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Evidence-based review of the current guidance on first aid measures for suspension trauma

Prepared by **Health and Safety Laboratory** and the **University of Birmingham**
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Research Report

HSE

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Evidence-based review of the current guidance on first aid measures for suspension trauma

Dr A Adisesh, L Robinson, A Codling & Dr J Harris-Roberts
Health and Safety Laboratory
Harpur Hill
Buxton
Derbyshire SK17 9JN

Dr C Lee & Professor K Porter
University of Birmingham
Academic Department of Traumatology
Institute of Research and Development
Birmingham Research Park
Vincent Drive
Birmingham B15 2SQ

In 2002 the UK Health and Safety Executive (HSE) published a review entitled 'Harness Suspension: Review and Evaluation of Existing Information'. It was noted in this report that the rescue plan was an essential part of fall protection arrangements. The report quoted and summarised advice extracted from various papers concerning harness suspension and noted that, 'some of the advice appears to conflict'. Nevertheless, although this document was not intended to be a review of the medical advice for rescue from suspension it has been frequently cited in such a context and in support of measures that differ from standard UK first aid practice. Consequently, it was the recognition that authoritative guidance was needed for first responders, in the workplace setting, to any cases of a fall into harness suspension, which led to this project being undertaken.

The Health and Safety Laboratory (HSL) was asked to review the advice and guidance available on suspension trauma. This review was used to address the questions of whether the current information and advice available for treating suspension trauma casualties was adequate and in line with current practice and recommendations, and whether there was a need for HSE to produce guidance.

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CONTENTS

EXECUTIVE SUMMARY

In 2002 the UK Health and Safety Executive (HSE) published a review entitled "Harness Suspension: Review and Evaluation of Existing Information"[1]. It was noted in this report that the rescue plan was an essential part of fall protection arrangements. The report quoted and summarised advice extracted from various papers concerning harness suspension and noted that, "some of the advice appears to conflict". Nevertheless, although this document was not intended to be a review of the medical advice for rescue from suspension it has been frequently cited in such a context and in support of measures that differ from standard UK first aid practice. Consequently, it was the recognition that authoritative guidance was needed for first responders, in the workplace setting, to any cases of a fall into harness suspension, which led to this project being undertaken.

Objectives

The Health and Safety Laboratory (HSL) was asked to review the advice and guidance available on suspension trauma. This review was used to address the questions of whether the current information and advice available for treating suspension trauma casualties was adequate and in line with current practice and recommendations, and whether there was a need for HSE to produce guidance.

The requirement for this work arose because first aid training organisations and first aiders were not clear about the correct positioning of rescued casualties in the event of a harness suspension situation.

Main Findings

There is little scientific published literature regarding the circumstances and consequences of harness suspension, and none that tests the effect of sitting a rescued casualty in the semi-recumbent posture that some authors have suggested.

Main Recommendations

- No change should be made to the standard United Kingdom (UK) first aid guidance for the post rescue recovery of a semi-conscious or unconscious person in a horizontal position, even if the subject of prior harness suspension.

- No change should be made to the standard UK first aid guidance of ABC management, even if the subject of prior harnesses suspension.

- A casualty who is experiencing pre-syncopal† symptoms or who is unconscious whilst suspended in a harness, should be rescued as soon as is safely possible.

- If the rescuer is unable to immediately release a conscious casualty from a suspended position, elevation of the legs by the casualty or rescuers where safely possible may prolong tolerance of suspension.

- First responders to persons in harness suspension should be able to recognise the symptoms of pre-syncope. These include light-headedness; nausea; sensations of flushing; tingling or numbness of the arms or legs; anxiety; visual disturbance; or a feeling they are about to faint.

† Presyncope refers to the premonitory symptoms of impending collapse

1. Seddon P. Harness suspension: review and evaluation of existing information CRR 451/2002, HSE Books, HMSO, Norwich; 2002.

1 INTRODUCTION

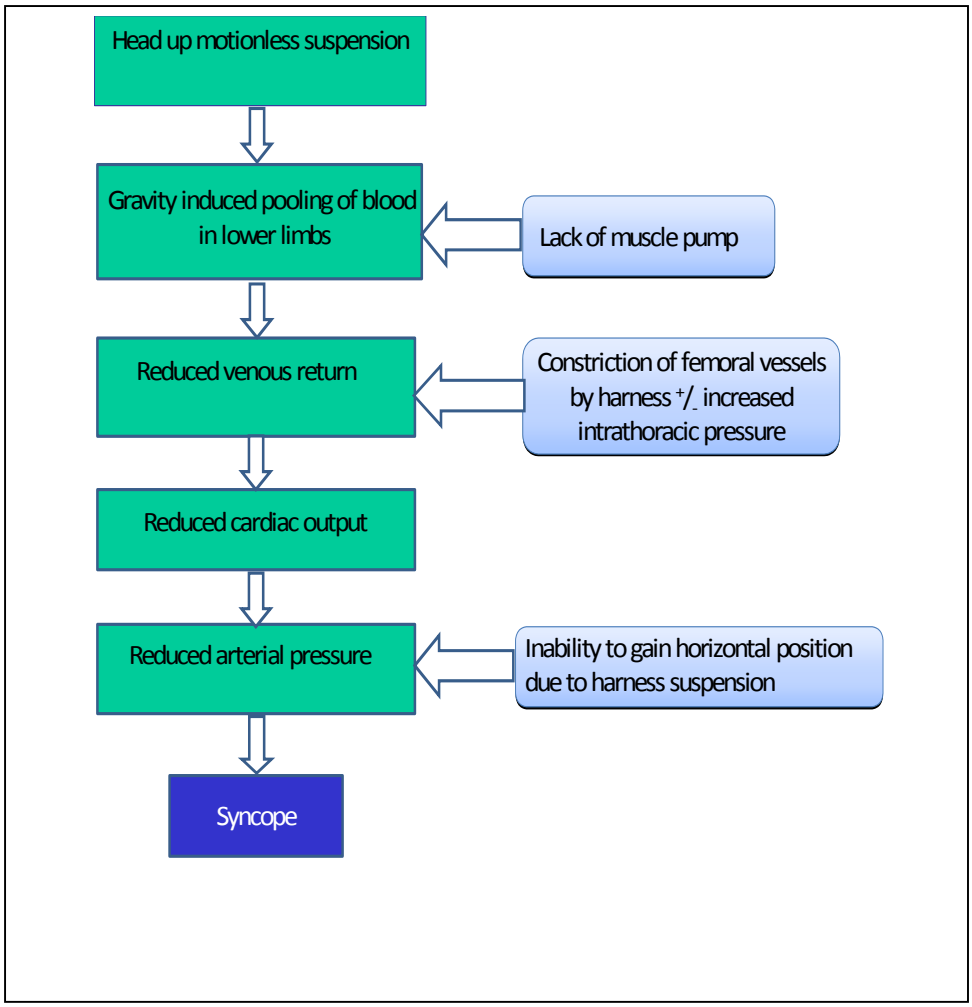
The term “suspension trauma” is one, which has developed as parlance amongst many who work in the fall protection industry and training sector. In an earlier Health and Safety Executive (HSE) report[1] and a number of published articles, suspension trauma was used to describe the situation of a person falling into suspension on a rope and then becoming unconscious. In this scenario the loss of consciousness is not due to any physical injury but rather it is thought that orthostasis, motionless vertical suspension, is responsible. “Trauma” is therefore an inappropriate epithet, which may be better replaced by the descriptive term “syncope”.

Syncope is the sudden transient loss of consciousness and postural tone with spontaneous recovery[2]. The causes of syncope can be classified as vascular: resulting from changes to blood vessels or their reflex responses, cardiac: relating to structural abnormalities of the heart or to changes in its rhythm, neurological: conditions such as migraine or seizures, metabolic: due to ingested or other toxicants e.g. drugs or alcohol and including abnormalities of biochemistry, psychogenic: anxiety, panic and somatisation disorders, and finally, syncope of unknown origin.

Syncope occurring with vertical suspension is principally related to the motionless state (Figure 1) and can be induced by use of a cardiac tilt table in which the subject rests in the upright position with their back against a board with support from a bicycle type seat but without a foot rest. Pooling of blood in the gravitationally dependent legs leads to the clinical state described as orthostasis. After prolonged vertical tilt most subjects will become symptomatic. This may produce symptoms such as light-headedness; nausea; sensations of flushing; tingling or numbness of the arms or legs; anxiety; visual disturbance; or faintness. This state is often referred to, as “presyncope” i.e. if some postural or physiological correction does not take place syncope will consequentially follow. In suspension with some types of chest harness the discomfort caused may lead to increased pressure within the chest cavity further reducing venous blood return. Normally, on standing, 500 to 800 ml of blood is displaced to the abdomen and legs causing physiological consequences on cardiac output, blood vessel tone and reflex responses, which should maintain stable blood pressure. A drop within 3 minutes of standing of 20mmHg in systolic blood pressure or 10mmHg diastolic blood pressure is defined as postural hypotension. Some people are more likely to suffer this condition than others and some circumstances such as dehydration, alcohol and prescribed medication can affect an individual predisposition[2].

The term “suspension syncope” or indeed “suspension presyncope” does not therefore assume that any one pathological mechanism is responsible for the loss of consciousness or symptoms occurring in suspension and acknowledges that multiple factors may operate. Experimental evidence and clinical experience point to suspension orthostasis as being the most common circumstance likely to induce syncope in otherwise fit and healthy subjects. The published literature was reviewed to establish if there was a need to change the current first aid guidelines. The literature reviewed fails to document cases occurring during industrial use of fall protection. Seddon[1] states that in response to a request to a questionnaire placed on the Industrial Rope Access Trade Association website for 6 months with periodic reminders, he had no reports of presyncope or syncope. The only casualties he became aware of from direct enquiries were cases occurring during rescue training when subjects were deliberately suspended and motionless.

Figure 1 - The Mechanism of Suspension Syncope



The medical complications arising from suspension in harnesses were highlighted by a 1972 conference of Mountain Rescue Doctors in Innsbruck[3]. One of the conference papers proposed, "…. we therefore take the view that a person cut free from the rope should only sit or lean against the rock, but not lie down in order to prevent the blood returning too quickly to the right atrium"[4]. This paper which has not been published in the peer reviewed medical literature gave an opinion on management and a hypothesis to support the proposal but provided no experimental evidence to indicate any benefit. The authors lay their own test subjects in a supine position. The assertion of the need to prevent a supine posture following rescue from suspension was repeated by Damisch and Schauer[5] in 1985 with a footnote to their work conducted at Innsbruck examining a series of harnesses and also by Petermeyer and Unterhalt[6] in 1997. Although these authors reiterated the advice given by Flora et al, no evidence of benefit was presented to support the hypothesis. Seddon's review (2001) repeated and referenced this advice, however other authors and advisers may have promulgated the considerations for rescue and treatment mentioned without their own critical assessment of the primary research. The present work provides a critical review of the medical evidence for the management of suspension syncope using widely accepted methodology for evidence appraisal.

2 METHODOLOGY

2.1 EVIDENCE BASED REVIEW METHOD

The project team agreed that the best method of forming authoritative advice would be to undertake an evidence-based review of the medical literature. Clinical practice guidelines are “systematically developed statements to assist practitioner and patient decisions about appropriate health care for specific clinical circumstances". Their purpose is "to make explicit recommendations with a definite intent to influence what clinicians do" [7].

A guideline development group was formed which consisted of the guideline leader, project manager, guideline co-ordinator and two member / appraisers (Figure 2). The Scottish Intercollegiate Guideline Network (SIGN) methodology[7] was the framework for the development of the guideline. A set of four questions was formulated between the guideline development group and the HSE customer. The Population Intervention Comparison Outcome (PICO) format was utilised to address the information requirements (Figures 3 & 4). Following the completion of the evidence-based review and compiling of the draft report, a meeting of relevant stakeholders was held at the Health and Safety Laboratory to discuss the circumstances of harness suspension, the review methodology and the initial recommendations formulated from the work undertaken. Feedback was actively sought from the invited stakeholders and taken into account in the production of the final report.

2.1.1 Figure 2 – Guideline Development Group

Guideline Leader
Dr Anil Adisesh
Deputy Chief Medical Officer, Centre for Workplace Health,
Health and Safety Laboratory, Buxton, UK

Guideline Co-ordinator
Jacqui Foxlow
Occupational Health Nurse, Centre for Workplace Health,
Health and Safety Laboratory, Buxton, UK

Project Manager
Alison Codling
Senior Occupational Health Nurse, Centre for Workplace Health,
Health and Safety Laboratory, Buxton, UK

Member/Appraisers
Dr Caroline Lee, Specialist Registrar in Emergency Medicine,
Academic Department of Clinical Traumatology, University of Birmingham, UK

Prof. Keith Porter, Professor of Clinical Traumatology,
Academic Department of Clinical Traumatology, University of Birmingham, UK

2.1.2 Figure 3 – Key Questions

Q.1 What circumstances can cause suspension trauma?

Q.2 How common is suspension trauma?

Q.3 What first aid should be applied to a known case of suspension trauma?

Q.4How is suspension trauma recognised clinically?

2.1.3 Figure 4 – Key Questions Organised into PICO Format

	POPULATION	INTERVENTION	COMPARISON	OUTCOME
Q1	Anyone suspended & developing suspension trauma	Suspension	Anyone suspended & not developing suspension trauma	Risk Factors
Q2	Anyone suspended & developing suspension trauma	Suspension	Anyone suspended & not developing suspension trauma	Prevalence
Q3.1	Anyone suspended & conscious with any signs and symptoms	Suspension	Anyone suspended & conscious with any signs and symptoms of suspension trauma	Appropriate first aid following conscious suspension
Q3.2	Anyone suspended & unconscious	Suspension	Anyone suspended & unconscious with signs and symptoms of suspension trauma	Appropriate first aid following unconscious suspension
Q4	Anyone suspended with any signs & symptoms	Suspension	Anyone suspended with signs & symptoms of suspension trauma	Differentiation of suspension trauma signs and symptoms

2.2 LITERATURE SELECTION

A list of relevant key words to be used in a literature search was agreed. Information scientists from the Health and Safety Executive's Knowledge Centre performed a literature search. Abstracts were reviewed and papers selected for critical appraisal.

2.2.1 Databases Interrogated

The search was run on:

Medline coverage 1951 to present
Embase coverage 1974 to present
CISDOC 1987 to present
Hseline 1987 to present
Nioshtic and Nioshtic 2 1977 to present
OSHline 1998 to present
Rilosh 1975 to present
Healsafe 1981 to present
ROSPA 1980 to present

The search returned a number of abstracts related to the hypotensive effects of medication and other medical causes of orthostatic hypotension these articles were deselected at initial screening as were other obviously non-relevant subjects.

The search strategy is detailed in Figure 5 with the numbers of articles returned at each step. The flow of articles through the evidence review is enumerated in the subsequent flow chart (Figure 6).

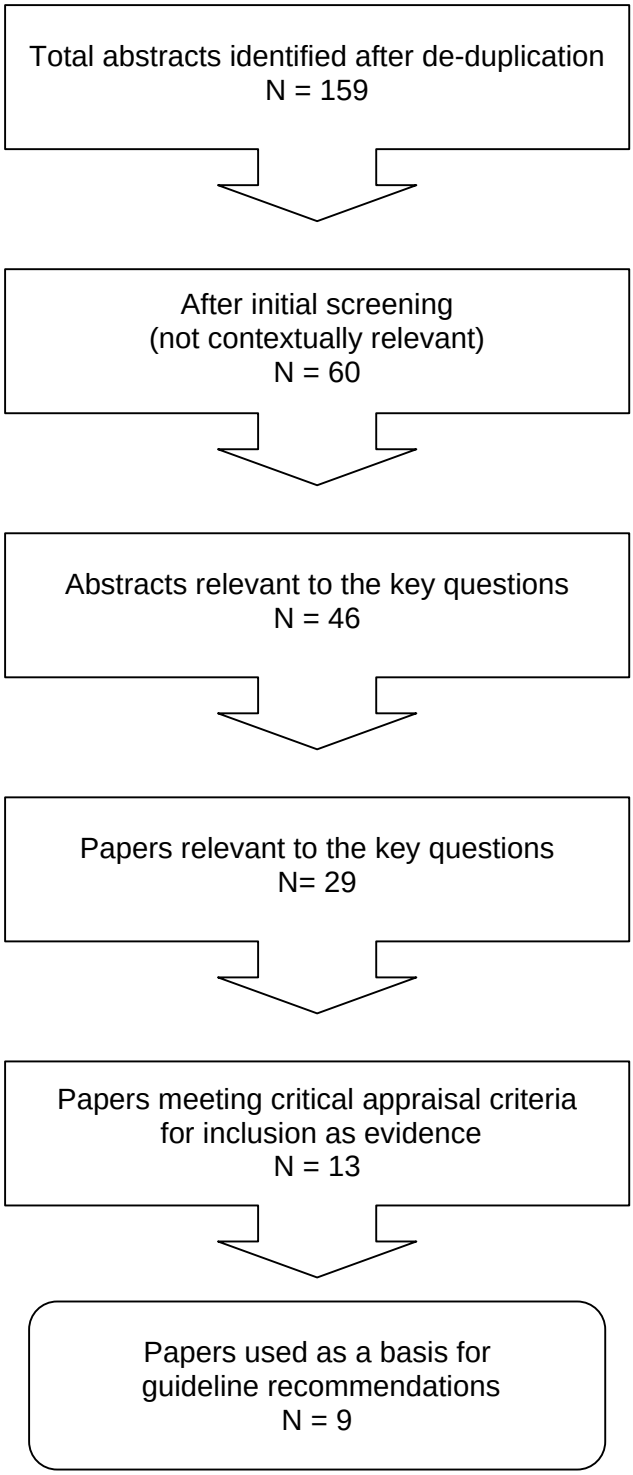
2.2.2 Figure 5 - Search Strategy

Search Step	Search Term	Total
1	SUSPENSION NEAR TRAUMA	27
2	SUSPENSION NEAR (MEDICAL ADJ EFFECT$1)	0
3	SUSPENSION NEAR (PHYSIOLOGICAL ADJ EFFECT$1)	12
4	SUSPENSION NEAR UNCONSCIOUS$4	5
5	SUSPENSION NEAR SYNCOPE	0
6	SUSPENSION NEAR PRESYNCOPE	0
7	(SUSPENSION NEAR MEDICAL or SUSPENSION NEAR PHYSIOLOGICAL) and (HARNESS$3 OR PARACHUTES$4 OR MOUNTAIN$7 OR CLIMB$3 OR CAVE$3 OR SPELEOLOG$4 OR ROPE OR ROPES)	7
8	(SUSPENSION NEAR MEDICAL or SUSPENSION NEAR PHYSIOLOGICAL) and (FALL OR FALLS OR FALLING OR FELL)	8
9	Search steps 1 to 8 limited to human tag (Medline and Embase only)	17
10	RESCUE ADJ DEATH	28
11	HARNESS$3 NEAR (INDUCED NEAR PATHOLOG$3)	6
12	HARNESS$3 NEAR (MEDICAL NEAR EFFECT$1)	3
13	HARNESS$3 NEAR (PHYSIOLOGICAL NEAR EFFECT$1)	0
14	HARNESS$3 NEAR UNCONSCIOUS$4	3
15	HARNESS$3 NEAR SYNCOPE	0
16	HARNESS$3 NEAR PRESYNCOPE	0
17	Search steps 11 to 16 limited to human tag (Medline and Embase only)	21
18	ORTHOSTATIC NEAR SHOCK	36
19	ORTHOSTATIC NEAR HYPOTENSION	15861
20	ORTHOSTATIC NEAR INTOLERANCE	1171
21	ORTHOSTATIC NEAR SYNCOPE	497
22	ORTHOSTATIC NEAR PRESYNCOPE	72
23	ORTHOSTATIC NEAR SYNDROME	702
24	Search steps 18 to 23 and SUSPENSION	77
25	Search steps 18 to 23 and (HARNESS$3 OR PARACHUTES$4 OR MOUNTAIN$7 OR CLIMB$3 OR CAVE$3 OR SPELEOLOG$4 OR ROPE OR ROPES)	44
26	Search steps 18 to 23 and (FALL OR FALLS OR FALLING OR FELL) in title or descriptors	474
27	Search steps 24 to and 26 limited human tag (Medline and Embase only)	525
28	Not drug in title or descriptor (medline only)	112
29	Search step 27 And harness$3 (medline only)	10
30	274 (HEAD ADJ UP ADJ TILT) NEAR SYNCOPE	541
31	(HEAD ADJ UP ADJ TILT) NEAR PRESYNCOPE	38
32	((VASO ADJ VAGAL) OR VASOVEGAL) NEAR SYNCOPE	78
33	((VASO ADJ VAGAL) OR VASOVEGAL) NEAR (PRESYNCOPE)	0
34	VENOUS NEAR POOLING NEAR SYNCOPE	15
35	VENOUS NEAR POOLING NEAR PRESYNCOPE	0
36	Search steps 30 to 35 and SUSPENSION	1
37	Search steps 30 to 35 and (HARNESS$3 OR PARACHUTES$4 OR MOUNTAIN$7 OR CLIMB$3 OR CAVE$3 OR SPELEOLOG$4 OR ROPE OR ROPES)	0
38	Search steps 30 to 35 and (FALL OR FALLS OR FALLING OR FELL) in title or descriptor	4
39	Steps 36 to 38 Limit human tag (medline and Embase only)	5
40	Step 39 And harness$3 (medline and Embase only)	0

Note: near means within 5 words, $3 means 3 letter truncation.

There was no language restriction.

2.2.3 Figure 6 - Flow Chart for Study Selection



2.3 CRITICAL APPRAISAL OF PAPERS

The selected papers were assessed for methodological quality, using a proforma adapted from the Critical Appraisal Skills Programme (Appendix 1). The SIGN grading system was used to grade the levels of evidence offered by each paper reviewed and the recommendations made by the appraisers. Considered judgement forms were completed so that the basis for the recommendations could be understood more clearly.

Appraisers were also asked to identify any follow-on papers listed in the references of the papers they were appraising.

2.4 STAKEHOLDER WORKSHOP

A stakeholders' workshop was convened on the 30 April 2008 to discuss the draft evidence based review report produced by the Health and Safety Laboratory on behalf of the Health and Safety Executive.

Stakeholders from industrial training organisations and professional bodies concerned with fall arrest and rope access, union representatives, medical researchers and advisers, rescue services including the ambulance service and sport organisations, and colleagues from the Health and Safety Executive were invited to attend (Appendix 4). The guideline development group and colleagues from the Engineering Safety Unit at the Health and Safety Laboratory gave presentations about the background to the review, harnesses for fall protection, medical aspects of orthostasis, the SIGN methodology (figure 7) and the evidence review with draft recommendations. The discussion within the workshop and subsequent information provided by attendees was most helpful in further developing the final report. It is hoped that this process of engagement of the participants will assist with acceptance and dissemination of the recommendations.

2.4.1 Figure 7 - SIGN Evidence and Recommendation Grading System

Levels of Evidence

1++	High quality meta-analyses, systematic reviews of randomised controlled trials (RCTs), or RCTs with a very low risk of bias
1+	Well-conducted meta-analyses, systematic reviews of RCTs, or RCTs with a low risk of bias
1–	Meta-analyses, systematic reviews of RCTs, or RCTs with a high risk of bias
2++	High quality systematic reviews of case-control or cohort studies High quality case-control or cohort studies with a very low risk of confounding, bias, or chance and a high probability that the relationship is causal
2+	Well conducted case-control or cohort studies with a low risk of confounding, bias, or chance and a moderate probability that the relationship is causal
2–	Case-control or cohort studies with a high risk of confounding, bias, or chance and a significant risk that the relationship is not causal
3	Non-analytic studies, e.g. case reports, case series
4	Expert opinion

Grades of recommendation

A	At least one meta-analysis, systematic review, or RCT rated as 1++, and directly applicable to the target population; or A systematic review of RCTs or a body of evidence consisting principally of studies rated as 1+, directly applicable to the target population, and demonstrating overall consistency of results
B	A body of evidence including studies rated as 2++, directly applicable to the target population, and demonstrating overall consistency of results; or Extrapolated evidence from studies rated as 1++ or 1+
C	A body of evidence including studies rated as 2+, directly applicable to the target population and demonstrating overall consistency of results; or Extrapolated evidence from studies rated as 2++
D	Evidence level 3 or 4; or Extrapolated evidence from studies rated as 2+

Good Practice Points

GPP	Recommended best practice based on the clinical experience of the guideline development group

3 FINDINGS AND RECOMMENDATIONS

This section includes the full recommendations for the first aid management of harness suspension and answers the PICO format questions that were framed. The presentation of the evidence is summarised in the considered judgement forms used for each question with the recommendations, which follow.

The individual studies used as evidence and the critical appraisal of this evidence is presented in Appendix 2.

After the completion of the evidence review there was a publication of high quality research conducted by researchers at the United States, National Institute for Occupational Safety and Health (NIOSH) concerning the development of a prototype harness accessory designed to deploy passively, allowing the legs to assume a bent knee posture when in suspension[8]. Although this study was not included in the evidence review, it confirms the finding of the elevated leg semi recumbent suspension position being better tolerated as reported by Madsen et al [9]. The authors also comment in respect of harness suspension in chest and back suspension without this posture that, “to ensure that no more than 5% of workers would experience symptoms [of suspension presyncope or syncope], rescue would have to occur in 7 minutes for a chest attachment point and in 11 minutes for a back attachment point”. In this study the elevated leg semi recumbent suspension position was tolerated for a mean of 58 minutes with all withdrawals being due to discomfort rather than medical symptoms or signs[8].

3.1 LIST OF EVIDENCE BASED RECOMMENDATIONS

	SIGN Grade
Fall arrest systems incorporating a harness should be a last measure since the means for recovery from a fall into suspension may exceed the time to presyncope, which may then be followed by syncope in a time period which is unpredictable.	**B**
In head up suspension, elevation of the legs may prolong tolerance.	**B**
No change should be made to the standard UK first aid guidance for the post rescue recovery of a semi-conscious or unconscious person in a horizontal position, even if the subject of prior harness suspension.	**B**
No change should be made to the standard UK first aid guidance of ABC management, even if the subject of prior harness suspension.	**B**
A casualty who is experiencing pre-syncopal symptoms or who is unconscious whilst suspended in a harness, should be rescued as soon as is safely possible.	**B**
If the rescuer is unable to immediately release a conscious casualty from a suspended position, elevation of the legs by the casualty or rescuers where safely possible may prolong tolerance of suspension.	**B**
First responders to persons in harness suspension should be able to recognise the symptoms of pre-syncope. These include light-headedness; nausea; sensations of flushing; tingling or numbness of the arms or legs; anxiety; visual disturbance; or a feeling they are about to faint.	**B**
Head down suspension should be treated with as much urgency as head up suspension.	**D**
Methods of collating data on non-fatal and fatal falls in all personal fall protection systems where there is a risk of suspension in a harness should be explored together with the availability of data, as a denominator on the number of hours of fall protection used.	**D**
Post mortem examinations on fatalities after falls into rope suspension should specifically look for hypothesised features of ‘suspension trauma’ to establish whether there is any existence of this clinical entity.	**D**
Supplementary oxygen, if available, should be administered to any person who has suffered syncope during harness suspension.	**GPP**
Consider removing a harness suspended person from suspension in the direction of gravity i.e. downwards, so as to avoid further negative hydrostatic force, however this measure should not otherwise delay rescue.	**GPP**
An emergency 999 ambulance or equivalent qualified paramedical or medical provider should be called for anyone who becomes unconscious in harness suspension whether apparently recovered or not.	**GPP**

3.2 CONSIDERED JUDGEMENT FORMS

Considered Judgement Forms - Key question 1: What circumstances can cause suspension trauma?
1. Volume of evidence *Comment here on any issues concerning the quantity of evidence available on this topic and its methodological quality.*
All the studies reviewed, including those not meeting criteria for inclusion as evidence, have investigated the effect of motionless head up suspension in various harnesses or using a tilt table. The effect of lower limb movement in suspension does not appear to have been formally assessed. Only one paper accepted as evidence reports the effects of inverse (head down) suspension and then in the context of post mortem findings.
2. Applicability *Comment here on the extent to which the evidence is directly applicable to UK practice*
The experimental circumstances reported are expected to be analogous to those seen in industrial rope access where the subject has been in motionless suspension.
3. Generalisability *Comment here on how reasonable it is to generalise from the results of the studies used as evidence to the target population for this guideline.*
In the experimental situations subjects were raised to suspension whereas in harness-based personal fall protection systems, it is expected that victims will unexpectedly fall into suspension. The physiology of the latter situation may differ significantly but it is not clear whether this would usually delay or enhance the effects of orthostasis. The research available does allow inference of the effects solely of orthostasis.
4. Consistency *Comment here on the degree of consistency demonstrated by the available of evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence*
There is high consistency of the reported findings in motionless suspension both in symptoms described and the effects of harness type.
5. Clinical impact *Comment here on the potential clinical impact that the intervention in question might have - e.g. size of patient population; magnitude of effect; relative benefit over other management options; resource implications; balance of risk and benefit.*
N/A
6. Other factors *Indicate here any other factors that you took into account when assessing the evidence base.*
N/A

Evidence statement		Grade
Motionless head up suspension leads to syncope. Madsen P et al 1998, Mallard M 1990, Orzech M A et al 1987.		1+
Head up suspension in mountaineering or caving has lead to fatalities. Flora G, Holzl HR 1972, Patscheider H 1972, Fodisch J 1972, Mallard M 1990.		3
The duration of suspension may be determined by anthropometric values for some body harnesses. Weber P, Michela-Brundel G 1997.		1+
Motionless head up suspension leads to presyncope in most normal subjects within 1 hour and in a fifth within 10 minutes. Madsen P et al 1998.		1+
There is a near linear relationship between head up tilt and time to presyncope in normal subjects. Madsen P et al 1998.		1+
Recommendation		
Fall arrest systems incorporating a harness should be a last measure since the means for recovery from a fall into suspension may exceed the time to presyncope, which may then be followed by syncope in a time period which is unpredictable.		B
Evidence statement		Grade
Head up suspension with elevated legs is better tolerated than with legs dependent. Madsen P et al 1998.		1+
Recommendation		
In head up suspension elevation of the legs may prolong tolerance.		B
Evidence statement		Grade
Head down suspension has been fatal in some circumstances but may take longer to cause loss of consciousness. Madea B 1993.		3
Recommendation		
Head down suspension should be treated with as much urgency as head up suspension.		D

Considered Judgement Forms - Key question 2: How common is suspension trauma?
1. Volume of evidence *Comment here on any issues concerning the quantity of evidence available on this topic and its methodological quality.*
No systematic studies of the incidence of suspension trauma or falls into rope protection were found. Flora and Holzl report 23 falls in 17 years from the Austrian Alps. 10 (43%) of these were fatal but information bias is likely with a more complete ascertainment of fatal than non-fatal falls. Seddon comments in his 2002 review that he had no reports of symptoms relating to suspension trauma despite a widely distributed request in the UK.
2. Applicability *Comment here on the extent to which the evidence is directly applicable to UK practice*
The incidence is unlikely to be relevant to industrial rope access and even mountaineering conditions in the UK will differ from Austria although the potential for falling into suspension exists.
3. Generalisability *Comment here on how reasonable it is to generalise from the results of the studies used as evidence to the target population for this guideline.*
The type of harness Flora and Holzl refer to is a simple rope around the chest and has specific problems associated with its use. The harness is not typical of those used for harness-based personal fall protection systems or in modern-day climbing and caving. However motionless orthostatic suspension would have complications independent of harness design.
4. Consistency *Comment here on the degree of consistency demonstrated by the available of evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence*
N/A
5. Clinical impact *Comment here on the potential clinical impact that the intervention in question might have - e.g. size of patient population; magnitude of effect; relative benefit over other management options; resource implications; balance of risk and benefit.*
N/A
6. Other factors *Indicate here any other factors that you took into account when assessing the evidence base.*
N/A

Evidence statement		Grade
There is no evidence reporting the incidence of suspension trauma in industrial fall prevention.		
Recommendation		
Methods of collating data on non-fatal and fatal falls in all personal fall protection systems where there is a risk of suspension in a harness should be explored together with the availability of data, as a denominator on the number of hours of fall protection used.		GPP
Post mortem examinations on fatalities after falls into rope suspension should specifically look for hypothesised features of 'suspension trauma' to establish whether there is any existence of this clinical entity.		GPP

Considered Judgement Forms - Key question 3: What first aid should be applied to a known case of suspension trauma?
1. Volume of evidence *Comment here on any issues concerning the quantity of evidence available on this topic and its methodological quality.*
There are no studies that have been designed to answer this question. In a number of harness suspension studies subjects experienced presyncope and even in some cases syncope. All subjects were successfully recovered by lying supine. Several authors give opinions about an alternative recovery position but in none of the studies were subjects recovered in the semi-recumbent way later suggested. There is no evidence of so-called “reflow syndrome” or reperfusion injury being reported in suspension orthostasis.
2. Applicability *Comment here on the extent to which the evidence is directly applicable to UK practice*
N/A
3. Generalisability *Comment here on how reasonable it is to generalise from the results of the studies used as evidence to the target population for this guideline.*
Only anecdotal evidence suggests that the standard first aid may have any adverse effect.
4. Consistency *Comment here on the degree of consistency demonstrated by the available of evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence*
In all studies recovery of symptomatic subjects was undertaken supine.
5. Clinical impact *Comment here on the potential clinical impact that the intervention in question might have - e.g. size of patient population; magnitude of effect; relative benefit over other management options; resource implications; balance of risk and benefit.*
To change the recommendation for first aid recovery of a semi-conscious or unconscious person in specific circumstances may be confusing for first aiders and lead to inappropriate measures for other victims, which could potentially be fatal. To recommend a change in current first aid practice even for the specific circumstance of suspension trauma it must be shown that the risk of change is outweighed by the benefit. Since there are no reported cases of industrial suspension orthostasis the most likely circumstances of semi-conscious or unconscious victims that a first aider will be confronted with, will be from other causes even in a construction workplace and they must be clear about the prompt action required. It is also possible that in some cases of semi-conscious or unconscious victims suspended on a rope, that the cause of their comatose state is due to other physical injury and that to fail to put them in a horizontal position may be deleterious.
6. Other factors *Indicate here any other factors that you took into account when assessing the evidence base.*
None

Evidence statement		Grade
All study subjects recovered from suspension or head up tilt presyncope, uneventfully after being placed quickly into the supine position. Orzech M A et al 1987, Madsen P et al 1998, Mallard M 1990.		1+
One case of syncope with bradycardia during lowering from suspension recovered quickly without any medically adverse effects when placed in the supine position. Other cases of syncope without bradycardia subjectively completely normalised after a few minutes in the horizontal position. Orzech M A et al 1987.		1+
Recommendation		
No changes should be made to the standard UK first aid guidance for the post rescue recovery of a semi-conscious or unconscious person in a horizontal position, even if the subject of prior harness suspension.		B
No changes should be made to the standard UK first aid guidance of ABC management, even if the subject of prior harness suspension.		B
An emergency 999 ambulance or equivalent qualified paramedical or medical provider should be called for anyone who becomes unconscious in harness suspension whether apparently recovered or not.		GPP
Evidence statement		
Head up suspension with elevated legs is better tolerated than with legs dependent. Madsen P et al 1998.		1+
Recommendation		
If the rescuer is unable to immediately release a conscious casualty from a suspended position, elevation of the legs by the casualty or rescuers where safely possible may prolong tolerance of suspension.		B

Evidence statement		Grade
Motionless head up suspension leads to presyncope in most normal subjects within 1 hour and in a fifth within 10 minutes. Madsen P et al 1998.		1+
There is a near linear relationship between head up tilt and time to presyncope in normal subjects. Madsen P et al 1998.		1+
If harness suspension is prolonged after the onset of syncope irreversible hypoxia and death may result. Flora G, Holzl HR 1972, Patscheider H 1972, Fodisch J 1972, Mallard M 1990.		3
Recommendation		
A casualty who is experiencing pre-syncopal symptoms or who is unconscious whilst suspended in a harness, should be rescued as soon as is safely possible.		B
Supplementary oxygen, if available, should be administered to any person who has suffered syncope during harness suspension.		GPP
Consider removing a harness suspended person from suspension in the direction of gravity i.e. downwards, so as to avoid further negative hydrostatic force, however this measure should not otherwise delay rescue.		GPP

Considered Judgement Forms - Key question 4: How is suspension trauma recognised clinically?
1. Volume of evidence *Comment here on any issues concerning the quantity of evidence available on this topic and its methodological quality.*
Many harness suspension studies have enquired about the symptoms experienced by volunteer subjects in suspension. These symptoms that occur prior to the onset of syncope are termed presyncope and have been well characterised. The onset of syncope itself was not deliberately studied in any of the works reviewed although some episodes of syncope were reported. Most studies have also used the onset of systolic hypotension <90mmHg or bradycardia as medical withdrawal criteria.
2. Applicability *Comment here on the extent to which the evidence is directly applicable to UK practice*
Directly applicable to UK practice.
3. Generalisability *Comment here on how reasonable it is to generalise from the results of the studies used as evidence to the target population for this guideline.*
The symptoms experienced in volunteer studies are expected to be the same as those that would occur in motionless harness suspension excluding the effects of any fall or other injury.
4. Consistency *Comment here on the degree of consistency demonstrated by the available of evidence. Where there are conflicting results, indicate how the group formed a judgement as to the overall direction of the evidence*
There is a high level of consistency between studies in the presyncope symptoms sought and reported.
5. Clinical impact *Comment here on the potential clinical impact that the intervention in question might have - e.g. size of patient population; magnitude of effect; relative benefit over other management options; resource implications; balance of risk and benefit.*
Those persons including first responders to harness suspension will be able to recognise the symptoms of presyncope and therefore impending syncope.
6. Other factors *Indicate here any other factors that you took into account when assessing the evidence base.*
None

Evidence statement		Grade
Study subjects in harness suspension most often reported light headedness, nausea, sensation of flushing, tingling and/or numbness of arms/legs, drowsiness in decreasing order of frequency with visual disturbance and anxiety in single cases. Orzech M A et al 1987, Weber P, Michela-Brundel G 1997, Mallard M 1990.		1+
Subjects with presyncope may have one or more symptoms. Orzech M A et al 1987, Weber P, Michela-Brundel G 1997, Mallard M 1990.		1+
Recommendation		
First responders to persons in harness suspension should be able to recognise the symptoms of pre-syncope. These include light-headedness; nausea; sensations of flushing; tingling or numbness of the arms or legs; anxiety; visual disturbance; or a feeling they are about to faint.		B

4 FURTHER RESEARCH

As a result of the literature review and appraisal, areas were identified which may benefit from further study and these are listed below for other researchers and stakeholders in this field to consider addressing:

- Does lower limb activity affect the duration of tolerated harness suspension?

Although it has been often said that activity of the lower limbs in suspension is protective against suspension syncope, no trials were found that formally addressed this question.

- What is the physiological effect of an unexpected drop into harness suspension?

All the trials retrieved either raised subjects into suspension or used cardiac tilt table testing. Whilst this may be a useful simulation of harness suspension, a more realistic test might use a drop at least to determine if there is any difference between these situations.

- What is the predictive value of anthropometric data on head up tilt and suspension tolerance?

Further knowledge of the effect of these anthropometric data may aid future harness design and methods of aiding tolerance of suspension.

- What standard format should be used for recording a fall event?

A standard recording format for a fall event would aid comparison of information gathered from different workplaces or fall scenarios. The aggregation of such information may be used for both preventive purposes and reporting to the health care responders e.g. ambulance services.

- When fall protection is used how often do workers fall into suspension and what symptoms are experienced?

The collation of such data would inform the need for further preventive measures and the incidence of suspension syncope or presyncope.

- What is the effect of the semi-recumbent bent knee posture on recovery from orthostatic presyncope?

Whilst there is limited evidence that suspension in a semi-recumbent bent knee posture is better tolerated, there is no evidence to support assertions that post rescue this position is physiologically superior or even equivalent to the horizontal position recommended in UK first aid guidance. This question could be addressed quite readily through appropriate human studies.

- Do any toxic metabolites accrue during orthostasis that may be likely to have adverse physiologic effects?

One of the putative pathophysiologic mechanisms that led some authors to advise against lying victims of suspension syncope horizontal was that toxic metabolites would re-enter the circulation and cause adverse effects. Investigation of whether such metabolites accrue and their concentration, would be a first step towards evaluating whether any adverse effects from prolonged suspension may be envisaged with horizontal positioning.

- What is the time interval between the onset of presyncope symptoms and syncope in orthostasis?

Knowledge of factors that may aid the prediction of incipient syncope would be helpful for first responders to cases of harness suspension.

- Suggested Audit Criteria:

Priority topic	Criteria
First aid at work trainers should be aware of the appropriate action for a post rescue suspension casualty.	% of first aid at work providers training to the evidence based guidance.
First aiders should be aware of the appropriate action for a post rescue suspension casualty.	% of first aiders aware of the evidence based guidance.
First aiders should be able to recognise the symptoms of pre-syncope.	% of first aiders aware of the symptoms of pre-syncope.

5 APPENDICES

5.1 APPENDIX 1 - CRITICAL APPRAISAL FORM

Reviewer(s):

Author, title:

Study type (tick all that apply)

Randomised controlled trial
Systematic review
Meta-analysis
Qualitative research
Literature review
Case-control study
Longitudinal/cohort study
Other
(Please describe)

Initial comments:

SCREENING QUESTIONS

1. Does the paper have a clearly focused aim or research question?
Yes No Can't tell
Consider:
1. population studied
2. interventions delivered
3. outcomes

2. Is the chosen method appropriate?
Yes No Can't tell
Consider whether:
1. the authors explain their research design
2. the chosen method address the research question

Is it worth continuing?
Yes No

Please explain

Detailed questions
3. Has the research been conducted rigorously?
Yes No Can't tell
Consider:
1. search strategy described
2. inclusions and exclusions
3. more than one researcher
4. resolving issues of bias

4. Is it clear how data has been analysed?
Yes No Can't tell
Consider:
1. were study results combined
2. if so was this reasonable

3. in-depth description of the analysis process
4. all participants accounted for
5. contradictory findings explained

5. Is there a clear statement of findings?
Yes No Can't tell
Consider:
1. sufficient evidence to support conclusions
2. do findings support the research question
3. precision of results
4. all important variables considered

6. How are the results presented?
Consider:
1. are the results presented numerically, i.e. p-value, OR (odds ratio)
2. are the results presented narratively

7. What is the main result?
Consider:
1. how large is the size of the result
2. how meaningful is the result
3. how would you sum up the bottom-line result in one sentence

8. Are there limitations to the research?
Yes No Can't tell
Consider:
1. was the sample size large enough
2. were all important outcomes considered
3. was the intervention process adequately described
4. was there any follow-up data
5. do the authors acknowledge weaknesses

9. Can the results be applied to a UK context?
Yes No Can't tell
Consider:
1. any discussion on how the findings can be used
2. findings considered in relation to current practice
3. estimation of benefits and costs

Accept for inclusion as evidence Yes No Can't tell

Refer to guideline leader Yes No

Guideline leader's notes:

Any references that need to be followed up from this article?

5.2 APPENDIX 2 - EVIDENCE TABLES

Title	Author(s)	Citation	Year	Language	Study Design	Study population/ Methodology	Intervention	Comparison	Outcome measures	Main Results	Effect size	SIGN
Test program to evaluate human response to prolonged motionless suspension in three types of fall protection harnesses	Orzech M A, Goodwin M D, Brinkley J W, Salerno M D, Seaworth J	Harry G Armstrong Aerospace Medical Research Laboratory, Wright Patterson Air Force Base, Ohio, USA	1987	English	Individual RCT	13 healthy subjects (1 female)	Motionless suspension in 3 types of harness.	Tolerance of harness by duration of suspension.	Withdrawal was when subjective tolerance limit was reached, syncope, hypotension or a medical decision based on reported symptoms. Heart rate, respiratory rate and suspension duration were measured and reported.	The findings give a clear order of preference for the harness types with motionless supension with the full body harness then chest harness being tolerated better than the body belt. The differences are stated to be statistically significant but no statistical result is given. One episode osyncope is recorded occurring with the full body harness but with a longer period of suspension for this subject than in the other harness types.	Mean duration of suspension in full body harness 14.38mins (CI95 4.84), chest harness 6.08 (2.03), body belt 1.63 (0.76).	1+
Comments: Although a matrix for random allocation was used it is said that subjects were incompletely randomised to the order of harness use due to scheduling difficulties. The authors felt that tachycardia and tachypnoea were consistent with anxiety as well as any change due to venous pooling. No results of BP measurements are given it is noted that a standard sphygmomanometer was used.												
Cardiorespiratory response to free suspension simulating the situation between fall and rescue in a rock climbing accident	Roeggla M, Brunner M, Michalek A et al	Wilderness Environmental Med. 7;109-114	1996	English	Individual RCT	6 healthy non smoking subjects, age 25-35 yrs, mean weight 77.2 +/- 11.3 Kg, height 1.84 +/-0.07m	A randomised crossover of motionless suspension in sit or chest harness. Tests were terminated after 3 minutes in the absence of other endpoints.	Tolerance of sit or chest harness.	Measurement of non-invasive BP and cardiac output with spirometry, SaO2 and End Tidal CO2 before and after 3 mins during suspension.	The chest harness caused impairment of all measured variables other than SaO2 but there were no changes in the sit harness. There were consistent results for all subjects studied.	Parameter, measured difference and CI95 for chest harness suspension: FEV1 1.17 (CI 95 0.56 to 1.77), FVC 1.58 (0.62 to 2.55), BP sys 33.67 (18.11 to 49.23), BP dia 8.83 (1.83 to 15.84), HR 9.0 (2.33 to 15.67), CO 1.6 (0.57 to 2.62), SaO2 0.17 (-0.62 to 0.96), ETCO2 - 3.67 (-5.38 to -1.95)	1+
Comments: The heart rate in suspension decreased which is in contrast to other reports with an initial tachycardia. . Some of the conclusions cannot be sustained from the data presented e.g. that a chest and sit harness or full body harness are preferable since these were not tested. The authors comment that, "Direct compression of circulation to the arms was ruled out by an unchanged pulse contour in pulse oximetry and PORTAPRES in suspension compared to rest".												
Tolerance to head-up tilt and suspension with elevated legs	Madsen P, Svendsen L B, Jorgensen L G, Matzen S, Jansen E, Secher N H	Aviation Space and Environmental Medicine,1998; 69:8, 781-784	1998	English	Cluster RCT	87 subjects were studied, Subjects were aged on average 25 years, range 20-41 years.	79 subjects underwent 50 degree head up tilt and 9 with an elevated leg suspension, 1 subject was common to both groups.	Tolerance of 50 degree head up tilt versus elevated leg suspension.	The outcome measures were symptoms or signs of presyncope. Subjects were also withdrawn due toexperiencing discomfort without presyncope or on completing 1 hour suspension.	There was a clear difference in the tolerance between head up tilt and elevated leg suspension with the latter being better tolerated. The authors state that 87% of subjects experienced presyn cope in head up tilt, 69 of 79. However 3 of the 79 subjects withdrew due to discomfort meaning that 91% of the subjects remaining had presyncope. 6 subjects (8%) had presyncope within 5 mins and 17 (22%) within 10mins with 50% experiencing presyncope within 27 mins.	1/9 subjects in elevated leg suspension experienced presyncope and 69/76 subjects in head up tilt p<0.02 giving a Hazard Ratio 0.13.	1+
Comments: Two groups of subjects are used rather than comparing the effects of the different positions on the same subjects. The authors do not discuss this but this may have been due to the invasive monitoring required. All symptomatic subjects were recovered in a supine position.												
Physiological limits of suspension in harness.	Weber P, Michela-Brundel G	Johann Wolfgang Goethe University	1997	German	Individual RCT	15 subjects (3 female) were randomised to sequentially use 3 types of harness in one activity and two motionless suspension situations.	Motionless suspension either hanging from a ladder or free hanging.	Tolerance of suspension.	Duration of suspension which was stopped with pain, subjective or objective orthostatic symptoms and if physiological measurement indicated orthostasis. Measurements of ECG, breathing pattern and rate, BP and thigh circumference were made. Symptom reporting was also recorded	Data are presented as median duration of suspension for each harness type and suspension situation. The change in physiological parameters is described. Statistical analysis of these data are not presented howevermultivariate analysis was undertaken which is reported to show no effect of sex or type of suspension on the physiological measurements. The timing of measurements had a significant effect with heart rate, breathing rate, BP amplitude, and thigh circumference being affected from least to most in that order. Multiple regression was applied to examine predictive aspects of suspension duration.	Two prediction equations are given for suspension duration one for each of the different suspension situations tested. The most important explanatory variables are body weight, height, shoulder width, and stomach girth. The equations explain 68% variation of duration for ladder hanging and 74% for free hanging suspension	1+
Comments: Although the subjects and researchers were not blinded it does not seem likely that one type of harness would have been preferred a priori. The harnesses tested were of a similar design and the results may only be applicable to those harnesses. This is a relatively small study and the results have not been repeated.												

Title	Author(s)	Citation	Year	Language	Study Design	Study population/ Methodology	Intervention	Comparison	Outcome measures	Main Results	Effect size	SIGN
Fatal and non fatal accidents involving falls into the rope	Flora G, Holzl HR	Papers of the Second International Conference of Mountain Rescue Doctors (Austria) (1972)	1972	German	Case Series	10 fatal cases of mountaineering falls with hanging on a climbing rope and 13 non fatal falls are described.	NA	NA	Length of time reported hanging before death or rescue.	Only one fatality had a reported hanging time less than 2 hrs and only one survivor a reported hanging time greater than 2 hrs.	NA	3
Comments: Some cases are from the authors personal knowledge others are secondary sourced but a systematic collection of data on climbing falls does not appear to have been undertaken. A statement is made that "Any fall into the rope is life threatening: in the absence of a sit harness or foot sling it leads after 10-20 minutes to paralysis of both arms and after a hanging time of over 2 hours to death". This statement however assumes complete ascertainment of data on falls which is not presented in the paper.												
Anatomical examination results in the case of death caused by hanging on the rope	Patscheider H	Papers of the Second International Conference of Mountain Rescue Doctors (Austria) (1972)	1972	German	Case Series	The post mortem findings in 4 cases of death hanging on a climbing rope are described.	NA	NA	NA	The paper describes the pathological findings of death whilst hanging on a rope. The author has experience of 137 climbing deaths, 11 of these were associated with a fall into a rope and 6 died from strangulation by the rope. The 5 remaining cases are described pathologically.The authodescribes vacuolisation of heart muscle and liver cells with minor liver necrosis. The analogy is made with hypoxic changes seen in animal experiments and in crashed pilots dying at altitude. It is also noted by the author that orthostasis and heavy exertion caused similar changes in animal experiments.		3
Comments: The histopathological changes do not appear to have been independently corroborated by another pathologist and are potentially subject to observer bias. No details on the circumstances of death are given such as the hanging time. The final assertion made is that, "For the rescue process it appears important to avoid placing the climber abruptly in the horizontal position after detachment from the rope, so that a life threatening condition does not end in disaster". No supporting evidence for this assertion is given.												
In the case of Morphological findings death after hanging on a rope for four hours	Fodisch J	Papers of the Second International Conference of Mountain Rescue Doctors (Austria) (1972)	1972	German	Case Report	A single case of death whilst hanging on a rope for 4 hours.	NA	NA	NA	Hepatocyte vacuoles and fatty degeneration of liver parenchyma, and some renal changes are described along with patchy myocardial degenera tion. The finding described as "impressive" was of necrobiosis and necrosis of differenct brain ganglion cells. Fibrin clots in liver sinusoids and splenic arterioles are suggested to indicate a coagulopathy or premortal circulatory shock	NA	3
Comments: This paper describes the histopathological findings of one pathologist which are potentially subject to observer bias.The circumstances of the accident and rescue are not described. The histopathologic changes are consistent with hypoxia.												
Death in a head-down position	Madea B	Forensic Science International, 1993; 61:119-132	1993	English	Case Series	This article describes the circumstances of death by suspen sion with the legs in elevation above the head in 4 cases found in the literature and a further 5 anecdotal descriptions.	NA	NA	NA	It is suggested from the post mortem changes that death in "reverse suspension" may take several hours. This is evidenced by the finding of a poly morphonuclear cell infiltrate in the gravitationally dependent forearms.	NA	3
Comments: This paper is a reminder that suspension may occur in both head up and head down positions.												
Rescue and prevention	Mallard M	French Caving Federation 1990	1990	French	Case Series	12 fatalities and 4 cases of exhaust ion on a rope are reported. There is a brief description of 3 attempts at harness suspen sion in a hospital setting.	NA	NA	NA	The causes of death in the reported fatalities included the possibility of hypoglycaemia, hypother mia and drowning. Rescue took over 20 hours in two fatal cases. Two cases of exhaustion one with loss of consciousness and the second with other symp toms improved after being placed in the recovery po sition. The harness suspension in a hospital setting cannot be regarded as an experiment since only 3 subjects were involved in a single suspension using different circumstances. One subject but it is not clear which one, became unconscious.		3
Comments:Factors other than motionless suspension may have contributed to fatalities. The recovery position was successfully used in those rescued.												

5.3 APPENDIX 3 - GLOSSARY OF TERMS

Bradycardia: Abnormally slow heart rate or pulse.

Hypotensive/Hypotension: Abnormal lowering of the blood pressure.

Hypoxia: A diminished amount of oxygen to the tissues.

Nausea: The sensation of feeling sick.

Orthostatic: Relating to or caused by erect posture.

Orthostatic Hypotension: Also known as postural hypotension, and, colloquially, as head rush or a dizzy spell, is a form of hypotension, which there is a sudden (less than 3 minutes) fall in blood pressure that occurs when a person assumes a standing position usually after a prolonged period of rest.

Pre Syncope: Symptoms and signs, which are indicative of impending collapse.

Reflow Syndrome: A putative state said to be caused when stagnant pooled blood in the legs is allowed to rapidly flow back into the circulation.

Semi-Recumbent: Lying on the back at a 45^{o} angle.

Supine: Lying horizontally on the back with the face upwards.

Suspension: The state of being suspended; something on or by which something else is suspended or hung; something that is suspended or hung.

Syncope: The sudden transient loss of consciousness and postural tone with spontaneous recovery as may occur with a simple faint.

Trauma: A body wound or shock produced by sudden physical injury, as from violence or accident.

Unconscious: Without awareness, sensation, or cognition. This may vary in depth from deeply unconscious where no response can be obtained to a level of consciousness where the individual can be roused by speech or non-painful stimuli.

Vasovagal: Relating to or involving blood vessels and the vagus nerve.

5.4 APPENDIX 4 - STAKEHOLDER WORKSHOP SUMMARY AND SATKEHOLDER LIST

Review of the Current Guidance and Advice Available on First Aid Measures for Dealing with Suspension Trauma Casualties

Stakeholders Workshop 30.04.08

There were 42 attendees including the presenters, at the stakeholder's workshop convened to discuss the draft evidence based review report produced by the Health and Safety Laboratory on behalf of the Health and Safety Executive.

Louise Robinson, Professor Keith Porter and Anil Adisesh gave presentations before the draft recommendations were reviewed in the afternoon session. Anil Adisesh gave an overview of the review background and methodology. The purpose of the review was to produce, "Simple, clear, agreed and authoritative recommendations for first aid for those who may be suffering from suspension trauma, using fall arrest systems in the workplace". The use of the term "suspension trauma" might itself be questioned since whilst suspension is a necessary condition, trauma is not an accurate description of the possible ensuing medical circumstances.

Louise Robinson's presentation on harnesses for fall protection concluded that suspension in a fall arrest harness at work was unintentional. It was intentional with industrial sit harnesses. Both situations were applicable to sport climbing harnesses. An overview was given of fall arrest systems, which are used where it is not practical to fit any permanent means of fall prevention. The user's position of suspension in front and rear attachment harnesses was illustrated and examples of harnesses were displayed. The use of industrial sit harnesses for rope access was then presented with illustrations of the suspension position for an unconscious subject. It was however noted that the "cow's tail" back up would limit the fall to about 1 metre and hence also limit consequent injury. Falls in sport climbing were more likely to be of greater distance since there is a dependency on the protection used and the skill of the belayer. Rescue of casualties was discussed with the options of remote rescue, rescue in descent and self-evacuation. Lowering a casualty is generally preferable since this is a less demanding manual handling task.

Professor Keith Porter described the medical condition of orthostasis and the attendant complications. Reference was made to previous models explaining the course of uncorrected orthostasis and a simplified diagram was presented. Some other medical conditions and treatments are associated with orthostatic changes. The range of diagnoses was discussed. Rescue of casualties from water is a different medical situation from hanging suspension since there are the physiological effects of the loss of external hydrostatic pressure and thermal effects to consider. Some authors have failed to recognise these differences. Elevation of the legs when in hanging suspension is better tolerated than with the legs dependent. This was a finding from the review of recent research but had previously been the subject of conjecture. The inability to exercise the legs against a fixed point was considered to be contributory to collapse with potentially fatal consequences.

There followed interaction with the workshop in clarifying various questions.

Do harnesses reduce venous return?

Do harnesses produce a tourniquet effect?

Is there a significant reperfusion effect?

What happens in parachutists?

Anil Adisesh then outlined the Scottish Intercollegiate Guideline Network (SIGN) methodology that was used to perform the review. This is a structured method of formulating a question and then gathering evidence to address the question with critical appraisal of the literature.

The second session discussed each of the 4 questions raised by the review and the draft recommendations. Helpful points were made during this discussion period about correct technical terminology for fall prevention, time to rescue, use of alternative terms for “suspension trauma”, and gathering intelligence on falls from height. Other questions and discussion addressed the issue of first aid response and whether this applied to non-work situations. It was clarified that the work was undertaken with a focus on the workplace and other organisations may wish to take account of it in developing their own guidelines and practice.

A point of discussion but also broad agreement amongst the clinical professionals present was that, “no changes to the standard UK first aid guidance for the recovery of a semiconscious or unconscious person in a horizontal position was recommended, even if the subject of prior harness suspension.” Airway management may determine whether a prone or supine position was used again in accordance with standard UK first aid guidance. The sometimes quoted suggestion of recovery in a semi-recumbent or sitting position was considered to be without any sound evidence base and may prove dangerous through prolonging the lack of blood return to the brain.

Other discussion followed on the management of persons rescued from fall prevention and the possibilities of further research in this area. There was general agreement that the review was welcomed, as clarity was required for first responders and first aiders. Following the meeting some further comments were gratefully received by email and post.

Suspension Trauma Workshop Stakeholders, 30 April 2008

Selly Oak Hospital x 2 representatives
Warrington Hospital
London Ambulance Service NHS Trust
Dorset Ambulance Service
UVSAR
Simian Risk Management
William Hare Limited, Brandlesholme House
Fall Protection Associates
IKAR GB
Central Highrise Ltd
Relative Solutions
Maritime and Coastguard Agency x 2 representatives
USR
BCRO
Chairman MR E &W
IRATA x 2 representatives
Safesite (WAHSA rep)
Spanset (UK) Ltd
Rig Systems Ltd
National Access and Rescue Centre (NARC)
Eastwood & Partners
British Red Cross
CMO, St John Ambulance
Scottish Power
Chairman of IRATA's Equipment Committee
HSE x 3 representatives
HSL x 5 representatives

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Published by the Health and Safety Executive 05/09

HSE

Health and Safety Executive

Evidence-based review of the current guidance on first aid measures for suspension trauma

In 2002 the UK Health and Safety Executive (HSE) published a review entitled 'Harness Suspension: Review and Evaluation of Existing Information'. It was noted in this report that the rescue plan was an essential part of fall protection arrangements. The report quoted and summarised advice extracted from various papers concerning harness suspension and noted that, 'some of the advice appears to conflict'. Nevertheless, although this document was not intended to be a review of the medical advice for rescue from suspension it has been frequently cited in such a context and in support of measures that differ from standard UK first aid practice. Consequently, it was the recognition that authoritative guidance was needed for first responders, in the workplace setting, to any cases of a fall into harness suspension, which led to this project being undertaken.

The Health and Safety Laboratory (HSL) was asked to review the advice and guidance available on suspension trauma. This review was used to address the questions of whether the current information and advice available for treating suspension trauma casualties was adequate and in line with current practice and recommendations, and whether there was a need for HSE to produce guidance.

This report and the work it describes were funded by the Health and Safety Executive (HSE). Its contents, including any opinions and/or conclusions expressed, are those of the authors alone and do not necessarily reflect HSE policy.

RR708

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