Cooling intravenous fluids by refrigeration: implications for therapeutic hypothermia

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Cooling intravenous fluids by refrigeration: implications for therapeutic hypothermia

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ABSTRACT

Background: ILCOR recommend the use of therapeutic hypothermia (32–34°C) for 12–24 h in unconscious adult patients with spontaneous circulation after cardiac arrest with a VF rhythm. Among various methods of inducing hypothermia, the rapid infusion of ice-cold intravenous fluid has been used.

Methods: To investigate the time required to cool intravenous fluids in a domestic refrigerator and freezer, bags of compound sodium lactate were placed on the upper shelf of a refrigerator. Continuous temperature measurement was performed for 2 h for 10 500 ml and 10 1000 ml bags. The procedure was then repeated in the freezer.

Results: The mean time for 500 ml bags to cool to 4°C or below was 90 minutes or more in a refrigerator and 60–90 minutes in the freezer. 1000 ml bags are cooled to 4°C or below within 120 minutes in the freezer, but it takes longer in a refrigerator.

Conclusion: As induced hypothermia should be started as soon as possible in eligible patients, crystalloids should be stored in a refrigerator.

In 2003, an advisory statement issued by the International Liaison Committee on Resuscitation (ILCOR) recommended the use of therapeutic hypothermia (32–34°C) for 12–24 h in unconscious adult patients with spontaneous circulation following community cardiac arrest where the presenting rhythm was VF.[1]

This was based on two randomised controlled trials published in 2002, which compared mild hypothermia with normothermia.[2 3] Both trials reported a significant improvement in neurological outcome and the larger European study also demonstrated a significant survival benefit.

According to a survey in 2005, only 26% of intensive care units in the UK follow ILCOR's recommendation.[4] The majority (52%) of units induced hypothermia with cold intravenous fluids.

The rapid infusion of ice-cold intravenous fluid has been used to induce hypothermia. Bernard *et al*[5] demonstrated that 30 ml/kg of ice-cold Hartmann's solution infused over 30 minutes rapidly and effectively induced hypothermia in patients following cardiac arrest.

There are numerous studies looking at methods of warming intravenous fluids but we were unable to find any information on cooling fluids. We decided to investigate the length of time it would take to cool intravenous fluids in a domestic fridge and freezer.

MATERIALS AND METHODS

Having obtained institutional approval, bags of compound sodium lactate (Hartmann's solution) were used. Starting at room temperature, the wrapping was partly removed and a thermistor probe (Comar K 1625, Stevenage, UK) was inserted through the injection port of each bag then sealed. The bag was then placed on the upper shelf of a commercially available refrigerator (LEC Medicine Fridge, Leeds, UK). Continuous temperature measurement was performed for 2 h. This was done for 10 500 ml bags and 10 1000 ml bags. The procedure was then repeated except that the bags were placed in the freezer compartment.

Data were analysed using the Arcus Quickstat V1.0 statistical program (StatsDirect, Altringham, UK).

RESULTS

Our results show that 500 ml bags can be cooled to less than 4°C within 90 minutes in a freezer and within 120 minutes in a refrigerator.

The 1000 ml bags are cooled to 4°C or below within 90–120 minutes when cooled in the freezer compartment. However, more than 120 minutes

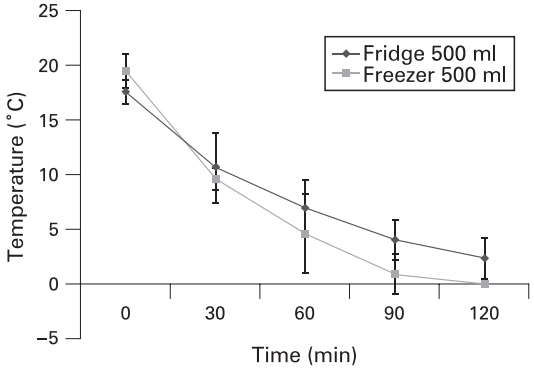

Figure 1 500 ml bags with 95% error bars.

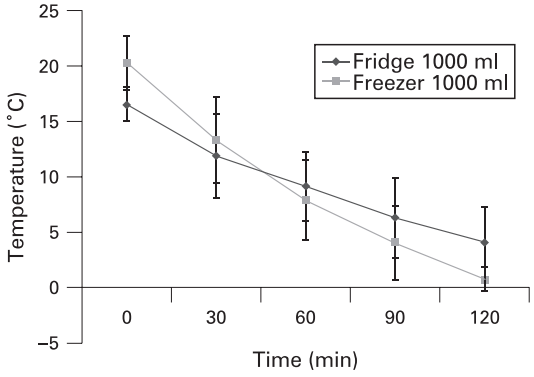

Figure 2 1000 ml bags with 95% error bars.

are required to reach the same temperature when using a refrigerator.

Data for cooling 500 ml bags are displayed in fig 1 and data for cooling the 1000 ml bags are displayed in fig 2 (with 95% error bars).

DISCUSSION

Previous studies have demonstrated that the rapid administration of fluids at 4°C can effectively and safely induce therapeutic hypothermia. The infusion of 30 ml/kg of ice-cold Hartmann's solution over 30 minutes produced a significant drop in median core temperature to 33.8°C.[5] This was also associated with improvements in mean arterial pressure, renal function and acid-base balance and there were no adverse effects such as pulmonary oedema. In this study, Hartmann's solution was stored at 4°C in a blood bank fridge and was immediately available. The mean time to initiation of the intravenous infusion was 73 minutes.

ILCOR recommended that cooling should be initiated as soon as possible after re-establishing a spontaneous circulation. Therapeutic hypothermia using ice-cold intravenous fluids has been successfully initiated in the prehospital environment and during cardiopulmonary resuscitation.[4 6]

Although our study indicates that fluids can be cooled to 4°C within 2 h, this may cause delays in the initiation of therapeutic hypothermia. We would advocate that clinicians intending to use ice-cold intravenous fluids to induce therapeutic hypothermia should store fluids in a fridge rather than trying to cool fluids when they are required.

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Competing interests: None.

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