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A review of newspaper clippings over the summer brought to light three major incidents involving sea kayakers (or open water kayaking) that must give cause for concern - all were near-miss accidents that could easily have resulted in fatalities. These incidents point to the increasing popularity of sea kayaking, and probably only represent a tip of the ice-berg - if there were three accidents that received prominent newspaper attention, how many more near-miss accidents were never reported?

The first occurred on Lake Wakatipu. A 30 year-old Queenstown paddler was tipped from his kayak on the afternoon of Tuesday December 4 while returning across the lake from a climbing trip to Cecil Peak. He had earlier paddled across to Cecil Peak and was returning despite very cold and blustery conditions. He was alone. He spent some three hours in the water attempting to tow his capsized kayak and pack ashore before striking out without his gear and reaching Hidden Island. He was lightly clad and spent a very cold night out on the island before being rescued early the next morning. His pack floated ashore near the Lakeland Hotel later in the day.

The second incident occurred on the Wairarapa coast when a canoeist was found by fishermen clinging to one of two overturned kayaks around midday near the Cape Palliser lighthouse. He was in an advanced state of hypothermia and was unable to talk. The fishermen had happened across the overturned kayaks some 450m from shore when checking crayfish pots. At the time there was a stiff north-westerly wind whipping up a choppy sea, making the discovery of the kayaks and the paddler a matter of sheer chance. The paddler from the other kayak was later discovered sitting on a rock 40m from shore while the remainder of the paddlers' companions, a group of campers from Wellington, were ashore assisting a third person from the surf. The kayaks involved were described as suitable for river use.

The third incident received national radio network news coverage and probably came the closest to a fatality. Two paddlers went out in kayaks from Island Bay, Wellington to Rat Island at around 6.30 pm on Saturday January 5. Some 30 minutes into the trip one of the paddlers was tipped out by a wave larger than usual and he was unable to regain his kayak. The other kayaker came to his assistance and attempted to tow him ashore (no mention is made of an attempted deep-water rescue!) A stiff southerly wind at the time dashed them onto rocks where the swimmer broke some ribs and sustained head and shoulder injuries. Local residents saw that the paddlers were in some difficulty and alerted the police at 7.15pm. By the time police were able to get to the pair the swimmer was suffering from severe hypothermia in addition to his other injuries. He reported " I wasn't really aware what was going on. I must have been shivering for about 45 minutes but it wasn't until later in hospital that I really felt cold".
He also stated that they were both experienced and had been out in far worse conditions. He was reported to be very fit, a regular marathon participant and involved in a number of sports, had worked for the IHC for four years and has a Diploma in Sport and Recreation.

The Editor comments: One begins to wonder about the possibilities for future fatalities when a pair of 'experienced' paddlers, and one who claims to be an active sportsman who presumably has been involved in taking youngsters out in the outdoors in a leadership role, and might also, I assume, have been involved in some canoeing activity with these youngsters, find himself in a classic situation where a reliable self-rescue such as a deep-water rescue technique, would have resulted in the incident being no more than a brief swim.

All the paddlers in these incidents were of sufficient age (early 30's) to have sufficient maturity to have been able to accurately assess the risks of their ventures.

Two years ago I was teaching a group of primary school children some basic kayak skills including deep-water rescues, in a swimming pool. In attendance at the pool was an instructor from the local canoe club (the club had loaned me the kayaks as I was not working in my home town). At the end of my session while loading the kayaks back onto the club trailer, the Instructor told me, "We don't teach rescues like that anymore, they are pretty useless in whitewater. It's best to get them rolling right from the beginning". My experience at the Sea Kayak Forums in Nelson over the last few years, and the Coastbusters symposium last year, indicate that the general ability in self-rescue skills amongst 'experienced' sea kayakers is little better than that demonstrated in these three incidents. The answer to the problem is pretty clear - more emphasis must be given to a complete range of paddling skills during instruction programmes, before branching out into sea, whitewater, or other types of paddling skills.

On October 16 1990 a kayaker drowned on Lake Gunn, Fiordland, when out paddling with a companion. They were wearing heavy clothes including gum-boots and had decided to go paddling before starting work for the day. The wind had come up and the kayak had swamped. Again, hypothermia set in during the swim ashore. Inadequate flotation is a contributing factor in many such accidents, but not essential. Proper clothing and an ability to deep-water rescue would have solved the problem.

Hypothermia is not a problem if you can get out of the water and back into your kayak. Wet-suits help. The longest recorded survival period of a wet-suited swimmer in New Zealand is 18 hours in Cook Strait by a Scuba diver who had drifted away from her dive boat by strong tidal currents. This incident clearly points to the key to survival by lone paddlers - proper clothing for immersion. Unfortunately few sea kayakers, myself included, wear their wet-suits on trips because of the lack of comfort. For the last 5 years I have worn a dry-suit when conditions warrant, but mostly I paddle in light clothing, polypropylene, or better, polyester thermal clothing which is far superior to wool.

The enclosed notes on hypothermia have been written with the sea kayaker in mind, and differ a little from the notes I previously supplied to river canoeists where hypothermia problems are slightly different. The notes below are similar to the talk I gave at the Coastbusters Symposium in 1990 - many people have been asking for these notes and this is as an appropriate time as any to provide them.

HYPOTHERMIA AND THE SEA KAYAKER

Firstly, some terms: Hypothermia refers to the medical condition that results from a drop in the body's core temperature. Clinical hypothermia exists when the core temperature drops 2^{o}C or more. Exposure is a term used to describe the effects of general cooling of the outer shell of the body; cold muscles and the reduction of strength and fine muscle control that results from this cooling. Exposure will generally have to progress with further cooling into a state of hypothermia before death results. However, a person suffering from exposure, may have sufficient reduced strength and mobility to seriously impede swimming, and drowning may result long before a state of hypothermia is reached. The problem for sea kayakers seems to be the reduced swimming ability that results from the outer shell cooling, and the reduced strength that makes completion of deep-water rescue, and self-rescue (using a paddle float) difficult. For this reason it is vital that paddlers know and practise deep-water and self-rescue skills so that swimmers are not left in the water for any length of time. Under rough conditions 10-15 minutes may be the limit before muscle strength loss has reached a stage where the swimmer can no longer contribute much to the rescue. Getting back aboard a rescued kayak takes the most effort and with a paddler in an advanced state of exposure, maybe the stirrup re-entry will be the only option left. Therefore, when a capsize occurs and the paddler fails to roll, other party members must move fast if later problems are to be avoided. Kayak groups should therefore keep fairly close together if conditions are such that a capsize may occur. The following article describes the cooling process, from initial cooling, through exposure to hypothermia.

Hypothermia, and the effects of the cold on the body resulting from accidental immersion in cold water are not easily solved and therefore need careful attention by those at risk if deaths are to be prevented. Cold water can kill in a number of ways and can be categorised in terms of the duration that one is exposed to the cold.

SUDDEN IMMERSION

Sudden immersion in cold water when the skin is drastically cooled will cause a number of shock responses involving respiratory and circulatory problems that can kill. The immediate effect of skin cooling is to cause peripheral vasoconstriction where blood vessels constrict, squeezing blood into the central body region. This causes a dramatic rise in central blood pressure which, when accompanied with alarm-induced increases in heart rate, can cause heart failure of those with weak circulatory systems, particularly the elderly. Another initial response is hyperventilation - the first few seconds of immersion are accompanied by huge gasps, and followed by several minutes of rapid breathing of up to five times the normal breathing rate. Picture an elderly tourist who falls from a raft into the cold water of the Shotover River. Should he not suffer immediate heart problems he will be breathing rapidly while attempting to swim through difficult whitewater to regain the raft. This person will be unable to time his breathing with the frequency of waves breaking over his head. The likelihood of such a person aspirating significant quantities of water and drowning within a few seconds of falling into the water is great. A number of such drownings have been reported. For sea kayakers, these problems of sudden immersion are seldom noticed, as wave spray has generally cooled the skin to a level where there is no longer a shock response in a capsize. Perhaps the only time you will experience these problems occur when you are very warm from a hard paddle and you capsize, or when breaking out through the surf and the first wave hits you when you are still dry and warm. It pays to splash water over your face to cool the skin if you expect to hit cold water later.

Another aspect of the sudden immersion response is that the strong vasoconstriction of the skin, arms and legs leads to a cold outer body shell compared to the inner core region. While this is the body's mechanism for protection, it leads to a cooling of the muscles and nerves of the limbs and outer trunk, with consequent slowing, weakening and less coordinated movement. If a person is not wearing a buoyancy-aid, or holding onto a floating object, the ability to swim is greatly impaired, so that even good swimmers drown more quickly than expected. Instances where swimming has failed with ten minutes in water below 5^{o}C are common. A swim through a lengthy section of rough water or surf could well result in the swimmer being unable to make it ashore and rescue himself and may be swept onto rocks or drowned in the dumpers before rescuers can reach him.

One further way in which cold water increases the likelihood of drowning in the early phase of accidental immersion is that breath-holding ability is severely curtailed. In 10°C water, average breath-holding duration is only about 20 seconds, and this greatly reduces successful escape from entanglement, and will limit the time you have to set up for a roll and come topside.

It must be remembered that these explanations of how cold water can kill in the very early stages of immersion do not involve death from hypothermia of the central body core, but rather of problems associated with rapid cooling of the periphery. It is these periphery cooling effects that account for many drownings and watersport fatalities, rather than the long-term cold water immersion problems that involve the classic symptoms of central core cooling and hypothermia.

The treatment for sudden immersion problems is immediate rescue, or in the very least, support in the water so that the victim's head is held clear of the water. The use of throw lines will be insufficient, or merely presenting the end of your kayak for them to clutch may be of little value as these victims will be having difficulty coping with survival and will not respond to thrown lines, shouted instructions or self-help aids of any form. The wearing of a good quality, high buoyancy (5.5 kgf minimum) buoyancy-aid is an essential safety measure. The use of wet-suits and dry-suits can delay the effect of the cold, however it is the effect of the cold water on the face in particular that sets in train the sequence of events leading to sudden immersion drowning.

Upon rescue, most victims will be able to return to normal with their own body heat sources. If rewarming is considered, remember that the core temperature will have remained unaffected and there will be no need for slow and gradual rewarming as would be the case for hypothermic patients. Rapid rewarming is quite acceptable. The key to rewarming hypothermic patients is to rewarm at no more than the speed at which they cooled down.

LONG-TERM COLD WATER IMMERSION

Under most sea kayak circumstances, it is the gradual cooling over a period of time, followed by more rapid cooling in the event of a swim, that problems begin to emerge. Water immersion victims with some means of flotation to assist in overcoming the effects of sudden immersion risk hypothermia. By 5-10 minutes of immersion their skin temperature will have dropped to that of the water around them. Once the skin temperature drops to 32°C shivering will commence, the victim will feel extremely cold and may believe that he has only a few minutes to live. With time skin temperatures go so low that the body numbs out - you lose all ability to feel cold and you may no longer be aware that you are seriously hypothermic. Actually it takes from 15 to 20 minutes for the central core to begin to cool. After this time, core temperatures begin to drop consistently. With the peripheral vasoconstriction that accompanied the initial entry into cold water, central blood pressure will have risen. The body's reaction to this rise in blood pressure will be to counter it by decreasing blood volume; urination rates will soar to as much as four times normal. Hydrostatic pressure, the pressure of the water around you when immersed in the sea, adds to the squeeze that forces blood from the periphery into the core and raising central blood pressure. It is thus that immersion hypothermia is more a problem than when on land.

When core temperature reaches 34°C, maximum levels of shivering will have been reached but will be insufficient in producing sufficient heat to stem heat loss from the body. The heart rate may be elevated to as high as 140-150 beats/min. At this stage victims will begin to exhibit impairment of function which may lead to inappropriate behaviour.

With little blood supply to the extremities, shivering and any limb movement will result in anaerobic utilisation of available energy supplies, blood acidity levels will rise (acidosis) and this blood, re-entering the core area will trigger a blocking of any further release of energy supplies - a metabolic block (the method the body has of protecting itself from acidosis), cutting available energy supplies for further heat production. In the field the metabolic block may be noticed as a cessation of shivering when the patient has not undergone rewarming. Core temperatures will spiral down with disastrous consequences. If victims can maintain fluid intake, and consequently blood volumes, this metabolic block can be ameliorated. It should be noted that some hypothermic patients, when rescued will still be shivering, particularly if they have not been moving greatly. Any movement of the limbs, however, may shunt acidic blood into the core area, triggering the metabolic block, or worse putting undue stress on the heart and causing cardiac arrest. Rescue from the water will reduce the hydrostatic pressure and if the victim is stood up, or forces to climb up into a boat, blood will flow down into the thighs, resulting in cooling of this blood, and creating also a sudden drop in blood pressure that may be sufficient to cause the rescued victim to faint and fall back into the sea. If at all possible, rescue victims and keep them horizontal. When rewarming, elevate the legs in the initial stages.

When core temperatures begin to fall to around 30°C unconsciousness can occur, and drowning will be the inevitable result. At core temperatures below 30°C victims can experience heart arrhythmias, death usually follows at this point.

The predicted survival times for persons in cold water will vary greatly. As a generalisation, death through hypothermia in water of 10°C will take between two to three hours depending upon body size and movement in the water. However, unconsciousness and drowning is more often the case, reducing these predicted survival times considerably. In most boating and certainly in sea kayak cases the participants will generally already have lowered core temperatures through exposure to cool winds and atmosphere at the time they enter the water. Therefore, any calculation of survival times must take into account the possible pre-immersion body state. A long swim near the end of a day on the sea may well result in sufficient cooling of the core to reach an unconscious state and drowning very rapidly, so too for a kayaker that suffers a capsize on a river bar entrance or in surf returning from a day trip. Certainly, the victim's behaviour in the water, affected by mild hypothermia, may be such that they cannot be relied upon to rescue themselves or to exit from the sea or surf unaided.

TREATMENT OF HYPOTHERMIA

These notes will be restricted to the first-aid, nonhospital situation in the field where sophisticated equipment for rewarming will not be found.

It cannot be stressed enough that the recovery from severe hypothermia in the field is not easy. The primary concern of the first-aider on any trip is to ensure that participants are protected from hypothermia and to intervene early in the hypothermic sequence. In particular where a trip involves difficult conditions towards the end of the day, ensure that participants are not already suffering from lowered core temperatures as a long swim in cold water may push core temperatures to a critical low level, prevent the victim from self rescue, and to prevent endogenous heat production as a recovery option.

When a person is suffering from any level of hypothermia, the first essential is to maximise removal from the cold, from the water in particular and wind, and to insulate the body. The second step is to determine whether the patient can rewarm with only his or her endogenous heat production. Shivering will suffice for people who are mildly hypothermic if they are not fatigued and if insulation is good. With mild hypothermia of a patient just rescued from the water, exercise is often effective in providing rapid rewarming as long as the air environment is not too cold - keep them paddling hard. If endogenous heat production of the patient is insufficient for rewarming (as judged by an assessment of the core temperature through knowledge of the degree of exposure to the cold, or by behavioral symptoms - the person may have ceased to shiver, be unable to exercise through injury or lack of room) exogenous heat will be required. A victim who is alone and without fire or stove has only a poor chance of recovery.

Exogenous heat sources may be:

1.Warm objects placed on the body, water bottles, heated rocks wrapped to avoid burning the patient.

2.Body contact. Warm person(s) donate body heat to the patient.

3.Inhalation heat donation. The patient breathes heated (43°C) water-saturated air. Boil a billy in a confined area such as in a tent so that the patient breathes the steam.

4.Warm shower or bath (even a small tub with limbs out of the water). Do not leave even mildly hypothermic patients unattended in a bath. The lowered blood volumes of those exposed to the cold for any extended period of time, will cause a drop in blood pressure upon rewarming, fainting and subsequent drowning in the bath.

Warm drinks are useful only if the patient is sufficiently conscious and in control of body function to make sure he does not gag or choke while drinking. Not very much heat can be gained by drinking small amounts of warm fluids (it was once estimated that you would need to drink 3 gallons or hot tea to raise the temperature of a person 2°C, however warm tea in the stomach will warm the central core region and is a valuable aid to recovery if hypothermia is not severe), however the great advantage is in rehydration.

When a severely hypothermic patient is rescued and rewarming takes place, the warm core will lose heat to the colder muscles and periphery regions. This afterdrop of core temperature may involve a drop of as much as 1°C. Any rewarming that donates heat to the periphery regions will reduce the periphery vasoconstriction, allow circulation of the warm core blood to the cool outer shell and will increase afterdrop. In some cases extending the hypothermia to the level of cardiac failure. It will also bring acidic blood and electrolyte inbalances into the core, further complicating recovery and adding additional strain on the heart. Having the victim stand up will increase these problems - keep the victim laying down with legs elevated if at all possible.

Rewarming shock can also occur due to the inability of the heart to increase output in response to lowered blood pressure created by lowered blood volumes. Any rewarming of the periphery will reduce vasoconstriction and result in a sudden drop in blood pressure.

As a general rule, leave the periphery and limbs cold, but insulated. Donate heat to chest, neck, and head. The primary object of first aid treatment of hypothermia is to arrest further core cooling. Any rewarming can be done at leisure and slowly. To avoid inducing ventricular fibrillation, handle unconscious patients gently.

NOTE: The World Life Saving Council, at a meeting of international representatives in Germany in August 1990 made the following statements about hypothermia treatment.

1. The conscious victim of hypothermia should be rewarmed with blankets. He is at little or no risk provided that he is protected from further heat loss.

2. The unconscious cold victim with a PULPABLE PULSE requires urgent transfer to hospital. He should be handled with extreme care avoiding unnecessary movement and preventing further heat loss.

3. The UNCONSCIOUS, COLD victim who is apparently PULSELESS presents the greatest problem. If breathing is present, however shallow or slow, then CPR SHOULD NOT BE PERFORMED. If breathing is absent and pulse also absent, CPR is ESSENTIAL after carefully rechecking for a pulse.

The graphs below show the relationship of skin and core temperatures (rectal and tympanic) to metabolic heat production during cooling and rewarming. The subjects of this study were not exercising and wore only bathing clothes. The metabolic rate above rest level is soley from shivering. Note that although skin temperature, and thus the sensation of being cold, drops rapidly and achieves near minimum levels within a few minutes of immersion, it takes up to 20 minutes for core temperatues to drop 1°C. The decline in core temperature does not begin until skin temperature has reached minimum levels. Note also that, during rewarming, the metabolic rate and the feeling of coldness declines rapidly once the skin temperature is raised to normal, despite core temperatures being at their lowest point due to the 'afterdrop' of core temperature caused by the lag-time required to decrease the large thermal gradient in muscle tissue.