperature to one of lower temperature. External rewarming techniques therefore cannot transfer heat to the core until the temperature of the skin is raised to at least the level of the core.[2] Also as a function of the second law, if the temperature of the surrounding environment is warmer than the skin temperature, heat loss cannot occur, except by sweating.[2] Since most heat loss occurs through the skin, wrapping the patient in a heat reflective shell can effectively prevent heat loss.

The HPMK™ (Hypothermia Prevention & Management Kit™) by North American Rescue is designed for the specific needs of preventing heat loss. This kit contains a self-heating, four cell liner designed to provide continuous dry heat for up to six hours at a temperature up to 106°F. It also features a high performance Heat Reflective Shell (HRS™) that provides a protective covering around the body, preventing heat loss through evaporative, convective, conductive, and radiating processes. This system creates an extremely effective insulating barrier that allows the self-heating liner to warm the air temperature between the patient's body and the HRS™ thus preventing heat loss. The HPMK™ provides the simple and cost effective solution to preventing hypothermia during patient care.

Aggressive hypothermia prevention decreases the negative effects of heat loss and reduces death associated with secondary hypothermia. Since the prevention of hypothermia is much easier than its treatment, significant attention should be paid to preventing hypothermia from occurring in the first place. Heat loss prevention should begin as soon as possible after injury and the HPMK™ is uniquely designed to meet this need. By actively addressing post-injury hypothermia, prehospital care providers will decisively impact their patient's outcome by more than just a few degrees. ■

REFERENCES:

1. The Hypothermia After Cardiac Arrest Study Group: Mild therapeutic hypothermia to improve neurologic outcome after cardiac arrest. New Engl Med 2002: 346: 549-556.
2. Gentilello LM, Pierson DJ. Trauma critical care. Am J Respir Crit Care Med. 2001; 163: 604–607.
3. Cheney F.W. Should normothermia be maintained during major surgery. JAMA 1997; 277: 1165-1166.
4. Helm M, Lampl L, Hauke J, Brock KH. Accidental hypothermia in trauma patients. Is it relevant to preclinical treatment? Anaesthesist 1995; 44: 101-107.
5. Luna GK, Maier RV, Pavlin EG, et al. Incidence and effect of hypothermia in seriously injured patients. J Trauma 1987; 27: 1014-1018.
6. Arthurs Z, Cuadrado D, Beekley A, et al. The impact of hypothermia on trauma care at the 31st combat support hospital. Am J Surg 2006: 191(5): 610-614.
7. Moore, Ernest, Feliciano, David V., and Kenneth L. Mattox. Trauma. 5th ed. New York: McGraw-Hill Professional, 2003.
8. Salomone, Jeffery P. and Peter T. Pons, eds. PHTLS Prehospital Trauma Life Support. 6th ed. Missouri: Mosby Elsevier, 2007.