Clinical question.

In infants and children in cardiac arrest (prehospital [OHCA], in-hospital [IHCA]) (P), does the use of self-adhesive defibrillation pads (I) compared with paddles (C), improve outcomes (eg. successful defibrillation, ROSC, survival, transthoracic impedance, ease of use) (O)?

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

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

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).

Databases searched:

- Pubmed, Embase, AHA endnote library and cochrane library.
- Pubmed (Feb 15th 2009)
- Embase (Feb 15th 2009)
  (Cardioversion [subject heading] OR defibrillation [subject heading]) AND electrodes [subject heading]
- AHA Endnote Master Library (Oct 2007)
- Searched for keywords: paddles OR electrodes OR pads
- Cochrane library (Feb 15th 2009)
- Searched for paddles OR pads OR electrodes OR cardioversion OR defibrillation
- Searches were re-done on Jan 31st 2010.

State inclusion and exclusion criteria

Inclusion criteria:
- studies comparing efficacy of self-adhesive pads to paddles in improving 'outcomes' (successful defibrillation or cardioversion, ROSC, survival to hospital admission/discharge, neurologically intact survival, transthoracic impedance, ease of defibrillation, etc.)
- 'human adult' or animal studies to be included as 'extrapolated' data

Exclusion criteria:
- studies which do not directly compare self-adhesive pads to paddles
- studies focusing on implantable defibrillators

Number of articles/sources meeting criteria for further review:

- Pubmed: 683 hits
- Embase: 651 hits
- AHA database: 247 hits
- Cochrane: no reviews related to ILCOR question

The additional search on Jan 31st 2010 resulted in 71 further hits, none of which were included in the worksheet.

One further in-press was included.
## Summary of evidence

### Evidence Supporting Clinical Question

<table>
<thead>
<tr>
<th>Level of evidence</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
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- **Jakobsson, 1990 25 E4**
- **Lloyd, 2008, 2510 E5**
- **Bradbury, 2000 203 E2**
- **Stults, 1987 872 B**

- **Caterine, 1997 588 E2**
- **Brown, 2001 233 E2**
- **Bojar, 1988, 587 E2**
- **Drury, 2001 283 E1**
- **Deakin, 2001 157 E1**
- **Wilson, 1987 380 A E2**

### Level of evidence

A = Return of spontaneous circulation  
B = Survival of event  
C = Survival to hospital discharge  
D = Intact neurological survival  
E1 = pad size ‘fit’ and ‘mass’  
E2 = ease of use/time to deliver shock  
E3 = decreased transthoracic impedance  
E4 = successful cardioversion  
E5 = safety of use during compressions

*Italicics = Animal studies*

## Evidence Neutral to Clinical question

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- **Deakin, 1998 43 E3**
- **Perkins, 2007 109 E2**
- **Perkins, 2002 405 E2**

- **Tibballs, 2010, in-press**
- **Kerber, 1985 57 E3**

### Level of evidence

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# Evidence Opposing Clinical Question

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<tr>
<td></td>
<td>Deakin, 1998 43 E3</td>
<td>Dodd, 2004 283 E3</td>
<td>Kerchhof, 2005 1292 E4</td>
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<td>Cornwell, 2006 425 E1</td>
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*Italics = Animal studies*
Discussion: There is a paucity of clinical data in infants and children that directly addresses this particular ILCOR question. The recommendations contained within this worksheet are based primarily on extrapolated data from adult out-of-hospital defibrillation and in-hospital cardioversion, along with studies investigating differences in transthoracic impedance (a major determinant of successful defibrillation) and the practicalities of self-adhesive pads vs. hand held paddles.

One observational, pediatric LOE 2 study (Tibballs, 2010, in-press) demonstrated equivalent ROSC for paddles and self-adhesive pads. The number of subjects treated (with data available) with paddles was small (only 12) compared to those treated with self-adhesive pads (44 subjects). There was no difference between paddles and self-adhesive pads when used in either the anterior-posterior or anterior-lateral position.

Only one study compared survival of patients in ventricular fibrillation when using self-adhesive pads vs. paddles (Stults, 1987, 872). In this pre-hospital before-after intervention study, the investigators determined survival to hospital admission significantly increased from 30 to 52% (p<.025) after the introduction of self-adhesive pads. The same study showed the self-adhesive pad group to have improved time to delivery of first shock (2.5 vs. 1.6 minutes) and reduction of ECG artifact resulting in inappropriate defibrillation (23 vs. 3%). One limitation of the study was the restriction in the paddle group to only use monitoring electrodes rather than a ‘quick look’ through the paddles, thereby increasing time to defibrillation.

Two studies compared success of cardioversion for atrial fibrillation using self-adhesive pads vs. paddles. In the larger of the two studies (Kirchhof, 2005, 1292) the investigators used a two-by-two factorial design, with subjects randomized to monophasic vs. biphasic DC cardioversion – the first hundred patients were scheduled to receive the therapy through self-adhesive pads while the subsequent subjects were to be cardioverted using paddles. Paddles converted a greater proportion of subjects to sinus rhythm overall (96 vs. 88% p=0.04) and this was true for both the monophasic and biphasic waveforms. The other study (Jakobsson, 1990, 25) was pseudorandomized, based on date of birth, and had a greater success rate for cardioversion at 200 joules with self-adhesive pads (8/11) than paddles (5/11).

Multiple studies have evaluated transthoracic impedance using self-adhesive pads or paddles in adults and in animals. The earliest study (Ewy, 1977, 127) demonstrated significantly higher transthoracic impedance in mongrel dogs through self-adhesive pads vs. paddles, but may not be applicable to today’s defibrillation equipment. The majority of subsequent human studies have shown similar transthoracic impedance for self-adhesive pads comparing concurrent (Deakin, 1998, 43) or historical controls using paddles (Kerber, 1985, 57). The increased transthoracic impedance for the PhysioControl pads in the Deakin study (Deakin, 1998, 43) was more likely related to pad size difference (smaller contact surfaces generally result in higher transthoracic impedance) than a true difference between self-adhesive pads and paddles. One recent study did however demonstrate higher transthoracic impedance for self-adhesive pads in both the antero-apical and antero-posterior positions (Dodd, 2004, 283). With relation to longer-term use of gel pads for defibrillation paddles, two studies have shown significant drying after approximately 30 minutes (Drury, 2001, 283 and Deakin 2001, 157) with one of the studies confirming increases in transthoracic impedance (Deakin, 2001, 157). This drying and increased transthoracic impedance is felt not to be an important issue with the self-adhesive pads as the backing prevents evaporative loss.

Multiple studies have indirectly suggested improved utility of the self-adhesive pads when compared to paddles (Caterine, 1997, 588) particularly for operative and cardiac catheterization procedures (Brown, 2001, 238; Bojar, 1988, 587 and Wilson, 1987, 380). In addition, self-adhesive pads don’t seem to have the same issues of spurious asystole that have occurred with hand-held paddles and gel-pads (Bradbury, 2000, 203). Practitioners should however be cautious using self-adhesive pads with small infants, as some models may be too large to use without contact between electrodes (Cornwell, 2006, 425)

One LOE 5 study (Lloyd, 2008, 2010) suggests that it may be safe to continue chest compressions during countershock when medical gloves are worn.

Finally, in the simulated testing environment, practitioners perform defibrillation at least as quickly with self-adhesive pads as they do with paddles (Perkins, 2002, 405 and Perkins, 2007, 109).

Acknowledgements:


**Citation List**


- LOE 5 (extrapolated adult data). Graded as *poor*. Favours question.


- Spurious asystole may be displayed following defibrillation through pad and gel pad combination (i.e. pt actually not in asystole but defibrillator displays asystole)
- Does not seem to be a problem with self-adhesive pads.
- Requires rhythm confirmation through monitoring leads if the defibrillator displays asystole following delivery of a shock.
- LOE 5 (extrapolated data from defibrillator tester). Graded as *fair* (compared to self-adhesive pad). Favours question.


- Case report demonstrating ‘ease of use’ of the self-adhesive pads on a patient in the prone position.
- LOE 5 (extrapolated adult data). Graded as *poor* (case report). Favours question


- Smearing of gel between electrodes (which may be possible with the relatively smaller thoracic area of children) shunts current away from the heart. Indirectly favours the use of self-adhesive electrode pads
- LOE 5. Graded as *poor* (no controls). Favours question.


- Reports two cases of self-adhesive pads being ‘too large’ for neonatal patients forcing treating team to use pads
- Problem may be limited certain brands of self-adhesive pads
- LOE 4. Graded as *poor*. Opposes question


- Randomized cross-over design comparing two types of paddles and two types of gel-pad
- 40 adult male subjects with electrodes in antero-apical position
- Varying operators of defibrillation pads/paddles (MD’s, RN’s, students, etc)
• No difference in transthoracic impedance using Hewlett Packard pads or paddles
• Significant difference in transthoracic impedance using PhysioControl pads and paddles, however this difference may have been related to the smaller size of the PhysioControl pads (which is known to increase transthoracic pressure)
• Included in worksheet twice – once as neutral to question and once opposing
• LOE 5 (extrapolated adult data). Graded as good (RCT crossover design). Neutral and opposes question.


• Studied evaporative water loss from gel pad and change in transthoracic impedance.
• Energy not delivered through pads therefore evaporation was due simply to drying and not to current delivery.
• LOE 5 (extrapolated adult data). Graded as poor for question (no controls). Favours question (under presumption that water loss from self-adhesive is not significant and therefore transthoracic impedance remains stable).


• 21 subjects requiring cardioversion for atrial fibrillation or flutter
• Randomized crossover design
• Measured transthoracic impedance in antero-apical (AA) and antero-posterior (AP) position
• Pads and paddles applied by one of two cardiologists
• Transthoracic impedance was significantly less for paddles in both the AA and AP positions
• LOE 5 (extrapolated adult data). Graded as good. (RCT with crossover design). Opposes question.


• Evaporative loss from gel pads was not dramatically increased from defibrillation use (when compared to historical controls where gel pads were exposed but not applied current) and did not reach levels concerning for increased transthoracic impedance until 30 minutes after application.
• LOE 5 (extrapolated adult data). Graded as poor for question (no controls). Favours question (under presumption that water loss from self-adhesive is not significant and therefore transthoracic impedance remains stable).


• Compared transthoracic impedance in mongrel dogs at 2 different setting (100 watt and 400 watt)
• LOE 5 (animal study). Graded as good (as RCT crossover design). Unsure if results from gel pads from that time period could be applied to current generation. Opposes question.

- Pseudorandomized patients with atrial fibrillation based on date of birth (leaving uneven groups - 15 subjects in paddles group and 11 in self-adhesive electrode group)
- 8/11 subjects in self-adhesive electrode group were cardioverted with 200 J while only 5/15 were successfully cardioverted with 200 J delivered via paddles.
- LOE 5 (extrapolated adult data). Graded as *fair* to question (pseudorandomized). Favours question.


- Authors report mean first shock transthoracic impedance as 75 ohm which was similar to historical controls
- Seems to report same data as study below (Kerber, 1985) in a review type article therefore excluded from table.
- LOE 5 (extrapolated adult data). Graded as *fair* for question (historical controls and unclear if they had done a statistical comparison to state the pads and paddles were ‘similar’). Neutral to question.


- Report both the initial animal data and subsequent human trials
- Defibrillation in 11 mongrel dogs – showed lower transthoracic impedance and greater defibrillation success rates for paddles, particularly at lower energy levels.
- LOE 5 (extrapolated animal data). Graded as *fair* (as it was pseudo-randomized i.e. rotating order for treatment). Opposes question.

- Report transthoracic impedance in pads placed on humans was similar to previously reported studies using pads.
- LOE 5 (extrapolated from adults). Graded as *fair* (as it compared transthoracic impedance to historical controls). Neutral to question.


- Pseudo-randomized 201 adult subjects with atrial fibrillation for pad vs. paddles - first 100 patients supposed to receive pads and second 100 patients received paddles (was randomized for monophasic or biphasic defibrillation)
- Paddles were more successful (100/104 patients) than self-adhesive pads (85/97)
  - Better success for monophasic or biphasic waveforms
- LOE 5 (extrapolated from adult data). Graded as *fair*. Opposes question

- No direct comparison to ‘use of paddles’ – however suggestion to include this study came from the worksheet presentation to the ILCOR pediatrics taskforce (mar 2009)
- Study aimed to simulate conditions of cardiac arrest (rescuer would apply 20 lbs of pressure to patient’s sternum in the area typical for chest compression).
- Self-adhesive pads were placed in the anteroposterior position
- Only used adult patients that required cardioversion for atrial fibrillation or atrial flutter.
- Study suggests that it may be safe to continue chest compressions at the time of defibrillation if self-adhesive pads are used


- Minimal differences between time to defibrillation, using paddles vs. pads, for ERC (7.4 vs. 7.0 seconds) and AHA guidelines (1.6 vs. 1.5 seconds).
- Unlikely to make any significant clinical difference
- LOE 5 (extrapolated manikin study). Graded as good (RCT crossover design). Neutral to question.


- No difference between time to defibrillation using paddles or self-adhesive pads in a simulated cardiac arrest
- LOE 5 (extrapolated manikin study). Graded as good (RCT crossover design). Neutral to question


- Before-after study of paddles vs. self-adhesive pads
- Monitoring during first phase (paddles) was done through three-standard ECG leads – quick look through paddles was not allowed
- In the treatment phase (paddles), the monitoring and defibrillation was done through the self-adhesive pads
- Mean on-scene time to defibrillation was significantly shorter for self-adhesive pads (1.6 min) vs. paddles (2.5 min) p<.001
- 95% defibrillation success rate with self-adhesive pads vs. 71% success for paddles p<0.005
- Subjects were significantly less likely to have artifact misinterpreted as ventricular fibrillation using self-adhesive pads (3%) vs. pads (23%)
- LOE 5 (extrapolated adult data). Graded as fair (not an RCT). Supports question.


- Observational study comparing ROSC for ventricular fibrillation or pulseless ventricular tachycardia when using paddles or self-adhesive pads.
• No difference in ROSC between groups (only 12 patients in paddles group with 44 patients in SADPs group)

• LOE 2. Fair quality.


• Demonstrates that self-adhesive pads are easy to apply and use in the cath lab.
• LOE 5 (extrapolated adult data). Graded as *poor* (no controls). Supports question