s EMS evolves, it is necessary to review medical practices and determine which of those benefit patients and which do not. The best way for such evaluation is through the principles of science and evidence-based medicine (EBM). When the scientific method is applied to EMS practices, some have shown benefit and some have not. Based on the results of scrutiny, practices that do not show significant patient benefit should be discarded, while practices that show enhanced benefit should be embraced. However, it is not that simple. Some scientific studies are better than others.

Thus, a change in practice should only be made when the scientific evidence either supporting or refuting the practice is significant, which is determined by looking at the number, quality and types of scientific studies available. Over the coming year, we will critically evaluate numerous EMS practices, with particular emphasis on those that have not stood up to scientific scrutiny. As an EMS provider, you should always question a practice or opinion and, when necessary, look at the scientific evidence yourself and form your own opinion.

Reference

EMS Myth #1

Medical Anti-Shock Trousers (MAST) autotransfuse a significant amount of blood and save lives

Paramedics in the 1970s and 1980s often used Medical Anti-Shock Trousers (MAST), also called the Pneumatic Anti-Shock Garment (PASG), for all forms of trauma. It was the standard of care. On many occasions, I came to believe that I had seen patients pulled from the jaws of death after MAST application. In EMS circles, we told stories about doctors or nurses removing or cutting off MAST in the emergency department, only to have the patient become immediately hypotensive and die. EMS people were not the only true believers in MAST. They were often a common component of trauma resuscitation rooms and operating rooms. Inevitably, we would have to retrieve the MAST from the OR, as they remained on the patient until the surgical lesion was repaired. We knew the MAST worked. We had seen it work. But, did the MAST really work?

MAST History

The concept of the MAST was first described in 1903 by famed surgeon George W. Crile as a “pneumatic rubber suit” to decrease postural hypotension in neurosurgical patients. During World War II, Crile’s suit was used to prevent blackouts in pilots who were subjected to high G forces while flying combat aircraft. The National Aeronautics and Space Administration (NASA) claimed responsibility for developing the medical anti-shock trousers at their Ames Research Center in the 1960s. MAST were introduced into medical practice during the war in Vietnam and called “Military Anti-Shock Trousers.” The value of MAST in the military setting was documented when soldiers with massive trauma, previously considered fatal, were able to survive a 45-minute helicopter ride to a definitive care hospital. MAST were introduced into civilian EMS in the 1970s.

It was postulated that the MAST reversed hypotension by three different mechanisms: 1) Increasing peripheral vascular resistance; 2) tamponading of intra-abdominal bleeding; and 3) autotransfusion of blood from the lower extremities and abdomen to the head and upper trunk.

Most authorities supported the theory that MAST provided a significant autotransfusion. McSwain estimated the amount of blood autotransfused to be 750–1,000 mL.
In another paper, McSwain estimated that approximately 20% of a patient's blood volume was autotransfused into the heart, brain and lungs following application of MAST. Diliman also estimated the amount of blood autotransfused to be approximately 20% of the total blood volume (approximately 1,200 ml in a 85-kg man). Based upon these reports, the EMS textbooks of the era picked up the information on MAST, and it was incorporated into day-to-day EMS teaching.

The first paramedic text stated: "The pressure applied to the leg squashes at least 2 units of blood into the extremities, where it is lost virtually all, and into the systemic circulation. The net effect is as if the patient were given a 2-unit transfusion of blood in a steady, then it is an AUTO-TRANFUSION, since the patient is transfusing himself with blood from his extremities. Remember, though, that the converse is also true. When the MAST is deflated, blood returns to the legs, and it is as if the patient suddenly lost 2 units of blood. Thus, the MAST is never deflated until adequate volume replacement has been achieved." The first edition of Basic Trauma Life Support stated the following: "No one has proven how MAST transfers work, but the most likely mechanism is an increase in peripheral vascular resistance by way of sympathetic compensation. The important thing is that they do work to improve blood pressure and cerebral circulation in the hemotrauma or spinal shock victim."

Likewise, the first edition of Pre-Hospital Trauma Life Support stated, "If the patient is hypotensive or has an injury to bleeding within the abdomen, the pneumatic antishock garment (PAG) should then be placed on the patient and inflated until an adequate blood pressure is obtained. The early use of the PAG will assist in reducing rapid intraperitoneal bleeding.

Applying the Scientific Method

Later, researchers applied the scientific method to study the effects and effectiveness of MAST and found that the actual benefits were far less than originally thought. Researchers at Valley Medical Center in Fresno, CA, evaluated the effects of the MAST on healthy volunteers. After removing one liter of blood from the volunteers, the MAST were applied. The amount of blood autotransfused from the lower extremities and abdomen to the head and upper trunk was measured using sequential radiographic scans. They found that application of the MAST resulted in an autotransfusion of less than 5% of the patient's total blood volume. This was approximately 300 ml in an 85 kg man. This amount was much less than initial estimates that ranged from 750-1,200 ml. A similar study measured the amount of blood autotransfused following MAST application to dogs who were suffering hemorrhagic shock following phlebotomy. Again, the amount of blood autotransfused was approximately 5% of the total blood volume. Based on these studies, statements about the autotransfusion capabilities of the MAST were dropped. Instead, teaching was changed and stated only that MAST increased peripheral vascular resistance.

Researchers then began to look at patient outcomes following application of the MAST. The initial study that questioned the benefit of the MAST was conducted in Houston, TX, in 1989 using the Houston Fire Department EMS system. During a 2½-year period, 201 consecutive patients presenting with penetrating anterior abdominal injuries and an initial prehospital systolic blood pressure of 90 mm Hg or less were entered into the study. All prehospital care was provided by the Houston Fire Department and all patients were delivered to the same regional trauma facility (Ben Taub Hospital). The patients were randomized into control and MAST groups by an alternate-day assignment of MAST use. The resulting study groups were found to be well matched for survival probability indices, prehospital response and transport times, and the volume of IV fluids received. The results demonstrated no significant difference in the survival rates of the control and MAST treatment groups. Based on these data, researchers concluded that, contrary to previous claims, the MAST provides no significant advantage in improving survival in urban prehospital management of penetrating abdominal injuries.

Another prospective, randomized study investigated 201 traumatic shock patients greater than 15 years of age with blunt or penetrating trauma and a systolic blood pressure of 90 mm Hg or less with clinical signs of hypotension. The patients were randomly assigned to a MAST or non-MAST group. The researchers found that there were no significant differences in hospital stay or mortality between MAST and non-MAST patients. Similarly, in the subset of patients with blunt trauma, MAST were not found to be beneficial. In a prestigious Cochrane Review, researchers performed a meta-analysis of the two studies described above and found that the duration of Intensive Care Unit (ICU) stay was 1.7 days longer in the MAST-treated group. They concluded that there was no evidence to suggest that MAST/PASG reduce mortality, length of hospitalization or length of ICU stay in traumatic patients. In fact, they found, MAST may actually increase these. They concluded that the data do not support the continued use of MAST/PASG in trauma patients.

Conclusion

Based on available data, in 1997 the National Association of EMS Physicians issued a position paper on use of MAST/PASG in modern EMS. The association concluded that MAST are definitely beneficial in ruptured abdominal aortic aneurysm and possibly beneficial in hypotension due to pelvic fracture, anaphylactic shock refractory to standard therapy, otherwise uncontrollable lower extremity hemorrhage and severe traumatic hypotension (palpable pulse, no blood pressure). Even considering these possibilities, any benefit from application of the MAST may be accomplished through rapid transport to a trauma centre. Many EMS services have kept MAST for use in possible pelvic and lower extremity fractures. Patients with femur fractures are best treated with traction splints, while patients with pelvic fractures are best treated with a long backboard or similar device. Furthermore, the MAST are expensive (approximately $30 per pair) and take up valuable storage space on the ambulance. MAST are a relic of our past and belong in EMS museums, not on modern ambulances or rescue vehicles.

Next Month: EMS Myth #2

Thrombolytic therapy is the standard of care for acute ischemic stroke

References

10. Cardone NL: Longboard Care in the United States.
THE COMING WAVE

from page 90

A Revolution in the Making

On a chilly October morning, I'm en route to the hospital with an eight-year-old seizure patient, who was actively seizing when I arrived. Her seizure resolved with our first dose of Valium, and while moving her to the ambulance, she became frightened and combative. Now she's resting comfortably in the recovery position, her breath lightly fogging the oral-nasal capnography sensor. Her EtCO₂ reading is normal. With our capnography, I would never let her sleep.

I would be too concerned about how effectively she was breathing and whether she could be dangerously hypoventilating. I envision having to wake her every couple of minutes and start her cycle of fear and agitation all over again. Capnography has already told me everything I need to know. She's doing just fine on her own. She stirs a bit to the touch of my stethoscope and continues sleeping. By the time we reach her at the ED, she is oriented enough to recognize her mother. I add her to my growing list of patients who have benefited from noninvasive capnography.

This isn't the first time I've evaluated a new device, technique or intervention. Change is part of the character of EMS. I appreciate our industry's willingness to explore new ideas in the hope that we might improve our ability to care for our patients. Medicine in the field lacks the traditional support and resources of in-hospital care. It is this lack of support that makes technology like capnography so important to emergency responders. We have more than just a new monitoring modality; we have an opportunity to lead. New patient monitoring technology traditionally takes root in the hospital. Typically, it is only after new equipment is tested and proved effective that it is given consideration by field providers. Noninvasive capnography offers the chance to reverse those roles. When the usefulness of this device becomes more widely known, it will be the hospitals playing catch-up, perhaps for the first time in history.

Steve Whitcomb, NREMT-P, is a paramedic with more than a decade of field experience. He joined PrideMark Paramedic Services, Arvada, CO, five years ago, shortly after the organization's creation. He is a full-time operations team leader and an avid student of personal fulfillment in emergency services.