The Timing of Exertional Heat Stroke Survival Starts Prior to Collapse

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This is a non-final version of an article published in final form in:

Adams WM, Hosokawa Y, Casa DJ. The Timing of Exertional Heat Stroke Survival Starts Prior to Collapse. *Current Sports Medicine Reports.* 2015;14(4):273-274.

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http://dx.doi.org/10.1249/JSR.0000000000000166

Abstract:

Adams et al. ([1]) reported that secondary school football coaches lacked a fundamental understanding of the causes and symptoms of exertional heat stroke (EHS). This lack of understanding was supported by the coaches' inability to identify prevention strategies to minimize the risk of EHS and the symptoms they would look for in an athlete suspected of having EHS ([1]). This evidence helps support reasons for strong educational programs for on-site personnel and for employing athletic trainers (AT) at secondary schools to oversee the health and safety of the student athletes competing in school athletics programs.

Keywords: exertional heat stroke | treatment | cold water immersion

Article:

Adams et al. ([1]) reported that secondary school football coaches lacked a fundamental understanding of the causes and symptoms of exertional heat stroke (EHS). This lack of understanding was supported by the coaches' inability to identify prevention strategies to minimize the risk of EHS and the symptoms they would look for in an athlete suspected of having EHS ([1]). This evidence helps support reasons for strong educational programs for on-site personnel and for employing athletic trainers (AT) at secondary schools to oversee the health and safety of the student athletes competing in school athletics programs.

In 2013, an interassociation task force convened to establish best practice recommendations for the prevention of sudden death in secondary school athletics programs ([3]). Among the recommendations were the best practices surrounding EHS. It was recommended that all sports teams follow an appropriate heat acclimatization protocol ([5]) for all preseason practices, set up an education program for coaches, athletes, and parents on the common causes of EHS, and institute preventive measures to minimize EHS risk ([3]). Proper recognition and assessment (central nervous system dysfunction and rectal temperature >105°F [40.5°C]) of EHS and immediate on-site treatment using cold water immersion (CWI) or a similar cooling protocol

prior to transport to a nearby health care facility is critical for survival ([3]). Early recognition and immediate cooling reduce the area (degree-minutes) under the cooling curve, which reduces both morbidity and mortality.

The treatment of EHS is centered on reducing body temperature below the critical threshold of cell damage (105.5°F [40.83°C]) by cooling the body to under 104°F (40.0°C) within the first 30 min of collapse to ensure survival without long-term sequelae ([4,7,8]). CWI with water temperature of 2°C to 14°C provides a rapid decline in body temperature, which allows an athlete with a body temperature of 108°F (42.2°C) to be cooled down to below the critical threshold of cell damage in about 10–15 min ([7,11]). A recent article by DeMartini et al. ([10]) examined 18 years of Falmouth Road Race treatment data for 274 cases of EHS with presenting body temperature over 104°F (40°C) and showed that immediate evaluation using rectal thermometry and CWI treatment resulted in a 100% survival rate.

In reality, the onset of body temperature above the critical threshold body temperature is likely to occur well before the time of collapse since body temperature at collapse is usually between 106°F and 110°F (41.1°C and 43.3°C). Some athletes are able to exercise with body temperatures above this critical threshold body temperature without CNS dysfunction or signs and symptoms of EHS. However, athletes who develop EHS lose the ability to thermoregulate and are likely to have been exercising above the critical threshold for an unknown amount of time when collapse or CNS dysfunction is observed. For example, if an athlete with suspected EHS has a body temperature measured at 108°F (42.2°C), the time the athlete spends in the critical range (>105.5°F [40.83°C]) ([11]) could be lengthy. This highlights the critical nature of the time available to effectively cool the body under the threshold for cell damage and improve the potential for survival.

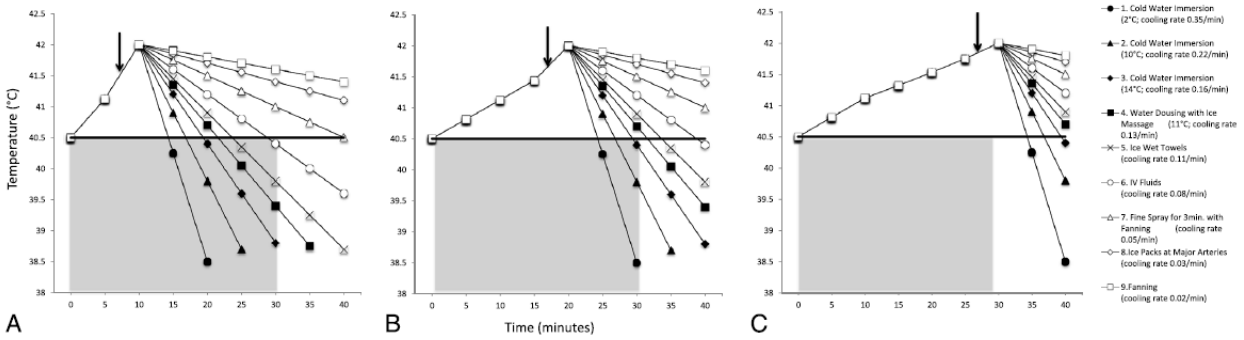

Figure. A, B, and C. Three scenarios for EHS treatment where the *shaded area* indicates the 30-min window needed to cool the body to ensure survival and minimize long-term sequelae. The *black line* indicates a temperature measure just below the critical threshold. The arrows indicate the moment of recognition. The cooling modalities show average cooling rates per time as reported in the literature ([2,9,10,12–16]). A. Optimal/immediate treatment. B. Delayed treatment. C. EHS recognition and treatment are absent.

The Figure ([2,9,10,12–16]) shows a hypothetical model presenting three different scenarios of EHS treatment with an athlete collapsing with a body temperature of 107.6°F (42°C). In the Figure, A shows the optimal treatment that would occur when EHS is promptly recognized and treated, B shows the suboptimal treatment that would occur when appropriate care is provided but delayed,

and C shows delayed treatment where the management of the condition, recognition, and treatment is absent. All scenarios in the Figure support the need for using CWI as the treatment of choice for EHS ([9,10,14]), and having qualified medical personnel, such as an AT present during all athletic events at the secondary school setting and strong educational programs to train the coaching staff to assist the AT or act accordingly in the absence of an AT to properly care for athletes with EHS.

Given that at least 5 to 10 min, and more realistically 15 min or more, will likely elapse from the onset of body temperature above the critical threshold, the collapse, and subsequent recognition of body temperature of the athlete, it becomes crucial for AT and all on-site personnel to be cognizant of the first 30-min period of survival and follow evidence-based best practice protocols to quickly and effectively treat the athlete on site ([6]). Cool first, transport second; the clock is ticking, and it has already started well before the athlete is on the ground.

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