**Clinical question.**

Does the use of intravenous fluids (I) improve outcome (O) (eg. survival) In adult patients with ROSC after cardiac arrest (prehospital or in-hospital) who have cardiovascular dysfunction (P), ?

**Is this question addressing an intervention/therapy, prognosis or diagnosis?** : Intervention/therapy

**State if this is a proposed new topic or revision of existing worksheet:** New topic

**Conflict of interest specific to this question**

Do any of the authors listed above have conflict of interest disclosures relevant to this worksheet? No

**Search strategy (including electronic databases searched).**


5) "heart arrest" OR "cardiopulmonary resuscitation") AND ("fluid therapy" OR "volume expansion") 109 hits No articles met the criteria

6) "cardiogenic shock" OR "heart failure") AND ("fluid therapy" OR "volume expansion") (PubMed) 297 articles hit

7) "after cardiac arrest" AND "fluid therapy" 29 articles hit. No article met the criteria.

8) "volume expansion" AND "after cardiac arrest" 9 articles hit. No articles match
Then hand search of articles retrieved and relevant studies of each of them are checked.

Cochrane review: No results
Embace search: not performed

- **State inclusion and exclusion criteria**
These studies were excluded.
Not cardiac arrest cases, pre-resuscitation cases, and during resuscitation cases. We cannot apply the study of during resuscitation cases to the post resuscitation cases, because the hemodynamics of during CPR is profoundly different from of which after ROSC.
Not adult cases, Studies about pharmacotherapy or trauma cases.

- **Number of articles/sources meeting criteria for further review:**
11 articles are selected for further review.

## Summary of evidence

### Evidence Supporting Clinical Question

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| B = Survival of event               | D = Intact neurological survival | *Italics* = *Animal studies*

### Evidence Neutral to Clinical question

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### Evidence Opposing Clinical Question

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REVIEWER'S FINAL COMMENTS AND ASSESSMENT OF BENEFIT / RISK:

Therapy/Intervention
Intravenous fluids seem to have two main functions in the post resuscitation setting, one is hemodynamic optimization and the other is induction of therapeutic hypothermia.
Post resuscitation state has many characteristics in common with sepsis; accordingly it is reasonable that early goal directed therapy, by correcting central venous pressure, mean arterial pressure, and oxygen saturation of central venous in stepwise fashion in patient with sepsis, improve the patient outcome with post resuscitation syndrome.

Sunde 2007 29 suggests standardization of post resuscitation care, and Gaieski 2009 418 also combine the therapeutic hypothermia and early goal directed therapy. Gaieski et al examine the feasibility of establishing an algorithm for the patient with ROSC and demonstrate 28% reduction in mortality when compare with conventional therapies. Jacobshagen 2009 1223 evaluate retrospectively the effects of a rapidly infused high volume of fluid on respiratory function in resuscitated patients and recognize that high volumes of intravenous fluid do not cause a respiratory failure. The optimal volume status for post cardiac arrest patients has not been defined by prospective trials.

The infusion of ice cold fluids is easy and effective for inducing therapeutic hypothermia. 2 liters of 4 degree Celsius normal saline or Ringer’s solution commonly used without complication.

Bernard 2003 9, report that the feasibility and efficacy of the cold infusion for induction of hypothermia after cardiac arrest. Virkkunen 2004 299, use cold Ringer’s solution instead of natural saline for cooling and they evaluate haemodynamic effects of it. They suggest the possibility of earlier induction of therapeutic hypothermia in pre-hospital setting by paramedics in pre-hospital setting.

Kliegel 2005 347, combined an endovascular cooling device with the cold infusion for induction of hypothermia after cardiac arrest. Kim 2005 715 confirms that mild hypothermia can be induced only by a cold infusion and not associate with adverse effect of cardiac function.

Kligel 2007 46 tries to not only induce therapeutic hypothermia but also maintain body temperature. Kim 2007 3064 and Hammer 2009 418, attempt to start cooling before arrival at the hospital. Intravenous fluids are effective in lowering the temperature without an increase the time patient spent in the field. Kämäräinen 2009 900 conduct RCT to evaluate the efficacy and safety of cold infusion method in comparison with conventional therapy with spontaneous cooling. They point out the superiority of Ringer’s solution over natural saline.

Acknowledgements:
Nil

Citation List

Bernard S, Buist M, Monteiro O, Smith K
Induced hypothermia using large volume, ice-cold intravenous fluid in comatose survivors of out-of-hospital cardiac arrest: a preliminary report.

LOE 4 fair. Support
The first report of the feasibility and efficacy of ice cold infusions for therapeutic hypothermia

Early goal-directed hemodynamic optimization combined with therapeutic hypothermia in comatose survivors of out-of-hospital cardiac arrest.
LOE 3 fair. Support.
They compare the outcome treated early goal directed therapy combined with therapeutic hypothermia against conventional therapy.


LOE 3
They try to induce therapeutic hypothermia in out of hospital setting.


LOE 4 fair Retrospective case series support
They evaluate retrospectively the effects of a rapidly infused high volume of fluid on respiratory function in patients resuscitated after cardiac arrest and found that high volumes of ice-cold intravenous fluid do not cause a statistically significant further deterioration in respiratory function, although the patients with ROSC are significantly reduced left ventricular function.


LOE 1 (RCT) Fair support
They evaluate the efficacy and safety of cold infusion method in comparison with conventional therapy with spontaneous cooling. The main finding of this study is that the prehospital infusion of 4degree Celsius Ringer’s solution after ROSC decreased the nasopharyngeal temperature compared with patients receiving conventional fluid therapy before admission. Add to this, they use ice-cold Ringer’s solution and point out it is superior to natural saline, because the use of natural saline induce the victims to acidosis by increase chlorine.


LOE 4, Fair, case series pilot study.
Kim et al conclude that mild hypothermia can be easily induced only by a cold infusion without adjusting the amount of fluids to body weight and not associate with adverse effect of cardiac function. The mean baseline EF of moderately reduced but the difference that was not significant.

Kim et al attempt to start infusion of cold water in pre-hospital setting by paramedics using up to 2L of 4 degree Celsius normal saline. They thought it would be effective in lowering the temperature before arrival at the hospital. They demonstrated the feasibility and effectiveness of this approach in inducing mild hypothermia by hospital arrival. Field cooling was not associate with an increase the time patient spent in the field. An adverse effect such as lung edema proceed from volume infusion and deterioration of cardiac function because of the decrease of body temperature seems not occur.

**Cold simple intravenous infusions preceding special endovascular cooling for faster induction of mild hypothermia after cardiac arrest--a feasibility study.**  

LOE 4 fair case series. Supporting.  
They investigate the efficacy and safety of cold infusions for induction of hypothermia after cardiac arrest preceding further cooling and maintenance of hypothermia by endovascular cooling.

**Cold infusions alone are effective for induction of therapeutic hypothermia but do not keep patients cool after cardiac arrest.**  

LOE 4 fair prospective observational case series. Supporting.  
They try to maintenance body temperature of resuscitated and induced therapeutic hypothermia victims by repeated administrations of cold infusions and find it is difficult. Different from other studies about therapeutic hypothermia, they use 30ml/kg/30min 4 degree Celsius crystalloid over 30min for induction. Although large amounts of fluids were administrated within 30 min, no serious side effects observed. To avoid cardiac decomposition due to fluid overload, the volume of the fluid and repetitive cold infusions were allowed only every 6 hours.

Sunde K, Pytte M, Jacobsen D, Mangschau A, Jensen LP, Smedsrud C, Draegni T, Steen PA.  
**Implementation of a standardised treatment protocol for post resuscitation care after out-of-hospital cardiac arrest.**  

LOE 3 fair support. retrospective control study.  
They suggest standardized therapeutic algorithm for the resuscitated patient, following in the early goal directed therapy for sepsis.

Virkkunen I, Yli-Hankala A, Silfvast T.  
**Induction of therapeutic hypothermia after cardiac arrest in prehospital patients using ice-cold Ringer's solution: a pilot study.**  
Case series LOE 4 fair
It is a pilot study of cooling and haemodynamic effects of prehospital infusion of ice-cold Ringer’s solution. They represent that this technique is also readily available to non-physician care providers, the induction of therapeutic hypothermia can be started earlier if found safe and well tolerated in larger trials.