

EM CASE OF THE WEEK

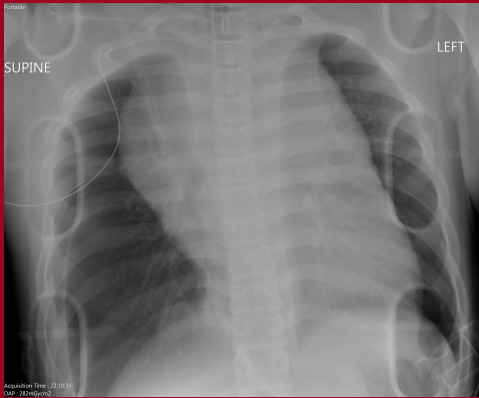
BROWARD HEALTH MEDICAL CENTER DEPARTMENT OF EMERGENCY MEDICINE

Pediatric Therapeutic Hypothermia

A 15-year old male comes into the ED after collapsing at home in respiratory distress. The EMS arrive 10 minutes after his collapse and finds him non-responsive. He is intubated then rushed to the ED. At the ED, father reported that he was eating an apple, began gasping, and then collapsed. CXR showed widened mediastinum (shown left). Patient's ABG shows a pH of 7.18, pCO₂ of 48, pO₂ of 274. After emergency stabilization, the patient is transferred to PICU where the attending doctor initiates hypothermia protocol

What is the primary benefit of cooling this patient?

- Reduced Mortality*
- Improved neurological outcome*
- Fewer cardiac events while in PICU*
- Improved oxygen availability to tissues*



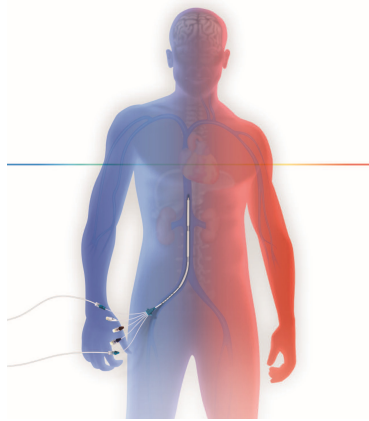
Patient's CXR showed a widened mediastinum, likely causing a tracheal obstruction and accounting for the patient's presentation

EM CASE OF THE MONTH

EM Case of the Month is a monthly "pop quiz" for ED staff. The goal is to educate all ED personnel by sharing common pearls and pitfalls involving the care of ED patients. We intend on providing better patient care through better education for our nurses and staff.



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Take Home Points

- Therapeutic hypothermia is still in its infancy, meaning that many questions about protocol and optimal strategy are a work in progress.
- Therapeutic hypothermia saves brain.
- Research has shown improved mortality and cerebral outcome in adult and newborn patients.
- Generally, protocols target 32-34°C over 12 to 24 hours with gradual rewarming over the next day
- Broward Health uses a triple lumen cooling catheter to cool patients.
- Shivering must be controlled with paralysis.

Therapeutic Hypothermia

Answer: B) Improved neurological outcome

Therapeutic hypothermia (TH) is lowering core body temperature in patients who have had cerebral hypoxia secondary to cardiac or respiratory arrest. Currently, TH is not standard therapy. Neither its mechanism, nor optimal strategy have been discerned. Studies have shown clear benefits on improved neurological outcomes, but mortality benefits are less definitive in pediatric patients.

Discussion:

Mechanisms that contribute to brain ischemia are varied and not fully understood. Research done to elicit mechanisms of TH have been done on rat models. Although there are multiple mechanisms to explain TH's effect on neurological preservation, the currently accepted belief is that reducing core body temperature reduces the brain's oxygen demand. Each 1°C drop in body temperature caused a 6-7% decrease in cerebral oxygen consumption.

In 2002, NEJM published two randomized control trials that examined the therapeutic effects on TH on patients who collapsed and were resuscitated, providing the first high-quality studies on TH. Since then, a 2011 Cochrane Review showed that TH improved neurological outcome by about 50% and survival to hospital discharge by about 33%.

Research on pediatric TH is based on ischemic infants following birthing complications (cerebral palsy infants). A 2013 Cochrane review of combined 1500 infants showed that TH significantly reduced combined mortality and severe neurological disability by 25%. Although the Cochrane study showed mortality benefit, each trial that it examined showed no mortality benefit when taken individually. As a result, the mortality benefit of TH in pediatric populations is less definite than the neurological benefits.

Practical Considerations

Amid this reliable evidence, many practical considerations surfaced.

- What is an optimal body temperature?
- How should you control a patient's shivering?
- What devices do you use to cool and monitor body temperature?

There is no set protocol suggested by any of the governing bodies such as AHA, or American Neurological Association, only the recommendation that TH is beneficial. Answering the questions above requires examination of the literature.

Optimal body temperature

Early studies in the 50's to 70's showed that cooling patients to 30°C for one week increased mortality. Newer studies showed improvement because the cooling was far less aggressive at 32-34°C for less than a day, demonstrating that cooler is not always better.

A 2013 study from NEJM compared 33°C vs. 36°C protocols, showing no difference in mortality or neurological outcomes, providing guidance toward an optimal core temperature.

In addition, a trial called THAPCA is recruiting pediatric patients and collecting data from multiple centers that will compare 33°C hypothermia to aggressive normothermia, and then compare neurological outcomes and mortality outcomes at one month and one year.

Controlling shivering

Shivering must be controlled. Aside from making it technically difficult to obtain labs, monitor vitals, and place equipment, it directly counteracts the intention to cool the patient.

Cooled patients are paralyzed either by buspirone, fentanyl, or neuromuscular blockade (which requires continuous EEG)

What devices do you use?

Broward Health uses a commercially available triple lumen catheter to cool patients, but there are other methods. Among others, these include cooling pad devices and even ice packs if your target temperature is mildly hypothermic.

Future Research

The fact that chilling a person to either 33°C or 36°C will have similar outcome led to the suggestion that perhaps cooling a patient is not the key part of TH, but rather prevention of fever. THAPCA and future trials will help answer those questions.

What happened to our patient?

Unfortunately, this patient still had poor neurologic outcomes despite the best efforts of Broward Health. It is likely that the time to intervention was simply too long, and the majority of the damage happened before arrival. Despite this, the research tells us that TH is an effective intervention and the child received the best available treatment.

1. HYPOTHERMIA AFTER CARDIAC ARREST STUDY GROUP. MILD THERAPEUTIC HYPOTHERMIA TO IMPROVE THE NEUROLOGIC OUTCOME AFTER CARDIAC ARREST. *N ENGL J MED.* 2002 FEB 21;346(8):549-56.
2. BERNARD SA ET AL. TREATMENT OF COMATOSE SURVIVORS OF OUT-OF- HOSPITAL CARDIAC ARREST WITH INDUCED HYPOTHERMIA. *N ENGL J MED.* 2002 FEB 21;346(8):557-63.
3. NIELSEN N ET AL. TARGETED TEMPERATURE MANAGEMENT AT 33°C VERSUS 36°C AFTER CARDIAC ARREST. *N ENGL J MED.* 2013 DEC 5;369(23):2197-206.
4. BOHN DJ, ET AL. INFLUENCE OF HYPOTHERMIA, BARBITURATE THERAPY, AND INTRACRANIAL PRESSURE MONITORING ON MORBIDITY AND MORTALITY AFTER NEAR DROWNING *CRIT CARE MED* 1986; 14:529-34

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