Hypothermia and rescue in the field situation.

No previously healthy person should die of hypothermia
after he has been rescued and treatment has been started.
(Cameron C. Bangs, M.D. The Mountaineers 1986).

A reduction in the number of preventable hypothermia-related deaths depends on both treatment and prevention strategies. Better treatment techniques increase the likelihood of resuscitation once the victim is rescued. This suggests that education, prevention and treatment are equally important. Both the knowledge and technology needed to cope with hypothermia exist it is now a matter of preparedness and application.

A sampling revealed that the present method of pre-hospital care is to wrapping the cold victim in a blanket. This merely provides insulation, which works well for warm people, but has no benefit to a hypothermic patient as pre-hospital care.

If a hypothermic victim is alive when rescued but dies during recovery, and there is no other significant trauma or disease, this suggests that death may have resulted from either inappropriate or ineffective treatment, or no treatment at all.

Modern hypothermia management is based, to some extent, on unhappy experiences. Vangaard reports the case of 16 Norwegian fishermen pulled alive from the North Atlantic all 16 died shortly afterwards, possibly as a result of exercise (moving/walking) induced core temperature afterdrop. These, and many other experiences, have slowly improved hypothermia protocols.

All organizations faced with a probability of treating hypothermia should be prepared to apply the best care available, and not that which is merely available or assumed sufficient to prevent death.

Over the past several years Search and Rescue (SAR) personnel have become increasingly skilled at managing accidental hypothermia.

The most critical phase of HYPOTHERMIA MANAGEMENT for SAR personnel during the first 30 minutes following rescue are (1) keep the patient alive, (2) thermally stabilize the patient, (3) transport the patient to a site of complete medical care.

An important and often neglected consideration is the stress experienced by first responders in treating hypothermia victims under adverse conditions in the field. In some cases, evacuation of the victim is not possible or advisable, and the victim must be stabilized on-site. Severe injuries or arduous terrain may delay transport, as often found in caving and mountaineering accidents, difficult maneuvers of the stretcher through constricted passages and the negotiation of pits, up or down, with lengths anywhere between 10 and 200 feet. Such an evacuation has been reported to have taken 24 hours to complete.

Delay in transporting a patient may also apply to urban settings in a motor vehicle accident, or building collapse, due to earthquakes for example. This problem can also be complicated with trauma.

All body functions are slowed in hypothermia, including heart rate, breathing rate, metabolism and mental activity. A victim of hypothermia may display a variety of different signs and symptoms.

SAR personnel can both observe and measure the most important of these:

- Pulse (slow to none);
- Breathing (slow to none);
- Mental status (slurred speech, unresponsiveness to pain or verbal stimulus,
- Staggering walk or unconsciousness);
- Cold skin; and
- Low rectal temperature.

Severely hypothermic patients may have other problems that are not easily detected by rescuers, but which may affect the patient's survival. These include:

- Changes in blood chemistry;
- Changes in oxygen and carbon dioxide content of the blood;
- Irregular heart beats;
- Dehydration;
- Differences in temperature between deep body tissues and superficial body tissues.

Hospital humidifiers are designed primarily for the humidification and warming of anesthesia gases at normal body temperature, but has been adapted by hospitals for inhalation rewarming. This is because no inhalation rewarming equipment, dedicated for treatment of hypothermia, existed before the development of the RES-Q-AIR system. Thermometers are often placed incorrectly (before the one way flow valve), thus not registering the effect of room air being drawn in through a "flow through" open face mask, the inhaled temperature is consequently much lower than measured.

The growing popularity of outdoor recreation has resulted in greater demand for an effective on-site method of treating hypothermia. Other than for mild cases, the most effective and safest treatment for all levels of hypothermia is the addition of heat to the body core, rather than via the periphery, to prevent post-rescue collapse.

The RES-Q-AIR system meets the needs of all remote hypothermia treatment scenarios. The ease of operation and convenience of the systems are an attractive and unmatched feature. These units provide PRIMARY CARE in almost any location under the most adverse conditions, including caves and crevasses, it is ideal for remote situations, including small bush hospitals as well as for use during transport of hypothermia victims, in ambulances, helicopters, and on board ships. Units in use and applied during rescues involving hypothermia cases by the Canadian Coast Guard, have saved lives. Several hypothermia specialists promote use of the RES-Q-AIR in ambulances in remote regions. A feature such as positive pressure ventilation with oxygen increases the versatility of the system.

Beside this strategic donation of heat, inhalation rewarming also eliminates respiratory heat loss, which accounts for 10% to 30% of the body's heat loss. This is particularly important in rescue situations where the ambient air is cold (cooling of the core through respiration). This cooling, if not stopped, can lead to ventricular fibrillation. Thermally stabilizing a patient, with suitable equipment, is necessary.

As the only non-invasive hospital treatment suitable for active core rewarming in the field, inhalation rewarming donates heat directly to the head, neck, and thoracic core (the critical core) through inhalation of warm, water-saturated air at 44 °C (107 °F). This method also warms the pothalemus, the temperature regulation center, the respiratory center, and the cardiac center at the base of the brainstem. In many cases, this rewarming of the central nervous system at the brainstem reverses the cold-induced depression of the respiratory centers, and improves the level of consciousness.

RESCUING THE PATIENT:

Keep the patient in as horizontal a position as possible. This will help prevent shock and make it easier for the patient's heart to maintain blood flow to the brain. This position is particularly important for patients taken from the water. The pressure of surrounding water on the patient's body acts, in a small way, like anti-shock trousers. When the patient is taken from the water, this pressure is removed, and the patient's blood pressure may drastically fall. If patients cannot be rescued in a horizontal position (e.g. as in a rescue basket), they must be so placed as quickly as possible once aboard the vessel or aircraft.

EXAMINING PATIENT:

Remember ABC's (Airway, Breathing, Circulation); make sure the patient has an open airway, is breathing and has a pulse. If there is a high probability that the patient is severely hypothermic, breathing and pulse may be slow, shallow and very hard to detect. Therefore, take a full minute or more to measure these vital signs. Hypothermia patients with any measurable pulse or respiration obviously do not require Cardio-pulmonary Resuscitation (CPR). However if both pulse and respiration are absent, commence CPR. If the patient is found facedown in the water, assume a case of cold-water near drowning. In this event commence CPR immediately. Note mental status; evaluate the patient's level of consciousness, size of pupils, ability to respond if conscious, ability to walk if ambulatory and ability to think clearly. Where any of these characteristics are abnormal, suspect possible severe hypothermia.

Examine the patient for other possible injuries. Look especially for frostbite, soft tissues injuries, fractures, etc. Remember that when affected by hypothermia, the patient's ability to feel and respond to pain are depressed. Therefore a very careful search for these other injuries is necessary.

Check vital signs; measure pulse, breathing rate, blood pressure and Core temperature measurements are essential (e.g. Tympanic). If tympanic temperature cannot be obtained, take a rectal or oral temperature. These other sites are not as accurate as the tympanic temperature, but at least you will know the patient is no colder than the temperature recorded in these sites (both of which are almost always lower than tympanic temperature). In all temperature recordings, low reading thermometers (down to 70°F/21°C) are essential. Are these provided in all your first aid kits? Ordinary household thermometers are not good enough, since they go down to only 94°F/34°C. Glass thermometers are also unsuitable since hypothermic patients can thrash about, causing possible breakage and consequently, injury.

TREATING LIFE-THREATENING EMERGENCIES:

Commence CPR, if necessary; mouth to mouth or mouth to mask breathing during CPR is best because either provides warm, humidified air to the patient. However, every effort needs to be made to use equipment that can ventilate the patient with 100% heated, humidified oxygen.

Avoid Advanced Cardiac Life Support (ACLS); normal defibrillation and drug treatments are not useful in treating severe hypothermia, since the cold heart will not respond as expected. Worse the heart can be damaged by repeated defibrillatory shocks. If administered, drugs will not be metabolized or cleared normally by the patient's liver and kidneys. Instead, they will accumulate in the body and become active as it warms.

Control bleeding in the usual manner.

Control shock; evaluate the patient carefully, especially before using anti-shock trousers. Inflation of the trousers may expose the heart to a sudden rush of cold, acidotic, venous blood isolated in the legs. Sudden temperature and/or pH changes in the heart have been suspected of causing cardiac arrest in severely hypothermic patients. Anti-shock trousers should only be used if the patient's low blood pressure is due to blood loss or severe fluid depletion. Moving a hypothermic patient's extremities may also cause cold peripheral blood to be pumped into the central circulation, affecting cardiac rhythm. Gentle handling is critical!

Increased flow of cold blood from the periphery (muscle pumping from removing clothing, or wrapping in blankets, or from aggressive external rewarming) can cause afterdrop, increasing the depth of hypothermia in critical core tissues, especially the heart. It is better to cut away clothing!. Stimulating the peripheral circulation also reduces the blood volume in the body core, causing rewarming shock, and increases the workload on the heart. The blood returning from the periphery can also include metabolic waste products that cause fatal heart arrhythmias. Active external rewarming is generally safe only for mild hypothermia, because externally applied heat stimulates the peripheral circulation. The dangers associated with this have been explained; also comparative clinical studies have indicated that active external rewarming has a higher mortality rate than active internal rewarming.

FURTHER MANAGEMENT:

Handle the patient very gently to avoid cardiac arrest.

INSULATE from further heat loss; this is one of the primary goals for rescuers in treating severe hypothermia. Do not expose the patient's skin to cold air, wind or spray, especially the down wash created by helicopter rotor blades. If patients need helicopter transportation, GENTLY wrap them in blankets, sleeping bags, etc., and also be sure to insulate their heads. Deliver heated, humidified oxygen or air by mask at a temperature of 107°F/44°C. This treatment will prevent further respiratory heat loss which is significant in hypothermia and will help to stabilize heart, lung and brain temperatures.

Apply external heat (thermo-pads, hot packs, heating pads, etc.) to the head, neck, trunk and groin, in conjunction with inhalation therapy, defending the core temperature. These sources of external heat MUST be insulated from direct contact with the patient's skin (wrapped, etc.), in order to prevent thermal burns. Hypothermic skin is very sensitive to heat and is easily burned.

Postpone orally administered treatment; give nothing by mouth until the patient is considered sufficiently conscious to both cough and swallow (i.e. fully conscious). Hot drinks are not effective in warming a severely hypothermic victim. They may be useful, however, in raising the morale of mildly hypothermic victims.

Administer WARM intravenous (IV) fluids: if a blood vessel can be found, despite vaso-constriction, administer already warmed to body temperature 5% dextrose in water or 5% dextrose in normal saline. Do not use Ringer's lactate because the hypothermic liver may not be able to metabolize the lactate normally. Most hypothermic patients are dehydrated, administer 300-500 cc's of dextrose in water or saline rapidly, followed by 75-100 cc/hr. DO NOT ADMINISTER COLD IV FLUIDS. Use an IV warmer or carry a plastic IV bottle inside a rescuers clothing (preferably next to the skin) to keep the fluids warm.

Transport to a medical facility as soon as possible.

Hypothermia fatalities are significantly greater in immersion hypothermia, but the evidence is often indirect and fatalities are often recorded as drowning.

Hypothermia fatalities are also associated with sociological problems and old age, alcohol and drug intoxication being perhaps the most significant contributing factors. Over 50% of hypothermia deaths reviewed in Manitoba, Alberta and British Columbia are related to alcohol intoxication. Documentation of pre-hospital, post-rescue deaths is rare. Information on such cases probably does exist, but is not published.

Most are presumed dead on discovery (DOD), after prolonged exposure. This is consistent with findings of an investigation of exposure-related hypothermia fatalities in Washington, D.C. (MMWR, 1982). Only 10% of these were taken to hospital, and no treatment results are presented. The issue of presumed death is an interesting one. In the last decade, the dramatic resuscitation of cold water "drowning" victims has re-defined the limits of life under these circumstances.

We have not encountered any discussions, in any type of publication, concerning treatment of a mass hypothermia incident, such as would be encountered during military conflicts, natural disasters, earthquakes and maritime tragedies.

Nevertheless, we would suggest that these possibilities are real and that the problem needs to be addressed. Cold exposure was a significant issue in the Falkland Island conflict, both at sea and on land. Cold injuries were also a major problem during the Korean War and WW II.

A review of some of the major anecdotal evidence suggests that mortality rates are generally low during hospital treatment of hypothermia, particularly for primary hypothermia in healthy patients. Success in hypothermia treatment is increasing, largely as a result of better over all management and understanding of hypothermia physiology.

Active internal rewarming techniques in a hospital include: gastric, thoracic and peritoneal lavage (circulation of heated solutions in body cavities); diathermy (use of ultra sound and microwave); extra corporeal circulation (circulating and heating of the blood outside the body); and inhalation rewarming (ventilation of patients with heated, humidified air or oxygen). Heated IV solutions are also used. Extra corporeal circulation is used for profoundly hypothermic patients. Rapid core rewarming is possible with this method. However it is a complex procedure that can be accomplished only in intensive care facilities. The risk of complications demands that it is used only when absolutely necessary. Extra corporeal circulation (ECC) is the treatment of choice for profound hypothermia. The facilities for this method are found only in major medical centers. Peritoneal lavage is a less complicated procedure and can be used for treating severe hypothermia. Rapid rewarming is also characteristic of this method. Nonetheless, like ECC, it is an invasive method ("surgical") and can result in complications.

Hayward's 1984 study recorded cardiac temperature. In that investigation, there was conclusive evidence that there was no afterdrop associated with the inhalation rewarming method, nor with spontaneous rewarming, but the rewarming rate of the core, especially the heart, was greatest with the inhalation rewarming technique. The rate of rewarming was greatest for the hot water bath therapy however, afterdrop of the heart temperature was observed.

The general awareness of hypothermia is growing. An increased participation in land-based and water-based recreation over the last 15 years has been accompanied by hypothermia education. Research programs on immersion hypothermia has been conducted at the University of Victoria (British Columbia) This group has been responsible for the development of survival behaviors (HELP and HUDDLE positions), hypothermia prevention clothing (UVIC Thermo-Float jacket), prevention technology (Sea Seat) and treatment technology (RES-Q-AIR). This research has also provided data on predicted survival times for man in cold water.

Misconceptions of hypothermia still abound, regardless of the publicity of research results the media still reports accounts of people dying of hypothermia in less than 5 minutes after falling into cold water. Research and real life experience indicate that people survive cold-water immersion much longer than popularly believed. These and other misconceptions are partly based on continued reference to outdated information and "mind set". Association of hypothermia with shock resulting from trauma is rarely considered an event that can happen frequently and even during summer months.

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