ATLANTIC KAYAK TOURS™

Cold Water Paddling

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Fact: Almost without fail each year, one report or another surfaces about the death of a kayaker; usually a solo paddler, usually a middle-age or older male, and quite often found floating face down in his boat.

Fact: Immersion in cold water kills more sea kayakers than any other factor in the sport. Cold water is the single most serious threat to the survival of an unprepared paddler.

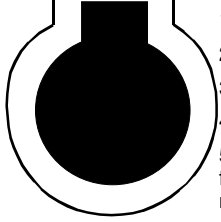
Fact: Hypothermia is not normally the issue in cold water paddling, but rather a predictable series of "shock" reactions that first impair, then quickly preclude, effective self-rescue actions.

Fact: A review of 6 fatal and 12 near-fatal accidents (1985) noted that all but one involved water temperatures of 50°F or less. A more recent review of 20 accidents, 19 involving immersion of 26 people in cold water noted that 10 died before they could be rescued and the remainder had varying degree of hypothermia.

Fact: "Cold Water Kills" is the introduction to the medical safety section of the annual Cold Water Workshop held by Atlantic Kayak Tours. Our goal is to provide you, the beginning, intermediate or advanced paddler with the information you will need to keep yourself safe, healthy and enjoying paddling no matter what the season.

HYPOTHERMIA FIRST AID

SYMPTOMS	F	TREATMENT
NORMAL	98.6°	**ALL CASES** Move victim to dry shelter and warmth Handle gently Remove wet clothes Insulate body, head, and neck Apply mild heat to body core Rewarm gradually
MILD HYPOTHERMIA Shivering[1] Cold hands and feet Still Alert and able to help self Numbness, clumsiness, pain from cold	97°	**MILD HYPOTHERMIA** Prevent further heat loss and let body rewarm Give warm, sweet drinks; no alcohol or caffeine Keep victim warm for several hours
MODERATE HYPOTHERMIA Shivering may decrease or stop[2]	93°	**MODERATE HYPOTHERMIA** Apply gentle heat to stabilize temperature[3] Offer drinks only after victim is fully conscius Have victim checked by doctor if possible
SEVERE HYPOTHERMIA[4] Shivering decreases or stops Loss of mental clarity; abnormal behavior Victim appears drunk; may resist help Semiconscious or unconscious[2] Muscular rigidity increasing	90°	**SEVERE HYPOTHERMIA** Avoid jarring victim; handle gentle Ignore pleas to be left alone Lay victim on back; keep immobile Apple mild heat
CRITICAL HYPOTHERMIA Unconscious; may appear dead Little or no aparent breathing or pulse Skin cold; may be bluish-gray Eyes may be dilated Very rigid	82°	**CRITICAL HYPOTHERMIA** Assume patient is revivable; don't give up Look, listen, and feel for breathing and pulse for 2 minutes[5] Medical help imperative



Body temperature (taken rectally)

1) With immersion victims shivering may not happen.

2) This stage of hypothermia is hard to distinguish.

3) Apply gentle heat to neck, armpits & groin. Victim must be kept supine.

4) This is a full emergency situation and outside help is needed immediately.

5) With critical hypothermia it is still debatable if CPR should be done. Many feel that you will be pumping supper cool blood through the patient doing more harm than good.

Cold Water Equipment

What you wear for cold water paddling will vary depending on the water temperature, weather and the wind, but the same theory applies for any temperature.

To keep warm your skin must be dry. The first layer is used to move the moisture away from your skin and into the outer layers. The shell is used to keep you and your insulation dry. Most insulation works much better when dry.

Dress light. As you stand on the shore before going out you should feel cool. As you start paddling you will warm up quickly. Adjust you temperature by adjusting your head gear and gloves. You can also put a wind breaker/Storm Cag over your dry suit.

Following is a list of clothing. It is listed in order from against your skin to the outer layer. The middle layers are used to adjust for different temperatures.

Torso

Thin Poly/Capilene ..... Against your skin.
Henderson Polartec 2000 ..... Warm & wind resistant.
Thicker Poly/Capilene ..... For colder temperatures.
Pile jacket ..... To put on at breaks

Head

Wool/Polatec hat for cool water Use to adjust comfort level.
Full hood for cold water ..... Polartec works great.

Feet

Polatec or Pile socks ..... Inside wet suit booties.
Latex Socks ..... Option on dry suits
Foam pad under heel area ..... To help keep feet warm.

Hands

Wool Gloves or mittens ..... For cool water.
Neoprene Gloves or mittens ..... For cold water.
Pogies ..... With gloves inside.

Shell

Dry Suit ..... Gore-Tex has best protection.
Dry Top ..... Keep you dry while in boat.
Storm Cag ..... Not breathable.
Paddling Jacket ..... Patagonia Skanorak is good.

Equipment

First aid kit ..... With hypo thermometer.
Bivouac bag ..... Large enough for two.
Space Blanket ..... For emergency shelter.
Hot Liquid ..... To prevent or rewarm.
Small stove & pot ..... To heat water or food.
Spare clothes ..... In waterproof bag.
VCP Igloo ..... A 6 person wind shelter.
VHF Radio ..... Best signaling equipment.
Signaling equipment ..... Standard smoke & flares.

What is killing the kayakers?

For years, most paddlers thought that the foremost danger in cold water paddling was hypothermia, and mistakenly concluded that cold water drownings were caused by hypothermia. Mistakenly because new evidence suggests otherwise. So what is it? What is happening to the kayakers found upside down, still inside their boats, apparently never making attempts to exit or self rescue themselves? What happened to the 9 physically fit and tough U. S. Marines who capsized their boat one frigid winter day on the Potomac River, not one making it to shore alive? What could have happened to these paddlers? Did they drown? Did they die of hypothermia? Did they die of shame? Well, the answer may be both yes and no to all of these questions. What we can surmise though is that some sudden disabling event happened to precipitate these casualties. Most likely the injuries were part of a series of complex events that combines aspects of cold shock, hypothermia and drowning.

Cold Shock

A new theory, developed within the last few years by Moulton Avery may well explain what is happening to some paddlers when suddenly immersed in cold water. “Cold Shock” can best be described as a series of physiologic events within the human body, characterized by incapacitation, immediate loss of breathing control and a high risk of sudden drowning.

Cold Shock Responses

Cold shock happens when you are suddenly immersed in cold water. Don't mistakenly think that the water must be freezing. Cold shock can occur even in water temperature above 50°F. Wearing a dry suit, without proper clothing beneath is not protection from cold shock.

Immersion in cold water is characterized by the rapid development of a number of shock responses that can result in sudden drowning. A few of these responses can be consciously suppressed or moderated but most are beyond control. The most important shock response involves loss of the ability to control breathing.

The Gasp Reflex

Loss of breathing control begins the moment water makes contact with the skin, triggering a series of huge involuntary gasps for air. If your head is underwater when you gasp, you will immediately drown. Example: Oct. 1987, Water temperature: 41°F. Fit paddler, calm waters, folding double kayak with 36" beam. Found hanging upside down in his boat, having made no attempt to exit. Not dressed for immersion.

Have you ever been in the shower when the hot water stops and cold water continues? The uncontrolled gasp is what we worry about. Don't think you can control the gasp reflex, it is a physiological reflex. The only way to protect against the gasp reflex is to dress properly with full head gear including wet suit hood, nose clips and ear plugs. This is a subject we are still learning about and all the facts are not in.

Hyperventilation

Following a successful wet exit, the huge gasps are followed by immediate uncontrolled hyperventilation (rapid breathing). The colder the water the more dramatic the response. Hyperventilation increases breathing rates 4 to 5 times normal within 30 to 60 seconds of immersion, and it takes up to 5 minutes for relaxed volunteers in cold water experiments to stabilize their breathing at around twice the pre-immersion level.

Breathlessness

Paradoxically coinciding with hyperventilation is a strong claustrophobic feeling of not being able to get enough air, a frightening sensation which continues for up to 3 minutes before gradually declining. Breathlessness increases potential for panic and disorganized behavior and makes hyperventilation more difficult to control.

Alkalosis

Hyperventilation rapidly reduces blood levels of carbon dioxide (CO_2), causing respiratory alkalosis. This diminishes blood flow to the brain resulting in confusion, dizziness and possible loss of consciousness. Sustained hyperventilation causes tetany, a tingling and numbness in the hands and feet which progressively develops into severe cramping of the extremities.

Inability to hold your breath

An average person's ability to hold a breath in water below 60°F is one third of that in warmer water. Studies with volunteers in 41°F water have shown a reduction from 45 to 9.5 seconds with a low of 0.2 seconds. Imagine the implication for the unprepared kayaker trying to set up to roll or wet exit after capsize.

Inability to synchronize breathing

Loss of breathing control and reduced breath-hold time make it difficult to synchronize breathing while swimming and can result in water inhalation and subsequent drowning.

Panic

Pain, claustrophobia and general disorientation caused by the other shock responses increase the likelihood of panic. Panic elicits a "flight or fight" response in the body, our way of protecting self from harm. Release of adrenaline (epinephrine) in response to the panic dramatically rises heart rate and blood pressure to 2-3 times normal. Individuals at risk for vascular illness (heart attacks or strokes) can be dramatically affected.

In conclusion, an unprepared kayaker suddenly immersed in cold water runs a very high risk of drowning as a direct result of cold shock long before hypothermia has a chance to develop. The only known method of preventing cold shock is proper dress for cold water (wet or dry suits, including head and neck protection).

Hypothermia

Human Beings and the Cold

Hypothermia: Hypothermia is called the silent killer and can happen even if you don't capsize or get wet. Hypothermia occurs when the body core temperature begins to fall below its normal 98.6°. Wind, rain or sweating can lead to hypothermia.

With slow onset hypothermia as the core temperature drops below 97° shivering usually starts and you might feel your hands and feet are cold (even if properly covered). This is why its said that, if your feet are cold, put on a hat. To preserve core heat, the body will slow the circulation of blood to its extremities, so they get cold first. This is one of the hypothermia warning signs. It should not be disregarded. Even at this early stage, hypothermia is very dangerous. The loss of dexterity can make it impossible to open a hatch for extra clothing, or you might be unable to use a paddle float to do a self rescue, and many kayakers have not been able to put their spray skirts back on. This can happen even with the best hand gear made. As stated, it isn't improper hand gear, but the bodies survival instinct of slowing circulation to the extremities.

As the core temperature drops to the lower nineties, shivering will slow or stop and the person might begin to feel warm again. This is when the real danger begins. The loss of mental alertness will occur, causing wrong decisions to be made. The victim will lose coordination, increasing the likelihood of a capsize. At this stage it becomes very difficult to warm the person safely outdoors, or for the person to save themselves. The victim's body will not be able to warm itself.

First aid for hypothermia is difficult in the marine environment. Heat packs, warm drinks, extra clothing and an emergency shelter should be carried when cold water paddling. Every kayaker's first aid kit should include a hypothermia thermometer. Standard thermometers don't go down to a low enough temperature. Standard first aid techniques should be used. In moderate to severe cases try to keep the person still and calm, to slow circulation. Keep track of vital signs. Always talk positively around a first aid victim, even when the person is unconscious.

A couple of heat packs inside dry clothing can help a mild hypothermia victim. We carry a bivouac sack large enough for two people get into. With the use of an emergency shelter, care must be taken that the victim is protected from the cold ground. An Ensolite or Thermerest type of pad will provide insulation from the ground. Always get the victim out of wet clothes and into prewarmed clothing. Keep the victim out of the wind and rain.

Figure 2

Full Gore-Tex drysuit is the best protection as an outer layer for cold water paddling. It keeps the water out and the Gore-Tex breaths to keep you dry. The drysuit keeps you and your insulation dry, it doesn't keep you warm. This is a Kokatat heavy duty suit.

With any stage of hypothermia the person should slowly be warmed. For any stage beyond very mild hypothermia care must be given on how the victim is warmed. There is a danger in warming a person from the outside. When the body's surface gets warm, circulation will increase, causing greater cooling of the core and more severe hypothermia or death. Warm the core slowly by applying dry heat to the large surface circulatory area including the head, neck, chest, and groin, but try not to warm the extremities.

Human beings are fragile organisms. We are warm blooded mammals, requiring and producing heat at the cellular level. Our environment acts as either a heating or a cooling force on the body and in order to survive, we must be able to generate heat, retain heat and discharge heat depending on body activity and ambient external temperature.

Body temperature is a measure of metabolism - the general level of chemical activity within the body. The optimum temperature for chemical reactions to take place in the body is 98.6°F. Above 105°F many body enzymes become denatured and chemical reactions cannot take place leading to death. Below 98.6°F chemical reactions slow down with various complications which can lead to death.

The hypothalamus, is the major center of the brain for regulating core body temperature. It is sensitive to blood temperature changes of as little as 0.5° Celsius and also reacts to impulses received from nerve endings in the skin. The hypothalmus works to keep our core temperature, essential to overall metabolic rate of the body, at an optimum steady state. The temperature of the periphery is not critical.

Core = the internal body organs, particularly the heart, lungs, brain, kidneys, and gut (intestines).

Periphery = the appendages (arms and legs), skin, and muscle tissue.

How Your Body Regulates Core Temperature

Vasodilatation (dilation of blood vessels) increases surface blood flow & increases heat loss (when ambient air/water temperature is less than body temperature).

Vasoconstriction (constriction of blood vessels) decreases blood flow to periphery & decreases heat loss.

Sweating - cools the body through evaporative cooling.

Shivering - generates heat through the increase in chemical reactions required for muscle activity. Visible shivering can maximally increase surface heat production by 500%. However, this is limited to a few hours because of depletion of muscle glucose and the onset of fatigue.

Increasing/Decreasing Activity will cause corresponding increases in heat production and decreases in heat production.

Behavioral Responses - putting on or taking off layers of clothing will result in heat regulation

How We Lose Heat to the Environment or Stay Dry = Stay Alive!

Radiation

The loss of heat to the environment due to the temperature gradient (this occurs only as long as the ambient temperature is below 98.6°F). Factors important in radiant heat loss are the surface area and the temperature gradient.

Conduction

Through direct contact between objects, molecular transference of heat energy.

- Water conducts heat away from the body 25 times faster than air because it has a greater density (therefore a greater heat capacity).
- Steel conducts heat away faster than water. Example: Generally conductive heat loss accounts for only about 2% of overall loss. However, with wet clothes the loss is increased 5 times.

Convection

A process of conduction where one of the objects is in motion. Molecules against the surface are heated, move away, and are replaced by new molecules which are also heated. The rate of convective heat loss depends on the density of the moving substance and the velocity of the moving substance (water convection occurs more quickly than air convection). Wind chill is an example of the effects of air convection. The wind chill table gives a reading of the amount of heat lost to the environment relative to a still air temperature.

Evaporation

Heat loss from converting water from a liquid to a gas.

- Perspiration - evaporation of water to remove excess heat.
- Sweating - body response to remove excess heat.
- Insensible Perspiration - body sweats to maintain humidity level of 70% next to skin - particularly in a cold, dry environment you can lose a great deal of moisture this way.
- Respiration - air is heated as it enters the lungs and is exhaled with an extremely high moisture content.
- It is important to recognize the strong connection between fluid levels, fluid loss, and heat loss. As body moisture is lost through the various evaporative processes the overall circulating volume is reduced which can lead to dehydration. This decrease in fluid level makes the body more susceptible to hypothermia and other cold injuries.

Figure 3

A full Polartec 2000 wet suit is a replacement for the traditional neoprene wetsuit. It is made of Polartec with an outer layer of Lycra laminated to it. This suit is made by Henerson. It is comfortable and can be warn as a wetsuit or under a drysuit. It has the thermal protection of a 2.5 mm wet suit.

Response to Cold

Heat Retention - (positive factors)

- Size/shape (Eskimo vs. Masai)
- Insulation (layering/type)
- Fat (as insulation)
- Shell/core (shunt blood to core) shell acts as a thermal barrier Total = Heat Retention

Heat Production - (positive factors)

- Exercise, shivering Limited by:
- Fitness
- Fuel stores (glycogen)
- Fluid status (efficient exercise)
- Food intake (kindling, sticks, logs) Total = Heat Production

Cold Challenge - (negative factors)

- Temperature
- Wet (rain, sweat, water)
- Wind (blowing, moving, e.g. biking) Total = Cold Challenge

Heat Retention + Heat Production Less Cold Challenge = Hypothermia

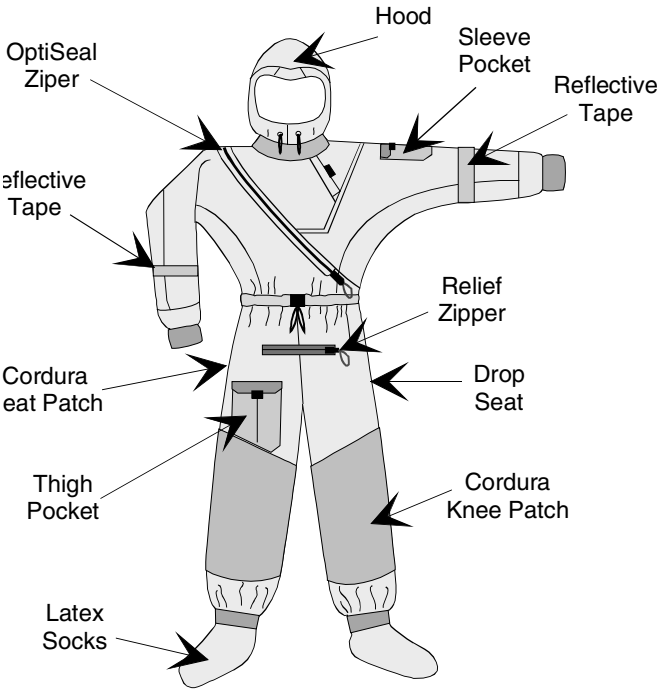


Figure 4

Kokatat offers many options on their Gore-Tex drysuits. All the options are good but adds to the price. Most paddlers will get the relief zipper (for men) or the drop seat (for women). If you do night paddling the reflective tape is worth while. On the light duty suites the reinforcement patch should be ordered. Some but not all options can be added later.

Hypothermia

Hypothermia defined:

"a decrease in the core body temperature to a level at which normal muscular and cerebral functions are impaired."

Two types:

Sudden Onset - rapid chilling from cold water exposure.

Long Onset - progressive exposure over a period of time. Usually occurs with exposure below 50° wind, wet from rain, sea spray or perspiration all create problems. May develop silent hypothermia with gradual onset of physical and mental fatigue unaccompanied by shivering.

Conditions Leading to Hypothermia

- Cold temperatures
- Improper clothing and equipment
- Wetness
- Fatigue, exhaustion
- Dehydration
- Poor food intake
- No knowledge of hypothermia
- Alcohol intake - causes vasodilatation leading to increased heat loss

What are "hypothermia" temperatures

- Below freezing
- 40° - Ex. Shenandoahs, wind and rain
- 60° - Ex. Rayanna and hurricane
- Any temperature less than 98.6° can be linked to hypothermia (ex. hypothermia in the elderly in cold houses) or peripheral circulation problems such as trench foot and frostbite.

Signs and Symptoms of Hypothermia

Watch for the - "Umbles" - stumbles, mumbles, fumbles, and grumbles which show changes in motor coordination and levels of consciousness

Mild Hypothermia

Core temperature 98.6 - 96°F.

- Shivering - not under voluntary control
- Can't do complex motor functions (ice climbing or skiing) can still walk & talk
- Vasoconstriction to periphery

Moderate Hypothermia

Core temperature 95 - 93°F.

- Dazed consciousness
- Loss of fine motor coordination - particularly in hands - can't zip up parka, due to restricted peripheral blood flow

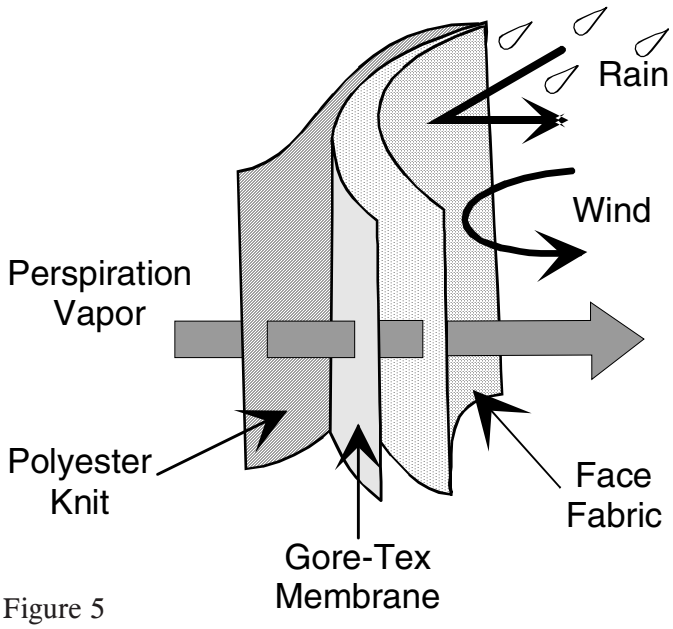


Figure 5

Gore-Tex had a reputation of not working in salt water. Kokatat has a three layer cloth with the Gore-Tex laminated inside. If used multiple days in salt water it should be rinsed out every couple of days and can even be rinsed in salt water.

- Slurred speech
- Violent shivering
- Irrational behavior - Paradoxical Undressing - person starts to take off clothing, unaware he/she is cold
- "I don't care attitude" - flattened affect

Severe Hypothermia

core temperature 92 - 86° and below (immediately life threatening).

- Shivering occurs in waves, violent then pause, pauses get longer until shivering finally ceases - because the heat output from burning glycogen in the muscles is not sufficient to counteract the continually dropping core temperature, the body shuts down on shivering to conserve glucose
- Person falls to the ground, can't walk, curls up into a fetal position to conserve heat
- Muscle rigidity develops - because peripheral blood flow is reduced and due to lactic acid and CO2 buildup in the muscles
- Skin is pale
- Pupils dilate
- Pulse rate decreases
- At 90° the body tries to move into hibernation, shutting down all peripheral blood flow and reducing breathing rate and heart rate.
- At 86° the body is in a state of "metabolic icebox." The person looks dead but is still alive.

Death from Hypothermia

- Breathing becomes erratic and very shallow
- Semi-conscious
- Cardiac arrhythmia's develop, any sudden shock may set off Ventricular Fibrillation (uncoordinated heart rhythm - quickly leads to death)
- Heart stops, death

How to Assess if someone is Hypothermic

- If shivering can be stopped voluntarily = mild hypothermia
- Ask the person a question that requires higher reasoning in the brain (count backwards from 100 by 9's). If the person is hypothermic, they won't be able to do it. [Note: there are also other conditions such as altitude sickness that can also cause the same condition.]
- If shivering cannot be stopped voluntarily = moderate - severe hypothermia
- If you can't get a radial pulse at the wrist it indicates a core temperature below 90 - 86°.
- The person may be curled up in a fetal position. Try to open their arm up from the fetal position, if it curls back up, the person is alive. Dead muscles won't contract - only live muscles.
- An old Emergency Room adage: A person is never dead until they are warm and dead. This means that even if you don't have vital signs you assume the person is still alive and treat them for hypothermia. Remember, people have survived sustained periods of hypothermia and drowning from cold water. Cold water induced Mammalian reflex slows heart rate, oxygen and energy requirements in an effort to preserve life.

Treatment of Hypothermia

The best method of treating hypothermia and / or cold shock is to prevent it from happening in the first place.

Wind Chill

Wind Speed	Actual Air Temperature (F)				
MPH	50	40	30	20	10
5	48	36	27	17	-5
10	40	29	18	5	-8
15	35	23	10	-5	-18
20	32	18	4	-10	-23
25	30	15	-1	-15	-28
30	28	13	-5	-18	-33
35	27	11	-6	-20	-35

Dress appropriately for the water temperature regardless of the air temperature. A general rule of thumb is to wear wet or dry suits when water temperatures is less than 50°F.

- The head is a primary heat loss area.
- Avoid cottons
- Wool, nylon or synthetics will not prevent cold shock
- Carry dry extra clothing
- Carry a sleeping bag or space blanket

Field Treatment

Always remember your ABC's when assessing some one for cold related injuries. Their AIRWAY must be open, they must be BREATHING and their must be blood CIRCULATING, otherwise your efforts are for naught!

Learn CPR if you don't know already. Your training may save a life!

Gently remove cold, wet clothing. Place into dry clothing, sleeping bag, wrap with space blankets. Prevent further conductive or convective heat loss.

External heat - chemical or other heat packs to armpits, groin, around neck, scalp (near major blood vessels), body to body contact (share your heat but must be skin to skin contact).

Warm Liquids - Small sips of warm not hot liquids.

Avoid alcohol - A vasodilator, alcohol causes blood vessels to dilate and releases cold blood from the extremities into the core. May precipitate heart arrhythmias and sudden death.

Move gently and only horizontally - Avoid after drops of blood pressure and release of cold blood to the core. Sudden, vertical position changes can cause after drop and sudden death.

Seek medical attention as soon as possible.

Preparation

Preperation is the key to cold water paddling. You must dress for the water temperature, not the air temperature. In cold water a drysuit is required. In cool water, a wetsuit is needed. While in warm water, shorts and a tee-shirt may be fine (depending on the weather), extra clothing should always be carried. Any water colder than body temperature can starts hypothermia. The only way to know if you are dressed for the water is to stand in the water and if after ten minutes you still feel warm, then you are properly dressed.

Besides a wet/dry suit, other items you should consider are; nose clips, ear plugs (designed for swimmers) neoprene hood, neoprene gloves and booties. Capilene or polypropylene, should be worn under your wet/dry suit and booties. In real cold water or exposed paddling, bees wax or mineral oil covering your face, neck, hands and feet will aid protection. Eskimos used to grease up before paddling. The face, neck, hands and feet are very hard to insulate properly and the bees wax or mineral oil will help.

In 40° water, survival time is well under one hour. Within a few minutes your hands will be frozen and useless. At that point you can not rescue yourself. Even at 50° water temperature hypothermia can set in quickly. Don't think it won't happen to you. Remember as stated earlier, a hypothermia victim is not dead, until they are warm and dead. This means that even if you don't have vital signs you assume the person is still alive and treat them for hypothermia. At this stage of hypothermia you must get the person to the hospital. A VHF radio and other signaling equipment is required. Time is very important. You are dealing with a life and death situation. No one should be allowed to get to an advanced stage of hypothermia. Cold water paddling takes skill, leadership, and expensive equipment. There is no way around this.

Many paddlers who know how to do an Eskimo roll think they are safe, because if they capsize they will roll up. I have seen many experienced kayakers with "bomb proof" rolls miss their roll in cold water. The shock of cold water makes rolling much more difficult. The best defense is to dress properly, and at the beginning of the trip practice a roll. This should only be done with an experienced rescuer spotting you.

Conclusion

Cold water kills! This is a very important subject. Many paddlers take cold water paddling lightly. If you read accounts of sea kayaking deaths, you understand the importance of this subject. While many deaths may be called a drowning, it is the cold water that is the killer. We recommend you read additional literature on the subject of cold water, hypothermia and cold shock. Research is continuing on these subjects and the treatments have changed over the years, so it is best to read newer information. If you haven't done so already we strongly recommend taking our Cold Water Workshop.

Why do we go through all of this? Because some of the best paddling is available when the water is cold.

For more information about cold water kayaking and safety go to our web site (http://members/aol.com/KayakTours) and check our links page.