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Trauma rounds

For emergency medicine and trauma professionals

Spring 2011

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In This Issue

Drowning

by Samuel A. Tisherman, MD

The *Oxford English Dictionary* defines drowning as "Perishing from suffocation in water; suffering inundation." This dual definition — dying from drowning as opposed to merely being submerged — was long reflected in our medical terminology, with modifying terms such as "near," "active," "passive," and "secondary." Today we have for the most part abandoned these modifications, because they are confusing and have little clinical relevance.

Drowning results in more than 500,000 deaths worldwide each year. It is one of the most common causes of accidental death, particularly in those under age 15.

Two age peaks for drowning incidence have been identified. The first peak involves infants and young children, who are susceptible to events near pools or bodies of water. In addition, infants and toddlers may drown in toilets or bathtubs. Interestingly, the elderly share similar risks with infants and toddlers near swimming pools and bathtubs.

The second peak involves adolescents and young adults, who are at risk because of the use of alcohol and recreational drugs near bodies of water. Up to three-fourths of boating-related submersion events are related to

(Continued on Page 2)

Drowning *(Continued from cover)*

alcohol or drug abuse. Submersion events may be associated with spinal cord injuries from diving, hypothermia, syncope, seizures, co-morbid medical conditions, or even just panic.

Prevention of submersion events is critical. This requires adult supervision, along with appropriate fencing of pools and other bodies of water. In adolescents and young adults, avoidance of alcohol or recreational drugs is critical. Swimming with a partner can increase safety. Use of personal flotation devices while boating can clearly help. In addition, child abuse should be considered in infants or small children with atypical presentations.

Pathophysiology of drowning

Clinically, drowning affects mainly the lungs and brain. Some mammals react to submersion with the diving reflex, consisting of bradycardia, apnea, and vasoconstriction. This parasympathetic response is thought to be protective, but evidence for this reflex in humans is generally lacking, except perhaps in infants.

Submersion victims typically panic, sense air hunger, and struggle to stay above the water. Consequently, they tend to attempt inspiration, leading to aspiration. In approximately 10 to 20 percent of drownings, sufficient laryngospasm occurs to prevent inhalation of water into the lungs. Most victims, however, do aspirate a significant amount of water.

There have long been suggestions of differences between inhalation of fresh water versus salt water, but it now seems that these differences are minimal in survivors. Inhalation of enough water to cause electrolyte abnormalities is usually fatal. Regardless of the type of water, there is washout of pulmonary surfactant, with resultant impairment of gas exchange. Aspiration of foreign materials, such as chemicals, bacteria, or gastric fluid, can further impact pulmonary function.

The resultant hypoxemia from drowning can lead to variable degrees of neurologic disability. This disability is significantly worse if cardiac arrest ensues. Submersion victims who did not suffer a cardiac arrest generally fare better.

Managing the drowning victim

Prehospital management of a submersion victim should begin with the standard ABCs of resuscitation. Supplemental oxygen should be administered. Orotracheal intubation may be required for airway protection and/or achieving adequate arterial oxygenation. For the patient in cardiac arrest, cardiopulmonary resuscitation (CPR) should begin with two rescue breaths followed by chest compressions. (Note that this recommendation differs from the most recent American Heart Association recommendations for chest-compression-only CPR in cardiac arrest.)

If the mechanism of submersion suggests the potential for spinal injury, rescuers should follow routine C-spine precautions.

The emergency department team should institute standard resuscitation and stabilization approaches, including achieving adequate arterial oxygenation, adequate ventilation, and stable hemodynamics. Serum electrolytes should be monitored. If indicated, clinicians should obtain a blood alcohol level and a drug screen. An expeditious workup for associated injuries is critical.

Submersion in cold water may be particularly protective to the brain. Frequently, protective levels of hypothermia are reached prior to the occurrence of cardiac arrest. Both the medical literature and the lay press contain a number of dramatic cases of submersion for greater than one hour with normal functional outcomes. Some resuscitation attempts have included the use of extracorporeal membrane oxygenation.

Although clear guidelines do not yet exist, clinicians should rapidly warm patients to 33 to 34°C. If a patient is stable after a cardiac arrest from drowning, but does not awaken upon reaching 34°C, the resuscitation team may consider continuing mild hypothermia at 33-34° C for 12 to 24 hours, based on the clinical trials of hypothermia in comatose survivors of cardiac arrest.

Follow-up care

After the initial resuscitation efforts, most of the care that is required is supportive. Ventilator management should mirror that of other patients with acute lung injury. There is no role for empiric steroids or antibiotics. Cardiovascular support may require fluid resuscitation, inotropes, and/or vasopressors. Drowning victims are at risk for either hypervolemia from fluid resuscitation or hypovolemia from a "cold-induced diuresis" (vasoconstriction causing central fluid overload and a reflex diuresis). Advanced hemodynamic monitoring, including placement of a pulmonary artery catheter or obtaining an echocardiogram, may be helpful. These patients are also at risk for the development of a variety of arrhythmias from hypoxemia and hypothermia.

From a neurologic perspective, so far there has been no benefit demonstrated for the use of mannitol, hypertonic saline, or fluid restriction. There does not seem to be a role for intracranial pressure monitoring, unless there is a concomitant head injury.

Prognostication is difficult following drowning, particularly if therapeutic hypothermia at 34°C is continued for 12 to 24 hours. Axioms that seemed true regarding neurologic findings in post-cardiac arrest victims prior to the widespread use of therapeutic hypothermia don't seem as robust as previously thought.

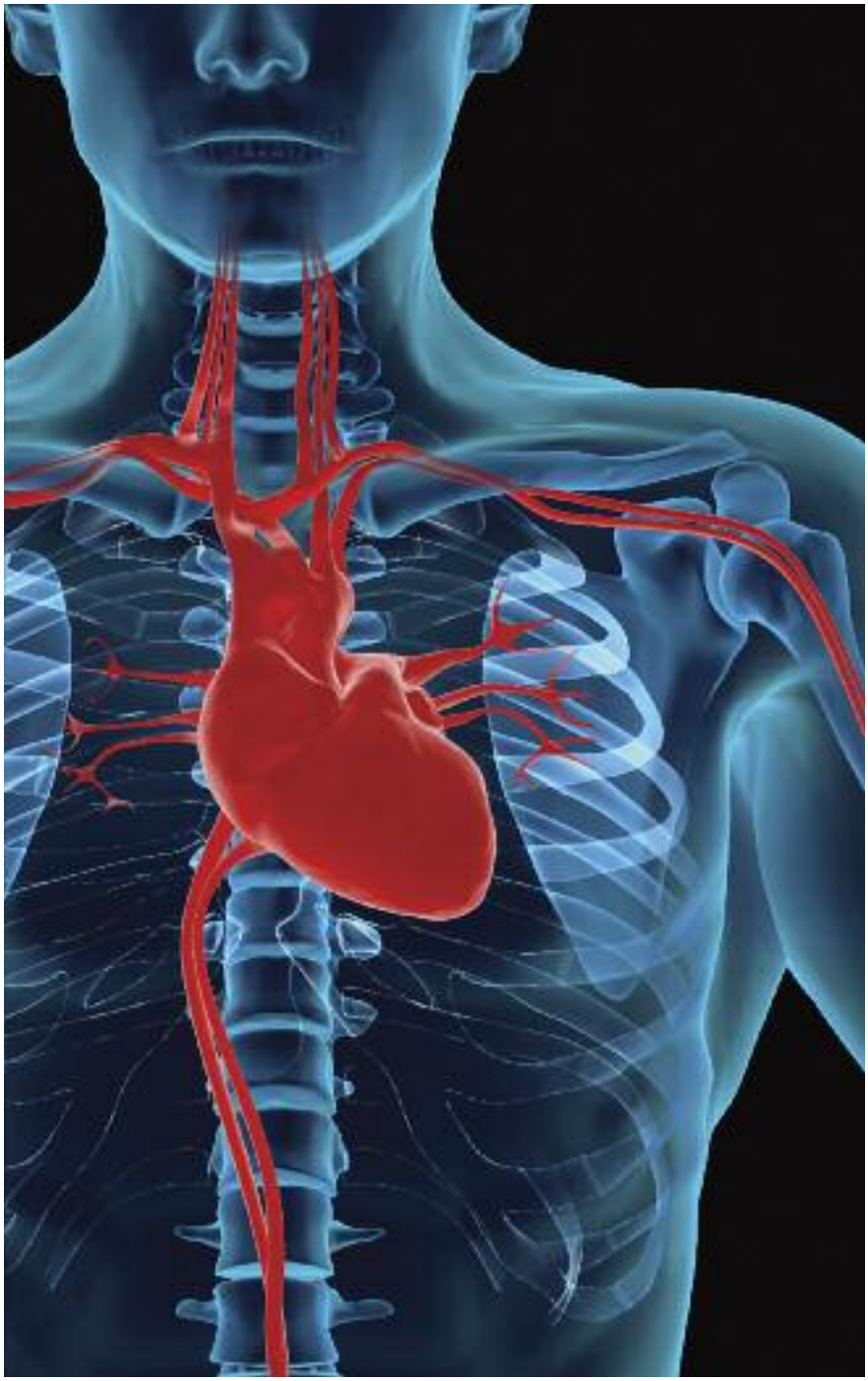
To summarize, though often preventable, drowning remains a significant cause of morbidity and mortality. Management should focus on early and aggressive resuscitation, followed by high quality critical care. Prognosis remains difficult to determine.

Samuel A. Tisherman, MD, is a professor of critical care medicine and surgery and director, Neurotrauma Intensive Care Unit, UPMC Presbyterian.

Drowning results in more than 500,000 deaths worldwide each year. It is one of the most common causes of accidental death, particularly in those under age 15.

Evolution of Blunt Thoracic Aortic Injury Management

by Rabih A. Chaer, MD



Traumatic thoracic aortic transection is a highly fatal condition; more than 80 percent of patients die at the accident scene. Of those who do reach a hospital, one-third die of their aortic injury early in their hospital course. An estimated 15 percent of all deaths from motor vehicle crashes are secondary to blunt aortic injury, second only to the 60 percent caused by head injury.

Traumatic thoracic aortic injuries usually involve the proximal descending thoracic aorta, at the ligamentum arteriousum, just distal to the takeoff of the left subclavian artery. Open repair of aortic transection had been the standard of care since the first successful intervention nearly 50 years ago. This procedure, however, carries significant risks in these patients, who almost always have serious associated injuries. Endovascular repair recently has emerged as a minimally invasive, low-risk alternative, and is the focus of this article.

TEVAR: A new approach

Although thoracic endovascular aortic repair (TEVAR) has been approved and developed only for the treatment of degenerative aneurysmal disease, applications for other pathologies are emerging, including dissections and transection. TEVAR offers many theoretical advantages over open procedures for the treatment of blunt aortic injury. The endovascular procedure can be performed rapidly, even under local anesthesia, and with little or no anticoagulation. It also avoids a thoracotomy and aortic cross-clamping. In addition to simplifying the management of multiple trauma victims, it also may allow surgeons to offer treatment to many critically ill patients who previously might not have tolerated open repair.

A review by the American Association for the Surgery of Trauma summarized the status of TEVAR use for traumatic aortic transections in late 2007. The review found a relentless trend to replace open aortic repair with TEVAR; it cited a 1997 study showing that two-thirds of all patients with transection in 2007 in the United States were then being managed with the new procedure, with significantly decreased mortality and paraplegia rates.

UPMC experience with TEVAR

At UPMC, we performed our first TEVAR for a patient with a false aneurysm from a chronic transection in 1999, and our first acute case in 2004. Our early experience with a midterm follow-up was reported in 2007. Since 1999, we have treated 85 patients with thoracic aortic transection.

Our results with open repair had mirrored the national experience, with a mortality of 19 percent for open repair, and one death in the TEVAR group.

Since January 2007, all blunt traumatic thoracic aortic injuries at UPMC Presbyterian have been treated with TEVAR. We have been utilizing several devices designed for general vascular surgery, including the Gore TAG® Thoracic Endoprosthesis (W. L. Gore & Associates Inc, Flagstaff, Ariz.), the Zenith TX2® (Cook Inc, Bloomington, Ind.), the Talent™ stent graft (Medtronic, Minneapolis, Minn.), and aortic extension cuffs in patients with small-diameter aortas.

Newer-generation grafts specifically designed for the treatment of aortic transection are intended to address some of the challenges with TEVAR, including the acute angulation and small diameter of the aortic arch, and the poor conformability of current devices. The new devices are under clinical trial at UPMC, and may overcome some of the anatomic challenges currently encountered.

Conclusions

Endovascular repair has replaced open repair for blunt thoracic aortic transaction to a great extent. These changes have resulted in a major reduction of mortality and procedure-related paraplegia. Even with endografts not designed for traumatic transection, the results of TEVAR in the acute setting are superior to open thoracotomy, which can always be done safely later if needed.

The use of transaction-specific grafts currently in trial will likely minimize the incidence of graft-related long-term complications and contribute to improved outcomes. UPMC is taking part in a multi-institutional trial of the latest generation of aortic grafts specifically designed for traumatic transaction. In a patient population typically only in their third or fourth decade of life, rigorous long-term data will need to be obtained before TEVAR can completely replace open aortic repair for transection.

Rabih A. Chaer, MD, is an assistant professor of surgery, Division of Vascular Surgery, UPMC Presbyterian.

TEVAR offers many theoretical advantages over open procedures for the treatment of blunt aortic injury. The endovascular procedure can be performed rapidly, even under local anesthesia, and with little or no anticoagulation.

New Tool Facilitates EMS Safety Training

A new survey developed by UPMC researchers and colleagues in the EMS Agency Research Network (EMSARN) is now available to EMS agencies. The EMS Safety Attitudes Questionnaire (EMS-SAQ) was developed to help EMS agency officers responsible for safety training and quality assurance. It measures multiple aspects of safety practices in EMS and identifies areas of strength and weakness. It will assist EMS management in identifying safety classes and training that will address the individual agency's needs.

"There's a saying that 'if you've seen one EMS agency, you've seen one EMS agency,'" says principal author P. Daniel Patterson, PhD, MPH, EMT-B, assistant professor of emergency medicine at UPMC Presbyterian. "Each service has its own culture and ways of doing things, needs, patterns of utilization, and specific patient population."

"There's a saying that 'if you've seen one EMS agency, you've seen one EMS agency.'"

In light of this, he argues, not only is it unproductive to apply a one-size-fits-all safety training to all EMS agencies. It's particularly inappropriate to try to apply training programs tailored to the emergency department, critical care, ambulatory care, or other settings, as virtually all safety programs available have been.

"Simply put, the EMS environment is different!" says Dr. Patterson. The EMS-SAQ allows EMS training officers in individual agencies to identify areas where training is likely to do the most good in protecting both EMS personnel and their patients.

Dr. Patterson's team has reported extensive testing of the EMS-SAQ in a study that appeared in the October-December 2010 issue of *Prehospital Emergency Care*. The authors analyzed data from 61 air-medical and ground-based EMS agencies spread across the four major U.S. Census regions, with some participation in Canada. The EMS-SAQ is based on safety culture surveys used in other health care settings to measure clinicians' perceptions of safety climate, teamwork, stress recognition, and other components of workplace safety culture.

"We didn't reinvent the safety measurement wheel," Dr. Patterson explains. "We simply did some very rigorous modification and testing of previously used tools so that we can say with confidence this tool is 'EMS-tested and EMS-approved.'"

The EMS-SAQ is now available to individual EMS agencies through the EMSARN website (www.EMSARN.org or www.emssafetyculture.org). Agencies can access the tool via the publication in Prehospital Emergency Care (http://informahealthcare.com/doi/full/10.3109/10903127.2010.497900), or they can enroll in ongoing research led by Dr. Patterson and EMSARN. The advantage to study participation is that EMSARN personnel can provide web-based survey resources, develop detailed agency-specific reports, and make specific and confidential recommendations based on agency scores. Participation is voluntary, and the data are provided in a secure and confidential report. The ongoing research is important for improving measurement, awareness, and safety in EMS.

"It makes little economic sense to adopt a safety program or intervention and many months later ask if it had an impact," Dr. Patterson says. "The first step for all EMS agencies is to find out what their safety culture looks like."

For additional information: P. Daniel Patterson, PhD, MPH, EMT-B et al., (Oct-Dec 2010) "Variation in Emergency Medical Services Workplace Safety Culture," Prehospital Emergency Care *14(4):448-460.*

Calendar of Events

Continuing Education Classes

Name	Date	Time	Location	Cost
ITLS Provider/Renewal *(provider class is both days; renewal is day two only)*	April 5 and 6	8 a.m. to 5 p.m. *(both days)*	Uniontown Fire Department 80 N. Beeson Ave. Uniontown, PA 15401	UPMC/CMC Command Providers: $20.00 Renewal: $20.00 Non-UPMC/CMC Command Providers: $50.00 Renewal: $40.00
BLS Skills Review	April 6	6 to 10 p.m.	Arnold EMS 1811 Fifth Ave. Pittsburgh, PA 15068	None
Ventilator Class *(Presented by Scott Dolan, EMT-P)*	April 14	5 to 7 p.m.	Fayette EMS 301 South Arch St. Connellsville, PA 15425	None
PALS Renewal/ PEARS Provider	April 15	8 a.m. to 5:30 p.m.	Union VFD 304 S. Scotland Lane New Castle, PA 1610	UPMC/CMC Command Providers: $5.00 Non-UPMC/CMC Command Providers: $45.00
Firefighter Rehab Class	April 20	6 to 8 p.m.	Central Volunteer Fire Company of Elizabeth Township 425 Scenery Drive Elizabeth, PA 15037	None
CPAP for BLS	April 21	6 to 8 p.m.	Lifestat Ambulance Service 301 Salt St. Saltsburg, PA 15681	None
ALS for BLS Part 1 *(may be taken before or after completion of part 2)*	April 26	6 to 10 p.m.	Chippewa Fire Department 2568 Darlington Road Beaver Falls, PA 15010	None
BLS Skills Review	May 10	6 to 10 p.m.	Lifestat Ambulance 301 Salt St. Saltsburg, PA 15681	None
ITLS Provider/Renewal *(provider class is both days, renewal is day two only)*	May 12 and 13	8:30 a.m. to 5 p.m.	Scott Township VFD 3712 Harlensburg Road New Castle, PA 16101	UPMC/CMC Command Providers: $20.00 Renewal: $20.00 Non-UPMC/CMC Command Providers: $50.00 Renewal: $40.00
CPAP for BLS	May 17	6 to 10 p.m.	Lifestat Ambulance Service 301 Salt St. Saltsburg, PA 15681	None
ALS Skill Validation Session	May 24	1 to 3:30 p.m.	Guardian Angel EMS 929 Lebanon Road West Mifflin, PA 15122	None
BLS Skills Review	May 26	5 to 8 p.m.	Fayette EMS 301 South Arch St. Connellsville, PA 15425	None
ALS for BLS Part 2 *(may be taken before or after completion of part 1)*	May 31	6 to 10 p.m.	Chippewa Fire Department 2568 Darlington Road Beaver Falls, PA 15010	None

continued on back page

Advanced Trauma Life Support 2011

April 7 to 8
April 8 *(re-verification)*

Oct. 5 to 6 *(held at UPMC Northwest)*
Oct. 6 *(re-verification, held at UPMC Northwest)*

Nov. 17 to 18
Nov. 18 *(re-verification)*

For more information about ATLS courses, email maleyjl@upmc.edu or call 412-647-8115.

For a list of nationally available ATLS courses, see http://web2.facs.org/atls/ATLSSearch.cfm?Search=USA.

Consider the opportunity to earn continuing education credits by reading *Trauma Rounds* and completing the corresponding continuing education test. After reading, log on to http://prehospitalcare.UPMC.com/traumarounds.htm. On the *Trauma Rounds* website, you can print the test and mail the completed version back to UPMC, or you can take the test online through the Pennsylvania Department of Health's online testing program.

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for 24-hour emergency consultation, referral, and transport arrangements

Calendar of Events *continued*

Continuing Education Classes

Name	Date	Time	Location	Cost
Preceptor Course	June 2	6 to 10 p.m.	UPMC Passavant McCandless Campus Assembly Hall 9100 Babcock Blvd. Pittsburgh, PA 15237	None (please call for details: 888-647-9077, ext. 1)
ALS Skill Validation Session	June 16	6 to 8:30 p.m.	Lifestat Ambulance 301 Salt St. Saltsburg, PA 15681	None
ALS Skill Validation Session	June 23	5 to 8 p.m.	Fayette EMS 301 South Arch St. Connellsville, PA 15425	None
ALS Skill Validation Session	Sept. 28	6 to 8:30 p.m.	Harmony EMS 102 Mennonite Lane Harmony, PA 16037	None

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