Hypothermia Physiology, Signs, Symptoms and Treatment Considerations

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As you know, hypothermia is a temperature related disorder. Therefore, it is necessary to understand human physiology as it pertains to temperature stress. Man is considered to be a tropical animal. Normal functioning of the human animal requires a body temperature of 37 degrees Celsius (98.6 degrees Fahrenheit). Comfortable human survival using only that protection from temperature stress which is provided physiologically at birth would therefore require an environment providing a temperature of 37 degrees Celsius, plus or minus perhaps 1 degree.

The body can self-compensate for small upward or downward variations in temperature through the activation of a built-in thermoregulatory system, controlled by temperature sensors in the skin.

The response to an upward variation in body temperature is the initiation of perspiration, which moves moisture from body tissues to the body surface. When the moisture reaches the surface it evaporates, carrying with it a quantity of heat. The explanation for a person becoming thirsty when exposed to a hot environment for a period of time is that fluids lost due to perspiration must be replaced.

The response to a downward variation in body temperature is shivering, which is the body's attempt to generate heat. Shivering is an involuntary contraction and expansion of muscle tissue occurring on a large scale. This muscle action creates heat through friction.

Now that the necessary groundwork has been laid we can delve into the intricacies of hypothermia and its treatment.

THE DISORDER

Hypothermia is defined as a core temperature of less than 35 degrees Celsius. Hypothermia is also considered the clinical state of sub-normal temperature when the body is unable to generate sufficient heat to efficiently maintain functions.

Many variables contribute to the development of hypothermia. Age, health, nutrition, body size, exhaustion, exposure, duration of exposure, wind, temperature, wetness, medication and intoxicants may decrease heat production, increase heat loss, or interfere with thermo stability.

The healthy individual's compensatory responses to heat loss via conduction, convection, radiation, evaporation and respiration may be overwhelmed by exposure. Medications may interfere with thermoregulation. Acute or chronic central nervous system processes may decrease the efficiency of thermoregulation.

Let's look at the definitions of the aforementioned causes of heat loss.
Conduction: direct transfer of heat by contact with a cooler object - conduction of heat to the cooler object
Convection: cool air moving across the surface of the body, heat transferred to the cool air, warming it and cooling the body
Radiation: heat radiated outward from the warm body to the cooler environment
Evaporation: the loss of heat through the process of removing water from the surface of the body through vaporization
Respiration: inspired air raised to body temperature and then exhaled

Each of these causes of heat loss can play a large or small role in the development of hypothermia, depending on clothing, head cover, wind, weather, etc.

Once hypothermia develops, the heat deficit is shared by two body compartments, the shell and the core. The shell consists of the outer 1.65 mm of skin and has an average area of 1.8 square meters. This constitutes approximately 10% of a 70 kg mass. The remainder of the body is the core.

However, when we speak of Core Temperature it is the thoracic, or critical core we are concerned with, mainly the area of the heart, lungs and brain.

RECOGNITION OF SIGNS AND SYMPTOMS

Impending Hypothermia:
Due to physiological, medical, environmental, or other factors the person's core temperature has decreased to 36 degrees Celsius. The person will increase activity in an attempt to warm up. The skin may become pale, numb and waxy. Muscles become tense; shivering may begin but can be overcome by activity. Fatigue and signs of weakness begin to show.

Mild Hypothermia:
The person has now become a victim of hypothermia. The core temperature has dropped to 35 - 34 degrees Celsius. Uncontrolled, intense shivering begins. The victim is still alert and able to help self, however movements become less coordinated and the coldness is creating some pain and discomfort.

Moderate Hypothermia:
The victim's core temperature has now dropped to 33 - 31 degrees Celsius. Shivering slows or stops, muscles begin to stiffen and mental confusion and apathy sets in. Speech becomes slow, vague and slurred, breathing becomes slower and shallow, and drowsiness and strange behavior may occur.

Severe Hypothermia:
Core temperature now below 31 degrees Celsius. Skin is cold, may be bluish-gray in color, eyes may be dilated. Victim is very weak, displays a marked lack of coordination, slurred speech, appears exhausted, may appear to be drunk, denies problem and may resist help. There is a gradual loss of consciousness. There may be little or no apparent breathing, victim may be very rigid, unconscious, and may appear dead.

TREATMENT PREFACE
Treatment of cold injuries has long been controversial.

Hippocrates, Aristotle and Galen mention various cold injury treatments. Cold has had major impacts on military history. Hannibal lost nearly half his army of 46,000 crossing the Alps in 218 BC. Baron Larrey, Napoleon's chief surgeon, reported only 350 of the 12,000 men in the Twelfth Division survived the cold. He observed that those soldiers placed closest to the campfire during that retreat from Russia died. The winter of 1777 took its toll on Washington's troops. There were large losses to cold injuries in the Crimean and both world wars. About 10% of the United States casualties in Korea were cold related.

Be aware that hypothermia may masquerade as a variety of conditions, including death, in a variety of situations and seasons.

Always act on the premise that “no one is dead until warm and dead".
Patient’s cold, stiff and cyanotic, with fixed pupils and no audible heart tones or visible thoracic excursions have been successfully resuscitated. One patient recovered completely in the morgue.

The only certain criterion for death in hypothermia is irreversibility of cardiac arrest when the patient is warm.

Conclusions regarding the potential reversibility of coexisting conditions should be withheld until the patient is rewarmed. Resuscitation, including CPR if necessary, should be continued until either failure after hospital rewarming to 35 degrees Celsius or danger through exposure to rescuers exists.

The sole consensus regarding prehospital treatment is that all patients at some point should be rewarmed.

Initial management principles emphasize prevention of further heat loss, rewarming as soon as is safely possible at a "successful" rate and rewarming the core before the shell, in an attempt to avoid inducing lethal side effects during rewarming. This treatment goal is important, since hypothermia itself may not be fatal above 25 degrees Celsius core temperature.

Hypothermia causes several reactions within the body as it tries to protect itself and retain its heat. The most important of these is vasoconstriction, which halts blood flow to the extremities in order to conserve heat in the critical core area of the body.

When core temperature exceeds 30 degrees Celsius the major source of heat production is shivering thermo genesis.

This maintains peripheral vasoconstriction, which minimizes the severity of vascular collapse during rewarming. Induction of vasodilatation in these patients may precipitate rewarming shock and metabolic acidosis.

Rapid shunting of cold blood from the periphery to the core as the direct result of vasodilatation may cause the core temperature to drop. This phenomenon of a drop in temperature after initiation of therapy is termed core temperature after-drop.

Prevention of vasodilatation is the reason why it is imperative that the patient's extremities not be rewarmed before the core. If vasodilatation occurs, cold blood returning to the heart may be enough to put the patient into ventricular fibrillation.

The patient must also be handled very gently and not be allowed to exercise, as muscular action can pump cold blood to the heart.

Certain assumptions permit safe treatment. If the patient is unresponsive and not shivering, one should presume severe hypothermia.

At temperatures below 32 degrees Celsius, one should expect an irritable myocardium, a temperature gradient between the core and periphery, and relative hypovolemia (abnormally decreased volume of circulating blood in the body).

The patient is in a "metabolic ice-box", and sudden thawing may be disastrous to the cardiovascular system.

TREATMENT FOR THE DIFFERENT LEVELS OF HYPOTHERMIA

Impending Hypothermia:

- Seek or build a shelter to get the person out of the cold, windy, wet environment.
- Start a fire or get a cookstove going to provide warmth. Provide the person with a hot drink (no alcohol, coffee or tea).
- Halt further heat loss by insulating the person with extra clothes, etc. This person should recover from the present condition quite quickly.

Mild Hypothermia:

- Remove or insulate the patient from the cold environment, keeping the head and neck covered. This prevents further heat loss and allows the body to rewarm itself.
- Provide the patient with a warm, sweetened drink (no alcohol, coffee or tea) and some high energy food. Limited exercise may help to generate some internal heat, but it depletes energy reserves.

Moderate Hypothermia:

- Remove or insulate the patient from the cold environment, keeping the head and neck covered. Apply mild heat (comfortable to your elbow) to the head, neck, chest, armpits and groin of the patient.
- Use hot water bottles, wrapped Thermo-Pads, or warm moist towels.
- It is possible that you may have to continue this treatment for some time. Offer sips of warm, sweetened liquids (no alcohol, coffee or tea) if the patient is fully conscious, beginning to rewarm and is able to swallow. Patient should be seen by a physician.

Severe Hypothermia:

- Place patient in a prewarmed sleeping bag with one or two other people. Skin to skin contact in the areas of the chest (ribs) and neck is effective. Exhale warm air near the patient's nose and mouth, or introduce steam into the area.
- Try to keep the patient awake, ignore pleas of "leave me alone, I'm ok". The patient is in serious trouble, keep a close, continuous watch over the patient.
- Apply mild heat, with the aim of stopping temperature drop, not rewarming.
- If patient has lost consciousness be very gentle, as by now the heart is extremely sensitive. Always assume the patient is revivable, do not give up.
- Check for pulse at the carotid artery. If, after two minutes you find no pulse check on the other side of the neck for two minutes.
- If there is any breathing or pulse, no matter how faint, do not give CPR but keep very close watch for changes in vital signs.
- If no pulse is found begin CPR immediately, stopping only when the heart begins to beat or the person applying CPR can not carry on any longer without endangering himself.
- Medical help is imperative, hospitalization is needed.

CONCLUSION

Treatment of hypothermia should be approached with knowledge and care.

It is altogether too easy to cause more harm than good by using the wrong treatment. If one can not distinguish the level of hypothermia through visible signs and symptoms then he should assume severe hypothermia.

Through recent research and clinical findings it has come to be concluded that the safest and most effective method of treating hypothermia is through inhalation rewarming. The necessary equipment for providing inhalation rewarming therapy in the field is now readily available. However, this equipment may not be available when it is needed and people who may end up in the position of having to provide treatment must know the alternative methods which have been described here.

Always remember, gentle handling, insulation, no alcohol, coffee or tea, and don't try to rewarm a patient in a hurry.

Any method which will rewarm a patient in a hurry in the field will likely cause further complications, if not death.