WORKSHEET to accompany PROPOSED ARC Evidence-Based GUIDELINES

Worksheet Author: Paul Jennings	**ARC Subcommittee:**
Guideline(s) applicable (e.g. 4.3.5): Proposed	**Date submitted to council:**

Step 1: Gather the evidence

Define your search strategy.
(e.g. ((cardiopulmonary-resuscitation*:me or heart-arrest*:me) not (atrial-fibrillation:me of electrophysiology:me)) and hypothermia:ab))

MeSH Terms

Pathology
Hypotension, Orthostatic
Wounds and Injuries

Text Terms

Suspension Trauma
Orthostatic Shock
Orthostatic Intolerance
Harness
Harness Induced Pathology
Vertical
Trauma

List electronic databases searched (at least MEDLINE (http://igm.nlm.nih.gov/) Embase, Cochrane database for systematic reviews and Central Register of Controlled Trials, and hand searches of journals, review articles, and books.

This search was developed and run using the Cochrane Library 2008, Issue 2 (The Cochrane Library includes the Cochrane database for systematic reviews and the Central Register of Controlled Trials), Ovid MEDLINE(R) 1996 to 10 June 2008 and EMBASE.

• Describe search results; describe best sources for evidence.

The MeSH and text terms were combined appropriately using AND/OR operators. The search identified 4 possibly relevant studies.
Review of the titles and abstract of these studies identified no relevant Cochrane systematic reviews and 2 relevant papers (Medline).

••State major criteria you used to limit your search; state inclusion or exclusion criteria (e.g., only human studies with control group? no animal studies? N subjects > minimal number? type of methodology? peer-reviewed manuscripts only? no abstract-only studies?)

The search strategy was limited to human studies only. English language restrictions were applied.

Number of articles/sources meeting criteria for further review:

Title / Abstract review identified 2 relevant papers meeting criteria for further review

Create a citation marker for each study (use the author initials and date or Arabic numeral, e.g., "Elam 1958"). If possible, please supply file of best references; End Note 4+ preferred as reference manager, though other reference databases acceptable.

Step 2: Determine the Level of Evidence for each study.

For each article/source from step 1, assign a level of evidence—based on study design and methodology.

Level of Evidence	Definitions (See manuscript for full details)	Articles found (Use citation marker: e.g. Elam 1958)
Level I	Evidence obtained from a systematic review of all relevant randomised controlled trials	
Level II	Evidence obtained from at least one properly designed randomised controlled trial	Turner 2008
Level III-1	Evidence obtained from well designed properly pseudo-randomised controlled trials (alternate	

	allocation or other method)	
Level III-2	Evidence obtained from comparative studies with concurrent controls and allocation not randomised (cohort studies), case control studies, or interrupted time series with a control group	
Level III-3	Evidence obtained from comparative studies with historical control, two or more single arm studies, or interrupted time series without a parallel control group	
Level IV	Evidence obtained from case series, either post-test or pre-test and post-test	
Other	Please specify (e.g. animal, manikin)	

Step 2B: Critically assess each article/source in terms of research design and methods.

Was the study well executed? Suggested criteria appear in the table below. Assess design and methods and provide an overall rating. Ratings apply within each Level; a Level I study can be good or poor as a clinical trial, just as a Level II study could be good or poor. Where applicable, please append a code (A to E, as shown below) to categorize the primary endpoint of each study.

Component of Study and Rating	Good	Fair	Poor
Methodology	The methodological quality of the study is high with the likelihood of any significant bias being minimal	The methodological quality of the study is reasonable with the potential for significant bias being likely.	The methodological quality of the study is weak possessing considerable and significant biases.
Articles (use citation marker and code for outcome applicable: e.g. Elam 1998 D)		Turner 2008 E	

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

STEP 3. DETERMINE THE CLASS OF RECOMMENDATION. Select from these summary definitions.

CLASS	DEFINITION
Class A *Recommended*	Class A treatment recommendations are given to those guidelines which are considered to be beneficial and should be used
Class B: *Acceptable*	Class B treatment recommendations are given to those guidelines which may be beneficial and are acceptable to be used if considered appropriate in that setting

State a Class of Recommendation for the Guideline Proposal. State either a) the intervention, and then the conditions under which the intervention is either Class A or Class B; or b) the condition, and then whether the intervention is Class A or Class B

Guideline or intervention (Class of recommendation):

- **Class A:** Position the patient on their side, maintaining the victim's airway

REVIEWER'S FINAL COMMENTS AND ASSESSMENT OF BENEFIT / RISK: Summarize your final evidence integration and the rationale for the class of recommendation. Consider the frequency of adverse events and the possibility of harm? Describe any value or utility judgments you may have made, separate from the evidence. For example, you believe evidence-supported interventions should be limited to in-hospital use because you think proper use is too difficult for pre-hospital providers. Please include relevant key figures or tables to support your assessment

There are few papers specifically relating to the phenomenon of 'Suspension Trauma' within the peer reviewed literature. One significant literature review (Seddon, 2002) and several non-peer reviewed articles were located via internet searches and reference list reviews.

Turner 2008 conducted a prospective trial to assess the effect of three different harness systems on the comfort and physiological effects on 40 healthy volunteers. Whilst symptoms associated with orthostatic intolerance were identified, the paper did not discuss the acute care of patients suffering suspension trauma. Lee 2007 was a review article and concluded that whilst the theoretical possibility of suspension trauma exists, further research is warranted.

The most controversial component of patient management following suspension trauma is the immediate positioning of the patient. Whilst there is supposition based on theoretical physiological grounds that patients who have been suspended for a significant time (5 – 30+ minutes) should never be position supine, there is little consensus (or rigorous testing of the theory). Seddon 2002 recommends patients are managed by 'proping up the upper body for 20-40 minutes' among other management regimes.

Please submit completed document with the following attachments:

- Printed (paper) bibliography; and electronic version using a reference manager (eg. Endnote) if available. It is recommended that the bibliography be printed in annotated format. This will include the article abstract and any notes you would like to make providing specific comments on the quality, methodology and/or conclusions of the study, and/or reasons for exclusion.
- Key figures or tables from evidence-based analysis
- Full hard copies of the critical cited papers

Bibliography

Studies Identified by Search

Turner 2008 Turner NL. Wassell JT. Whisler R. Zwiener J. **Suspension tolerance in a full-body safety harness, and a prototype harness accessory**. [Evaluation Studies. Journal Article] Journal of Occupational & Environmental Hygiene. 5(4):227-31, 2008 Apr.

ABSTRACT

Workers wearing full-body safety harnesses are at risk for suspension trauma if they are not rescued in 5 to 30 min after a successfully arrested fall. Suspension trauma, which may be fatal, occurs when a person's legs are immobile in a vertical posture, leading to the pooling of blood in the legs, pelvis, and abdomen, and the reduction of return blood flow to the heart and brain. To measure suspension tolerance time, 22 men and 18 women with construction experience were suspended from the chest D-ring (CHEST) and back D-ring (BACK) of full-body, fall-arrest harnesses. Fifteen men and 13 women from the original group of subjects were then suspended using a newly developed National Institute for Occupational Safety and Health harness accessory (ACCESS), which supports the upper legs. Midthigh circumference changes were 1.4 and 1.9 cm, changes in minute ventilation were 1.2 and 1.5 L/min, changes in heart rate (HR) were 15.1 and 21.6 bpm, and changes in mean arterial pressure were 5.1 and -2.6 mmHg ($p < or = 0.05$) for all subjects during CHEST and BACK, respectively. Kaplan-Meier median suspension time for all subjects for the CHEST condition was 29 min (range 4-60 min) and 31 min (range 5-56 min) for the BACK condition. The 95th percentile for suspension time was 7 min for CHEST and 11 min for BACK. Cox regression revealed that body weight had a statistically significant effect on the time until experiencing a medical end point ($p < or = 0.05$) during the BACK condition. Mean (+/- SD) suspension time was 58 +/- 6 min (range 39-60 min) for all subjects for the ACCESS condition. There were no terminations due to medical symptoms during the ACCESS suspension, changes in physiological variables were small, and 85% of ACCESS subjects completed 60-min suspensions. These data provide information on motionless suspension tolerance time to standards-setting organizations and demonstrate the potential of a prototype harness accessory to delay or prevent suspension trauma.

Lee 2007 Lee C. Porter KM. **Suspension trauma**. [Review] [6 refs] [Journal Article. Review] Emergency Medicine Journal. 24(4):237-8, 2007 Apr.

ABSTRACT

Suspension trauma (also known as "harness-induced pathology" or "orthostatic shock while suspended") is the development of presyncopal symptoms and loss of consciousness if the human body is held motionless in a vertical position for a period of time. It has been described in experiments of personal fall protection, and has been implicated in causes of death in mountaineering accidents, but it seems neither to be widely known about nor to have been presented to the medical profession. This article highlights the potential existence of suspension trauma and suggests that more robust medical research using modern harnesses and healthy volunteers would be beneficial to assess whether this is purely a theoretical risk.

Review of the titles identified 2 relevant comments (letters).

1. Roggla G. Moser B. Roggla M. Re: **Suspension trauma**.[comment]. [Comment. Letter] Emergency Medicine Journal. 25(1):59, 2008 Jan.

2. Dobson J. **Put suspension trauma in proper perspective**.[comment]. [Comment. Letter] Occupational Health & Safety. 73(2):10, 2004 Feb.

Studies and Grey Literature Identified through Google and Reference List Search

1. Reagan R, NSW Department of Primary Industries Safety Alert; **Working at Heights Prevention of Falls and Fall Arrests**. Report No. SA06-02, 2006 Jan

2. Seddon P (2002) HSE **Contract Research Report; Harness Suspension: review and evaluation of existing information** CRR2002/451 http://www.hse.gov.uk/research/crr_pdf/2002/crr02451.pdf accessed 9 June 2008

A large literature review of past publications including many of those listed here. No original contributions or clinical testing but a useful summary of everything pre-2000. A second HSE research project (JN3547) is due to be completed in 2008, which aims to

decide if the HSE should release any official guidance. Again this will have no original information or clinical trial data to report, and any guidance will be created by yet another future research project.

3. Madsen P, Svendsen L B, Jorgensen L G, Matzen S, Jansen E and Secher N H **Tolerance to Head-up Tilt and Suspension With Elevated Legs** (1997) Aviation, Space and Environmental Medicine, Vol. 69, No. 8, pp781-784. August 1998

Extensive physiological data on compensatory processes in medically fit adults subjected to various static postures, conducted as part of research after several fatalities involving suspension. Includes proof of the knee-raising double strop procedure giving no significant symptoms for at leat 50 minutes.

4. Orzech M A, Goodwin M D, Brinkley J W, Salerno M D, Seaworth J **Test program to evaluate human response to prolonged motionless suspension in three types of fall protection harnesses** (1987) Harry G Armstrong Aerospace Medical Research Laboratory, Wright Patterson Air Force Base, Ohio, USA

5 volunteers suspended in various harnesses for up to 30 minutes. 3 reported severe discomfort and one lost consciousness at ~28 minutes.

6. Nelson B Climbing harnesses. **How long can you safely hang in your harness?** (1979) Off Belay Magazine (USA) (August 1979)

Comparative tests of several sit harness designs and one full-body harness, with 65 tests conducted. Mean suspension times tolerated were 0.5 to 17 minutes, with many symptoms reported including narrowing of pulse pressure.
Study of caving sit-harnesses, showing orthostasis was almost certain in any case of prolonged suspension. Tests famously aborted after several volunteers suffered severe symptoms.

7. Dawes R **Suspension trauma - a medical perspective** (2000) Technical Rescue, Issue 27 September 2000 (p20)

Basic guidance on the effects and proposed treatment, but critically failing to detail the risks of reflow syndrome and actions needed to prevent it.