Tri-County Ground Search and Rescue Group Inc.
Occasional Paper # 2

Water Borne Illnesses

by
Joseph LaBelle
Executive Search Coordinator

Ground Search and Rescue personnel should avoid infection by not consuming water from streams, brooks, lakes, etc. Should it be necessary to obtain water from these sources, it should be treated to eliminate the possible contaminates. Although the infections found in water in the area will not immediately incapacitate the searcher, there are sufficient organisms in the water for serious infection to occur. These infections can be extremely unpleasant and seriously incapacitate within a few days. This paper looks at the types of contaminants searchers are likely to encounter, and a number of treatments that can be used to mediate the risks.

Although we often marvel at the pristine wilderness we encounter when roaming around the woods, the water in those sparkling brooks and streams could in fact contain protozoa, bacteria or virus that could make life very uncomfortable for the searcher. Although the infection from any of these sources will not immediately incapacitate the searcher and threaten the mission, they can have long-term consequences on the searcher and their ability to respond to operation in the future.

In this paper we will look at the four types of contamination we are likely to encounter in the wilderness of Canada. We will also look at some of the methods available to treat questionable water found in the field.

Of course, the best tactic is to drink water that comes from known, clean and safe water sources. That excludes any water found in the wild.

The Various Type of Contamination

There are four different types of water "contamination" that can cause reactions in people. These are chemical, protozoa, bacteria and virus contamination.

Chemical Contamination

Unless you are using the same water source over a considerable period of time, naturally occurring chemical contamination is not of great concern. There are areas in Atlantic Canada where heavy metals, such as arsenic, cadmium and asbestos, are naturally present in unhealthy quantities, but the risk of consuming enough of these from natural sources is remote.

The same cannot be said for areas where industrial, agricultural or horticultural activity has changed the natural environment. Avoid water down stream from any manufacturing or mining activity. Agricultural operations are also large contributors to chemical water pollution in the form of pesticides, dioxin and phenols. Large quantities of these chemicals also leech out of golf courses.

Protozoa

These small creatures are the most widely recognised contaminants. They are also the largest of the animal pathogens. Hard shelled, single celled parasitic cysts, they range in size from 2 to 15 microns.[1] The most common protozoan pathogens are Giardia lamblia, and Cryptosporidium.

Giardia

By far the most talked about and known contaminant is Giardia lamblia. More commonly referred to simply as Giardia or Beaver Fever, this protozoa is very common in the wilderness, and, until the advent of treated municipal water systems, was considered ubiquitous in all populations getting their drinking water from surface sources. People tend to get sick with their first exposure to Giardia, and

[1] A micron is one millionth of a millimeter. A human hair will range in size from 50 to 150 microns. Anything smaller than 100 to 200 microns is invisible to the human eye.

there after develop some level of resistance. How long and effective this resistance might be is not really known.

Giardiasis, the illness from infection with Giardia protozoa, is contracted through faecal/oral transmission: you get it by drinking water in which an animal has defecated. Almost any mammal can carry giardia, but the primary culprits appear to be beaver and muskrat. As both of these animals are common in Canada, Giardia is a real threat to Ground Search and Rescue personnel.

Giardia cysts are between 8 and 12 microns in size, but are flexible and can get through holes 5 to 6 microns in diameter. In a dry environment, giardia can survive only a few days. In cold water, they can survive for two to three months. Drinking a few as 10 cysts can make you sick. Once ingested it takes five to seven days to get sick. Giardia, like most of the other pathogens reviewed here use your body as a place to reproduce. You might only consume a few cysts, but soon, after you get sick, you will defecate millions.

Giardiasis is characterised by diarrhoea that usually lasts one week or more and may be accompanied by one or more of the following: abdominal cramps, bloating, flatulence, fatigue, and weight loss. There are two prescription-only drugs used to treat the illness: metronidazole (Flagyl) and furazolidone (Furoxone). Either product can relieve symptoms in one to three days. Left untreated, it takes one to three weeks to recover from giardiasis.

Giardia is killed when boiled, treated with iodine or chlorine for the recommended length of time[2], or strained out by filters with an absolute pore size of less than 4 microns.[3]

Cryptosporidium

The newly recognized protozoa getting all the latest attention is cryptosporidium, particularly since there have been a number of high profile cases where municipal water supplies have been infected. Smaller than giardia, the protozoa measures 4 to 6 microns and can also squeeze through a smaller hole, this time down to 3 microns.

After ingestion, cryptosporidium cysts take two to four days to make you sick. The symptoms are almost identical to giardiasis, but the subject can also develop a low-grade fever. Infectious doses are also estimated to be 10 cysts. Death is uncommon but not unknown, particularly in the very young, the elderly and in those with reduce immune systems.

Crypto cysts also have faecal/oral transmission path with deer, elk and cattle being known carriers. Water down stream from a dairy farms or any other cattle operation should always be considered suspect.

It is harder to protect against cryptosporidium than giardia because iodine and chlorine are both ineffective. The only way to effectively treat your water against crypto is by boiling or filtering. If the later method is used, you need a filter with and absolute pore size of 1 or 2 microns or less.

Bacteria

There are many bacteria, almost all considerably smaller than the protozoa referred to above. Those that live in water and cause intestinal diseases include:

- The various strains of Escherchia coli, or E. Coli (causes diarrhoea); 0.5 microns
- Shigella (causes dysentery); 0.4 microns
- Campylobacter (causes diarrhoea, vomiting and fever); 0.2 microns
- Vibrio cholerae (causes cholera); 0.5 microns
- Salmonella (causes typhoid); 0.6 microns

Some of these bacteria are fond only in human faeces, such as Shigella; others like Campylobacter and Salmonella are present in many domestic and wild animals, and even in some reptiles.

Most bacterial infections become active between two and seven days from the time of ingestion. The infection dose can range from just 10 organisms for Shigella to 1,000 organisms for Salmonella. Symptoms can last from three days to months. Death is uncommon but not unknown, particularly in the very young, the elderly and in those with reduce immune systems.

Boiling or treating with iodine or chlorine can kill all bacteria. Water filters require absolute pore size of 0.45 microns or less, with some consideration being given to lowering the standard for bacteria protection to 0.2 microns (absolute).

Prescription drugs are also available for all these diseases.[4]

[2] The quantity of chemical treatment to use, and the length of time the product must remain in the water before the water is safe to drink depend on the pathogen you are fighting and the temperature of the water. Read the instructions carefully.

[3] More information on pore size and absolute size versus nominal size is presented on page 3.

[4] Shingella and E coli are treated with Trimethoprim-sulfamethoxazole (TMP-SMX); Campylobacter is treated with erythromycin. Tetracycline is the antibiotic of choice for Vibrio cholerae. Salmonella is usually treated with a fluroquinolone, while full-blown typhoid fever is often treated with chloramphenicol.

Viruses

Viruses are the smallest of the organisms that are pathogenic. Viruses are also more common in water supplies than are the bacteria. The water borne viruses that will cause disease in our area are:

- hepatitis A and E (causes hepatitis); 0.027 microns
- Norwalk virus (causes headaches, fever, intestinal discomfort); 0.027 microns
- rotavirus (causes headaches, fever, intestinal discomfort); 0.070 microns
- echovirus (causes meningitis, diarrhoea); 0.020 microns
- poliovirus (causes polio); 0.020 microns

Poliovirus has been virtually eliminated, and most of us have been vaccinated. However, boosters are recommended, and there has been an unfortunately tendency lately for some parents to not have children vaccinated. This has increased the risk of polio infection. Many of the others are common and are responsible for many of our common flu like ailments. Being common doesn't make them any more pleasant so care should always be exercised.

Transmission is again along the faecal/oral route, with incubation periods and length of illness varying from virus to virus.

There are no treatments for the diseases themselves, but the viruses can be killed by boiling and by iodine or chlorine treatment. Because of their small size, filters are ineffective against viruses.

Treating Water

The three most common field water purification techniques are chemical treatment, filters, and boiling. Each has its merits and drawbacks.

Chemical Treatments

Chlorine and iodine are the two most widely used chemical treatments. Of the two, iodine has enjoyed the greater popularity, because of low cost, light weight and simplicity. A number of products are on the market, including the locally available Potable Aqua. Portable Aqua also sells a two part product, one to provide the iodine protection, the other to dissipate the iodine taste. A simpler method is to use a bit of citrus juice or fruit drink crystals to reduce the iodine taste.

A long-term diet of iodine is not recommended. A regime of iodine treated water should not last over 2 to 3 weeks, although some authors have no problem with regular iodine use stretching over a few months.

Pregnant women and people with thyroid conditions should not use iodine-based treatments.

Some authors claim that two drops of javex in a litre of water is as good as any commercially prepared product. It is probably effective as a disinfectant, but javex and other chlorinated cleaners are not manufactured for internal consumption, and should therefore be avoided.

Also, remember that cryptosporidium is resistant to both chlorine and iodine. Only boiling or a filter will remove this protozoa from your water.

Filters

Filters attempt to strain out any pathogens that may be in the water. The most important aspect of the effectiveness of a filter is therefore the size of the largest particle that will pass through he filter. Filters are rated for the micron size. This is a case where "smaller is better"; a filter with a micron size of 0.5 microns with filter out organisms half the size of a filter with a 1 micron rating.

The micron size rating should be the "absolute" micron size, rather than the "average" or " nominal" pore size. An "absolute" size means that no single particle of that size will get through. The nominal size indicates that only 70% to 80% of the particles of that size will be filtered.

In purchasing a filter, look for a product that is rated at 0.3 microns or less.

Filters are marketed in a wide assortment of price ranges and configurations. As with most products, you get pretty much what you pay for. A low cost model will probably not provide you with the protection of a more expensive model. Look to pay at least $ 50 for a good reliable filter. You will have to regularly replace the cartridge in most filters. Manufacturers will provide you with an estimate of how many litres you can expect to filter with each cartridge, but the actual production will vary from model to model, manufacturer to manufacturer, and depending on the "clarity" of the water to be filtered.[5]

Remember the size of the contaminants discussed above, and compare any filter you wan to buy to

New treatments and medications are always being developed; as with any medication, always consult with your physician before make any drug.

[5] Backpacker Magazine carried a good comparative article in their December 1996 issue.

those organisms. (Because of their size, viruses cannot be filtered.).

Some manufacturers sell models that combine a filter mechanism with a chemical (most often iodine) treatment. These models will be referred to as purifiers.

Boiling

Boiling remains the most reliable method for purifying water. The World Health Organisation recommends boiling water for 5 to 10 minutes, while the US Centres for Disease Control recommend 3 to 5 minutes. These times are good, regardless of altitude.[6]

Boiling water will require fuel, either natural or synthetic, and will leave your water with a flat taste. Taste can be improved by adding fruit flavour powders or herbals teas.[7]

A Final Caution

Reading a document such as this can make one suspicious of all water. The risk is real, but for most people in reasonable health, the penalty for drinking contaminated water is a week or three of discomfort, and rest from wilderness activities. For those with weakened immune systems, whether from illness or age, the risk is greater.

Even with these risks, one must remember that the human body requires one to two litres of water a day in order to function. When your body does not get sufficient water, its performance decreases quickly and noticeably. Even mild dehydration increases the risk of hyperthermia and hypothermia. Physical stamina drops and even your ability to digest your food decreases.

Remember...life before limb: If the choice is between the risk of infection and dehydration, drink the water.

Water purification tablets are readily available and should be part of ever searcher's survival/first aid kit.

The Logistics section should always ensure safe water is available for GSAR personnel. It is the searcher's responsibility to ensure that they carry enough water to stay hydrated during a search. This means one to two litres per day in regular weather, and twice as much in weather that induces more perspiration.

When planning solo or group hikes, always consider the availability of water along the route, and carry sufficient supplies. If you are planning on being on the trail for more than a day, and secure water sources are not guaranteed, the $50 or so dollars for a water filter or purifier is well worth the investment. Many of the symptoms of these infections are discomforts when at home; on the trail, diarrhoea and vomiting can be critical because of the rapid dehydration they induce.

If you do consume unsecured water, and develop symptoms, seek medical attention and be sure to point out the possible source of contamination to your physician. Many of these infections are no longer common in urban environments, and they may not be top of mind for medical practitioners.

Summary

Water in the wilderness can contain contaminants that will range to mildly inconvenient to dangerous. Searchers should be able to obtain secure water from the Logistics Section of the search operation. It is the searcher's responsibility to carry the water needed to remain effective. All Ground Search and Rescue personnel should include water purification tablets in their first aid/emergency kit. Even in emergency situations, avoid unsecured water, but first guard against dehydration

[6] Water boils at lower temperature at high elevations.
[7] Caffeine is a diuretic, which means it increases the tendency towards dehydration. Herbal teas that don't contain caffeine.