Ice Water Immersion – Practicalities for Monitoring Hyperthermic Patients in the Prehospital Context

Lachlan Holbery-Morgan, MBBS, BHealthSci (Paramedic); James Carew, BHealthSci (Paramedic), BCom; Elyssia Bourke, MBBS, BMedSci; Ned Douglas, MBBS, BMedSci, FANZCA

Event Medical Services Australia, Moonee Ponds, Victoria, Australia

Correspondence:
Ned Douglas, MBBS, BMedSci
Event Medical Services Australia
PO Box 991
Moonee Ponds, Victoria, Australia, 3039
E-mail: ndouglas@emsa.com.au

Conflicts of interest: none

Keywords: ambulance; cooling; hyperthermia; prehospital

Abbreviations:
ECG: electrocardiograph
NIBP: non-invasive blood pressure

Received: March 4, 2019
Revised: June 3, 2019
Accepted: June 19, 2019

doi:10.1017/S1049023X19004886

Abstract

Immersion of patients in a body bag filled with ice and water is recommended as prehospital management of severe hyperthermia. Experienced paramedics have raised a number of concerns about the use of this technique; particularly, whether cardiac monitoring equipment would remain functional once immersed. This test showed that monitoring equipment does remain functional and provides advice about safety considerations. The test should reassure practitioners that such an approach is feasible.

Holbery-Morgan L, Carew J, Bourke E, Douglas N. Ice water immersion – practicalities for monitoring hyperthermic patients in the prehospital context. *Prehosp Disaster Med.* 2019;34(6):675–676.

Introduction

Sympathomimetic and serotonin toxicity are serious clinical entities that have recently contributed to a number of deaths in Australia after ingestion of serotonin or sympathomimetically active recreational drugs. A common contributor to morbidity and mortality in these patients was the hyperthermia associated with these clinical syndromes. Existing literature[1–4] recommended immersing patients in ice and water, as the rate of cooling is significantly faster compared to traditional fanning and misting techniques.[2] The outcomes related to hyperthermia are related directly to the time a patient remains hyperthermic. Therefore, rapid cooling needs to be instituted as an urgent priority in this patient group, including in the prehospital setting.

In clinical practice, when discussing this technique with experienced ambulance paramedics, concerns were raised about the safety of this technique during road ambulance transport, particularly whether monitoring equipment would function while the patient was immersed in water. The organization decided to conduct an operational test to address these concerns.

Report

The volunteer provided consent to the publication of the test. The body bag used was the standard body bag in use in Event Medical Services Australia (Moonee Ponds, Victoria, Australia). Three-lead electrocardiograph (ECG) monitoring, defibrillator pads, non-invasive blood pressure (NIBP), and fingertip pulse oximetry monitoring were applied using a Philips MRx monitor/defibrillator (Philips GMBH; Amsterdam, The Netherlands). The body bag was first placed on the ground before the volunteer entered it, with the face and right arm left unzipped and open to atmosphere. Before entering the body bag, ECG dots and defibrillation pads were applied (for the purpose of monitoring the ECG via the pads, rather than for attempts at defibrillation) while the volunteer was dry in conventional 3-lead ECG position and sterno-apical positions, as well as a NIBP cuff and SpO2 finger probe. The body bag was then filled with water, until the water level reached the volunteer's shoulders. A small towel was placed under the volunteer's occiput to raise it by approximately five centimeters to ensure the airway was clear of the water.

Approximately 80 liters of water were necessary to ensure coverage up to the top of the chest of the patient, and the patient's head and right arm were maintained outside of the body bag to ensure airway patency and simulate access for intravenous lines, NIBP, and the pulse oximeter. Some water did leak through the zips of the body bag.

A baseline set of observations were taken before immersion, and another set were taken after immersion. After immersion, all monitoring domains remained functional, and no significant changes in observations were observed. After 20 minutes immersion, the volunteer

removed them self from the body bag, and the adhesive ECG electrodes remained in place, as did the defibrillator pads.

Two adults were required to safely maneuver the body bag with patient immersed in water on the ground. The volunteer weighed 84kg (185lbs), so the total load was 164kg (362lbs), which was within the operating limits of ambulance stretcher and fixation devices. The test did not attempt driving the volunteer in an ambulance.

Discussion

The team suggested that the use of assisted moving devices (eg, HoverMatt; HoverTech International; Allentown, Pennsylvania USA) and many hands would be necessary to safely transfer a patient, and that the material of a body bag may be insufficiently strong to support this weight. To address this risk, the team suggested placing a spinal board rated to an appropriate weight under the patient before immersion. The team also suggested draining the water component before ambulance transport, to avoid large volume water leak, but to retain the ice component to maintain cooling. If the ice is removed, the body bag should be removed to avoid it acting as a blanket and retaining heat in the patient. While defibrillation pads were applied for monitoring purposes in this test, it is not suggested that it would be safe to defibrillate a patient while they are underwater. If defibrillation was required, the team suggests draining the water, drying the patient, and defibrillating in accordance with manufacturer's instructions.

Conclusion

This test showed that continual monitoring of vital sign parameters is possible despite immersion in water in a body bag in a road ambulance. Practical suggestions include the use of a pillow to maintain the airway, leaving the monitored arm outside of the body bag to maintain access, and calculating the total weight of the body bag before moving patients, as well as using assisted moving devices.

Author Contributions

Dr. Holbery-Morgan conceived the idea for the operational test, conducted the test, and was involved in the authorship of the publication. Mr. Carew conducted the operational test and reviewed the manuscript before publication. Dr. Bourke provided advice on the conduct of the operational test and authored the manuscript for publication. Dr. Douglas developed the procedures of the operational test, conducted the operational test, and authored and reviewed the manuscript for publication.

References

1. Laskowski LK, Landry A, Vassallo SU, Hoffman RS. Ice water submersion for rapid cooling in severe drug-induced hyperthermia. *Clin Toxicol Phila Pa*. 2015;53(3):181–184.
2. Armstrong LE, Crago AE, Adams R, Roberts WO, Maresh CM. Whole-body cooling of hyperthermic runners: comparison of two field therapies. *Am J Emerg Med*. 1996;14(4):355–358.
3. Proulx CI, Ducharme MB, Kenny GP. Effect of water temperature on cooling efficiency during hyperthermia in humans. *J Appl Physiol Bethesda Md*. 2003;94(4):1317–1323.
4. Bouchama A, Dehbi M, Chaves-Carballo E. Cooling and hemodynamic management in heatstroke: practical recommendations. *Crit Care Lond Engl*. 2007;11(3):R54.