Factors involved in the onsite management and are of exertional heat stroke in secondary school athletics

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Abstract:

Exertional heat stroke, defined as an internal body temperature 40.5°C or greater and neuropsychiatric impairment, is caused by an overwhelming of one's thermoregulatory system during physical activity. If not promptly recognized and treated, exertional heat stroke can cause long-term morbidity or mortality.[1,2] The key determinant for survival from exertional heat stroke is to reduce internal body temperature so that the time above the critical temperature threshold (40.83°C [105.5°F]) for cell damage is minimized.[1,3] Athletic trainers play a vital role in developing and implementing policies and procedures for the prevention, management, and care of exertional heat stroke to optimize patient outcomes. The purpose of this article is to provide clinicians with the key aspects of an exertional heat stroke management plan specific to secondary school athletics.

Keywords: heat stroke | heat illness | high school athletes

Article:

Exertional heat stroke, defined as an internal body temperature 40.5°C or greater and neuropsychiatric impairment, is caused by an overwhelming of one's thermoregulatory system during physical activity. If not promptly recognized and treated, exertional heat stroke can cause long-term morbidity or mortality.[1,2] The key determinant for survival from exertional heat stroke is to reduce internal body temperature so that the time above the critical temperature threshold (40.83°C [105.5°F]) for cell damage is minimized.[1,3] Athletic trainers play a vital role in developing and implementing policies and procedures for the prevention, management, and care of exertional heat stroke to optimize patient outcomes. The purpose of this article is to provide clinicians with the key aspects of an exertional heat stroke management plan specific to secondary school athletics.

Development of Preventive Evidence-Based Policies and Procedures

Although exertional heat stroke cannot be 100% prevented, many steps can be taken to both mitigate the risk of exertional heat stroke and ensure survivability in the event that exertional heat stroke occurs. Evidence-based best practices on the prevention[1,2,4,5] and management[1,2,4] of exertional heat stroke dictate the minimum standards that should be commonplace for all secondary school athletics. Although an appropriate preparticipation examination[6] allows for a thorough understanding of the athlete's previous health history and predisposing risk factors of exertional heat stroke, heat acclimatization and environmental-based activity modifications are the two most important strategies to improve an athlete's ability to tolerate exercise in the heat. An appropriate heat acclimatization policy phases in the duration, intensity, and protective equipment worn during exercise in the heat over a 10- to 14-day period.[5] An appropriate environmental-based activity modification policy that uses wet-bulb globe temperature instead of other metrics for monitoring environmental conditions (eg, heat index) allows for alteration of the timing/scheduling of physical activity, intensity of physical activity, and frequency and duration of rest breaks.[1,7] In addition, the wet-bulb globe temperature-based environmental activity modification policies should be specific to the geographic region in which activity is taking place.[8] Both of these strategies have been found to reduce the incidence of exertional heat stroke deaths[9] and overall incidence of exertional heat illness.[10] Furthermore, an established site-specific emergency action plan, annually rehearsed by all individuals associated with the care of secondary school athletes (athletic trainer, coaches, school administrators, and local emergency medical service [EMS] staff), is vital to expedite the timing and methods of care in the event of a medical emergency such as exertional heat stroke.[11]

Coaching, Administrator, and Parent Education

Only 35% of high schools in the United States employ a full-time athletic trainer (ie, on-site for all practices and competitions).[12] In the absence of an athletic trainer, medical decisions are often left to the coaches, who may have limited medical expertise. Although evidence purports coaches as having a high self-efficacy regarding the prevention and recognition of exertional heat stroke, they lack the fundamental knowledge surrounding this medical emergency.[13] Disseminating evidence-based education on the prevention and recognition of exertional heat stroke to all coaches allows for the transfer of knowledge to the individuals who have daily contact with secondary school student athletes, especially when the athletic trainer is not present. When a coach suspects exertional heat stroke in the absence of an athletic trainer, he or she should immediately activate the emergency action plan protocol and initiate cooling of the athlete, if possible, until the EMS arrives.

Similarly, annual educational sessions for parents and school administrators on the prevention, recognition, care, and return-to-activity of exertional heat stroke should be held. These can be offered in conjunction with other educational meetings held at the start of most athletics seasons. This provides the athletic trainer with the opportunity to discuss the evidence-based best practices for exertional heat stroke care and also allows parents and school administrators to learn how they may contribute to minimize the risk of exertional heat stroke through appropriate knowledge regarding prevention.

Onsite Management and Care

When exertional heat stroke is suspected and an athletic trainer is on-site, evidence-based standard of care requires on-site assessment of body temperature via rectal thermometry followed by aggressive whole body cooling to optimize the chances of survival.[1,2,4] Insertion of the rectal thermistor should be at least 15 cm (6 inches) into the rectum to minimize variation throughout the initial assessment, cooling, and recovery process.[14] Cold water immersion provides the most optimal cooling rate (mean: $0.22°C•min^{-1}$; range: 0.15°C to $0.35°C•min^{-1}$) to successfully reduce one's internal body temperature.[15,16] The tarp-assisted cooling method is an alternative treatment option that also provides acceptable cooling rates (0.15°C to $0.17°C•min^{-1}$) with as little as 113 to 151 L of ice water.[17,18] For athletes participating in equipment-laden sports (eg, American football and field hockey goaltenders), initiating the cooling process should take precedence over removing the protective equipment, especially in instances where non-compliance or equipment removal may prolong the time to cooling.[19,20] Finally, continuous assessment of rectal temperature following the removal of the athlete from the source of cooling (rectal temperature, 38.6°C) allows for continued care of the athlete while coordinating the transportation of the athlete to a medical facility for follow-up evaluation and testing.

Coordinating Care With Local EMS Staff

Athletic trainers should also communicate with their local EMS staff to ensure that policies are clearly delineated regarding care of a patient with suspected exertional heat stroke. The mantra for treatment of exertional heat stroke ("cool first, transport second") is established because of the pronounced increase in the likelihood of survival when a patient with exertional heat stroke is cooled on-site.[21] Nearly all EMS response and transportation times fall outside of the theorized time to ensure survival from exertional heat stroke.[3] With varying levels of EMS education regarding exertional heat stroke and policies that may restrict the ability for EMS to cool on-site, a preseason conversation between the athletic trainer, team physician, and EMS staff can facilitate the adoption of best practices before an exertional heat stroke ever occurs.[22] Furthermore, if exertional heat stroke occurs when the athletic trainer is not on-site, these conversations can help ensure that athletes receive appropriate care en route to the treating hospital.

With proper communication, EMS staff can greatly assist with the treatment of exertional heat stroke when they arrive on-site. The transition of care for a patient with exertional heat stroke can be gradual as the EMS staff assists with cooling and monitoring the patient while the athletic trainer ensures that an appropriate cooling endpoint is achieved (38.6°C).[23] If EMS staff is uncooperative with on-site cooling, the athletic trainer should serve as a patient advocate to cool the patient to a safe body temperature (rectal temperature, 38.6°C) before and during the transfer of care to a hospital. Nevertheless, the patient with exertional heat stroke should still be transported to an emergency care facility after cooling for monitoring and follow-up laboratory testing.

Return-to-Activity

Recovery and return-to-activity following exertional heat stroke must be guided and supervised to mitigate the risk of recurrence. The athletic trainer must be cognizant because the extent of the injury may dictate the recovery process. Once medical clearance is obtained, the athletic trainer is instrumental in guiding the athlete through a gradual and progressive return to physical activity followed by a gradual exposure to environmental heat stress to ensure heat tolerance.[24,25]

The secondary school athletic trainer is a vital component of the sports medicine team to ensure the safety of participating student athletes. Developing and implementing appropriate policies and procedures for the management of exertional heat stroke within secondary school athletics should focus on the prevention, management, care, and follow-up care to optimize patient outcomes.

Strategies to Overcome Barriers to Implementing Exertional Heat Stroke Best Practices

Although best practices surrounding the prevention, recognition, and care of exertional heat stroke have been well established in scientific and medical literature, the implementation of these best practices at the secondary school level is not without barriers. Identifying the known barriers and developing strategies for successful implementation of best practices (Table 1) is essential for optimizing the medical care of the secondary school student athlete. Although exertional heat stroke is not 100% preventable, it is 100% survivable with the proper policies and procedures in place.

Table 1. Barriers and Strategies for Successful Implementation of EHS Best Practices Within Secondary School Athletics

Barrier	**Strategies**
School administrators do not approve the use of rectal temperature assessment in minors	1. Hold educational meetings with the administrators and present the evidence-based best practices on the standard of care surrounding temperature assessment in exercising individuals.
	2. Get the support of your supervising physician and use the physician as another advocate for ensuring the standard of care is practiced in a case of EHS, which is a medical emergency.
The cost of the proper equipment (eg, rectal thermometer, cold water immersion tub, equipment to measure WBGT, and environmental stressors (eg, heat stress trackers with WBGT capabilities)	1. The cost of this equipment is minimal (rectal thermometer with flexible thermistor, \$300; cold water immersion tub, \$100–\$150; environmental monitor, \$300–\$500).
	2. Alternatives can be purchased to lower the cost. A rigid thermometer with an upper range of 43°C can be purchased for as little as \$10–\$20, but this would required multiple insertions at specific time points and the AT will be unable to have a continuous measure throughout the entire cooling bout. The AT can use tarp-assisted cooling, which requires a tarp (\$15–\$20) instead of a cold water immersion tub. Although not ideal and not recommended, a mobile weather app could also be used to get an assessment of environmental conditions from the nearest weather station.
Privacy concerns with rectal temperature assessment in secondary school student athletes	1. Sheets and/or towels can be used to drape the athlete while the rectal temperature is being taken. This provides privacy for the athlete while the athletic trainer lowers the clothing, inserts the rectal thermistor, and returns the clothing to its orginal position to avoid exposing the athlete.
	2. If the rectal temperature assessment occurs in an open environment, in addition to draping the athlete, move the athlete off to the side of the playing field area to allow for added privacy.

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