

A case of heat-related illness

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Abstract

Although heat-related illnesses are relatively uncommon in the UK, nonetheless, this can pose serious dangers to military personnel posted to the Middle East as well as tourists who are not acclimatised to the hot weather of a tropical country. This article illustrates some common presentations of heat-related illnesses by highlighting the case of a man who suffered from heat exhaustion after he lost consciousness in his car. This case happened in the authors' home country, Malaysia.

Key words

● Cooling techniques ● Heat exhaustion ● Heat-related illness ● Heat stroke

Accepted for publication 9 September 2010

A 70 year-old Malay man was admitted to the emergency department (ED) of Hospital Universiti Sains Malaysia after he was found unconscious by a passerby. He was found trapped inside his car parked under the hot sun. According to the patient, after he came out from his cardiac clinic visit, he had difficulty locating his car in a carpark full of vehicles. It took him 15 minutes to find it. Soon afterwards, he felt dizzy and he dozed off. He could not recall what happened after that. The passerby who brought him to the ED said that the patient was found trapped inside his vehicle. He was unconscious at that time. Fortunately, his car doors were unlocked.

On arrival at the ED, the patient was unresponsive to call. His axillary temperature was noted to be 41°C. Blood pressure was 140/80 mmHg and pulse rate 100 beats/min on admission. Capillary blood sugar was 10mmol/l. He was sweating profusely.

The man was treated as a case of heat-related illness. He was disrobed and given tepid sponging with a wet towel and large gauzes were placed over his trunk, axillary regions and groin. Tap water was sprayed over his entire body for further cooling. Intravenous hydration was initiated with view that the patient was confused. Over the next 30 minutes, his condition gradually improved. He regained consciousness and was subsequently transferred to the observation ward. His axillary temperature was

monitored regularly and it was noted to gradually decrease to 37.1°C after a period of two hours.

Blood investigations (full blood count, blood urea and serum electrolytes, serum creatinine and liver function tests) remained within normal range. His creatine kinase level was 230 unit/l (normal range 30–200 unit/L). He was well and discharged home after a six hours stay in the ED.

Discussion

This case highlighted the danger of heat-related illnesses that are often overlooked. He could be considered as fortunate because he was noticed trapped inside the car by a passer-by early enough to prevent further deterioration in the spectrum of heat-related illnesses. By definition, heat-related illness is a form of hyperthermia associated with systemic inflammatory response, which can lead to multi-organ dysfunction, predominantly encephalopathy, if left untreated (Lugo-Amador et al, 2004).

To differentiate hyperthermia from fever, hyperthermia occurs when the thermoregulatory centre at the pre-optic area in anterior hypothalamus remains normal, while the heat is being produced to the point where it exceeds the body's ability to dissipate heat. Fever, on the other hand, occurs as a response to pyrogens, with the hypothalamic set point being elevated (Lugo-Amador et al, 2004). The spectrum of heat-related illnesses can range from minor syndromes such as heat cramps, heat syncope and heat exhaustion to the more severe and life threatening heat stroke (Lugo-Amador et al, 2004).

In response to the sudden heating in heat-related illnesses, nearly all body cells express heat-shock proteins. These heat-shock proteins confer protection to the cells by allowing them to survive and tolerate the second more lethal stage of heat stress as well as to prevent protein denaturation (Bouchama and Knochel, 2002; Lugo-Amador et al, 2004). Once the protein denaturation occurs, a large number of enzymatic reactions in the body will be affected as enzymes are essentially proteins that catalyze chemical reactions. Eventually however, the cells will succumb to the deteriorating effect of heat stress.

The heat denatures cellular proteins and interrupts cellular enzymatic processes—resulting in cell swelling as well as causing cellular death (Lugo-Amador et al, 2004).

Temperatures above 41.6 °C to 42 °C are considered to be the critical thermal maximum for humans to tolerate for 45 minutes to eight hours (Lugo-Amador et al, 2004; Bouchama and Knochel, 2002). Extreme temperatures above 49 °C may result in near immediate cell death in less than five minutes (Bouchama and Knochel, 2002; Lugo-Amador et al, 2004). The patient highlighted in this case study had an admission core temperature of 41°C.

The distinction between heat exhaustion and the more severe form of heat-related illnesses, heat stroke, is not always clear-cut—although, clinically, heat stroke usually has a temperature greater than 40.6 °C, as well as evidence of central nervous dysfunction such as mental confusion (Bouchama and Knochel, 2002; Lugo-Amador et al, 2004).

In terms of clinical practice in the ED however, the principles are almost similar. The distinction between heat stroke and heat exhaustion, therefore, is rather arbitrary, and is important only in terms of prognostication as well as how expeditious cooling should be done. In fact, strict adherence to this criteria of theoretical definition may result in a delay of patient management (Khosla and Guntupalli, 1999; Lugo-Amador et al, 2004).

Failure to treat heat exhaustion adequately can result in the deterioration to heat stroke (Lugo-Amador et al, 2004). Heat exhaustion, in fact, serves as a warning sign—heralding the onset of an impending heat stroke (Khosla and Guntupalli, 1999). Therefore, if there is uncertainty in the differentiation between heat exhaustion and heat stroke, the patient should be treated aggressively and promptly as heat stroke, especially if the patient's mental status is questionable (Lugo-Amador et al, 2004).

First aid treatment

In terms of first aid treatment, at any cost, there should be no delay in removing the patient from the hot environment (Bouchama and Knochel, 2002; Lugo-Amador et al, 2004). Morbidity and mortality is directly associated with the duration of exposure to the hot environment, as well as how rapidly the core temperature is reduced (Lugo-Amador et al, 2004). In this aspect, we are grateful to the passer-by for removing him out from his car.

Cooling

Cooling should be instituted immediately. In this case, the evaporative cooling technique was implemented, rather than ice water immersion. These two methods (evaporative cooling and ice water immersion) are the most widely accepted methods of rapid cooling

(Harker and Gibson, 1995). Controversy exists and persists over which method is more effective (Harker and Gibson, 1995). In a review article by Harker and Gibson (1995), they commented that there is a geographical perspective and preference in terms of which method to be used. An evaporative cooling technique is preferred in the Middle East and South Africa—whereas clinicians in the US are divided in their preference (Harker and Gibson, 1995).

The principle behind the effectiveness of the evaporative cooling technique is that the energy required to evaporate water is greater than that required to melt an ice. To state it categorically, 1 gm of evaporated water dissipates seven times as much heat as melting 1 gm of ice (Harker and Gibson, 1995).

On the other hand, although ice water immersion would reduce the core temperature rapidly, it could be extremely uncomfortable, especially if the patient is still conscious. In this case, plenty of wet gauze over the flexural area of the body was applied, as well as copious spraying of tap water over his entire body. The cooling should reduce the temperature to 38.5 °C to 39 °C. Over cooling is not advisable.

Intravenous should be given to patients who cannot tolerate orally (Bouchama and Knochel, 2002; Lugo-Amador et al, 2004). Serum electrolytes and hematocrit should be monitored to ensure adequate hydration. Antipyretics have not been shown to be useful (Lugo-Amador et al, 2004).

Conclusion

In conclusion, it is imperative that we promptly recognize heat-related illnesses. This is because, above the humidity of 35%, convection alone does not adequately dissipate heat from the body (Bouchama and Knochel, 2002). Furthermore, public education is also very important—drinking plenty of water during hot weather is important and parents need to be educated regarding the importance of not leaving children unattended in cars, especially during hot weather.

As illustrated in this case, healthcare professionals need to be reminded that delineating heat stroke from heat exhaustion is not as easy as stated in textbooks. In cases of uncertainty, the patient should be treated as a case of heat stroke.

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