Avalanche rescue

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AVALANCHE RESCUE

- Approximately 150 persons die annually in North America and Europe in avalanches.
- Rapid extrication is the most important factor to increase a victim's chance of survival.

- It is divided to two parts 1. Before finding victims 2. After finding victims. During search and rescue we

AVALANCHE RESCUE EQUIPMENT

- Shovel

The first piece of safety equipment that an individual entering avalanche terrain should bring is a shovel, which can be used to dig snow pits for stability evaluation

AVALANCHE RESCUE

- **Probe**
  Probes are used to search for buried victims by spot probing in likely burial areas or to confirm transceiver findings before shoveling

AVALANCHE RESCUE

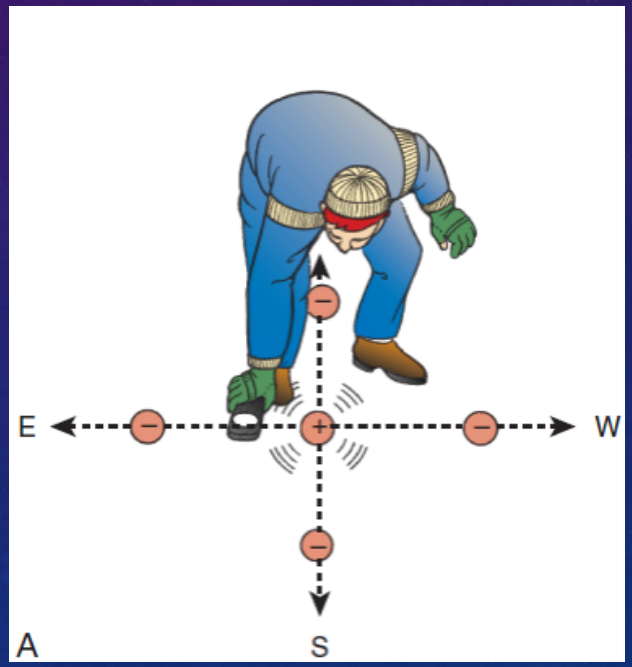
- Avalanche Rescue Transceiver
- Avalanche rescue transceivers (beacons) are one of the best personal rescue devices for quickly finding buried companions
- Transceivers are a fast and effective way to locate buried victims.

AVALANCHE RESCUE

- Avalanche Rescue Transceiver

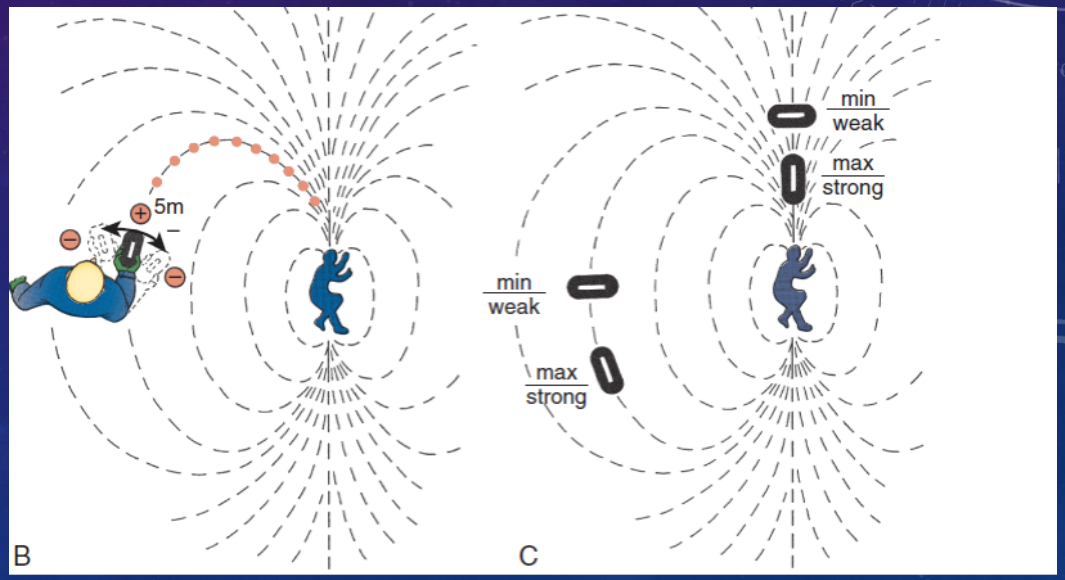
Transceivers act as electromagnetic transmitters that emit

- a signal on a standard frequency of 457 kHz.
- A buried victim's unit emits this repetitive signal in radial "," which the rescuers' units receive and analyze when switched to "receive" mode.



AVALANCHE RESCUE

- In approximately 30 to 50 m ,when audibly or visibly detected, the signal can guide searchers specifically to the buried unit in less than 5 minutes
- The searcher can discern the strongest signal before proceeding in a new direction.

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AVALANCHE AIRBAG

- The primary purpose is to prevent complete burial.
- introduced in 1985

COST AND BENEFIT ???

- Based on studies, the exact increase in survival benefit imparted by the use of an avalanche airbag device is uncertain???

EXAMPLE OF AIRBAG SYSTEM

AVALUNG

- Main goal: prolonging survival time by slowing the process of asphyxiation
- It functions mainly by separating inhaled from exhaled air in the surrounding burial snowpack,
- Stowable mouthpiece is located in the shoulder strap along with the inspiratory and expiratory valve housing.
-

AVALANCHE RESCUE

- The ABS and Avalung are designed as adjuncts to the basic companion (small-team) rescue equipment, which includes a transceiver, probe, and shovel.
- These devices should never be used to justify taking additional risks

BASED ON STUDIES

- 44% of completely buried avalanche victims did not have a transceiver
- Off-piste skiers, who commonly use mechanized support for ascent and who descend outside the secured ski area, are less frequently equipped with rescue devices

RECCO

- The electronic rescue system called RECCO (www.recco.com) enables organized rescue teams to find victims who are equipped with reflectors
- The system consists of two parts: a detector used by the rescue team (either on the ground or from helicopters) and a reflector worn by the recreationist.

RECCO

- The detector transmits a directional radar signal. When it hits the reflector, the signal's frequency is doubled and reflected back to the detector, and the rescuer can follow the signal to the buried person
- The reflectors are small , passive (i.e., no batteries) electronic transponders that are fitted into outerwear, ski and snowboard boots, and helmets.
- The system will detect some other electronic equipment (with diminished range), such as cell phones, electronic cameras, radios, and even turned-off avalanche rescue beacons

- So RECCO should be used by rescue teams together with avalanche rescue dogs, rescue beacons, and probers as part of the first response to any avalanche rescue.

CASE REPORT

- On February 2, 2015, 4 skiers left the secured ski area in Baqueira Beret, Spain (2300 m).
- During the descent, the group triggered an avalanche (60 m wide, 80 m long, 1 m [range, 0.6–1.2 m] average depth), which completely buried 2 of them.
- Neither skier was equipped with a transceiver, shovel, or probe.
- A third companion (who was not buried) was able to immediately call the rescue service, and after 3 minutes, the first ski patrollers arrived at the avalanche site.
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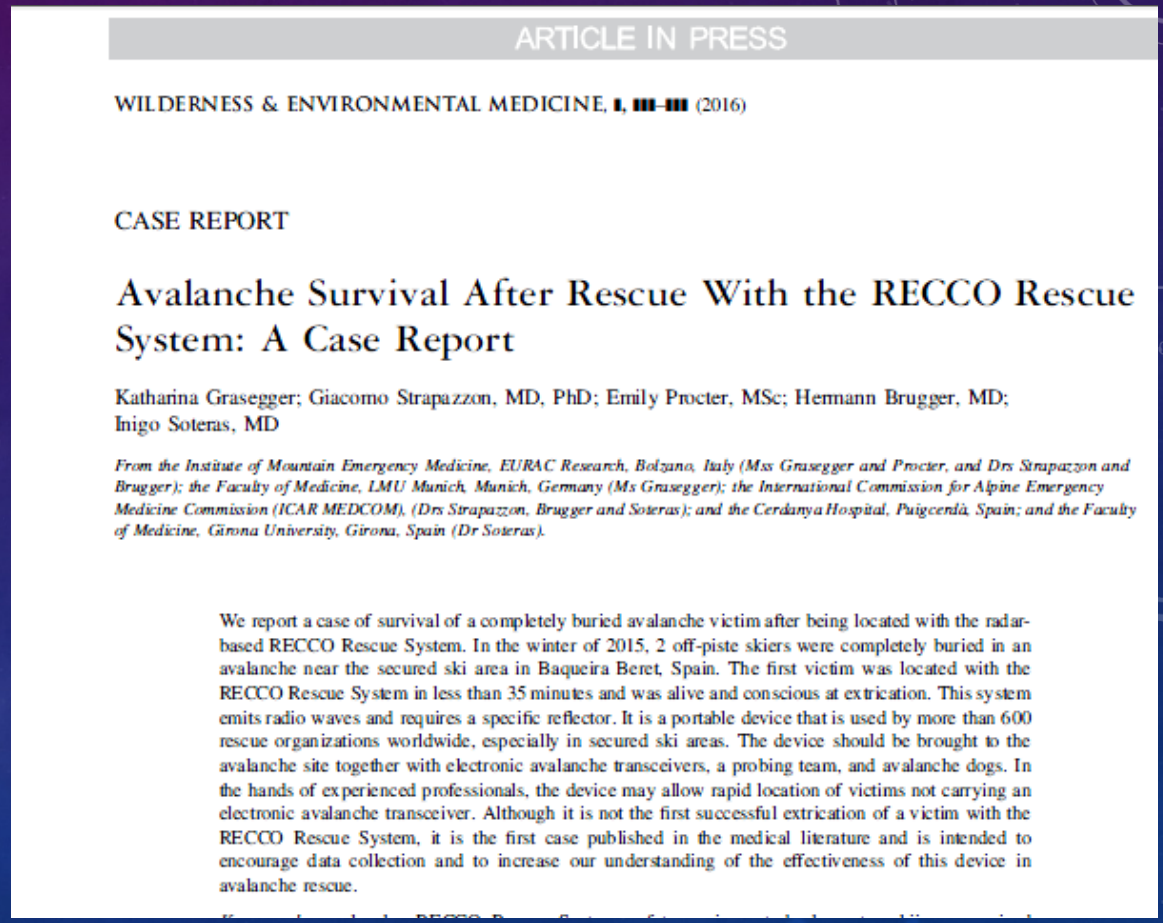

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CASE REPORT

Avalanche Survival After Rescue With the RECCO Rescue System: A Case Report

Katharina Grasegger; Giacomo Strapazzon, MD, PhD; Emily Procter, MSc; Hermann Brugger, MD; Inigo Soteras, MD

From the Institute of Mountain Emergency Medicine, EURAC Research, Bolzano, Italy (Mss Grasegger and Procter, and Drs Strapazzon and Brugger); the Faculty of Medicine, LMU Munich, Munich, Germany (Ms Grasegger); the International Commission for Alpine Emergency Medicine Commission (ICAR MEDCOM), (Drs Strapazzon, Brugger and Soteras); and the Cerdanya Hospital, Puigcerdà, Spain; and the Faculty of Medicine, Girona University, Girona, Spain (Dr Soteras).

We report a case of survival of a completely buried avalanche victim after being located with the radar-based RECCO Rescue System. In the winter of 2015, 2 off-piste skiers were completely buried in an avalanche near the secured ski area in Baqueira Beret, Spain. The first victim was located with the RECCO Rescue System in less than 35 minutes and was alive and conscious at extrication. This system emits radio waves and requires a specific reflector. It is a portable device that is used by more than 600 rescue organizations worldwide, especially in secured ski areas. The device should be brought to the avalanche site together with electronic avalanche transceivers, a probing team, and avalanche dogs. In the hands of experienced professionals, the device may allow rapid location of victims not carrying an electronic avalanche transceiver. Although it is not the first successful extrication of a victim with the RECCO Rescue System, it is the first case published in the medical literature and is intended to encourage data collection and to increase our understanding of the effectiveness of this device in avalanche rescue.

RECCO

- They started to search for the 2 buried victims with transceivers and the RECCO detector in a 10-m-wide search strip.
- After 6 minutes, the ski patroller using the RECCO detector received a weak signal.
- It was later determined that this signal was from a mobile phone carried by the victim in his chest pocket.
- The location of the victim (male, 45 years old, in supine position) was confirmed by probing and he was extricated alive, uninjured, and conscious after less than 35 minutes of burial from a depth of 1.3 to 1.5 m.

SECOND VICTIM

- .The RECCO was also used to search for the second victim, but no signal was detected.
- After 15 to 20 minutes, a probing team found the second victim (female, 40 years old), and she was extricated alive and conscious after 45 to 50 minutes from a depth of 1.3 m, not far from the first victim.
- The second victim had mild hypothermia (grade 1) and several contusions. Both victims were brought to a local hospital by helicopter. They survived without any neurological deficits.

WHEN VICTIMS DO NOT HAVE REFLECTOR

- In this case, neither of the buried skiers was wearing a RECCO reflector.
- The mobile phone of the first victim was oriented toward the surface of the avalanche and could be detected

CONCLUSION

- The RECCO reflector is practical for the user and requires no knowledge or maintenance as it is integrated in to sporting equipment, does not require a battery, and is light weight

AVALANCHE DOGS

- Trained search dogs, which are traditionally used in Europe early during avalanche rescues, are capable of locating buried victims very quickly
- There have only been nine reported live recoveries using dogs.

THE ABILITY OF AVALANCHE DOGS

- Their ability to find buried human scent may be affected by several factors, such as the

1. length of burial
2. Weather
3. snow density
4. contamination of the debris field with spit, urine, cigarettes, or gasoline from snowmobiles or generators

TYPES OF RESCUE

INDIVIDUAL RESCUE (SELF RESCUE)

1. Escaping to the side

- During the moment that the snow around a person begins to move, there is a split second during which that person can potentially move off the avalanche to more stable snow

- If the victim sees or feels an object, such as a tree or rock band, the person should make every attempt to grab and hang on

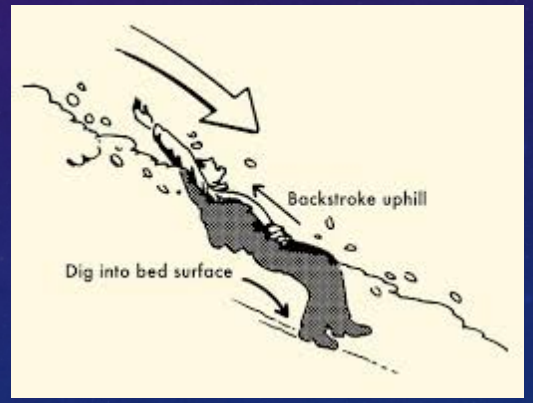
SELF RESCUE

- If caught

1. Shouted ALANACHE to alerts companions
2. Then close mouth & breath through the nose
3. Use AIRLUNG or activate AIRBAG if individual wear them

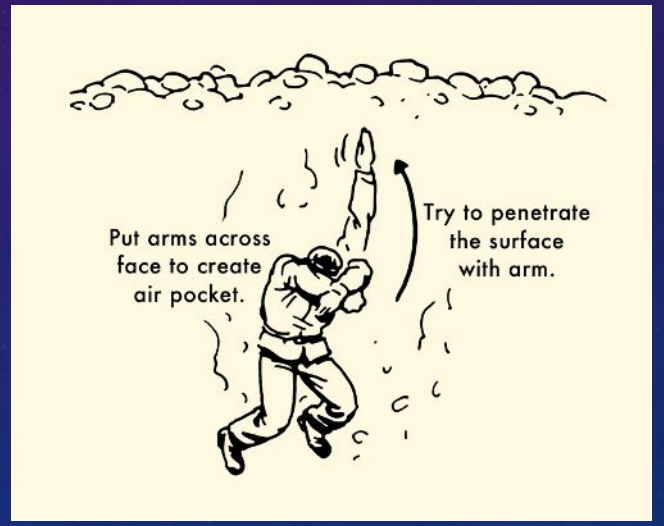
ACTIONS DURING THE SLIDE

- “swim to the surface” (i.e., struggling with the arms and legs flailing)?
- The idea is that the victim may be able to climb to the surface
- The efficacy of these actions has been questioned?



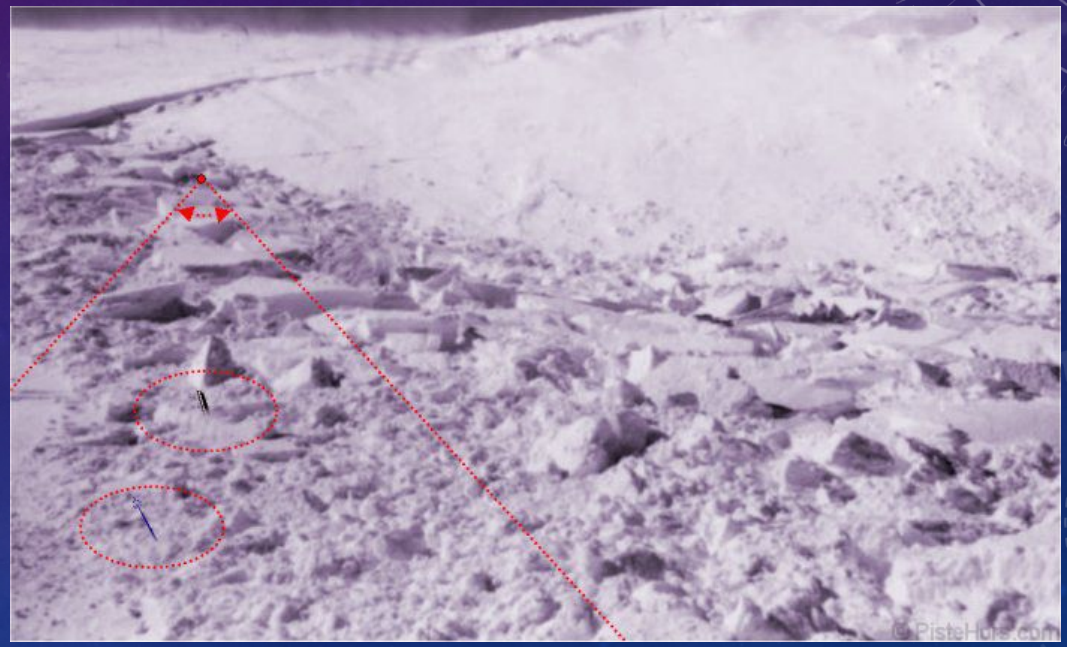
PENETRATE THE SURFACE WITH ARM

- If the victim senses that he is close to the surface, he should thrust a hand or a foot toward that directio



VISUAL CLUES

- Visual clues are the quickest method to find a buried avalanche victim.



SMALL-TEAM RESCUE (COMPANION RESCUE(

- At resorts, ski patrol members monitor the avalanche danger and attempt to trigger sensitive avalanches.
- Therefore, avalanches are rare in these areas.

BACKCOUNTRY USERS

- Every backcountry user should

1. Attend a cardiopulmonary resuscitation (CPR) course
2. Wilderness-oriented first-aid course
3. Carry appropriate avalanche rescue equipment to aid a fellow group member or another group.

SMALL-TEAM RESCUE (COMPANION RESCUE(

1. If the accident site may be within the range of cell phones or other communication methods, a call or text should be attempted immediately
2. If team members are certain that no cell reception or other communication is possible and that travel to communications is more than 30 minutes away, all should remain on-site for the search and rescue

MARKING THE LAST SEEN AREA

- A companion or eyewitness to an accident needs to act quickly and positively.
- But first: ensure that they and other rescuers are safe from secondary slides.

- The bed surface of an avalanche that has recently run is usually safe to enter

MARKING THE LAST SEEN AREA

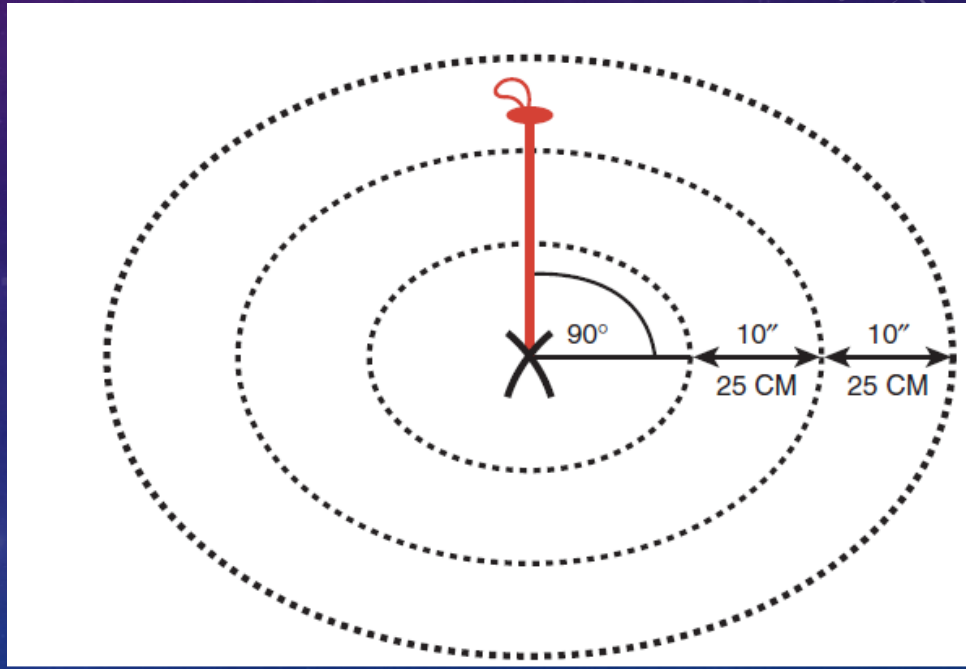
- First, the victim's last-seen area should be fixed and marked
- Persons equipped with transceivers should travel to the last-seen area to begin their search
- If an obvious clue is seen, shallow probing should be done into likely burial spots with an avalanche prob (i.e., spot probing).

RESCUE TRANSCEIVERS

- If they are skilled with a transceiver, companions can pinpoint the burial site in a few minutes and should confirm the location with a probe

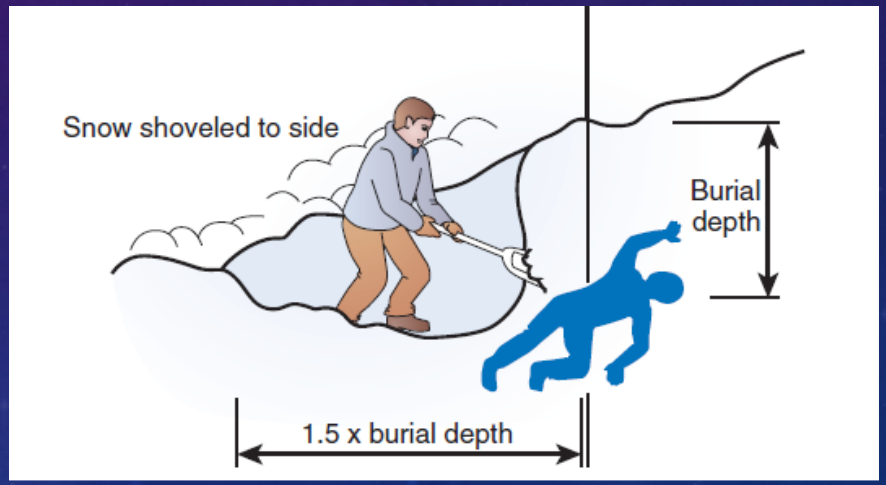
PROBING AFTER TRANSCEIVER SEARCH

- When the victim's location has been pinpointed, probing should begin.
- Concentric probing method. Probing should proceed from inward to outward in concentric circles spaced 25 cm (10 inches) apart.
- When the victim is located by a probe strike, the probe should be left in place and shoveling should begin.



SHOVELING TECHNIQUES

- Take much longer time than transceiver search
- Strategic shoveling technique for one or two rescuers

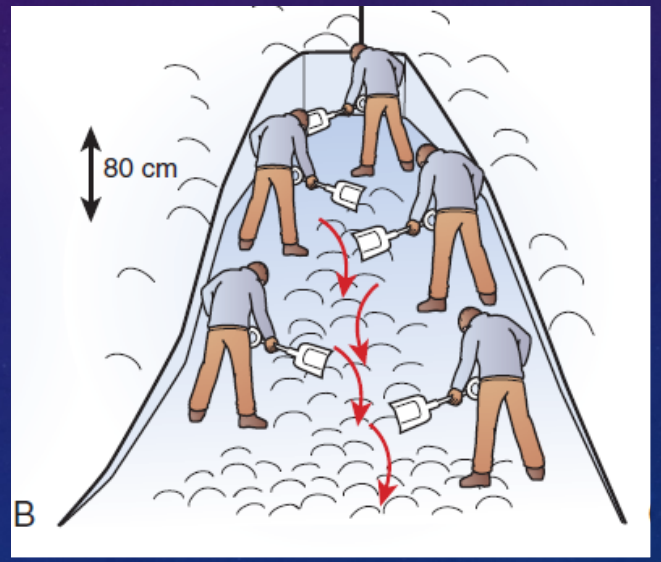


V-SHAPED CONVEYOR BELT SHOVELING APPROACH

- Positioning of rescuers, with a quick measurement of the distance between shovelers

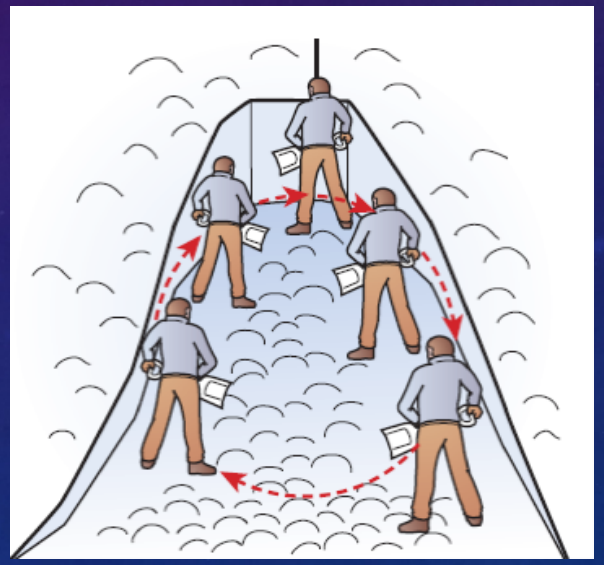
B SHAPE

- Working in sectors on the snow conveyor belt;.



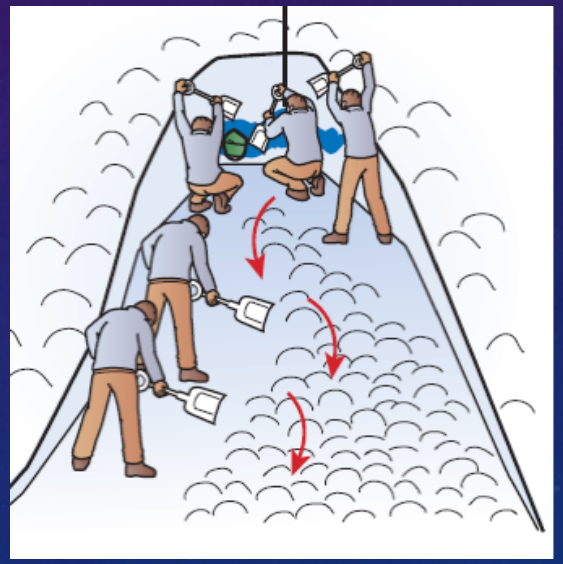
C SHAPE

- Clockwise rotation is initiated by the front person; job rotation maintains a high level of motivation and minimizes early fatigue

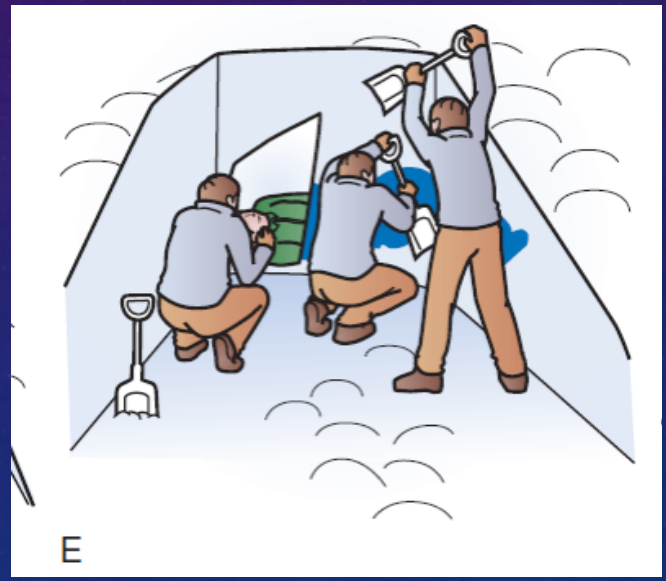


D SHAPE

- The buried victim is first seen. More rescuers are needed at the front,

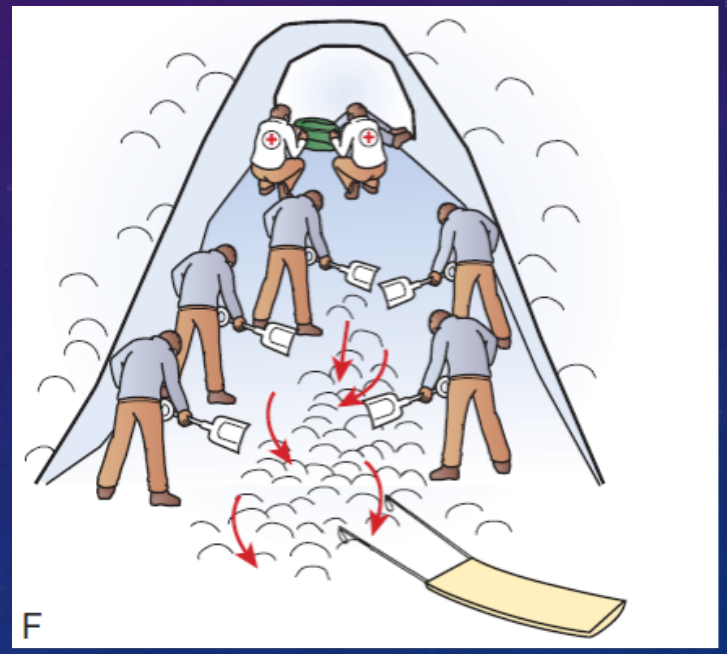


- Careful work occurs near the buried victim, while some shovelers aggressively cut the side walls to adapt the tip of the V to the real position of the victim



D SHAPE

- Interface to organized rescue. More space is shoveled only after medical treatment of the victim has begun.



PROFESSIONAL RESCUE INCIDENT COMMAND SYSTEM

- Members of organized rescue teams should have an awareness of ICS (Incident Command System)
- ICS only changes how incidents are managed; it does not change how avalanche rescuers do their job

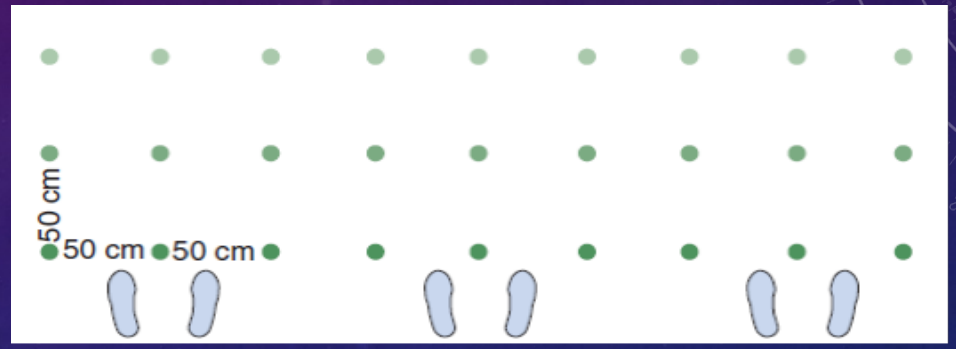
- all avalanche search and rescue operations have four key functional components

1. *Search: T*he goal of which is quickly finding and extricating any buried victims.

- a) *immediate search team,* should consist of skilled and swift-traveling rescuers who are competent not only in avalanche rescue but also in route finding and hazard evaluation, If they have no success, the team determines the most likely burial areas
- b) *emergency care:*
- *C) transportation,* which includes travel for additional rescuers to and from the accident site and for evacuation of victims.
- D) *Support*, which sustains the entire operation, especially when a rescue is prolonged.

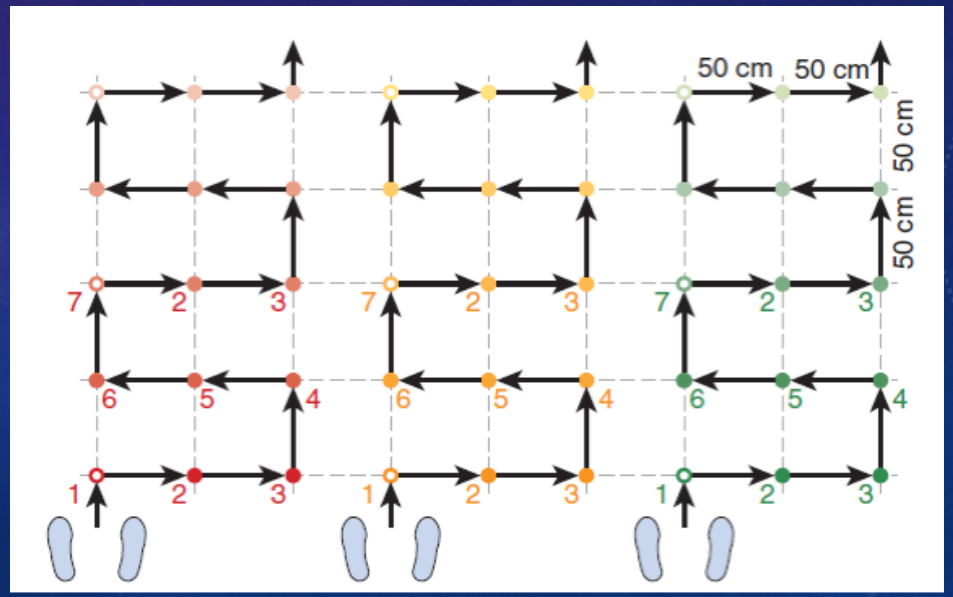
ORGANIZED PROBING SEARCH TECHNIQUES

- Rescue teams use probe lines to find most avalanche victims who are not equipped with transceivers or RECCO reflectors, or when an avalanche rescue dog fails to locate the victim



- Divided to

1. Three-probe spacing for 50-cm by 50-cm, three-holeper-step probe method
2. Slalom probing technique. On direction by the incident commander, each rescuer probes in the sites indicated by color *(red, yellow, green)* in the rescuer's respective area).



ORGANIZED PROBING SEARCH TECHN

- Seems that most of search methods should all be used concurrently
- Because probe lines are time intensive, few victims are found alive using this technique alone

Resuscitation of avalanche victims: Evidence based guidelines Intended for physicians and other advanced life support personnel

SURVIVAL PROBABILITY

- Survival depends on the grade and duration of burial and the pathological processes of asphyxia, trauma and hypothermia

Fit one full page to window

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Resuscitation great

Resuscitation of avalanche victims: Evidence-based guidelines of the international commission for mountain emergency medicine (ICAR MEDCOM) Intended for physicians and other advanced life support personnel☆

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ABSTRACT

Background: In North America and Europe ~150 persons are killed by avalanches every year.
Methods: The International Commission for Mountain Emergency Medicine (ICAR MEDCOM) systematically developed evidence-based guidelines and an algorithm for the management of avalanche victims using a worksheet of 27 Population Intervention Comparator Outcome questions. Classification of recommendations and level of evidence are ranked using the American Heart Association system.
Results and conclusions: If lethal injuries are excluded and the body is not frozen, the rescue strategy is governed by the duration of snow burial and, if not available, by the victim's core-temperature. If burial time ≤35 min (or core-temperature ≥32 °C) rapid extrication and standard ALS is important. If burial time >35 min and core-temperature <32 °C, treatment of hypothermia including gentle extrication, full body insulation, ECG and core-temperature monitoring is recommended, and advanced airway management if appropriate. Unresponsive patients presenting with vital signs should be transported to a hospital capable of active external and minimally invasive rewarming such as forced air rewarming. Patients with cardiac instability or in cardiac arrest (with a patent airway) should be transported to a hospital for extracorporeal membrane oxygenation or cardiopulmonary bypass rewarming. Patients in cardiac arrest should receive

GRADE OF BURIAL

- Grade of burial is the strongest single factor for survival (completely buried vs partial burials)

DURATION OF BURIAL

- Switzerland and Canada shows a progressive non-linear reduction in survival as duration of burial increases and distinct phases
- In Switzerland, survival probability remains above 80% until 18 min after burial (“survival phase”)
- whereas the Canadian survival curve shows an earlier and steeper decline from 77% at 10 min to 7% at 35 min,
- Due to denser snow in some region of trauma: a greater mortality from trauma and an earlier onset of asphyxia

ASPHYXIA

- Asphyxia : the most common cause of death in three case series that relied on autopsy
- Survival decreases rapidly in the “asphyxia phase”, : . in the first 35 min.
- If burial >35 min, airway patency should be determined upon exposure of the face

ASPHYXIA

- For victims buried <35 min found in cardiac arrest, presume asphyxia and initiate standard CPR with ventilations as soon as the head and chest are free regardless of airway patency
- For victims buried >35 min found in non-asystolic cardiac arrest with a patent airway but who are not hypothermic (≥32 ◦C), presume asphyxia and initiate standard CPR with ventilations as soon as the head and chest are free

- For victims buried >35 min found in asystolic cardiac arrest with an obstructed airway, resuscitation may be initiated but can be terminated if not successful

AIRWAY

- For unresponsive victims:

1. advanced airway management should be performed if the rescuer is competent in this skill and if airway management succeeds within a reasonable time

- For rescuers not experienced in advanced airway management: ventilation is most effective with mouth-to-mask or bag-mask techniques .

ON SITE MANAGEMENT

- Tourniquets are life-saving in limb injuries.
- In traumatic cardiac arrest survival is approximately 5.6% and prolonged CPR >16 min is associated with a poor outcome.
- In severe head trauma outcomes are improved with early intubation and normoventilation while hypo- and hyperventilation result in poor outcome

SPINAL STABILIZATION

- Recommendations. Rescuers should provide adequate spinal stabilization throughout extrication, on-scene management and transport.

HYPOTHERMIA

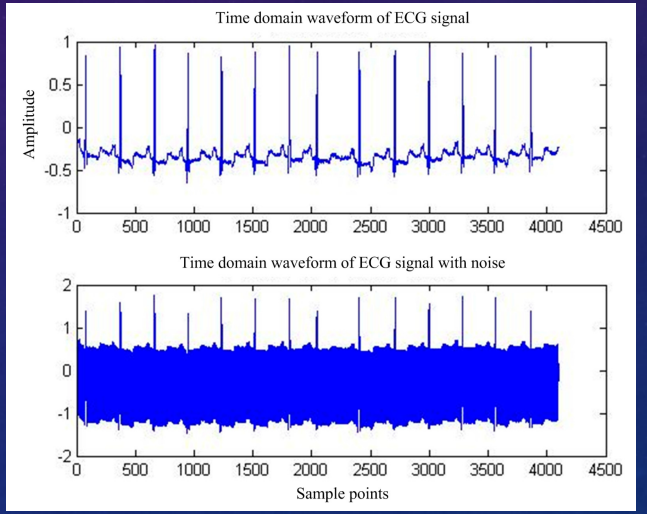
- Collapse of hypothermic avalanche victims during rescue is associated with lethal arrhythmias, according to case reports.
- Mechanical stimulation has been shown to produce lethal arrhythmias, too .
- A core-temperature of 32 ◦C is considered the threshold for ventricular fibrillation.

RESCUE COLLAPSE

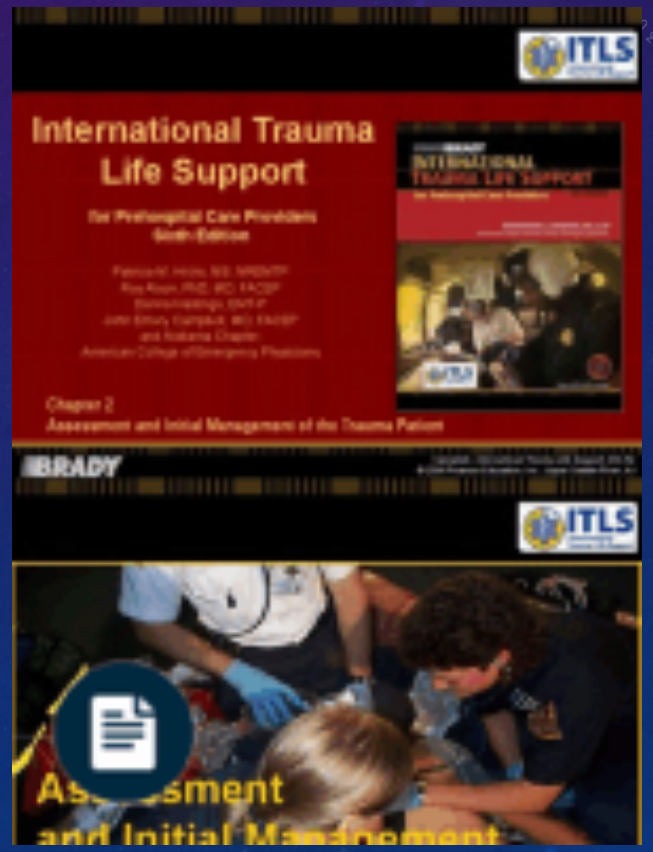
- Recommendations.

1. ECG monitoring should be applied upon extrication and continued during transport,
2. Mechanical irritation of hypothermic victims should be minimized
3. avoiding excessive limb extension, rough transport and unnecessary chest compressions

- Transport victims in the horizontal position



- Don’t rely on clinical hypothermia staging alone when asphyxia and/or trauma occur
- Obtain core-temperatures when hypothermia has management significance, with an oesophageal probe in the intubated or epitympanic thermistor probe in the non-intubated victim
- Epitympanic temperature measurements are influenced by ambient temperature



INSULATION

- Hypothermic victims should be insulated against further heat loss with dry, low-conductivity, whole-body assemblies covered in a windproof and water-resistant outer shell
- Remove wet clothing only if the victim can be insulated effectively, cut clothing cautiously if victim has a hypothermia staging of moderate or worse

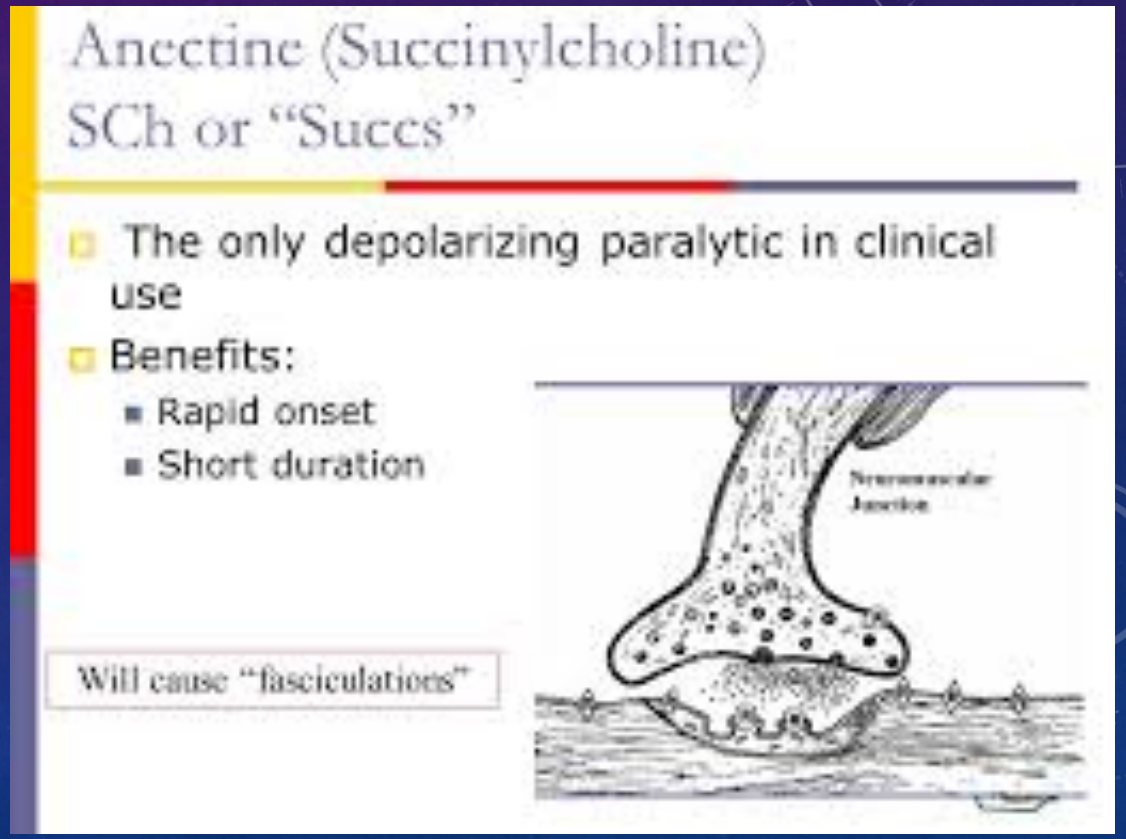
OXYGEN

- Apply supplemental oxygen to significantly hypothermic victims
- Pulse-oximetry may be unreliable

ADVANCED AIRWAY

- Advanced airway placement provides oxygenation and airway protection from aspiration and is low risk for triggering malignant arrhythmias.
- Depolarizing neuromuscular paralytics (e.g. succinylcholine) may increase the serum potassium level and affect subsequent decisions.

  Recommendation.
- Consider the impact of depolarizing paralytics on serum potassium if the latter is planned for resuscitation or advanced rewarming decisions

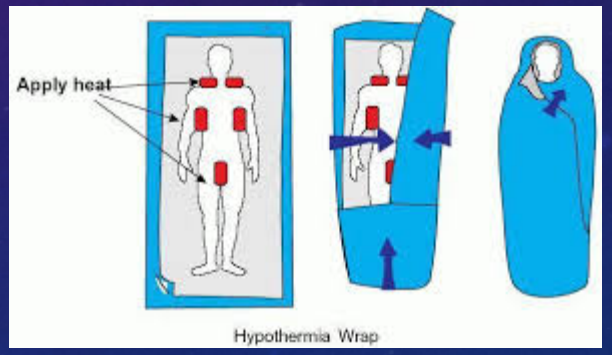


DEFIBRILLATION

- Use standard defibrillations when indicated, regardless of core-temperature
- Repetitions beyond three attempts may be delayed until core-temperature >30 ◦C
- Should be avoided if they cause interruption of CPR and/or transport to rewarming

TRANSPORT

- For victims with core-temperature 28-32 ◦C but no cardiac instability, i.e. systolic blood pressure ≥90 mmHg and no ventricular arrhythmias,>>>>> transport to the nearest appropriate hospital for active external and minimally invasive rewarming (i.e. warm environment; chemical, electrical, or forced air heating packs or blankets; warm iv-fluids) is recommended)



- Hypothermic victims with a patent or unknown airway, with cardiac instability or a core-temperature <28 ◦C, or in cardiac arrest, should be transported to a centre with ECMO or CPB
- if ECMO/CP is not available transport to an appropriate hospital for alternative active internal rewarming (e.g. thoracic lavage) with continued CPR is recommended.
- Notify the ECMO/CPB centre before departure

GENERAL CONSIDERATION

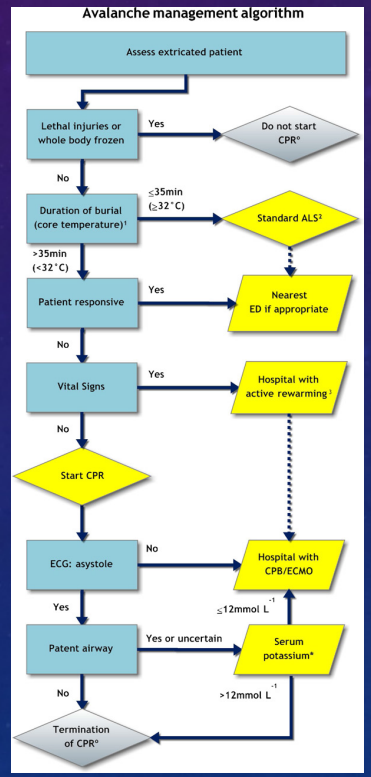
- Alert victims not requiring sedation or anaesthesia within 2 h may drink warmed, clear, calorie-containing, non-alcoholic, non-caffeinated fluids to sustain hydration and spontaneous rewarming

TERMINATION OF CPR

- Resuscitation may be terminated (or withheld) when rescuer safety is unacceptably high, lethal injuries such as decapitation or truncal transection have occurred, the body is completely frozen, a valid do-not-resuscitate order exists, or limitations in transport or other logistics render resuscitation futile
- Resuscitation may be terminated in unwitnessed cardiac arrest when, after 20 min of resuscitation

TAKE HOME MASSAGE

- The algorithm for the management of avalanche victims is shown in.
- If lethal injuries are excluded and the body is not frozen, the rescue strategy is governed by the duration of snow burial and, if not available, by the victim's core-temperature.
- If burial time ≤35 min (or core-temperature ≥32 ◦C) rapid extrication and standard ALS is important.
- If burial time >35 min and core-temperature <32 ◦C, treatment of hypothermia including gentle extrication, full body insulation, ECG and core-temperature monitoring is recommended, as well as advanced airway management if appropriate



TAKE HOME MASSAGE

- Unresponsive patients presenting with vital signs should be transported to a hospital capable of active external and minimally invasive rewarming such as forced air rewarming.
- Patients with cardiac instability or in cardiac arrest (with a patent airway) should be transported with uninterrupted CPR to an ECMO/CPB rewarming centre.
- Management should include spinal precautions and other trauma care as indicated

Thanks for your attention