**WORKSHEET for Evidence-Based Review of Science for Emergency Cardiac Care**

**Worksheet author(s)**  
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Date Submitted for review: 28-03-2009

**Clinical question.**  
In children and infants with cardiac arrest due to major (blunt or penetrating) injury (out-of-hospital and in-hospital) (P), does the use of any specific modifications to standard resuscitation (I) compared with standard resuscitation (C), improve outcome (O) (eg. ROSC, survival)?

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).**

“Cardiac arrest” AND “trauma OR injury” AND “infant OR Children” AND “resuscitation” AND (outcome OR ROSC OR Survival) AND (penetrating OR non penetrating wounds) AND “cardiopulmonary resuscitation”

Search in: PubMed, AHA EndNote library, EMBASE, Cochrane Library, Tripdatabase

PUBMED: 754 articles

penetrating OR non AND penetrating AND wound AND cardiopulmonary AND resuscitation AND [1990-2009]/py: 52 articles

COCHRANE: 1 article (the same of Pubmed)

ECC Endnote Library. No additional articles.

TRIPDATABASE: No additional articles

**State inclusion and exclusion criteria**

Inclusion criteria: age: 0-18 years  
condition: cardiac arrest due to trauma or injury

Exclusion criteria: adult patients  
Non-traumatic cardiac arrest  
Drowning

**Number of articles/sources meeting criteria for further review: 10**
# Summary of evidence

## Evidence Supporting Clinical Question

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<td>Perron 2001 C</td>
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<td>Huber-Wagner 2007 C,D</td>
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<td><strong>Level of evidence</strong></td>
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A = Return of spontaneous circulation  
B = Survival of event  
C = Survival to hospital discharge  
D = Intact neurological survival  
E = Other endpoint  
*Italicics = Animal studies*
### Evidence Neutral to Clinical question

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| Good              |   |   |   |   | Leaky F 2008 C,D  
Gausche M 2000 C,D  
von Elm E 2009, C,D |
| Fair              |   |   |   |   | Calkins 2002 C  
López-Herce 2006 C,D  
Crewdson 2007 C |
| Poor              |   |   |   | Stockinger 2004 C |   |
| 1                 | 2 | 3 | 4 | 5 |   |

**Level of evidence**

A = Return of spontaneous circulation  
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### Evidence Opposing Clinical Question

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**Level of evidence**

A = Return of spontaneous circulation  
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*Italics = Animal studies*
Trauma and accidents are the primary cause of mortality in children over one year of age. Despite this, there are few studies that have analyzed the clinical course in children with trauma who suffer cardiac arrest (Calkins CM, Crewdson K, López-Herce Cid J, Perron AD).

Studies in adults and children have shown that trauma victims who suffer cardiac arrest have a high mortality, higher than those who suffer cardiac arrest due to other causes (Calkins CM, Crewdson K, Huber-Wagner S, López-Herce Cid J Perron AD, Stockinger ZT).

Some studies have evaluated the effect of modifications to the standard recommendations for resuscitation in patients with trauma. Two of these modifications are prehospital intubation and internal cardiac massage.

Intubation in the field


The results of studies evaluating mortality in victims of trauma or accidents who have been intubated at the site of the accident are not conclusive. In some studies in adults, a higher mortality was found in patients who were intubated, though the differences were not statistically significant; however, the severity of the patient’s condition and the expertise of the person performing the intubation were not taken into account (Lecky F. et al). There are three studies performed in children. The one by Ehrlich PF et al is an observational study that only analyzed the complications of out-of-hospital intubation; it did not compare intubation with other methods of ventilation. The study of Gausche et al was a prospective controlled study performed on traumatic and non-traumatic children. In this study there were no differences in survival or neurological outcome when bag-valve-mask ventilation and endotracheal intubation performed by paramedics were compared. The study by Perron et al analyzed the risk factors for mortality from a pediatric trauma register. Patients requiring prehospital intubation presented a higher mortality. This study did not prospectively compare intubation with
other methods of ventilation, nor did it analyze the severity of the patient’s condition or the expertise of the person performing the intubation. It is likely that the intubated patients had more serious injuries and that this could be the cause of the higher mortality.

Internal cardiac massage
There are few studies that have analyzed the clinical course of adult patients with cardiac arrest secondary to trauma and who have received internal cardiac massage; these studies had few patients and no conclusion may be drawn from their results. There are no studies that have analyzed the use of this technique in children. There are no studies with mechanical cardiac devices in children.
The lack of relevant studies on this subject is related to the difficulty of performing randomized comparative studies in children with trauma in the out-of-hospital setting due to the relatively small number of patients, variability of causes, and different ability of the medical or paramedical staff attending the patients.

Other manoeuvres
Huber-Wagner S et al in a prospective trauma registry in adults found that the insertion of a chest tube on-scene could be detected as a factor significantly increasing the probability of survival. There are no studies in children about this matter.

Conclusions:
Cardiac arrest secondary to trauma in children has a high mortality.
No modification to standard resuscitation has been shown to improve survival.
Endotracheal intubation is the best method for isolating the airway and performing ventilation in children with traumatic or non-traumatic cardiac arrest. The decision to perform intubation and use alternative methods (ventilation with a bag, mask, or laryngeal tube) must be based on the state of the patient and the abilities of the health professional attending the cardiopulmonary arrest.
There is no experience with internal cardiac massage or mechanical cardiac devices in children.

Acknowledgements:
Citation List


LOE 4. Fair. Is a retrospective analysis on a Regional Pediatric Trauma Center. Authors studied only 25 children with cardiac arrest after blunt trauma and only two survived. Both had no head injury, had vitals in the field, and CPR was administered initially in the emergency department.


LOE 4. Fair. This is a ten-year retrospective study on a trauma database. 80 children with pre-hospital traumatic cardiac arrest were studied. The survival to hospital discharge was 8.7%.


LOE 5. Fair. This is a ten-year retrospective study in a pediatric trauma center. Moreover this study has very important limitations. 106 endotracheal intubations attempts performed by paramedics, flight nurse or physicians were analyzed. Only 6.5 % of these attempts were in patients with cardiac arrest and 4.5 % in respiratory arrest., and it did not analyze separately.


LOE 5. Good. This is prospective controlled study performed on 820 children who required out-of-hospital respiratory assistance. The main results of this study is not there were no differences in survival or neurological outcome when bag-valve-mask ventilation and endotracheal intubation is performed by paramedics. The main limitations was that trauma and non-traumatic causes, and cardiac or respiratory arrest and other causes for respiratory assistance were not analyzed separately.


LOE 5. Fair. Is a retrospective analysis in a prospective trauma registry in adults. The main result was that insertion of a chest tube on-scene was a factor significantly increasing the probability of survival.


LOE 5. Good. This a good Cochrane revision that analyzed the emergency intubation in randomized or controlled clinical trials in traumatic and non-traumatic adults and children. However only 3 studies were found (2 in nontraumatic adults and 1 (Gausche article in children). For this reason there are no data to perform a recommendation


LOE 4. Fair. It is a secondary analysis from a prospective multicenter study of cardiac arrest in children. The main limitation of this study is that only 28 children with traumatic cardiac arrest were studied. The main prognostic factors were respiratory arrest when resuscitation is started and duration of resuscitation less than 20 minutes.


LOE 4. Fair. Retrospective analysis of a National Pediatric Trauma Registry. 729 patients were analyzed. Prehospital intubation was associated with decreased intubation but this was performed in more severe patients.

LOE 5. Poor. This is a retrospective study in 588 adults patients with trauma who received cardiopulmonary resuscitation. The study confirm the low survival of traumatic cardiac arrest.


LOE5. Good. This is a good German Cochrane revision that analyzed the prehospital intubation in 17 randomized, controlled and observational studies in traumatic adults and children. 8 studies included children. The results of the different studies were non concordant. Patients with pre-hospital intubation had higher risk of pneumonia.