EDITORIAL

Should AED Devices Be Routinely Included in Wilderness Medical Kits?

Medical directors of wilderness expeditions and competitive adventure events are often faced with the difficult question of medical necessity for devices such as the automated external defibrillator (AED). Even with increasing availability and portability of the AED, arguments can still be made against the routine inclusion of an AED in expedition or adventure equipment lists. We hope to articulate several of these arguments below.

Right Place at Right Time?

Although AEDs have been proven to increase survival of cardiac arrest when a shockable rhythm is found, the time from collapse to first shock is very important.[1] For wilderness-based competitions in which participants may be covering large distances over hours to days, one must consider the question of where an AED should be physically located. Data from wilderness ultramarathons demonstrate that serious causes of collapse are more likely to occur out on the course,[2] and, by deduction, away from help. Once a downed participant is discovered on the course, it is unlikely that an aid station provider can receive news of the downed participant, pack appropriate response gear, and transport themselves to the participant within a critically short period during which an AED would be helpful. Although it may be argued that there may be time for an AED to be carried to any ill patient "just in case" the patient deteriorates (and therefore is in the right place at the right time), it is more likely that ventricular fibrillation would be associated with sudden collapse rather than a slow deterioration of an ill participant.

Environmental Concerns of Equipment

Although specialized AEDs and weatherproof cases for AEDs have begun to come to market, most are not designed to stand up to extreme conditions commonly experienced during adventure or expedition outings. Many have integrated temperature sensors and will fail outside their operating range. For example, the LifePak (Physio-Control, Redmond, WA) device has an operating temperature of 0°C to 50°C and storage temperature of –40°C to +70°C.[3] The device must be within the operating temperature range for at least 2 hours prior to use.[3] Given the propensity for the practice of wilderness medicine to occur in temperature extremes, there is significant risk that the AED will not be capable of functioning.

Actual Need

One common misperception of a clinical scenario requiring an AED is that lightning injury is likely to induce ventricular fibrillation. This is not true. The strike must occur at the exact time of the peak of the T wave to precipitate this shockable dysrhythmia; instead, asystole is much more likely to occur.[4] The likelihood of asystole is also greater than ventricular fibrillation in submersion injuries.[5] Finally, at remote endurance racing events, the incidence of cardiac arrest from acute coronary syndrome or other causes is extremely rare, with little to no data available on true incidence.

Definitive Care

Even if one were to be at the right place at the right time for a specific ailment requiring defibrillation, and even if defibrillation were successful, there are extremely limited situations in which definitive care would not be required immediately. Definitive care may require percutaneous coronary intervention, intensive care monitoring, and other interventions and resources unavailable in a wilderness situation. In many wilderness settings, evacuation could not be achieved soon enough for this definitive care to be implemented, at least in a way in which it is most effective.

Standard of Care Creep

At a most basic level, *standard of care* is defined as a level of care that similarly trained providers would deliver in a similar environment and in a similar situation. By blindly including an AED in a wilderness event's medical kit, the standard will inadvertently creep toward compulsory inclusion if only because "everyone is doing it." Common practice, no matter the medical necessity, may strongly influence the standard of care

Table. Suggested considerations for inclusion of AED in wilderness medicine kit

One or more of these:
-Participant activity is geographically confined to a reachable area
-A downed participant is potentially reachable in a few minutes
AND
One or more of these:
-Environmental conditions are favorable to AED operations
-The AED can be protected from the environment
AND
One or more of these:
-A participant requiring defibrillation can be evacuated expediently
-An EMS infrastructure is readily available to transport participant expediently

AED = automated external defibrillator; EMS = emergency medical services.

(eg, sterile gloves for laceration repair). Eventually there will be an implication that not packing an AED is below the standard of care—even if a well-performed risk assessment has been made for a given operational activity and deemed it unnecessary to be included. This has grave implications in light of the cost of these devices as well as their operating limitations and feasibility of transport in the backcountry environment. An analogous concern has been raised regarding point-of-care testing at all remote ultramarathons.[6]

Is There a Role for the AED?

We are not refuting the large body of evidence that shows the survival to hospital admission benefits of AED use in emergency medical services (EMS) systems. DeClerck et al[7] showed that cardiac events and AED usage are relatively infrequent but still important in a national parks setting. In 4 years and 64,045 EMS events, they found 327 calls for cardiac arrest with slightly more than half the cases (n = 210) being reachable with an AED, and about half of the victims (n = 95) surviving. Among those with cardiac arrest, 64.2% received treatment with an AED, with 29.1% surviving to hospital discharge.[7]

Webner et al[8] reviewed deaths from more than 1.7 million marathon runners and found a small, but real, risk of sudden cardiac arrest in this specific population. Risks of sudden cardiac arrest and sudden cardiac death were 1 in 57,002 and 1 in 171,005 respectively, with distinct benefits conferred by early AED and bystander cardiopulmonary resuscitation.[8]

Finally, some events and competitions may include a large contingent of support staff who tend to stay centrally located and may have a different set of risk factors than athletes or other participants. Sometimes, local inhabitants may be involved in support and incur special risk to the operations of the event or expedition. Depending on these specific factors, inclusion of an AED device may be warranted.

Summary

There is no doubt that the AED has potential uses in wilderness medicine care, and there is no doubt that it has helped save many lives both in the backcountry and frontcountry. The utility of this device is not universal to all situations, however, and caution should be used when considering the routine inclusion of this device in a wilderness medical kit. The Table describes when we would propose routinely having an AED present.

The standard of medical care delivered in the wilderness setting will always be different than our office or hospital practices, and although we should always strive to advance the science of our practice, we should remain cognizant of standard of care creep. Practicing evidence-based medicine, not based solely on feelings or availability of equipment, should be what guides the thoughtfully crafted medical kit. There may be something lost in translation of care from frontcountry to backcountry if we are not careful.

Jeremy D. Joslin, MD
Amy Sue Biondich, MD, MS
Department of Emergency Medicine, SUNY Upstate Medical University, Syracuse, NY

References

1. Weisfeldt ML, Sitlani CM, Ornato JP, et al. ROC Investigators. Survival after application of automatic external defibrillators before arrival of the emergency medical system: evaluation in the resuscitation outcomes consortium population of 21 million. *J Am Coll Cardiol*. 2010;55:1713–1720.
2. Holtzhausen LM, Noakes TD, Kroning B, de Klerk M, Roberts M, Emsley R. Clinical and biochemical characteristics of collapsed ultra-marathon runners. *Med Sci Sports Exerc*. 1994;26:1095–1101.
3. Physio-Control, Inc. Lifepak operating manual. Available at: http://www.physio-control.com/uploadedFiles/Physio85/Contents/Workplace_and_Community/Products/3305831_B_LR.pdf. Accessed November 16, 2015.
4. Kleiner JP, Wilkin JH. Cardiac effects of lightning stroke. *JAMA*. 1978;240:2757–2759.

5. Donoghue AJ, Nadkarni V, Berg RA, et al. CanAm Pediatric Cardiac Arrest Investigators. Out-of-hospital pediatric cardiac arrest: an epidemiologic review and assessment of current knowledge. *Ann Emerg Med*. 2005;46:512–522.
6. Hoffman MD, Joslin JD, Rogers IR. In Response to: Incidence of exercise-associated hyponatremia and its association with nonosmotic stimuli of arginine vasopressin in the GNW100s Ultra-endurance Marathon [letter]. *Clin J Sport Med*. 2016 Jan;26(1):e6.
7. DeClerck MP, Atterton LM, Seibert T, Cushing TA. A review of emergency medical services events in US national parks from 2007 to 2011. *Wilderness Environ Med*. 2013;24:195–202.
8. Webner D, DuPrey KM, Drezner JA, Cronholm P, Roberts WO. Sudden cardiac arrest and death in United States marathons. *Med Sci Sports Exerc*. 2012;44:1843–1845.