High Structure Rescue Training (Arqiva)

DURATION
1 Day

COURSE REQUIREMENTS
Medically Fit
Current Industry Recognised Climbing Certificate

RATIO OF TRAINERS TO TRAINEES
Up to 1 to 6



Height Safety Training
Equipment Supply
Kit Inspection

XI Training Limited Unit 1 Keer Bridge Depot
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High Structure Rescue / Evacuation

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Rationale and Theory for Rescue and Evacuation Systems

Rationale

An unconscious casualty suspended in a full body harness can suffer permanent damage or even death within 6-20 minutes (assuming that they have used the Fall Arrest Loop and are upright).

If they have not, then they could be hanging upside down and may suffer breathing problems, oxygen starvation and death within approximately 3-5 minutes. Rapid safe action is needed.

Rescue is required immediately as prolonged suspension in even a 'good' harness will cause unconsciousness and a build up of toxins due to reduced blood flow.

Consideration must be given to the most suitable position for an unconscious casualty with suspension trauma. A simple system of support under the knees & recovery to ground in the same position may help to reduce 'shunting' of cold, toxic blood returning to the heart and other vital organs causing death.

It would appear that laying a suspension trauma casualty down could cause death, however this must be taken into consideration with the priorities of other injuries.

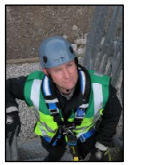
In a less than worse case scenario a climber may have deployed their fall arrest system and it may therefore be unsuitable for effective further use. In this circumstance the evacuation system is simply a means to get the climber to the ground safely. This could simply involve getting another workable fall protection system to the casualty so that they can climb back down safely.

Alternatively the climber may be injured, but still conscious and able to assist, in which case it is safest to lower them down on his or her own, the rescuer controlling the system from above.

Theory for Rescue and Evacuation Systems

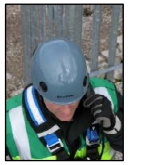
Contact should be made with the emergency services as soon as possible if they are required and / or with your company who may be able to contact a local Rigging Company and ask for assistance. It would be prudent for all Rigging / Access companies to have employees trained and available to assist with rescues in their area. Not to replace the need for rescue training for all climbers but to offer technical support and advanced stretcher rescue procedures when needed.

What To Do in a Worse Case Scenario



- Danger - to yourself, the Casualty, others, RF Hazards?
- Response - are they conscious? Shout.

- Decide what help you will need and call or send for it.
  Make sure access to site is clear and unambiguous



- Airway - turn them upright if needed and clear airway.
- Breathing - are they breathing? Look, listen and feel

- Make a quick assessment of the injuries. Keep treatment on the tower to a minimum unless life threatening. Be concerned about Suspension Trauma, if conscious tell casualty to "pump" legs.

- The priority is to evacuate to platform, or better still, the ground and then hand over to the emergency services.

- Once off the structure make the Casualty secure –Treat for suspension trauma, or ATTEMPT CPR IF REQUIRED. Treat for shock.

- Once handed over to the Emergency Services complete Accident Report and inform your manager.

- Rescue kits are designed for single use only. They must be returned to issuer if used. All components conform to current CE EN standards.

Equipment Used

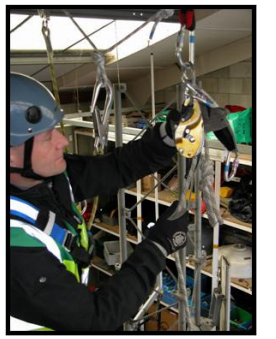
The Equipment used needs to be kept simple in order to avoid confusion.

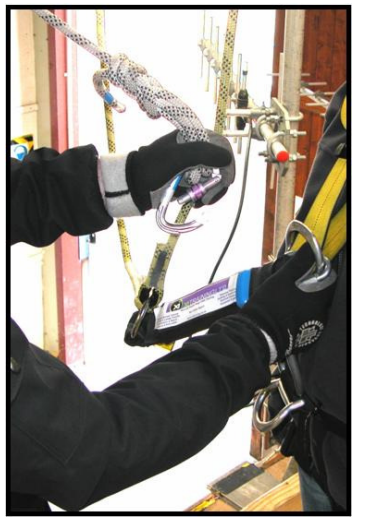
- 1 anchor sling to attach to the structure.
- 1 karabiner to link the sling to the rope.
- 1 rope of suitable size for the descender and suitable length.
- 1 auto locking descender which ideally stops both when you let go of it and when you grab it too hard. Industrial Descender (I.D.) or Double Stop.
- 1 pear shaped maillon or mini rigging plate to take a three way loading.
- 1 karabiner for attaching to the rescuer/ operator.
- 1 short wire pick off sling to provide a link to the casualty
- 1 karabiner to attach to the casualty

System to lower a single person from high structure

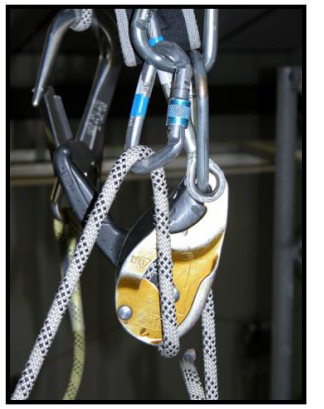
1. Attach the anchor sling to an unquestionably sound piece of the structure.

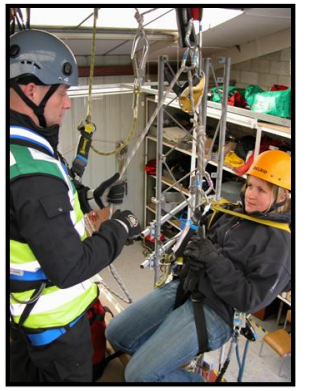
2. Suspend rescue rig upside down from anchor sling, park short rescue sling.
Check rope direction through I.D.!





3.Fasten the end of the rescue rope onto a fall arrest point on casualties harness.





4. When using the I'D descender, Increase friction if required, by clipping back to extra karabiner on Pear Maillon.

Check that ALL connector gates are closed and secure.

Remove their fall arrest attachment from the structure and slowly lower them to the ground, platform or area of safety.

System for Unconscious Casualty Pick Off

STOP, THINK, call for help.

1.Check that all equipment is present and rigged correctly in rescue bag

2.Reassure casualty and assist where possible on your ascent to anchor location. Keep first aid to a minimum





3. Attach the anchor sling and rescue rig to an unquestionably sound piece of structure, check ALL connector gates are closed and right way round (gate secures downward).



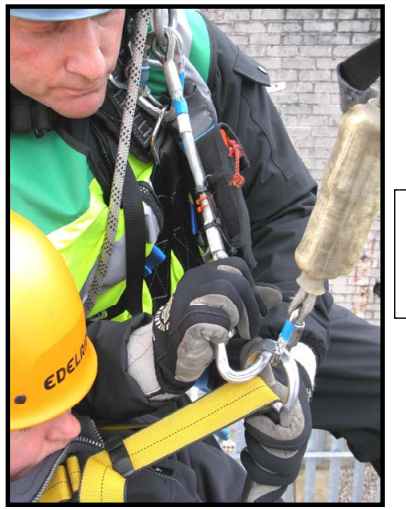
4. Connect the single connector to your work position.



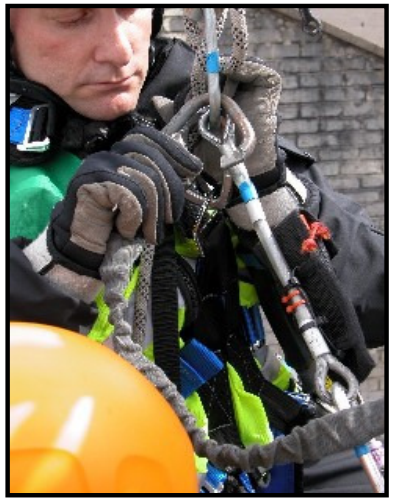
5. Make sure the descender works and then locked off, once certain that every thing is correct remove fall arrest attachments from the structure.

6. Descend in a controlled manner until just above the casualty.





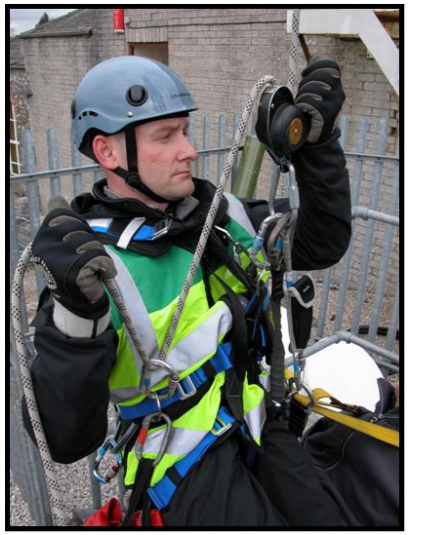
7. Keeping above the casualty much as possible, connect it to the casualties FALL ARREST loop. This will reduce loading on the system when you cut them away.



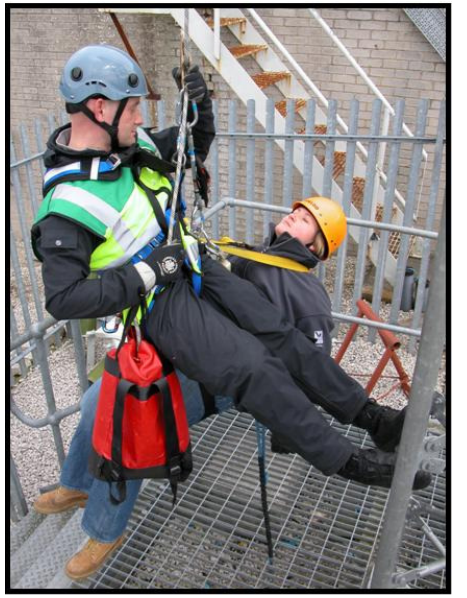
8. Where Possible attach casualties spare lanyard to the pear Maillon. Final inspection that all connector gates are closed and secure.



9. Remove knife (CAUTION), take the casualties weight with one hand, to reduce chance of a shock load. Make sure he/she is not caught on part of the structure, cut away from casualty and self.



10. When using the PETZL I'D to perform a casualty rescue a second connector *MUST* be used to increase the amount of friction available. This can be sited on the side D ring for light loads, and on the work position for heavier loads



11. Once hanging free secure the knife safely and descend slowly to the ground or platform. As you land assist the casualty into the most suitable position for their injuries.

System for Self Evacuation

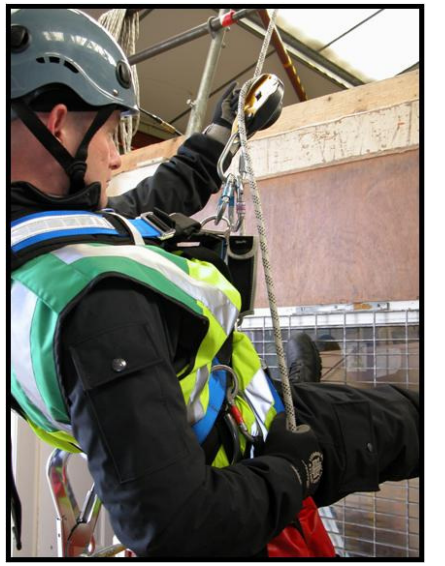
1. Secure the anchor sling to an unquestionably good anchor point.

2 Connect the Karabiner nearest to the device to your Front work positioning (or fall arrest) attachment point.



3.Test the device to ensure that it is rigged correctly and works. Then take up any slack in the system and lock the device.

4.Double check all connections and commit your weight to the descending system. Remove any other attachments (fall arrest / work positioning).



5.To descend, ensure you are holding the lower tail of rope firmly in your right hand and keep this hand down by your thigh. Your feet should be kept a shoulder width or so apart. Gently operate the lever with your left hand to descend.

Self Rescue using Automatic descent Controller (A.D.C)

This device generally operates on 9mm Kernmantle rope and utilises a geared speed controller at approximately 0.1m/s.

The device requires very little training and has proven itself useful for evacuation from cranes, man riding platforms and forklift vehicles. These devices are excellent for self-rescue when there is no chance of entanglement with objects below, or you have multiple evacuations of untrained persons. **Diagram1**

A.D.C.s are some what limited for two man use on masts and towers due to the lack of obstruction avoidance, and the possibility of the casualty becoming tangled in the structure, as the rescuer is remote from the casualty. **Diagram 2**

Some of these devices have the capacity for 2-person use, however this reduces the operational height of the A.D.C. and proves difficult for the single rescuer to manage the initial attachment to the casualty.

This could mean that a standard evacuation with rescuer and casualty together would still be needed and thus 2 systems required instead of the current 1.

It is easy to see the potential benefits of using A.D.C., however as with all rescue situations a high level of training is always required and the standard maintained.

Diagram 1

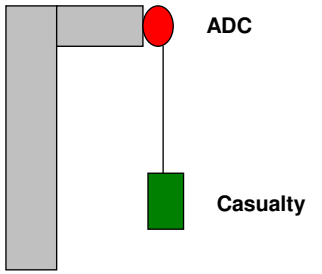
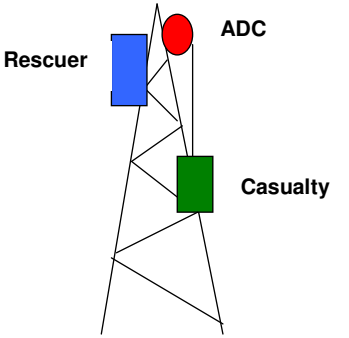


Diagram 2



Use of evacuation Triangle and Cracker Mini-hoist

Rescue Triangle

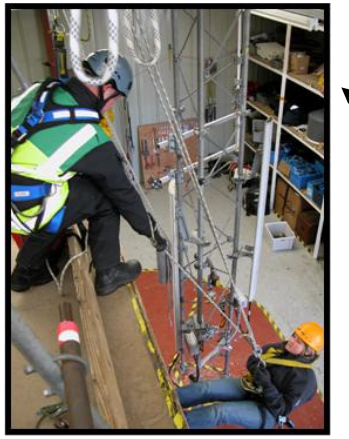
A rescue triangle is invaluable in situations where the casualty has no harness of where the harness they are wearing is damaged**.** It is simple and consists of a structural triangle of material with attachments at each of the three corners, which can be linked together to form a very basic harness.

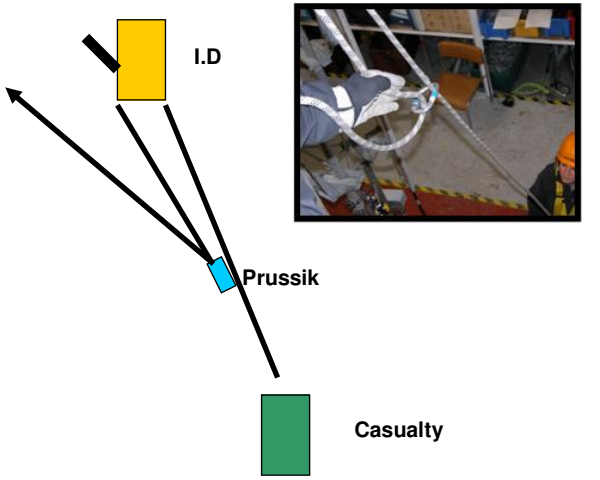
Cracker Mini-hoist

This is a small multiple pulley hoist system which can be attached to the rescuers rope by means of an ascender, to provide a means taking the casualties weight off their fall arrest system in order to release it. Commonly packaged in a small bag it is very useful if there is no soft link in their fall arrest equipment, such as in the Latchway system, which can be cut.

Use of simple Z drag to haul with the I.D

With the I.D in the lowering position, send a loop of the slack rope down to the causality and connect it to the fall arrest point. If you have additional kit slide a rope grab (Prussik) down the casualties line, clip the slack line into the Prusik karabiner & haul away, stop & reset the Prussik as needed. A pulley at the redirection point will make the system more efficient.





Will Your Safety Harness Kill You?
Workers and emergency response personnel must be trained to recognize the risks of suspension trauma.

by Bill Weems and Phil Bishop

I was surprisingly comfortable with my legs dangling relaxed beneath me, and my arms outstretched in a posture that must have resembled a crucifixion. I had no feeling of stress and mused as to why this was considered dangerous. I felt I could stay in this position for a long time. Three minutes later, maybe less, I wondered why I suddenly felt so hot. The next thing I knew, they were reviving me from unconsciousness.

I had just experienced what could be deadly for your workers who use safety harnesses. Fortunately for me, my suspension trauma occurred in the safe environment of the research ward of University of Texas Medical Branch Hospital at Galveston, Texas, where I was the first subject in a NASA experiment studying orthostatic intolerance in astronauts. Your workers won't be so lucky.

Harness-Induced Death

Wide ranges of situations require safety harnesses of various types. Workers requiring fall protection, workers entering many confined spaces, mountain climbers, deer hunters in elevated stands, and cave explorers all try to protect themselves through the use of safety harnesses, belts, and seats. What is little known however, is that these harnesses can also kill.

Harnesses can become deadly whenever a worker is suspended for durations over five minutes in an upright posture, with the legs relaxed straight beneath the body. This can occur in many different situations in industry. A carpenter working alone is caught in mid-fall by his safety harness, only to die 15 minutes later from suspension trauma. An electrical worker is lowered into a shaft after testing for toxic gases. He is lowered on a cable and is positioned at the right level to repair a junction box. After five minutes he is unconscious--but his buddies tending the line don't realize it, and 15 minutes later a dead body is hauled out.

The cause of this problem is called "suspension trauma." Fall protection researchers have recognized this phenomenon for decades. Despite this, data have not been collected on the extent of the problem; most users of fall protection equipment, rescue personnel, and safety and health professionals remain unaware of the hazard.

Suspension Trauma

Suspension trauma death is caused by orthostatic incompetence (also called orthostatic intolerance). Orthostatic incompetence can occur any time a person is required to stand

quietly for prolonged periods and may be worsened by heat and dehydration. It is most commonly encountered in military parades where soldiers must stand at attention for prolonged periods. Supervisors can prevent it by training soldiers to keep their knees slightly bent so the leg muscles are engaged in maintaining posture.

What happens in orthostatic incompetence is that the legs are immobile with a worker in an upright posture. Gravity pulls blood into the lower legs, which have a very large storage capacity. Enough blood eventually accumulates so that return blood flow to the right chamber of the heart is reduced. The heart can only pump the blood available, so the heart's output begins to fall. The heart speeds up to maintain sufficient blood flow to the brain, but if the blood supply to the heart is restricted enough, beating faster is ineffective, and the body abruptly slows the heart.

In most instances this solves the problem by causing the worker to faint, which typically results in slumping to the ground where the legs, the heart, and the brain are on the same level. Blood is now returned to the heart and the worker typically recovers quickly. In a harness, however, the worker can't fall into a horizontal posture, so the reduced heart rate causes the brain's blood supply to fall below the critical level.

Orthostatic incompetence doesn't occur to us very often because it requires that the legs remain relaxed, straight, and below heart level. If the leg muscles are contracting in order to maintain balance and support the body, the muscles press against the leg veins. This compression, together with well-placed one-way valves, helps pump blood back to the heart. If the upper-legs are horizontal, as when we sit quietly, the vertical pumping distance is greatly reduced, so there are no problems.

In suspension trauma, several unfortunate things occur that aggravate the problem. First, the worker is suspended in an upright posture with legs dangling. Second, the safety harness straps exert pressure on leg veins, compressing them and reducing blood flow back to the heart. Third, the harness keeps the worker in an upright position, regardless of loss of consciousness, which is what kills workers.

Phases of Fall Protection

There are four phases of fall protection: Before the fall, at fall arrest, suspension, and post-fall rescue. Each phase presents unique safety challenges. Suspension trauma can be influenced by all aspects of the fall, so they are all important. As with many aspects of safety, increasing the safety in one phase can compromise the safety of the others. Whatever training workers have received will determine how they respond to different phases. Here is a brief discussion of each aspect of fall protection.

Before the fall

The key issue of fall protection before the fall is compliance. If a harness is too uncomfortable, too inconvenient, or interferes too much with task completion, workers may not use the equipment or may modify it (illegally) to make it more tolerable. A

second major point is the length of the attachment lanyard, or, how far can a worker fall before his fall is arrested? The longer the fall, the greater the stress on the body will be when the fall is arrested. The shorter the lanyard, the more often it will have to be repositioned when workers are mobile. A moveable safe anchor is one solution, but this situation is only occasionally available.

Fall arrest

The whole concept of fall protection is that workers who fall will be stopped by the tethering system. The longer the attachment lanyard, the greater the acceleration time during the fall and the greater the stress on the body at arrest. Unfortunately, the posture of the falling worker is unpredictable.

Depending on the harness attachment point and the position of the worker's body at arrest, different harness attachments offer different advantages. An attachment near the shoulders means that any drag from the lanyard will serve to position the worker's body in an upright position so the forces are distributed from head to foot. The head is somewhat protected if the legs and body precede it in the fall, but this offers some disadvantages after the fall arrest is completed.

Suspension

Many safety professionals naturally assume that, once a fall has been arrested, the fall protection system has successfully completed its job. Unfortunately, this is not the case. A worker suspended in an upright position with the legs dangling in a harness of any type is subject to suspension trauma. Fall victims can slow the onset of suspension trauma by pushing down vigorously with the legs, by positioning their body in a horizontal or slight leg-high position, or by standing up. Harness design and fall injuries may prevent these actions, however.

Rescue

Rescue must come rapidly to minimize the dangers of suspension trauma. The circumstances together with the lanyard attachment point will determine the possibilities of self-rescue. In situations where self-rescue is not likely to be possible, workers must be supervised at all times. Regardless of whether a worker can self-rescue or must rely upon others, time is of the essence because a worker may lose consciousness in only a few minutes. If a worker is suspended long enough to lose consciousness, rescue personnel must be careful in handling such a person or the rescued worker may die anyway. This post-rescue death is apparently caused by the heart's inability to tolerate the abrupt increase in blood flow to the right heart after removal from the harness. Current recommended procedures are to take from 30 to 40 minutes to move the victim from kneeling to a sitting to a supine position.

Interference Among Phases

An arrest harness attachment on the front of the body facilitates self-rescue after a fall. However, a front attachment means the arresting lanyard may be in the way for many work tasks. An attachment point near the center of gravity (CG) makes post-fall body positioning much easier and increases the likelihood that a fallen worker will not be suspended in an upright vertical position.

Yet a front near-CG attachment point can greatly increase the bending stress on the spine at the instant of arrest, raising the possibility that the arrest itself results in serious injury. The most protective harnesses for suspension can be the least comfortable.

Recommendations
Safety harnesses save many lives and injuries. However, continual vigilance is needed to train and supervise workers to ensure harnesses are used safely. All phases of fall protection need to be examined for each particular application. Workers and emergency response personnel must be trained to recognize the risks of suspension trauma.

Before the potential fall:

1. Workers should never be permitted to work alone in a harness.
2. Rope/cable tenders must make *certain* the harness user is conscious at all times.
3. Time in suspension should be limited to under five minutes. Longer suspensions must have foothold straps or means for putting weight on the legs.
4. Harnesses should be selected for specific applications and must consider: compliance (convenience), potential arrest injury, and suspension trauma.
5. Tie-off lanyards should be anchored as high and tight as work permits.

After a fall:

1. Workers should be trained to try to move their legs in the harness and try to push against any footholds.
2. Workers hanging in a harness should be trained to try to get their legs as high as possible and their heads as close to horizontal as possible (this is nearly impossible with many commercial harnesses in use today).
3. It the worker is suspended upright, emergency measures must be taken to remove the worker from suspension or move the fallen worker into a horizontal posture, or at least to a sitting position.
4. All personnel should be trained that suspension in an upright condition for longer than five minutes can be fatal.

For harness rescues:

1. The victim should not be suspended in a vertical (upright) posture with the legs dangling straight. Victims should be kept as nearly horizontal as possible, or at least in a sitting position.
2. Rescuers should be trained that victims who are suspended vertically before rescue are in a potentially fatal situation.
3. Rescuers must be aware that post-rescue death may occur if victims are moved to a horizontal position too rapidly.

Recommendations on harnesses:

1. It may be advantageous in some circumstances to locate the lanyard or tie-off attachment of the harness as near to the body's center of gravity as possible to reduce the whiplash and other trauma when a fall is arrested. This also facilitates moving legs upward and head downward while suspended.
2. Front (stomach or chest) rather than rear (back) harness lanyard attachment points will aid uninjured workers in self-rescue. This is crucial if workers are not closely supervised.
3. Any time a worker must spend time hanging in a harness, a harness with a seat rather than straps alone should be used to help position the upper legs horizontally.
4. A gradual arrest device should be employed to lessen deceleration injuries.
5. Workers should get supervised (because this is dangerous) experience at hanging in the harness they will be using. [OHS endbug]

Authors

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Reference

Seddon, Paul. *Harness Suspension: review and evaluation of existing information*. Health and Safety Executive. Research Report 451/2002. 104 pp.

Pull quotes: All personnel should be trained that suspension in an upright condition for longer than five minutes can be fatal. Depending on the harness attachment point and the position of the worker's body at arrest, different harness attachments offer different advantages.
Fall victims can slow the onset of suspension trauma by pushing down vigorously with the legs, by positioning their body in a horizontal or slight leg-high position, or by standing up.

SUSPENSION TRAUMA FOR NON-MEDICAL PEOPLE!

What is suspension trauma?

Suspension trauma is the common name given to orthostatic shock resulting from being suspended motionless in a harness. Orthostatic syndrome is well understood within the medical community but strangely the idea that it can arise from being suspended in a harness is not.

The most common example of an orthostatic syncope is that of a soldier who, having been upright for a long period of time feints into a horizontal position, which is the body's way of enabling them to regain consciousness. A full body harness wearer who remains upright and motionless for a length of time is unable to employ this natural defence and so the situation becomes a dangerous one.

What causes suspension trauma?

The major factor in orthostatic syncope is that of venous pooling, where the blood accumulates in the lower parts of the body due to natural gravity. Usually motion encourages the body to continually pump blood around its system but when motionless the body fails to do this as effectively and the blood pools, bringing about hypovolaemia which results in a fall in cardiac output and arterial pressure. The body compensates for this state of affairs by going into orthostatic syndrome, which first sees tachycardia and an increased blood pressure, followed soon by a drop in pulse rate and blood pressure. These symptoms can lead to unconsciousness and death. German research in the nineteen-seventies saw the effects of orthostatic shock become evident within five minutes of being immobile in a harness.

Factors that may increase the risk of orthostatic shock in a suspended casualty include unconsciousness, entrapment, fatigue, dehydration, hypothermia, low glucose etc. Anxiety can also contribute to making the casualty's condition worse as this stimulates chemicals in the body leading to an imbalance that can promote hypovolaemia.

The symptoms (in no particular order)

- Pallor
- Cold sweats
- Nausea
- Ringing in the ears
- Blurred vision
- Loss of consciousness

The implication for rope rescuers

Possibly the most important thing to stress with regards to orthostatic shock and rope rescuers is the risk at which we're at. Think how often you or one of your Team members has simulated an unconscious casualty for a training exercise, or how often you've been suspended in an awkward position whilst treating a casualty. Mountain rescuers not only need to be aware of the possibility of suspension trauma in others, but also in themselves. Prevention is better than cure and common sense plays a big role in this with the rescuers only 'working' when fit to do so, making sure they take on plenty of fluids, keeping warm and, most importantly, by keeping moving.

A uniform treatment for suspension trauma has not yet been developed and this is a very real challenge for those in the wider medical community as well as those engaged specifically in rescue medicine. Quickly returning a casualty to the horizontal position will cause deoxygenated blood and toxins to flood from the area in which they have pooled into the heart and bring about cardiac arrest, and this should be borne in mind when dealing with any casualty who you suspect may have been susceptible to suspension trauma. The only suggested treatment at present would seem to be a slow returning of a casualty to the horizontal, which obviously proves problematic for a normal stretcher evacuation and must be balanced against whatever other medical conditions are present. Bear in mind that the ambulance crews that you hand the casualty over to may not be familiar with the term 'suspension trauma' but will be well aware of orthostatic shock.

The report

A copy of Paul Seddon's report for the HSE, *"Harness suspension: review and evaluation of existing information"* can be downloaded for free from the HSE website (http://www.hse.gov.uk/research/crr_pdf/2002/crr02451.pdf) or purchased from HMSO for about £20.

Key words explained

Orthostatic: "relating to, or caused by an upright posture"
Syncope: "temporary loss of consciousness caused by low blood pressure"
Hypovolaemia: "a decreased volume of circulating blood in the body"
Tachycardia: "an abnormally rapid heart rate"

Nick Mattock Bowland Pennine Mountain Rescue Team

PPE Purchase From Xi Training – Industrial Climbing

As well as training, Xi Training provides clients with PPE from a range of top manufacturers within industrial climbing. For more information regarding any of the products we sell, contact us.

Rescue Kit 50m & 100m

A full rescue kit suitable for the safe rescuing of a casualty from around 45m or 95m (depending on rope length)

Comprises: 1) 1.5m Wire strop 2) Klettersteig Karabiner 3) Rope 50m/100m 4) I'D Descender 5) Pear Maillon 6) x3 Karabiners 7) Rescue sheers and pouch 8) 30cm wire strop 9) Rescue Bag



1. 1.5m Wire strop—1.5m x 7mm, EN795B WLL 250kg

2. Klettersteig Karabiner—Screwgate EN362 45kN breaking loads

3. Rope 50m/100m—10.5mm Beal Antipodes—EN1891 A

4. I'D Descender— Petzl, Gold, EN341 A, EN12841 C

5. Pear Maillon—10mm Maillon rapide EN362, EN12275 Q WLL 250kg

6. x3 Karabiners—Steel, Oval, Screwgate, EN362

7. Rescue sheers and pouch—with safety clip and Velcro securing strap

8. 30cm wire strop—30cm x 7mm, EN795 B WLL250kg

9. Rescue Bag 50m/100m - 20 or 30 litres capacity (50m rope or 100m rope), with inside rope loop to tie rope to bag, red with rescue label, straps for carriage.