Clinical question.

BLS-034B

In adult and pediatric patients with cardiac arrest (prehospital [OHCA], in-hospital [IHCA]) (P), does the use of any specific rate for external chest compressions (I) compared with standard care (ie. approximately 100/min) (C), improve outcome (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? NO

Search strategy (including electronic databases searched).

Cochrane Library

PubMed: "Cardiopulmonary Resuscitation"[Mesh] OR “cardiac arrest” OR “death, sudden, cardiac” OR “heart arrest” AND "Chest compression” OR “cardiac massage” OR “cardiac compressions” OR “closed chest compressions” AND “rate”

Cochrane Library

PubMed: "Cardiopulmonary Resuscitation"[Mesh] OR “cardiac arrest” OR “death, sudden, cardiac” OR “heart arrest” AND "Chest compression” OR “cardiac massage” OR “cardiac compressions” OR “closed chest compressions” AND “physiology”

“Compression rate” AND “cardiac arrest” AND “survival”

18/1/10: 273 -160 - 14

AHA EndNote Master library

Current Controlled Trials

Forward searching via Web of Science

review of references from articles

Embase: 240 articles on 24/1/10

EBM-guidelines

Dates covered: until 18th January 2010

• State inclusion and exclusion criteria

No exclusion criteria

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

31 studies met criteria for further review. Of these 5 were LOE 3, 12 LOE 4 and were 14LOE 5.
## Summary of evidence

### Evidence Supporting Clinical Question

<table>
<thead>
<tr>
<th>Level of evidence</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<td><strong>Good</strong></td>
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<tr>
<td></td>
<td>Abella 2007C</td>
<td>Ko2005 ABC</td>
<td>Heidenreich2006 E</td>
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<td></td>
<td>Garza 2009 AC</td>
<td>Christenson 2009C</td>
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<td></td>
<td>Kramer-Johansen 2006 C</td>
<td>Abella(2) 2005A</td>
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<tr>
<td><strong>Fair</strong></td>
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<td></td>
<td>Kellum 2006CD</td>
<td>Fletcher 2008C</td>
<td>Perkins 2005E</td>
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<td><strong>Poor</strong></td>
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**Level of evidence**

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

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**Level of evidence**

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

### Evidence Opposing Clinical Question

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<tr>
<td></td>
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<td>Brown 2006E</td>
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<td>Williamson 2005E</td>
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**Level of evidence**

A = Return of spontaneous circulation  
C = Survival to hospital discharge  
E = Other endpoint  
B = Survival of event  
D = Intact neurological survival  
*Italics* = *Animal studies*
The compression rate, the compression ventilation ratio and the interval time (time to provide ventilations or pauses) determine the number of cardiac compressions delivered to an individual in one minute.

**RATE/CHEST COMPRESSION FRACTION/AMOUNT COMPRESSIONS DELIVERED IN ONE MINUTE**
- Rate: There were no studies found that examined another rate then the rate of 100/min, except for the studies that already have been taken into account for the guidelines of 2005. (cfr COSTR document 2005: “some studies in animal models of CA showed that high-frequency CPR (120-150 compr/min) improved haemodynamics without increasing trauma when compared with standard CPR [104-107](LOE 6) whereas others showed no effect [108] (LOE 6).”
- The number of compressions each minute is important: A LOE 3 study (Kellum MJ, 2006, 335) and a LOE 4 study (Christenson J, 2009, 1241) showed that survival improves when the chest compression fraction increased. A LOE 5 animal study (Hwang SO, 2008, 183) showed that different ventilation/compression ratio’s did not change haemodynamic outcomes.
- A LOE3 study (Garza, 2009, 2597) showed that when de chest compression fraction was optimised, both ROSC and the survival to discharge were more frequent;

**DUTY CYCLE** – the term “duty cycle” refers to the time spent compressing the chest as a proportion of the time between the start of one cycle of compression and the start of the next. =covered by another worksheet

**QUALITY/FEEDBACK/FATIGUE**
- In the guidelines 2005 already was observed that responders give fewer compressions than currently recommended (LOE 4) (Abella (1) 2005; 305; Abella (2) 2005, 428; Wik 2005, 299; Ko 2005, 163) and that the depth of compression was insufficient (LOE 4, Abella (1) 2005, 305; Wik 2005, 299).The depth of compressions will be covered in another worksheet.
- In evaluating the results of the Public Acces Deffibrillation Trial, Rea found that the quality of CPR was variable and often did not achieve guideline parameters (Rea 2009).
- Also other studies showed that quality of CPR was not sufficient (Peberdy, 2009, 1169)
- Endotracheal intubation efforts by paramedics can lead to prolonged interruptions in CPR as showed by Wang (LOE 4, Wang HE 2009, 645)
- Technical devices or other means of feedback can improve the quality of CPR as showed by LOE 4 studies (Fletcher 2008, 127) en LOE 3 studies (Kramer-Johansen 2006, 283; Abella 2007, 54) and LOE 5 studies (Beckers 2007, 100; Skorning 2010, 53; Peberdy 2009, 1169; Perkins 2005, 103). Combination of feedback and debriefing improved both compression rate and depth, LOE 5 (Dine 2008, 2817) – in Contradiction a LOE 5 study (Williamson 2005, 140) showed that audio prompts did not make any difference in trained lay persons, although they felt more comfortable when audio prompts were given. A LOE 5 study (Jäntti 2009, 453) showed dat auditive support corrected the rate of the cardiac compressions, but did not improve quality or rescuers fatigue.
- Strength or fatigue of rescuer determines the amount of compressions given in one minute.
- Sugerman showed in a retrospective analysis that during CPR with audiovisual prompts, the rate did not decline, although the depth of the compressions declined due to fatigue between 90s and 2 min. (Sugerman 2009, 981)

- 3 LOE 5 (Bjorshol 2008, 95; Deschilder 2007, 113) studies and a LOE 2 study (Losert, 2006, 2375; Olasveengen, 2007, 260) showed that high quality CPR was achievable by trained professionals (out-of-hospital). Two LOE 5 studies (Heidenreich 2006,1020; Trowbridge 2009, 6) showed that continuous compressions-CPR resulted in more adequate compressions per minute than standard CPR only for the first 2 minutes of CPR. Afterwards the difference diminished due to fatigue. Overall, continuous compressions CPR resulted in more total compressions per minute than standard CPR. – In contradiction, one LOE 5 study (Brown 2006, 253) showed that overall performance of CPR remains poor.

Acknowledgements:

none

Citation List


LOE 3- good quality- supportive clinical question – study with retrospective controls – feedback technology improves quality of CPR in IHCA – sponsored by Laerdal


LOE 4 case series – good quality – neutral to clinical question – quality of CPR was not OK (not consistent with current guidelines) on several parameters This study was supported by a grant from the Laerdal Medical Corporation,


LOE 4 – case series – good quality – supporting clinical question - – IHCA – chest compression rates below recommendations – suboptimal compression rates = poor ROSC- supported by an unrestricted grant from Laerdal Medical Corp (Stavanger, Norway).


Notes: LOE 5-fair quality – neutral to clinical question -.This study shows that trained paramedics can continue cardiac compressions at a suggested rate of 100/min for a long time at different CV ratio’s without a decline in chest compression quality (rate and depth). All compressions were delivered at a rate of 100/min. No other rates were studied.- financial support from Laerdal


LOE 5 – manikin study – good quality - opposing clinical question – overall performance of CPR remains poor-


LOE 4-good quality – supporting clinical question – prospective observational cohort study- better survival when increased chest compression fraction


LOE 5-manikin study- good quality – neutral to clinical question – 30:2 delivers more chest compressions (compared to 15:2) – quality of chest compressions remains unchanged


LOE 5 – good quality – neutral to clinical question- manikin study-


LOE 5 – manikin study – fair quality – neutral to clinical question – combination of feedback and debriefing improved rate and depth


LOE 4- fair quality – supporting -feedback: improvement quality CPR

LOE 3 good quality – supporting clinical question – retrospective observational cohort study – optimisation of chest compression fraction leads to increased ROSC and survival to discharge.


LOE 5 – manikin study – good quality – neutral to clinical question – effect of feedback guidance was most pronounced for chest compression RATE (less for depth)


LOE 5 – manikin study – good quality – supporting clinical question - CCC-CPR resulted in more total compressions per minute than STD-CPR


Notes: LOE 5. Fair quality study- neutral to clinical question -. Animal study that shows that CPR at different CV ratio’s has similar outcome in the first phase after ventricular fibrillation. All compressions were given at 100/min, so it does not give answer to our clinical question.


LOE 5 – manikin study – fair quality - neutral to clinical question – auditive support (metronome) = correction of chest compression rate = is NOT: affecting quality or rescuer fatigue.


LOE 3-fair quality – supporting clinical question- study with historical control group – survival higher when better quality CPR


LOE4 – case series- good quality – supporting clinical question –quality CPR correlates with survival in VF arrests


LOE 3 - good quality – supporting clinical question – study with retrospective controls – feedback improves quality of CPR


Notes: LOE 4 - fair quality – neutral to clinical question - No comparison of different rates for cardiac compressions.


Notes: LOE 4 - fair quality – neutral to clinical question – This retrospective study shows that quality of CPR improved over years. Cardiac compressions were given at a rate of 100/min. There was no comparison with other rates.


LOE 5 - manikin study – good quality – neutral to clinical question – quality of chest compressions is suboptimal. Improvement with CPR feedback technologies.


LOE 5 - manikin study – fair quality – supporting clinical question – feedback-adjuncts = improvement of ECC-performance


LOE 4 - good quality – neutral to clinical question – public access defibrillation trial – quality of CPR varied substantially


LOE 5 - manikin study – fair quality – neutral to clinical question – new visual feedback device: improvement of compression rate and depth


LOE 4 - case series – good quality – neutral to clinical question – clinical evidence for rescuer fatigue during CPR – rate remained cte, but depth declined

LOE 5 – manikin study – good quality – neutral to clinical question – CCC-CPR: quality diminishes after 2 minutes (fatigue?)


LOE 4- case series – fair quality – neutral to clinical question – OHCA – endotracheal intubation efforts by paramedics: prolonged CPR interruptions


LOE 4 – case series-good quality – neutral to clinical question poor quality of CPR in OHCA


LOE 5- fair quality – opposing clinical question- audio prompts don’t make any difference for trained rescuers

References from COSTR document 2005 – not being reviewed


