Shocking news about cold water

This article is taken from a canoeing site in Canada where accidents in cold water are common; it describes the three hazards of cold water. If you must go sailing in early spring it is vital to be aware of the very real hazards that you may encounter, please forgive the references to paddling!

Cold water and its effects are involved in virtually all kayaking and recreational boating deaths. For example, between 1985 and 1995, of the 182 deaths in the waters of the Pacific Northwest, only 2 occurred above 70o F, with 133 involving water between 40 - 60o F. This article will review some information which helps explain what makes cold water exposure so potentially risky, review some strategies to minimize that risk, and raise a few hairs with some stories of tragic, and mostly preventable, cold water deaths.

Some stories and some statistics
- an 18-year-old canoeist capsized into 10 deg.C lake water, and sank to the bottom before a rescuer towing the canoe could rescue him. He was wearing jeans, a shirt and no PFD.
- nine elite marines, water survival instructors, capsized in 2 deg.C water wearing sweatsuits and no PFDs. None of them survived the attempted 100 yard swim to shore.
- sixteen (16) Danish fishermen jumped into the icy waters of the North Sea when their trawler sank in a storm. They were in the water for a 2 - 3 hours before being rescued. They walked across the deck of the rescue vessel and went down into the galley to warm up. Each and every one collapsed and died in the galley.
- an average adult person has a 50/50 chance of surviving a 50 yard swim in 10 deg.C. water.
- a 50 year old person in 10 deg.C water has a 50/50 chance of surviving for 50 minutes

What does it all mean?
Cold water can kill in three ways. The canoeist probably suffered cold shock resulting in ineffective breathing, rapid onset of panic, confusion, and inneffective swimming, struggling briefly at the surface and then sinking. The marines may have managed the initial cold shock, but the cold water rendered their extremities neuromuscularly dysfunctional within several minutes, causing death by drowning. The fishermen were a more classic case of severe hypothermia, with body chemistry dysfunction causing cardiovascular collapse and death.

The vast majority of kayaking deaths in cold water occur well before body core temperature has fallen to the point of being dangerous. Even an unclothed person in 2 deg.C water will maintain core temperature for at least 20-30 minutes, so in this I article will concentrate on understanding and preventing cold shock and drowning.

Cold shock
Cold shock occurs when rapid cooling of the skin triggers a cluster of heart and breathing responses. The cardiac responses include an increase in heart rate of 40 -50%, and an increase in cardiac output of 60 - 100%, which combined with vasoconstriction of the extremities results in an average blood pressure increase to 175/93. Although a substantial strain on the heart, these changes are not likely to be a problem for a healthy, fit person but may be dangerous for those

with underlying heart disease or hypertension (there have been cases of apparently near instant cardiac arrest on cold water immersion).

The respiratory effects of cold shock have been estimated to account for a third of cold water deaths, including many extremely fit and healthy people. Review of reports of kayaking deaths by Charles Sutherland and others suggests to me that a much higher percentage of paddlecraft deaths are caused by cold shock. This has not been a favored topic of medical research, but study of work done by Dr. Michael Tipton and others makes it easy to understand the high level of risk that cold waters bring to the unprepared in our sport(details below).

Gasp!
Sudden immersion in cold water results in an involuntary(that means you can not stop it, and yes, that means all of us) gasp, followed by 1 - 3 minutes of involuntary (yes, that still means all of us) hyperventilation. Specific data are: 2.0 liter gasp in 27 deg.C water and 3.0 liter gasp in 10 deg.C water (i.e. nearly your entire lung volume), and in 10 deg.C water a 600 - 1,000 percent increase in ventilation(air in and out) in the first minute. This hyperventilation results in a profound lowering of blood carbon dioxide levels and raising of blood pH levels, which causes a large risk of ventricular fibrillation ("cardiac arrest"), muscular tetany (cramps), and cerebral vasoconstriction which starves the brain of oxygen, causing disorientation and confusion.

These effects, coupled with changes in lung mechanics caused by the pressure of water on the abdomen and chest result in subjective feelings of inability to breathe and panic typically lasting 1 - 3 minutes. Most importantly for survival of a capsized kayaker is a sharp reduction of maximal breath holding, for example - in one study from a mean of 45 seconds pre-immersion to a mean of 9.5 seconds on immersion in 5 deg.C water, with one subject averaging less than one second breath holding upon immersion. It is easy to see how these effects of gasp, hyperventilation, and impaired breatholding would result in prompt catastrophe upon a fall into choppy water or a capsize.

How cold is cold water?
Not, apparently, all that cold. The maximal hyperventilation response is reached at 10 deg.C, and near maximal gasp was reached at 11 deg.C. These are summertime water temperatures in some of the Northeast, and in most of it by November. This information is not meant to scare people away from cold water paddling, but certainly to caution them. Wonderful experiences may be had paddling in these conditions, but if we wish not to become Coast Guard statistics we must understand the risks and take measures to protect ourselves.

First, buy some protection
No, not that protection, this is about Safe Paddling, not Safe S*x, but wearing the right stuff can still make a big difference. That means a wetsuit or drysuit. Protecting the front of the torso and back of the chest will have the most profound effect on moderating the respiratory responses, while protecting the extremities has the greatest benefit in moderating the cardiac responses. Most of these responses are worsened by head immersion, which also markedly hastens the progression of hypothermia(if you manage to survive the cold shock), so head protection is important. Since both cold shock and later hypothermia inhibit effective swimming, wearing a PFD is essential to keeping the head out of water and prolonging survival.

Does practice make perfect?
A definite maybe. It does appear that repetitive immersions in cold water will

allow the body to adapt and moderate the cold shock response. After 6 - 8 immersions (daily, each time long enough for core temperature to drop>2o), the cardiac responses are substantially reduced. The breathing problems unfortunately are much less responsive to such efforts at training. A more important type of practice is to actually try out your cold water clothing in a variety of conditions. The studies referenced in this article seem to show a fairly consistent set of responses across a range of water temperatures from 0o to as high as 60o . There is individual variation though, and gear that works for your paddling partner may not be adequate for you. Most people find it very revealing to try floating in 30, 40, or even 50 degree water.

Make mine dry, very dry
In the wetsuit/drysuit debate I readily admit that I am a dry suit chauvanist, finding a drysuit much more comfortable. For the prevention of cold shock a well fitting wetsuit will be more than adequate, provided it is truly well fitting and substantially slows the contact of cold water with your torso. If loosely fitting, with overgenerous neck and arm openings there may still be a sufficient gush of frigid water to trigger these cold shock responses. Even with a well fitted wetsuit many find that first cold water flush unpleasant, and for long term survival in cold water a drysuit with appropriate insulation can be 2 -3 times more effective in staving off hypothermia. (I will work with you to make a drysuit affordable, they are a critical safety item if you paddle in cold water!) The newer lycra/fleece wetsuits can however be a very comfortable, moderate cost, no-excuse-for-not-wearing-it form of protection if you are confident that your paddling does not put you at risk of prolonged immersion.

What about hypothermia?
There are many excellent resources on prevention, recognition, and management of hypothermia. Some internet resouces are listed below so just a few points. Recognize and manage hypothermia early - thought processes become quickly impaired and can rapidly lead to decision making which turns an unpleasant situation into a dangerous one. In a non-immersion situation, the greatest heat loss is through the head and neck, insulation for these areas is most important. In maintaining extremity function good head protection has been shown to be more useful than better gloves or socks. Get out of the water! Water will cool 20 - 30 times faster than air. Movement in the water, such as swimming, will make this even worse. Severe hypothermia is a medical crisis. The victim must be handled gently and knowledgably. "No previously healthy person should die of hypothermia after he has been rescued and treatment has been started." (Cameron C. Bangs, M.D.)

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