

CASE REPORT

Use of cold intravenous fluid to induce hypothermia in a comatose child after cardiac arrest due to a lightning strike[☆]

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KEYWORDS

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Summary We report a case in which mild hypothermia was induced successfully using a cold intravenous fluid infusion in a 12-year-old boy who was comatose following 21 min of cardiac arrest caused by a lightning strike.

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Introduction

Mild hypothermia improves survival and neurological outcome in comatose adult survivors of ventricular arrhythmia-induced cardiac arrest.^{1,2} Guidelines also recommend that induced hypothermia is considered when children remain comatose after successful cardiopulmonary resuscitation (CPR).³ There is however little evidence about cooling methods in children resuscitated from cardiac arrest. We present the use of a cold intravenous fluid infusion to induce hypothermia in a child who was resuscitated after cardiac arrest caused by a lightning strike.

Case report

A 12-year-old boy presented to the Emergency Department with cardiac arrest after being struck by lightning whilst playing soccer. The soccer team coach found that the boy was unresponsive and not breathing and immediately started CPR. Emergency medical services (EMS) arrived at the scene 8 min after the collapse and confirmed cardiac arrest. EMS personnel continued CPR with bag-mask-ventilation and compressions during 7 min of transport time. The initial cardiac arrest rhythm was not checked. The cardiac arrest rhythm on arrival in the emergency department was asystole. Return of spontaneous circulation (ROSC) was achieved after a further 6 min of advanced life support including intravenous access, injection of a total of 2 mg adrenaline and atropine, and tracheal intubation. Initial blood pressure was 140/110 mmHg, pulse 164 per minute and temperature 36 °C. Physical examination showed mild subcutaneous emphysema around neck and burns on both legs and trunk. The heart rhythm was sinus tachycardia and chest radiograph showed infiltration on left upper lobe. The patient was comatose (Glasgow coma scale score 3) with

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Table 1 The neuropsychological tests used for evaluation and patient's results at each time-point

Neuropsychological tests	Prior to discharge	1 month	6 month
Memory Quotient (MQ) from Rey–Kim test	66	113	110
Full Scale Intelligence Quotient (FIQ)	76	92	91
Verbal Intelligence Quotient (VIQ)	78	93	83
Performance Intelligence Quotient (PIQ) from Korean-Wechsler Intelligence Scale	81	94	107
Korean-Mini Mental Status Examination	30/25	30/30	30/30

a sluggish papillary light reflex and occasional respiratory efforts. Hypothermia was induced after receiving written consent from his mother. Ice packs and a surface cooling system (Medi-Therm III®, Gaymar Industries, USA) with sedative and neuromuscular blocker infusion were initially used to induce hypothermia. This combination was not however successful at inducing hypothermia. A cold saline infusion (approximately 4 °C) was therefore tried. The initial volume of cold saline used was 30 ml/kg. Rapid infusion of 500 ml over 15 min reduced core temperature about 0.7 °C then slow infusion of an additional 500 ml for 45 min reduced core temperature by about 0.5 °C. The infusion was stopped when the temperature reached 34.5 °C in order to prevent overcooling. Target temperature (34 °C) was reached about 4 h after ROSC (Fig. 1). Hypothermia was maintained with the surface cooling between 33 and 34 °C for the first 24 h and the child slowly rewarmed over the next 24 h. The patient showed response to pain during the rewarming. There were no complications associated with hypothermia. Electroencephalography, somatosensory-evoked potential and MRI showed no abnormal findings on the third day. After 50 h, the patient showed response to verbal stimulation and his trachea was extubated on the fourth day. On the ninth day, neuropsychological tests showed decrease in mental fluency and memory impairment. The boy was discharged with a paediatric cerebral performance category (PCPC) score of 2 after 2 weeks. On 1- and 6-month follow-up, the patient had no neurological problems with a PCPC score of 1 and improved neuropsychological test results (Table 1).

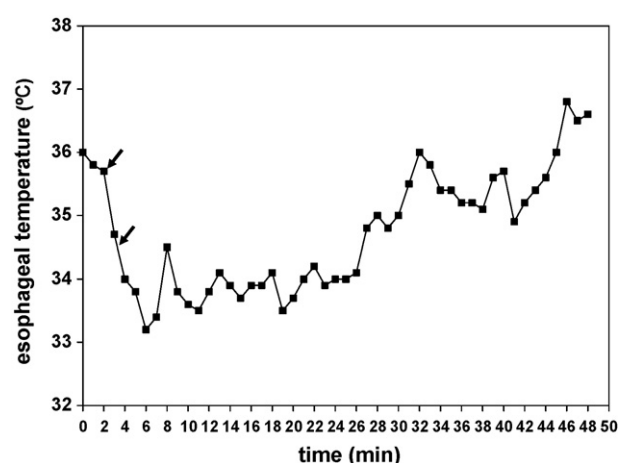


Figure 1 Oesophageal temperature of the patient during hypothermia treatment. Arrows mark the time-points at which the iced-saline infusion was used.

Discussion

Cardiac arrests due to lightning strike have a relatively good survival rate compared to other causes of arrest.⁴ However, there is a significant degree of morbidity among the survivors. Injuries arise as a result of the primary strike or a hypoxic insult from cardiac arrest.⁵ Consideration of mild hypothermia is recommended for comatose children after resuscitation³ based on extrapolation of studies in adults^{1,2} and neonates.^{6,7} There is still limited evidence to recommend routine use of induced hypothermia in children resuscitated from cardiac arrest.⁸

There are two previous reports reporting good survival after hypothermia treatment in children with cardiac arrest caused by lightning strike. Ravitch et al. reported a 10-year-old boy resuscitated with open cardiac massage and prolonged artificial respiration.⁹ They used moderate hypothermia with surface cooling using crushed ice for 4 days. Marcus et al. also reported a case of a 14-year-old boy who survived without neurological problems after 60 min of CPR.¹⁰ In our case, hypothermia was induced with a combination of methods. There is no supporting evidence for using cold fluid infusion in children. We chose to use it on the basis of reports in adults.^{11–13} However, we did not administer the large amount of cold saline over a short time as in the adult studies. About 500 ml of cold saline was rapidly infused over 15 min which induced about a 0.7 °C decrease in temperature and an additional 500 ml was slowly infused.

We feel prompt CPR at the scene and the use of hypothermia after ROSC contributed to our patient's good outcome. We cannot rule out the possibility that our patient would have had a good outcome even if hypothermia had not been used. It is debatable as to whether or not 21 min of CPR in paediatric patient's represents a prolonged arrest. Recent reports suggest that a duration of CPR longer than 20 min was associated with poor survival.¹⁴

In conclusion, this case suggests that inducing mild hypothermia in children who remain comatose after initial resuscitation from cardiac arrest using a cold intravenous fluid infusion is feasible.

Conflict of interest

None.

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