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СПАСАТЕЛЬ
Disasters

Caving is not a dangerous sport in itself, but the harsh environment of caves can turn even a minor accident into a tragedy. Accidents happen to anyone, so First Aid and rescue cannot be left to one person. How well you cope with adverse conditions is as much a measure of competence as how well you cope with the more expected problems of caving.

First Aid

It is the responsibility of every caver to do an accredited first aid course such as one of the St John Ambulance courses. A basic grounding in First Aid will help you assess the condition of a victim and thus make a decision that could save their life.

A First Aid kit should always be available on the surface. What the kit contains depends on where you are caving: the further away from civilisation, the more comprehensive medical supplies must be. Some cavers carry first aid kits underground, some do not. In an emergency, most cavers wear enough clothing from which to improvise bandages.

Exposure/Hypothermia

Exposure results when a person's body temperature drops lower than 34° C. Below this they are unable to generate sufficient heat to warm themselves and maintain correct body function. Those most at risk are cavers who are ill equipped, those who become cold, wet, exhausted or injured. Exposure symptoms include exhaustion, uncontrollable shivering, clumsiness, irrationality and inability to move through the cave. All cavers should watch others in the group, especially weak or injured cavers and when there are swims and wet pitches.

The only treatment available to cavers is to rewarm the patient. Once hypothermia has set in the victim will be incapable of rewarming themself. The best external heat source is another caver or two jammed into the same sleeping bag or under the same rescue blanket with several carbide lamps. The chances of rewarming a severely hypothermic caver in a cave are very low and the situation should simply not be allowed to arise.

Floods

Xongo Dwi Ñi, Mexico

... five minutes later

Active caves are often natural drains that can fill up with water. In potentially dangerous passages always keep an eye open for good escape routes. Not necessarily to escape from the cave but at least escape to a safe zone where you can wait for the water to drop. If there is no safe zone do not waste time in high risk areas. Should the water rise or suddenly turn cloudy brown get out of the water flow as fast as possible. Do not try to race the flood pulse down the cave and avoid flowing water as much as possible.

If a rope is hanging in floodwater and you will be hit by a lot of water on the way up or down, it is much safer to sit and wait. Once you are on a rope escape is limited and ascending waterfalls is exceptionally dangerous both from the possibility of drowning as well as from heat loss, exhaustion and eventual exposure caused by a heavy flushing with cold water. Only by experiencing a cave in flood can you truly appreciate the need for rigging ropes clear of the water.

Should you become trapped in a safe zone the best choice is to sit and wait for the water to drop. If wet, wring out all clothing and put everything on except a waterproof oversuit. This

will allow underclothing to dry out and once dry you can put the oversuit back on. Make a seat from a sack or ropes and sit in a foetal position under a rescue blanket. Forget how ugly cavers are and form a tight group to share body heat. If there is enough carbide, keep at least one lamp running under the rescue blanket to provide extra heat. When you have a choice find a dry open place out of the breeze where everyone can stretch out occasionally and try to sleep as much as possible. Every now and then check on the water level and turn the rescue blanket over to let any condensation dry off. Ration what food and carbide you have so that it will last as long as the expected stay allowing enough to get out when the time comes.

Exhaustion

Learn your limits. One caver 'done in' at the bottom of a deep cave can make for a slow and desperate ascent and ruin the trip for everyone. It is perhaps hard to admit that a trip is too difficult but this will certainly be better than having to be rescued. It may be the trip leader's duty to tell someone they cannot do the trip or must satisfy themselves with a shorter version of it.

People become tired faster when caves are cold, wet and strenuous and this can eventually lead to exposure. Badly rigged ropes or pitches rigged wetter than they need to be also tire people out. Never start up a pitch if there is any serious doubt of having enough energy to reach the top.

Trapped on rope—harness hang syndrome

Humans are not designed to stay still in a vertical position and any circumstance that keeps you immobile and with your feet substantially lower than your body is dangerous. It's what causes people to feint after standing too long. Falling over of course returns them to horizontal and they recover. If you are on a rope and feint, you stay right where you are. If you must stop for a long time on rope, move to a ledge where you can move about a little. If you are really stuck, at least move your legs—pushing against a wall is better than just swinging them in space—and don't try to sleep while you're waiting.

The problem is that if your legs are immobile and below you, your blood start to pool in them. Much of the pumping force required to return blood to your heart is supplied by muscle action. Blood isn't just pushed by your heart. If you remain still you will experience extreme discomfort within 30 minutes or less. By then it may be too late. There is a fair chance that you'll pass out. It gets worse. Once you have been immobile on rope for as few as ten minutes you are in grave danger. Even if someone can pick you off the rope and bring you to the ground, you have a high risk of dying as blood pooled in your legs rushes back to your heart.

Seddon, 2001 makes particularly scary reading. He describes cases of people losing consciousness just pretending to be victims and even just waiting to pretend. In several simulations' subjects acknowledged they wanted to be lowered to the ground, but lost consciousness before it could be done. In even more cases, mainly of climbers, victims often died once they were rescued from the rope.

If someone is incapacitated on a rope it is imperative that you reach them quickly and at least get them into a sitting position by attaching their chest harness to the rope, and foot stirrups to keep their legs horizontal and take some off the large blood vessels in their thighs.

Once on the ground, DON'T lay the victim horizontal. Put them in a sitting position, with their legs outstretched in front of them. Slowly lay them down over the space of 30-40 minutes.

Cave accidents

Immediately after a self rescue from -450 m.

The most common cause of cave accidents is falling off short, unprotected climbs or slopes. The most common technical accident is abseiling off the end of a rope. Clearly, you can avoid both by careful caving practices. Clearly too, once an accident does happen, the cause is academic. The injured victim must initially get to a safe zone then out of the cave in order to fully recover.

"At first we didn't understand what had happened. But when we heard shouts we realized what had happened and immediately started looking for the fallen caver...I was ascending the rope and as I was moving up, the wall was covered with blood. Finally I reached Sasha. His leg was twisted at 120 degrees. It looked like he had a compound fracture. I climbed higher so that I could see his face. His eyes were half closed. He was unconscious." [he had just fallen 30 m onto a rebelay loop attached only by his brake karabiner]— Bernard Tourte in the documentary 'Voronia 2003'

What to do

Every rescue situation is different and there is no formula to decide exactly what must be done. As a rescuer, your response must be based on two main factors – the severity of the injury and the availability of outside rescue.

Assess the accident victim's condition in the first instance and render First Aid. Only then if it is necessary, move the victim to a location where both they and the rescuers are in no immediate danger. In most cases, the victim will recover and be able to exit the cave under his own power or perhaps with a little help from the party. If you can do so safely, start the rescue immediately. However, anyone who is severely injured will certainly benefit from the expert medical attention and stretcher that a trained rescue team provides.

If a victim does require rescue, despatch someone immediately to the surface to raise the alarm. Those who remain in the cave can then concern themselves with stabilising the victim's condition and perhaps preparing the way for the rescue.

In remote areas an organised rescue group is a long way away and the best proposition may then be for the group to run their own rescue. Even this could be overridden in an extreme case. An untrained group would probably kill a severely injured victim in an attempted rescue from a difficult cave. Depending on the country, the best solution may then be to create an 'international incident' by visiting their embassy and importing a rescue team.

Rescue

Full scale cave rescue is the province of trained cave rescue groups who make it their business to keep abreast of the latest techniques and practise their skills. Those interested in cave rescue should get in touch with their local cave rescue group. In keeping with this book's theme of lightweight, I will leave cave rescue and medical treatment to the experts and concentrate on the mechanics of rescue as may be required by a small group in a remote area.

If you must move the victim to a safer area to await a complete rescue it is much easier to go down rather than up even if this means moving further into the cave. Lowering a victim takes no specialist equipment and little effort whereas any lift system requires at least two

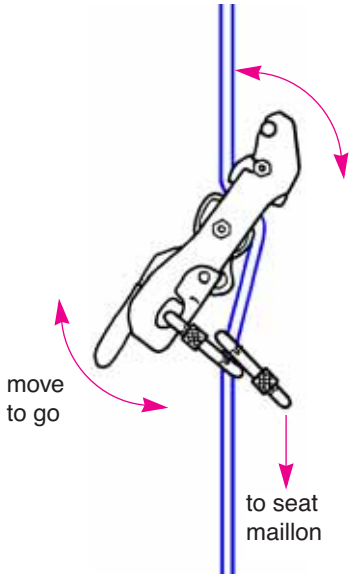
pulleys to work efficiently. Few cavers make a habit of carrying rescue pulleys with them but all caving groups should at least have some available on the surface. If no pulleys are available then the pulleys on bobbin descenders work better than karabiners.

Accidents to cavers while they are on the rope are rare. However, I will assume the worst possible case of an incapacitated victim hanging on the rope, with the rescuer carrying nothing more than his normal caving gear.

Obviously, there are several possibilities as to where the victim and rescuer are in relation to each other – victim above or below, on abseil or prusik, heavier or lighter than the rescuer. All of the techniques described below give a basic outline only.

For clarity I have simplified the rescue techniques that I have described but in a real or simulated rescue things are rarely so simple. Practise all rescue techniques before you need them so that in the event of an accident you can take the appropriate action as quickly as possible. Practise will also make it blatantly obvious that a single rescuer stands no chance of getting an incapacitated caver out of a deep cave.

Getting to the victim



'Abseiling' a taut rope

There is no real choice if the victim is trapped above. You must prusik up the same rope to the victim before you can take any other action. If the victim is below and you are not carrying a separate rope to descend to the victim and work from, you face the problem of descending a taut rope. The surest way is to prusik down but it is slow (see Down prusiking on page 132). For longer descents use a bobbin on as shown in "Abseiling a taut rope" or use a rack similarly with two bars (Michel, 1982)—practise first with a belay!

'Abseiling' a taut rope is a delicate procedure. Should the victim somehow unload the rope by climbing onto a ledge you will immediately start to freefall. With such dire consequences you should only use this form of descent with the utmost caution so as to avoid having two victims. Any form of shunt will provide some security provided you can activate it at the first sign of movement from the victim. Unless you are totally confident and have practised this previously, take more time, prusik down, and avoid a double rescue.

Lowering

The easiest and safest way to lower an incapacitated victim is to abseil with them hanging below you like a heavy sack. In this way you can fend them off rocks and keep in close contact during the descent. On arrival at the bottom you are there immediately to keep the victim from drowning in a pool or move them to a safer area. Whenever descending with a load as heavy as a person, rig your descender with extra friction such as an Italian hitch on the brake krab (see Extra friction on page 93).

Victim on ascenders

You must be on ascenders above the victim.

Light victim

- Attach a long cowstail to the victim's seat maillon and undo as many of his ascenders as possible.
- Prusik up until his last attachment point is unweighted then reach down and unclip it.
- Change from ascent to descent and descend (see Ascent to descent on page 133).

Heavy victim

In most cases you will be unable to lift the victim in order to release his ascenders or change from ascent to descent.

- For security, clip a short cowstail to the victim's short cowstail.

- Release the victim's ascenders until only his chest ascender remains attached.
- Connect a footloop or 1.5 m long sling to the victim's seat maillon then thread it through a karabiner or pulley on your top ascender then down to your own seat maillon.
- Push your top ascender up to pull the footloop tight.
- Clip a descender to the victim's seat maillon and attach it to the rope as high as possible. Add extra friction and lock-off the descender.
- Unclip your chest ascender and sit back to counterbalance the victim's weight against yours. Push the victim up with your arms and legs to unweight them enough for you to release their Croll.
- Sneak the victim's descender further up the rope as far as you can before lowering them onto it.
- Remove the counterbalance footloop.
- Prusik down and attach yourself as directly as possible to the victim's seat maillon —a chain of two karabiners is ideal.
- Prusik down until you are also weighting the descender already attached to the victim.
- You are now ready to remove your ascenders and descend in tandem with the victim.

Cutting the rope

This is what you would do if you had a separate rope:

- Descend on a separately rigged rope until you are just slightly higher than the victim.
- Use your arms and legs to lift them up and transfer as much weight to you as possible.
- Clip into their seat maillon with a chain of two karabiners.
- Add extra friction to your descender.
- Cut the **correct** rope and continue.

But if you're on the same rope?

(after Marbach and Tourte, 2000)

- Descend or climb up until your Croll is just below that of the victim.
- Attach your short cowstail to their seat maillon.
- Remove your foot ascender.
- Remove the victim's long cowstail (or separate safety cord) from their foot ascender.
- Attach the end of the rope to the bottom of their foot ascender. If you've just ascended the pitch, you could have brought the end with you. If the rope is tied below, take in slack from just below the victim and attach that to their foot ascender.
- Make sure that the victim's ascenders are about 30 cm apart.
- Clip a descender to the victim's seat maillon and attach it to the rope as high as possible below where it attaches to their foot ascender, add extra friction and lock it off.
- Stand in the victim's foot loop and remove your Croll. In the same movement, attach your foot ascender above that of the victim and sit back on it.
- Tie an end rope stopper knot just below their Croll – the rope will zip through and be gone once you cut it.
- Cut the rope just above the victim's Croll.
- Stand in the victim's footloop and remove your foot ascender. As you sit back, attach yourself to their seat maillon with a chain of two karabiners.
- Remove your short cowstail.
- Continue on down.

The important advantage of this second method is that you don't have to lift the victim. Also, the victim's Croll may be jammed tight if there has been any fall involved.

Victim on autostop

Using any other descender the victim would probably already be on the bottom! You can approach the victim from above or below.

- Tie an Italian hitch on the victim's brake krab and lock-off their descender.
- Clip as directly as possible to the victim's seat maillon and prusik down until all your weight is on the victim's descender.
- Release your own ascenders and descend using the victim's descender.

Rebelay

(Marbach and Tourte, 2000)

Fortunately, you have two descenders, your own and the victim's.

- Descend until you are just above the rebelay.
- Attach the second descender parallel to the first with its own karabiner on your seat maillon, then attach it to the rope below the rebelay. Lock it off.
- Descend until the load takes up on the second descender. Be very careful to stay on the same side of the rope as the victim.
- Remove the top ascender and continue.

Simple! Except that if there isn't enough slack in the rebelay you may end up with each rope partly loaded. Remember that the load is double and so is the stretch in the rope. If in doubt, sneak some extra rope through the knot from below. If you then allow too much, tie a Figure-8 loop above the rebelay to use up the slack before you move off. Of course, do this a few times and you won't have enough rope left to reach the bottom...

Larger groups with enough rope will find it easier to lower the victim on a separate rope threaded through a descender anchored to a backed-up belay at the top of the pitch. One person should abseil with the victim to keep them clear of rocks and call stop/go signals to the top.

Attach the lowering rope to the victim, then detach them from their own rope as described above. Next, descend with them until the lowering rope takes up.

If you have enough manpower or pulleys you can attach a lowering rope to the victim's rope at the belay above them, lift a little to release the belay then lower the victim and rope to the bottom. Keep the lowering rope attached through a descender at all times to avoid dropping the victim and use a totally separate belay rope and belayer for extra safety if these are available.

Organisation takes time and the victim may only have a few minutes. Getting to an unconscious victim quickly and putting a chest harness on them and lifting their legs is far more important than the comfort of the rescuers.

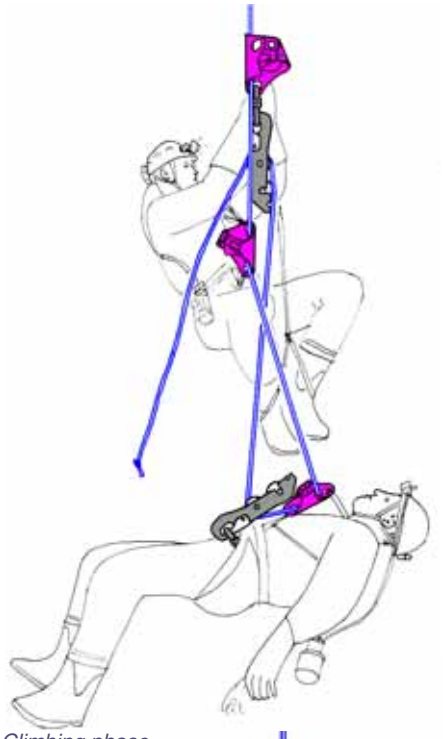
Lifting

Lifting an incapacitated victim requires considerably more time and energy than lowering but may still be preferable in the first instance if the bottom of the pitch is a long way, wet or otherwise unsafe.

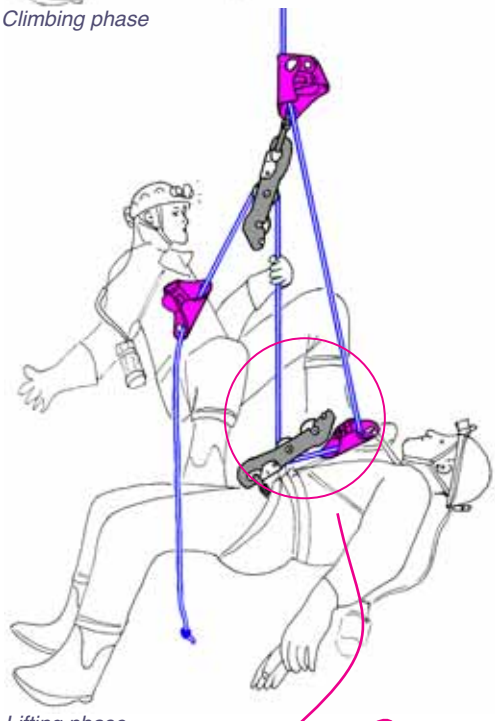
Direct lift

Clipping the victim onto the end of a cowstail and prusiking with them towing along behind will only work for suitably strong cavers and then only for short distances but may be possible and worthwhile to remove them from immediate danger quickly.

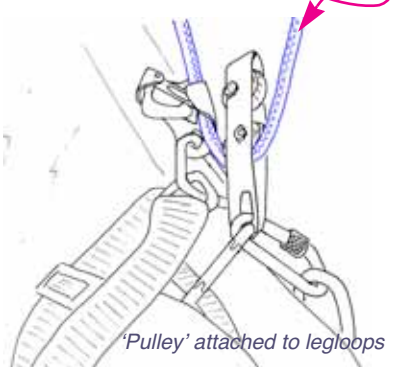
Counterbalance lift



Climbing phase



Lifting phase



'Pulley' attached to legloops

(Frog system, Gutierrez and Lopez, 1985)

You must be on ascenders above and the victim arranged with only their chest ascender attached to the rope.

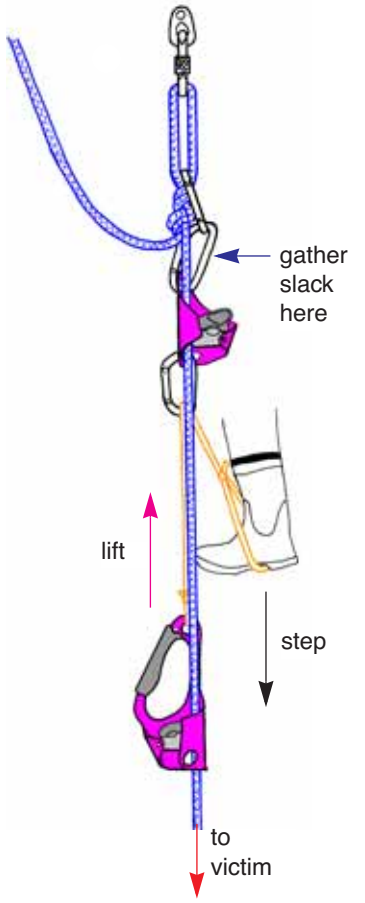
- Fix a pulley on the victim's seat maillon so that the rope comes out of the bottom of his ascender and then through the pulley.
- When the victim's chest ascender is mounted high on their chest, fix the pulley to their seat harness attachment loops parallel to the seat maillon. This is the best arrangement to use when you are starting from a ledge or the ground.
- On a mid-rope rescue, clip the victim's cowstail karabiners (or two spares) to their harness legloops and attach the pulley to them.
- Run the rope up from the victim's chest ascender and through a pulley that is hanging from the bottom of your top ascender.
- To lift, prusik up a few metres above the victim or as far as the rope will allow.
- Remove your chest ascender from the main rope and attach it to the rope coming down from your pulley.
- With a normal sit/stand prusik motion, lift the victim up countering your own bodyweight against the victim's whose chest ascender will lock in position after each stroke.
- When the victim reaches you, change back to the main rope and ascend again.

Rebelays

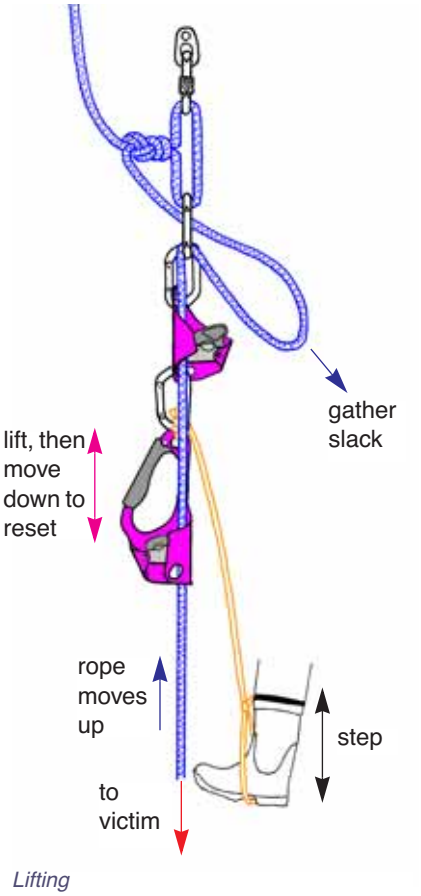
- Without removing the counterbalance setup, cross the rebelay yourself.
- Suspend the victim from their cowstail attached to the rebelay anchor. You'll have to thumb their Croll cam to ease them back onto their cowstail.
- Undo the rebelay and feed the rope through ready to go again.

The real difficulty lies in getting off the top of pitches. With a high belay it is feasible to lift the victim high enough to clip their cowstail to a tight handline and slide them away from the edge but for low belays and awkward starts it may not be possible without another rescuer or a specially constructed belay.

Lifting from the top



Getting slack into the system



Lifting

(Marbach and Rocourt, 1980)

This method only works if the rope is not attached below and the rescuer is at the top of the pitch but it does have some advantages over the previous method:

1. The rescuer hauls from a position of safety.
2. There is no need to double load the rope.
3. Lifting can start almost immediately.

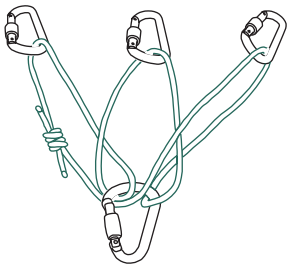
- Clip your cowstail to the rope anchor.
- **Invert** your chest ascender and clip it onto the rope just below the knot then attach it by a karabiner through its bottom eye to the knot loop.
- Attach a pulley or karabiner to the ascender's top (now lower) eye.
- Invert your footloop ascender, attach it lower down the rope and put its footloop through the pulley.
- Lift by standing in the footloop while simultaneously pulling up on the ascender. Push the slack gained through the chest ascender.
- When you have enough slack feed it through the chest ascender, then through the ascender's anchoring karabiner so you can pull it through with one hand while lifting with the other and standing in the footloop.
- Push the foot ascender down between strokes and continue the procedure until you can clip the victim's cowstail to the anchor or handline.
- The initial movements of this method are a good way of gaining slack at the top of the rope in order to set up a heavier haul or lowering system.

To arrange the lowering and lift systems described so far you require nothing more than what a vertical caver normally carries. Real pulleys, even those light nylon rings that clip directly to a karabiner, make lifting much more efficient than using bobbin pulleys, but few cavers carry them. One suggestion is to thread one onto the haul cord of every cave pack where it will always be handy but never in the way. Others carry one threaded on their carbide tube/power cable.

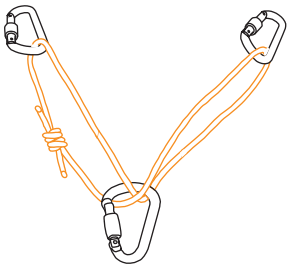
Heavy lift systems

Counterbalance lift


Photo: Enrique Ogalde

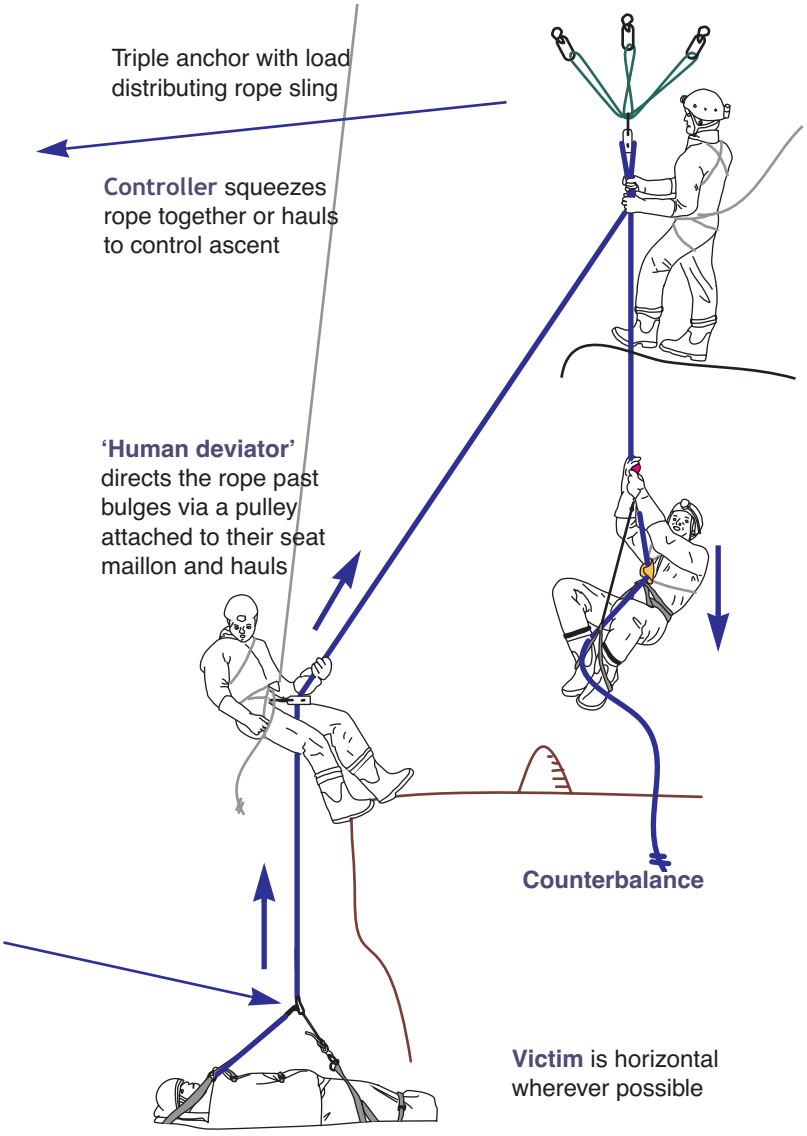


Load distributing anchors —use 3 normal anchors, or 2 very good ones.



Use rope, never tape. Twist the loops so that if any one anchor fails, the belay doesn't undo.

Use an ascender or shunt here so that you can easily vary the angle of the stretcher



The counterbalance method

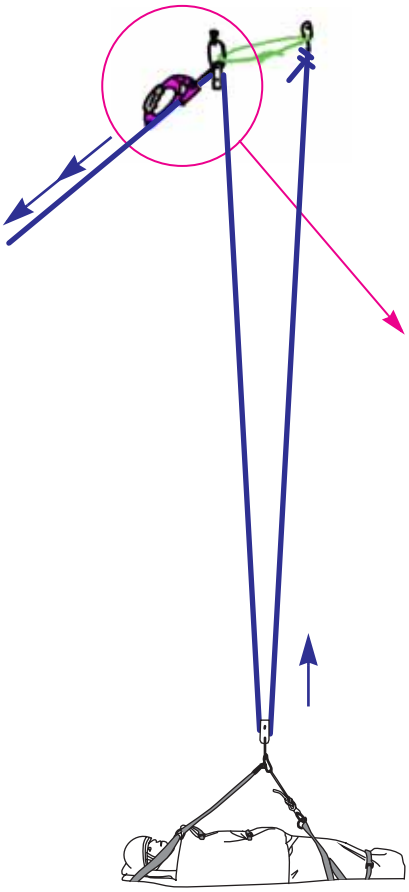
The preferred method is to mount a large pulley at the top of the pitch and run a rope up from the victim and through the pulley to a caver who can act as counterweight (Martinez 1979). Ideally, the counterweight caver prusiks near a ledge or comfortable safe area near the pulley. Place a controller at the pulley to control the rope.

On bigger pitches, a third caver prusiks on a separate rope beside the victim to fend off and un-snag the victim as necessary. Small, simple pitches are best managed with rescuers at the top and bottom with perhaps a guide line from below. It is better to not attach a separate lift or belay rope as this easily leads to tangles with the counterbalance rope.

Counterbalance lifts benefit from making a pitch as long as possible. Rig deviations with pulleys. Rig 'reverse' deviations where the rope would run over a bulge with 'human' deviations. That is, a caver stands on rope on the edge with a pulley attached to their seat maillon and directs the rope around the edge and helps pull the rope through to compensate for the drag in the pulley.

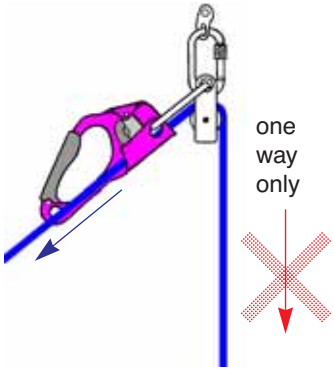
Pitch-head anchors should be doubled or tripled and fitted with load-sharing slings.

2:1 lift

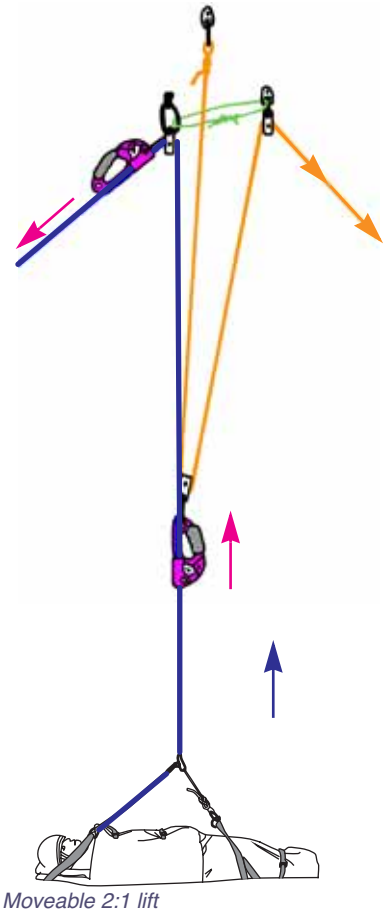


A simple 2:1 lift

As an alternative you can fit the victim with a single pulley and attach the rope at the top of the pitch so that it runs down to the victim, through their pulley and back up to the top. There it runs through another pulley and ascender so that it cannot slide back. This method has no advantages over the counterbalance unless the victim is much heavier than the rescuers. Even so it may be better to have the controller use their weight to help the augment that of the conterbalancer.

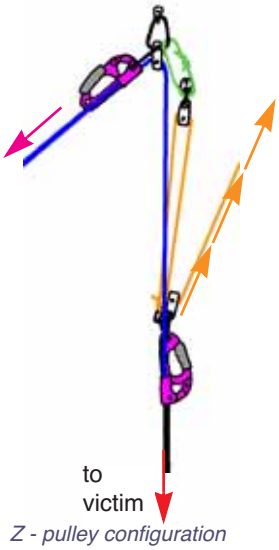


Using the same number of pulleys, but concentrating them at the top as a 'Moveable 2:1 lift' it is feasible to lift the victim on a single rope - perhaps the rope used to rig the pitch if none other is available. A Moveable 2:1 system lifts a metre or so of rope, then is reset to lift again.



Moveable 2:1 lift

A 'Z-pulley' configuration is similar to the Moveable 2:1 lift but gives a 3:1 advantage. This advantage however is countered by the need to pull upward instead of down so that a rescuer cannot use his body weight to counterbalance the load without an extra pulley at the top.



Z - pulley configuration

Heavy lift systems take time to set up and while it may be the way to get the victim out of the cave in the long run, small parties with little equipment or victims caught on the rope need the faster, lighter techniques - at least in the short term until they are out of immediate danger.


Ramales de Victoria, Spain

...and as always: practise


Croix du Sud, Papua New Guinea

Yes, they are logs in the photo:

"The flood

- phase 1: a loud drumming sound

-phase 2: 10 seconds later, a sudden increase in air pressure, ears popped, eyes stung and breathing strange

-phase 3: the wave... the flow changed instantaneously from 10 L/s to several cumecs. The accuracy of the measurement may be a little out due to the lack of objectivity of the observers.

-phase 4: 10 minutes later the altimeter bottomed out, and the pressure began to rise. Are we between two sumps?

-phase 5: after about 15 minutes the altimeter returned to its initial position, to our relief.

-phase 6: 2 hours waiting and the flow is back to 200 L/s. We stop the observations and get out of this horrible place!

The exploration of the most promising cave on the plateau was stopped because we only had equipment to rig to -500 m...and the passage continued 4 m wide and 5 m high..."

from the expedition report (Sounier, 1991)

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