Appendix 9

Post Severe Heat Exposure Cooling Methods for Fire Instructors

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Background

Fire service instructors' are frequently exposed to high temperatures, whilst wearing encapsulating protective clothing, resulting in high levels of physiological and perceptual strain (Petruzzello et al. 2009). The South East Regional Fire Service requested an investigation into the effect of different post heat exposure cooling methods by fire service instructors, to help improve recovery and inflammation. Many studies have evidenced the use of cold water immersion to improve cardiovascular recovery for subsequent performance gains (Pointon et al. 2012). The use of ice slurry as a method of internal cooling has been suggested to have similar benefits to recovery and subsequent performance, although these performance improvements seem to be the result of improved thermoreception rather than reduction in physiological strain (Siegel et al. 2011).

Methods

The study investigated the use of three cooling methods [Ice Slurry (ICE), peripheral (hands and feet) cooling (PERIPHERAL) or no cooling (CONT)] after intermittent exercise [5 mins walking (4km.h^{-1}, 1% gradient), 5 mins standing] for 45mins in the heat (50^{o}C and 10% RH). Participants cooled until they reached resting core temperature or a plateau in core temperature (3 consecutive measurements within 0.02 degrees) was achieved. Eight males (age 20±2 years; weight 75.7±7.1kg; height 177±7cm) completed all cooling conditions wearing full fire service kit and breathing apparatus, weighing 17kg. Physiological and perceptual measures were recorded throughout the heating process and then for every 5 mins throughout cooling. Venous blood samples were collected after heat exposure and after cooling for analysis of interleukin (IL)-6.

Results

There were no significant differences in time to cool across the trials [ICE (53.37±28 min), PERIPHERAL (57.25±20 min), CONT (57.42±20 min)]. Similarly rate of cooling was not different [ICE (0.0156±0.006 °C.min^{-1}), PERIPHERAL (0.0122±0.008 °C.min^{-1}), CONT (0.0125±0.009 °C.min^{-1})]. Physiological responses to cooling method also demonstrated no significant differences. Heart decreased significantly in all trials down to near resting levels [ICE (70±3 bts.min^{-1}), PERIPHERAL (67±6 bts.min^{-1}), CONT (67±8 bts.min^{-1})]. Inflammation measured using IL-6 demonstrated similar 26% declines in all trials with cooling. However IL-6 values still remained raised above normal resting values (1.72±0.39 pg.ml^{-1} at the end of the cooling period [ICE (5.08±0.30 pg.ml^{-1}), PERIPHERAL (4.80±0.41 pg.ml^{-1}), CONT (4.85±0.28 pg.ml^{-1})]. Perceptual thermal sensation was not different across trials throughout or by the end of cooling [ICE (3.25±0.75), PERIPHERAL (2.85±0.85), CONT (3.31±0.75)].

Conclusions

The findings demonstrate that post-cooling methods did not significantly reduce physiological strain or perceptions of thermal stress greater than sitting in a boiler suit in a cool environment. However, there is considerable variability in individuals' responses to heat tolerance and subsequent cooling rates. Due to the large variance significance is unlikely to be reported within a small sample size. In this instance it is important to look at meaningful differences in the application of the technique. When assessing rate of cooling and cooling time the ICE cooling method demonstrates a faster rate of cooling and subsequently a quicker (4 min / 7%) cooling time.

The results demonstrate the need for sufficient cooling times. Inflammatory data demonstrates that participants were still a long way from a recovered state even after ~55mins of recovery. In fire instructor current practices these cooling times are not logistically feasible, yet still instructors need to be informed of the need for sufficient recovery. Due to instructor's busy daily schedules and the relative ease and time efficiency of using ice slurry, it would be appropriate for instructors to use ice slurries as a means to improve rate of cooling where time is limited.

References

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