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

Worksheet author(s)  
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Clinical question.

In adult and pediatric patients with cardiac arrest while on a bed (prehospital [OHCA], in-hospital [IHCA]) (P), does the performance of CPR on a hard surface like backboard or deflatable mattress (I) compared with performance of CPR on a regular mattress (C), improve outcome (eg. ROSC, survival) (O)?

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

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).

Database search strategy:

Cochrane Library
Query: (Heart Arrest[MeSH] OR Cardiopulmonary Resuscitation[MeSH]) AND (backboard OR deflatable mattress OR hard surface OR firm surface) – 10 hits

Pubmed

Embase
(("heart'/exp AND arrest) OR (cardiopulmonary AND 'resuscitation'/exp)) AND ((backboard) OR (deflatable AND mattress) OR (hard AND 'surface'/exp) OR (firm AND 'surface'/exp)) AND [embase]/lim – 13 hits

Review of references [1 paper identified] and search using Google Scholar and Scopus [1 paper identified]. No additional papers were identified searching the AHA Endnote Database.

• State inclusion and exclusion criteria

Inclusion: human, surrogate (manikin), animal studies.
Exclusion: mathematical models, studies not using either a backboard or a deflatable mattress. Reviews and editorials.

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

Search narrowed after title/abstract review to 6 (LOE 5) papers.
# Summary of evidence

## Evidence Supporting Clinical Question

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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*
### Evidence Neutral to Clinical question

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<td>Tweed M, 2001 E</td>
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#### Level of evidence:
- **A** = Return of spontaneous circulation
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- **D** = Intact neurological survival
- **E** = Other endpoint

*Italics = Animal studies*

### Evidence Opposing Clinical Question

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#### Level of evidence:
- **A** = Return of spontaneous circulation
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*Italics = Animal studies*
Most in-hospital cardiac arrest occurs while a patient is lying in bed and resuscitation is most often commenced without moving the patient to the floor. No human studies have evaluated the effect of a backboard or deflatable mattress. The six studies identified in this worksheet examine the effect of performing CPR on a firm surface (backboard (Noordergraaf 2009, p. 546-552; Perkins 2009, p. 79-82; Andersen, 2007, p. 747-750; Perkins 2006, p. p1632-1635) or deflatable mattress (Perkins 2003, p. 2330-2335; Tweed 2001, p. 179-183) compared with performance of CPR on a regular (foam) mattress.

Four manikin studies have examined the effect of placing a backboard beneath a manikin on a foam mattress. Three studies measured the effect on chest compression depth and one study studied the total hand movement during chest compressions at fixed chest compression depths. Andersen et al. (2007, p. 747 - 750) documented increased chest compression depth (5 mm, 95% CI 3.6 – 7.5 mm, SD 4.6) when male hospital orderlies (mean age 43, range 28-61) performed chest compressions using a backboard compared to a foam mattress. However, no difference in proportion of compressions with correct depth (i.e. 40 - 50 mm) was observed and chest compression depth was within the recommended range without the use of a back board. The participants received information regarding the aims of the study. Despite participants were blinded to whether a backboard (covered by an overlay sheet) were used or not, possibly participants were able to detect when a back board was used during chest compressions. Furthermore, in this study no extra weight was added to the manikin to simulate the weight of an average adult. An increased manikin-weight may possibly have compressed the foam mattress and thereby decreasing mattress damping, possibly decreasing the observed effect of the backboard on chest compression depth. Perkins et al. (2009, p. 79 - 82) demonstrated an increased chest compression depth of 1.9 mm (95% CI 0.1 - 3.7 mm) and 2.6 mm (95% CI 0.9 - 4.5 mm) during 30 s of uninterrupted chest compressions guided by an accelerometer when using a narrow or wide back board compared to a foam mattress without a backboard. However, no difference in chest compression depth was observed when performed on an inflatable mattress with or without the use of a back board. In this study, no data (age, sex, education etc.) on the subjects doing chest compressions were provided. In another manikin study, Perkins et al. (2006, p.1632 - 1635) were unable to demonstrate a difference in chest compression depth when performing CPR using a backboard compared to CPR on a foam mattress. In this study chest compressions were performed by medical students (13 female, 7 male; mean age 20±1.5). The average time to place a backboard beneath a volunteer lying on a bed was measured to 10.6 ± 4 s (range 6.6 – 16.7 s). Chest compression depth was below the recommended 40 – 50 mm in all groups. Noordergraaf et al. (2009, p. 546 – 552) have reported, at fixed chest compression depths, that the total hand movement during chest compressions is reduced when a back board is used. The extraneous movement of the hand can be reduced by at least 50%, but not eliminated, when a back board is applied. In this study no weight was added to the manikin when chest compressions were performed without a back board. If additional weight was added to the manikin possibly the observed effect may have been reduced.

Placing a backboard beneath a patient may delay initiation of chest compressions if the backboard is not ready at hand. Furthermore, placing a backboard beneath a patient may lead to interruptions in CPR and potential IV-line/tracheal tube displacement. However, no data have been reported on the aforementioned.

Three studies investigated the effect of deflatable mattresses on chest compressions. Chest compression depth was insufficient (< 40 mm) when CPR was performed on air-filled mattress (inflated, deflating and deflated) and on a foam mattress (Perkins 2009, p. 79 – 82; Perkins 2003, p. 2330-2335; Tweed 2001, p. 179 – 183). In one study by Perkins et al. (2009, p.79 – 82) chest compression depth was increased on an inflatable mattress when compared to a foam mattress without a backboard while no difference in chest compression quality was found between the different types of mattresses in two other studies (Perkins 2003, p. 2330 - 2335; Tweed 2001, p. 179 – 183). Overall, chest compression depth was inadequate when performed on foam and air-filled (inflated, deflating and deflated) mattresses when compared to current guideline.

Acknowledgements:
Nihil

Citation List


LOE 5, Good. Supportive. No comment on industry funding. Chest compression depth in the backboard group: > 5 mm. Backboard: 44 x 58 x 1. No extra weight added to the manikin. Participants knew aim that chest compression depth was recorded.


LOE 5, Fair. Supportive. Chest compression depth fixed. 3 different mattresses + stretcher were tested. The effect of a backboard on workload for the rescuer (i.e. total hand movement) was most evident on the standard foam mattress. No extra weight added to the manikin when compressions were performed without back board.

LOE 5. Fair. Neutral. Bed height adjusted to middle-thigh. Manikin weighted to 70 kg. Blinding may not have been successful, because participants were able to perceive diff in mattress stiffness. Pressure redistributing mattresses were provided by Huntleigh Healthcare Ltd.


LOE 5. Fair. Neutral. No comment on industry funding. No extra weight added to the manikin.


LOE 5. Fair. Supportive. 70 kg added to manikin. BB(n): 457 x 1826 x 37 mm BB(w): 635 x 1509 x 4 mm Feedback from manikin: All groups, chest compressions within 40 – 50 mm.


LOE 5. Poor. Neutral. Only four participants. To detect a 10% difference in chest compression depth would require at least 20 measurements. 40 kg weight added to manikin (lower abd + upper leg). Primary endpoint: percentage of correct chest compressions. EC score was consistently high-low-high. Air-filled supporting surfaces were provided by Huntleigh Healthcare. Tweed C affiliated with Huntleigh Healthcare.