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

**Worksheet author(s)**

| Peter Morley | Date Submitted for review: 31st Jan 2010 |

**Clinical question.**

In adult cardiac arrest (prehospital [OHCA], in-hospital [IHCA]) (P), does the use of load distributing band (eg. Autopulse) (I) compared with manual CPR (C), improve any outcomes (eg. ROSC, survival) (O)? (ALS/BLS-CPR&A-086A)

**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: Revision (Load Distributing Band CPRW76A,W76B,W163F)

**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).**

PubMed (10 Nov 09):

#1 = "load distributing band"[All Fields] or "LDB"[All Fields] or “load-distributing”[All Fields] 120
#2 = “autopulse”[All Fields] 15
#3 = "cardiopulmonary resuscitation"[MeSH Terms] OR ("cardiopulmonary"[All Fields] AND "resuscitation"[All Fields]) OR "cardiopulmonary resuscitation"[All Fields] 11703
#4 = "heart arrest"[MeSH Terms] OR ("heart"[All Fields] AND "arrest"[All Fields]) OR "heart arrest"[All Fields] 37023

(#1 or #2) AND (#3 or #4) No limits: 21 hits

Embase (OVID):

#1 = load distributing.mp. or load-distributing.mp. or LDB.mp. or autopulse.mp. or auto-pulse.mp. 100
#2 = cardiac arrest.mp. or exp Heart Arrest/ 18552

#1 and #2 = 11

Cochrane (Cochrane Reviews, Other Reviews or Clinical Trials):

"load distributing band" in Title, Abstract or Keywords 3
"load-distributing" in Title, Abstract or Keywords 2
"LDB" in Title, Abstract or Keywords 5
“autopulse” in Title, Abstract or Keywords 0

AHA EndNote Database:

"load distributing band" or "load-distributing" or "LDB" or “autopulse" in Title, or Abstract 20

References of all articles searched for other relevant articles.

• **State inclusion and exclusion criteria**

Include: human studies, peer-reviewed publications, evaluating the use of autopulse device in cardiac arrests

Exclude: case reports (<5 cases), animal studies, manikin studies, abstract only

• **Number of articles/sources meeting criteria for further review:**

7: 2 LOE 1, 2 LOE 2, 2 LOE 3, 1 LOE 4

Excluded French article with no English abstract [Lapostolle, 2008, 621-3]
## 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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<tbody>
<tr>
<td>1</td>
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</table>

A = Return of spontaneous circulation  
B = Survival of event  
C = Survival to hospital discharge  
D = Intact neurological survival  
E = haemodynamics  
*Italics* = Animal studies
### Evidence Neutral to Clinical question

<table>
<thead>
<tr>
<th>Level of Evidence</th>
<th>Evidence Neutral to Clinical question</th>
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<tbody>
<tr>
<td><strong>Good</strong></td>
<td>[Hallstrom, 2006, 2620-8]C</td>
</tr>
<tr>
<td></td>
<td>[Hock Ong, 2006, 2629-37]D</td>
</tr>
<tr>
<td><strong>Fair</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Poor</strong></td>
<td>[Paradis, 2010, in press]*</td>
</tr>
</tbody>
</table>

**Level of evidence**

A = Return of spontaneous circulation  
B = Survival of event  
C = Survival to hospital discharge  
D = Intact neurological survival  
E = Other endpoint  
* = post hoc analysis of patients in Hallstrom 2006  
Italics = Animal studies

### Evidence Opposing Clinical Question

<table>
<thead>
<tr>
<th>Level of Evidence</th>
<th>Evidence Opposing Clinical Question</th>
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<tr>
<td><strong>Good</strong></td>
<td>[Hallstrom, 2006, 2620-8]D</td>
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<tr>
<td></td>
<td>[Steinmetz, 2008, 908-13]C*</td>
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<tr>
<td><strong>Fair</strong></td>
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<td><strong>Poor</strong></td>
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</tbody>
</table>

**Level of evidence**

A = Return of spontaneous circulation  
B = Survival of event  
C* = Survival to 30 days  
D = Intact neurological survival  
E = Other endpoint  
* = post hoc analysis of patients in Hallstrom 2006  
Italics = Animal studies
REVIEWER’S FINAL COMMENTS AND ASSESSMENT OF BENEFIT / RISK:

C2005 statements:
The load distributing band (LDB) is a circumferential chest compression device composed of a pneumatically actuated constricting band and backboard. A case control study of 162 adults (LOE 4) documented improvement in survival to the emergency department when LDB-CPR was administered by adequately trained rescue personnel to patients with cardiac arrest in the prehospital setting. The use of LDB-CPR improved haemodynamics in 1 in-hospital study of end-stage patients (LOE 3) and 2 laboratory studies (LOE 6).

Treatment Recommendation
In the hands of some groups, novel techniques and adjuncts may be better than standard CPR. The success of any technique depends on the education and training of the rescuers or the resources available (including personnel). Because information about these techniques and devices is often limited, conflicting, or supportive only for short-term outcomes, no recommendations can be made to support or refute their routine use.

Since the C2005 document, a number of additional relevant articles have been published regarding use of the Load distributing band (Autopulse) in human cardiac arrests. These have had conflicting outcomes, both supportive and opposing.

Supportive
One fair LOE 2 study [Casner, 2005, 61-7] in OOHCA where 69 AutoPulse were matched to 93 manual CPR (but only used when failed initial attempts at resuscitation). All matched cases were from the study period or the preceding 12 months. Survival to ED higher in autopulse group (A-CPR 39%, manual 29%, p = 0.003).
One fair LOE 2 study [Timerman, 2004, 273-80] used 31 sequential subjects (in-hospital cardiac arrest patients) as their own controls, and demonstrated improved haemodynamics. They received alternating periods of 90 secs of manual then AutoPulse CPR (A-CPR) following 10 min of failed standard advanced life support (ALS) protocol. A-CPR chest compressions increased peak aortic pressure when compared to manual chest compression (153 +/- 28 mmHg versus 115 +/- 42 mmHg, P < 0.0001, mean +/- S.D.). Similarly, A-CPR increased peak right atrial pressure (129 +/- 32 mmHg versus 83 +/- 40 mmHg, P < 0.0001), and A-CPR increased CPP over manual chest compression (20 +/- 12 mmHg versus 15 +/- 11 mmHg, P < 0.015).
One good LOE 3 study [Steinmetz, 2008, 908-13] was associated with improved ROSC but worse survival at 30 days (see below).
One good LOE 3 study [Hock Ong, 2006, 2629-37] in urban EMS, compared two epochs for OOHCA. A total of 499 patients were included in the manual CPR phase (January 1, 2001, to March 31, 2003) and 284 patients in the LDB-CPR phase (December 20, 2003, to March 31, 2005); the LDB device was applied in 210 patients. Intention to treat analysis and adjustment for confounders, demonstrated improved: Return of spontaneous circulation adjusted OR 1.94 (1.38-2.72), survival to hospital admission adjusted OR 1.88 (1.23-2.86) and survival to hospital discharge adjusted OR 2.27 (1.11-4.77). No difference in neurological outcome (CPC or OPC).
One good LOE 4 study [Krep, 2007, 86-95] was supportive of effectiveness. Case series of 46 patients with OOHCA. 25 (54.3%) ROSC, 18 (39.1%) to ICU, and 10 (21.8%) discharged.

Not supportive
One good LOE 1 study [Hallstrom, 2006, 2620-8] was reported, which was stopped early on advice of the safety monitoring board. The outcomes in this study were in the opposite direction to all of the other published reports. It was a multicentre RCT in OOHCA comparing LDB (554) with manual CPR (517). However, among the primary population, survival to hospital discharge was 9.9% in the manual CPR group and 5.8% in the LDB-CPR group (P = .06, adjusted for covariates and clustering). A cerebral performance
category of 1 or 2 at hospital discharge was recorded in 7.5% of patients in the manual CPR group and in 3.1% of the LDB-CPR group (P = .006). Concerns expressed about delays in implementation of device, and outcomes in one centre affecting overall results. Opposing for intact neurological survival but neutral for survival to hospital discharge. A post-hoc analysis of this study demonstrated significant heterogeneity between sites [Paradis, 2010, in press]. One site (site C) had a substantive decrease in survival to hospital discharge, whereas the other sites did not reflect these “safety concerns,” and these sites appeared to demonstrate a steadily “improving four hour survival” with patient enrollment.

One good LOE 3 study [Steinmetz, 2008, 908-13] was an OOHCA study in a physician staffed system, which assessed outcomes after implementation of new 2005 guidelines: 1 June 2004 until 31 August 2005 (before the implementation period) and 1 January 2006 until 31 March 2007. The Autopulse was available when the new guidelines were introduced. The Autopulse was used in 77 patients in the post-implementation period, of whom 40 (52.0%) obtained ROSC at admission vs. 124/342 (36.3%) in patients treated without the compression device, P = 0.01, but on univariate analysis the 30-day survival was not significantly different 10/77 5 13.0% vs. 57/342 5 16.7%, P = 0.43. However, logistic regression analysis of a combined dataset from both time periods confirmed that the use of an automated chest compression device was associated with worse 30-day survival (Odds Ratio 0.4 (0.2–1.0) P = 0.04).

Acknowledgements:

Citation List


LOE 2. Fair. Supportive.
OOHCA: 69 AutoPulse matched to 93 manual CPR (but only used when failed initial attempts at resuscitation). All matched cases were from the study period or the preceding 12 months. Survival to ED higher in autopulse group (A-CPR 39%, manual 29%, p = 0.003).


LOE 1. Good. Opposing (intact neurological survival) but neutral for survival to hospital discharge. Multicentre RCT in OOHCA comparing LDB (554) with manual CPR (517). Following the first planned interim monitoring conducted by an independent data and safety monitoring board, study enrollment was terminated. However, among the primary population, survival to hospital discharge was 9.9% in the manual CPR group and 5.8% in the LDB-CPR group (P = .06, adjusted for covariates and clustering). A cerebral performance category of 1 or 2 at hospital discharge was recorded in 7.5% of patients in the manual CPR group and in 3.1% of the LDB-CPR group (P = .006). Concerns expressed about delays in implementation of device, and outcomes in one centre affecting overall results.
Quality questions: Assignment was cluster randomised, with crossover. Not clear if initial randomisation list was concealed. Patients who entered the trial were accounted for at its conclusion. Analysed according to intention to treat. Patients and clinicians were not "blinded" to treatment received. Aside from the experimental treatment, the groups were treated according to the same protocol, though there were interuptions in CPR associated with application of the device. Patients were similar at the start of the trial.


Study in urban EMS, compared two epochs. A total of 499 patients were included in the manual CPR phase (January 1, 2001, to
March 31, 2003) and 284 patients in the LDB-CPR phase (December 20, 2003, to March 31, 2005); the LDB device was applied in 210 patients. Intention to treat analysis and adjustment for confounders, demonstrated improved: Return of spontaneous circulation adjusted OR 1.94 (1.38-2.72), survival to hospital admission adjusted OR 1.88 (1.23-2.86) and survival to hospital discharge adjusted OR 2.27 (1.11-4.77). No difference in neurological outcome (CPC or OPC).


Case series of 46 patients. 25 (54.3%) ROSC, 18 (39.1%) to ICU, and 10 (21.8%) discharged.


LOE 1, Neutral, Poor (post-hoc analysis)
A post-hoc analysis of the Hallstrom 2006 study (A cerebral performance category of 1 or 2 at hospital discharge was recorded in 7.5% of patients in the manual CPR group and in 3.1% of the LDB-CPR group (P = .006); survival to hospital discharge was 9.9% in the manual CPR group and 5.8% in the LDB-CPR group (P = .06, adjusted for covariates and clustering)). Demonstrated significant heterogeneity between sites. One site (site C) had a substantive decrease in survival to hospital discharge, whereas the other sites did not reflect these “safety concerns,” and these sites appeared to demonstrate a steadily “improving four hour survival” with patient enrollment.


LOE 3 Good Supporting for ROSC. Opposing for 30 day mortality (multivariate analysis).
OOHCA study in physician staffed system, assessed outcomes after implementation of new 2005 guidelines: 1 June 2004 until 31 August 2005 (before the implementation period) and 1 January 2006 until 31 March 2007. Autopulse available when new guidelines were introduced.
Autopulse was used in 77 patients in the post-implementation period, of whom 40 (52.0%) obtained ROSC at admission vs. 124/342 (36.3%) in patients treated without the compression device, P = 0.01, but on univariate analysis the 30-day survival was not significantly different 10/77 5 13.0% vs. 57/342 5 16.7%, P = 0.43. However, logistic regression analysis of a combined dataset from both time periods confirmed that the use of an automated chest compression device was associated with worse 30-day survival (Odds Ratio 0.4 (0.2–1.0) P = 0.04)


31 sequential subjects with in-hospital sudden cardiac arrest were included following 10 min of failed standard advanced life support (ALS) protocol. Alternating periods of 90 secs of manual then AutoPulse CPR (A-CPR). A-CPR chest compressions increased peak aortic pressure when compared to manual chest compression (153 +/- 28 mmHg versus 115 +/- 42 mmHg, P < 0.0001, mean +/- S.D.). Similarly, A-CPR increased peak right atrial pressure (129 +/- 32 mmHg versus 83 +/- 40 mmHg, P < 0.0001), and A-CPR increased CPP over manual chest compression (20 +/- 12 mmHg versus 15 +/- 11 mmHg, P < 0.015).
Excluded studies


Excluded. Animal study


Excluded. 3 cases of post-mortem "artifact" (abrasions).


Excluded. Animal study


Excluded. No english abstract.


Excluded. Single case report


Excluded. 2 cases.


Excluded. Letter


Excluded. Case report


Excluded. Manikin study


Excluded. Review only


Excluded. Case report of potential harm