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

**Worksheet author(s)**  
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Date Submitted for review:  
December 23rd, 2009

## Clinical question.

In adult cardiac arrest (prehospital [OHCA], in-hospital [IHCA]) (P), does the use of an ITD (I) compared with no ITD (C), improve any outcomes (eg. ROSC, survival) (O)?

**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? Nil

## Search strategy (including electronic databases searched).

- PUBMED using “impedance threshold device” as a quote, mapped to MESH terms and all fields, AND “cardiac arrest” as a quote, mapped to MESH terms and all fields
- PUBMED using “ITD” as a quote, mapped to MESH terms and all fields, AND “cardiac arrest” as a quote, mapped to MESH terms and all fields
- COCHRANE Database for systematic reviews, Central register of controlled trials
- EMBASE using “impedance” AND “threshold” AND “device” AND “humans” with mapping, explosion, and keyword selected
- Review of references from articles
- Forward search using Google Scholar CrossRef and SCOPUS with review of references from articles

## State inclusion and exclusion criteria

### Inclusion:
- All human studies discussing short-term or long-term outcomes, studies using the ITD in combination with other CPR strategies, meta-analytic studies

### Exclusion:
- All animal studies, pediatric studies, studies not discussing short or long term outcomes in patients with cardiac arrest, studies discussing mechanics of the ITD

## Number of articles/sources meeting criteria for further review:

**Total number of articles for further review based on above inclusion/exclusion criteria:** 8
## Summary of evidence

### Evidence Supporting Clinical Question

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<th>Level of evidence</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
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<td>Plaisance 2005 E <em>Wolcke 2003 AB</em></td>
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**Level of evidence**

- A = Return of spontaneous circulation
- B = Survival of event
- C = Survival to hospital discharge
- D = Intact neurological survival
- E = Other endpoint

*Italics = Animal studies*

*Used ACD CPR for resuscitation
## Evidence Neutral to Clinical question

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*Used ACD CPR for resuscitation

### Evidence Opposing Clinical Question

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**REVIEWER’S FINAL COMMENTS AND ASSESSMENT OF BENEFIT / RISK:**

**DISCUSSION:** The impedance threshold device (ITD) has been studied in humans with varying results for different patient populations.

In the first double-blinded randomized controlled trial [Aufderheide, 2005, p734-40] comparing the ITD with a sham device, there were no statistically significant differences in the two groups with respect to the primary endpoints: admission to the ICU and 24hr survival. Even though subgroup analysis of patients with PEA anytime during cardiopulmonary resuscitation showed statistically significant outcomes for the primary endpoints, analysis of patients with Asystole or Ventricular Fibrillation/Tachycardia failed to do so. The authors suggested that to be able to show any significant differences, a much larger patient population would be needed.

In the only available meta-analysis of randomized controlled trials [Cabrini, 2008, p1625-32], the results are promising for increasing rates of return of spontaneous circulation, short-term survival, and favorable neurologic outcome. However, there was no effect on favorable neurologic outcome in survivors, or improved long term survival. Interpretation of this meta-analysis is difficult, given the paucity of available randomized controlled trials as well as the different endpoints used by each trial. Some of the trials that were analyzed used ACD CPR as part of their protocols, which by itself could have resulted in improved outcomes.

The first randomized study to assess the effects of the ITD on hemodynamics in patients with cardiac arrest [Pirallo, 2005, p13-20] showed a 100% percent statistically significant increase in systolic blood pressures when the ITD was used during CPR. Their results correlate with similar studies on animals. No other conclusions could be drawn but use of the ITD was recommended in patients with cardiac arrest.

A prospective, randomized, blinded trial looking at the ITD together with Active Compression and Decompression [Plaisance, 2000, p989-94], showed an increase in diastolic arterial pressures, coronary perfusion pressures, and decreased time to ROSC. Even though a very small number of subjects were enrolled, the results were statistically significant. Again, however, the use of ACD CPR makes interpretation difficult.

In a promising multicenter randomized trial [Plaisance, 2004, p265-71], use of the ITD together with Active Compression and Decompression in patients with out-of-hospital cardiac arrest resulted in statistically significant improvement in short term survival. However, no differences were seen between the two groups for ROSC or hospital discharge rates. This was a relatively larger sample size making the results more generalizable.

A small study looking at the application of the ITD on facemask versus endotracheal tube [Plaisance, 2005, p990-4] was able to show a significant decrease in intratracheal pressures when used with either ventilation device. There was no effect on airway pressures. Thus, the authors suggest that the ITD can be applied to both facemasks and endotracheal tubes.

In the only case-control study available [Thayne, 2005, p103-8], use of the ITD resulted in a 50 percent increase in survival to ED admission. It was even more significant for patients with asystole. However, the use of historical controls decreases the quality of the evidence. This study also established feasibility of the device in a large prehospital system.

A clinical trial [Wolcke, 2003, p2201-5] evaluating the use of the ITD in patients with cardiac arrest receiving ACD compared to those receiving standard CPR without the ITD, showed promising results. Results were statistically significant for ROSC and short term survival, but were not significant for longer term outcomes such as discharge from hospital, and overall neurological function. However, this is the only study of its sort analyzing longer term outcomes. The use of ACD CPR makes it difficult to determine if improved outcomes were actually due to the use of the ITD.

Animal studies not included in this device have similarly established improved outcomes, and hemodynamic variables. As of yet, no specific risks of using this device have been demonstrated.

The Resuscitation Outcomes Consortium (ROC) PRIMED study was the largest randomized controlled trial to evaluate the utility of the ITD in patients with cardiac arrest. It was recently stopped as the researchers found that ITD use did not significantly improve or worsen survival rates for cardiac arrest patients. The results have not been published at this time.

**Acknowledgements:** None
Citation List


Level 1 Study. Good study design (prospective, randomized, double-blinded, intention-to-treat) and good power. 230 patients with Out of hospital cardiac arrest enrolled. Primary endpoints were ICU admission and 24 hr survival rates. Overall results were not significant for the primary endpoints. However, patients with pulseless electrical activity had better short term outcomes with the ITD, although some of them were not statistically significant. For ventricular fibrillation and asystole, there were no statistically significant results. This would require increased power (much higher enrollment numbers). No obvious biases were noted in the study. The study was partially paid for by the manufacturers of the ITD. One of the authors is the co-inventor of the ITD.


Level 5 study. Only available systematic review and meta-analysis of available randomized controlled trials evaluating the ITD for outcomes. Study selection and data extraction well defined. Shows improved early outcomes. However, given the limited number of randomized controlled trials, no comments can be made about long term survival. Different endpoints for each study make this meta-analysis difficult to interpret. Most of the studies analyzed had different protocols making generalizibility very difficult. Specifically, some protocols used ACD CPR as part of the protocol which could have contributed to improved outcomes. There was no funding from the industry.


Level 1 study. Endpoint was to measure improvements in systolic pressures with the use of the ITD in patients with cardiac arrest with any rhythm. Study was able to show statistically significant increases in systolic blood pressure. No other results were significant. There was convenience randomization to some extent as patients were recruited during daylight hours only. Provides evidence supporting the use of the ITD in patients with cardiac arrest. There was funding by the NIH and by the manufacturer of the ITD.


Level 1 study. Well designed prospective randomized blinded trial to assess hemodynamic effects of ITD on CPR with ACD. Time for ROSC with and without the ITD was also monitored. Shows statistically significant improvement in diastolic arterial pressures and coronary perfusion pressures as well as decreased time to ROSC with the use of the ITD. Small number of patients. One of the writers is co-inventor of the ITD

Level 1 study. Well designed randomized multicenter controlled double blinded prospective study to assess if the use of the ITD with ACD had any effect on survival. Good enrollment with mostly significant results except for ROSC and hospital discharge rates. This is one of the best studies available to show improved short term survival. One of the authors is the co-inventor of the ITD and funding for the study was provided by the device manufacturer.


Level 5 study. Not looking at end points, but rather focused on application of the device in two settings: facemask versus endotracheal tube and monitor for pressure differences. Was able to show significantly lower negative intrathoracic pressure with the use of the ITD. One of the authors is a co-founder of the device.


Level 3 Study. Well designed case-control study aimed at evaluating short term survival in the form of ED admission after use of the ITD, although historical controls were used. Able to show improved outcomes in all patients with the ITD but more so in patients with asystole. Most results were statistically significant. This study also establishes safety and feasibility of the device.


Level 5 study. This is a very designed sequentially randomized study. Authors were able to show statistically significant improvement in ROSC and short term survival. Results were not significant for discharge from hospital and neurological outcome at discharge. The use of ACD CPR confounds the results. One of the few studies looking at longer term survival.