Hepatitis viruses in water: Update on risk and control

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Abstract

Three different hepatitis viruses, designated hepatitis A (HAV), hepatitis E (HEV) and hepatitis F (HFV) are now known to be transmitted by water. HAV has a long history of water-borne transmission in all parts of the world. HEV has been discovered only recently, and is now known to cause outbreaks of clinical disease in certain parts of the world. Indications are that HFV causes sporadic cases in restricted areas. Although the mortality of infections caused by all three viruses is relatively low, clinical disease may be severe and incapacitating. Case fatality rates of 20 to 40% are on record for HEV infections in pregnant women. HAV is endemic in most of the population of South Africa. Recent evidence indicates that HEV is also endemic, with high incidence in some communities. Although HFV has not yet been recorded in the country, it could be imported rapidly. The risk of water-borne hepatitis in South Africa should, therefore, not be underestimated. The risk can be expected to increase as a result of population growth and escalating demands on limited water resources. Since vaccines are available only for HAV, and no meaningful treatment is available for any of the viruses, control of the diseases depends on prevention of transmission. This implies a major responsibility for the water industry and related health authorities. No practical methods are available for direct detection of any of the viruses. Monitoring of the safety of water supplies does, therefore, continue to rely on the meticulous application of indirect methods. Shortcomings of these indirect methods emphasise the need for practical techniques to detect the viruses.

Introduction

The term "hepatitis viruses" refers to a diverse group of viruses which all have the human liver as primary target of replication. "Hepatitis" is derived from "Hepar" (Greek for "liver") and the suffix "-itis" which denotes "inflammation". According to the Babylonian Talmud, hepatitis was common in the 5th century BC, and Hippocrates described the disease in detail (Grabow, 1976; Zuckerman, 1983; Zuckerman and Thomas, 1993). The replication of hepatitis viruses may result in mass destruction of liver cells. Consequences include failure of the liver to fulfil basic functions such as removal of bilirubin from the circulatory blood system. Bilirubin is released from red blood cells during the ongoing replacement of these cells by new ones. The colour of bilirubin is yellow to green, and accumulation in the blood circulation system results in excretion through the kidneys (dark urine), the digestive tract (dark stool) and visibility as yellow colour in the peripheral blood network at sites such as the eyes and hand palms. This symptomatic condition of accumulated bilirubin is known as "jaundice". Another typical consequence of the massive liver cell damage is release of liver enzymes into the blood stream. These enzymes include alanine aminotransferase (ALT) and aspartate aminotransferase (AST), the serum levels of which are used to diagnose hepatitis (Zuckerman and Thomas, 1993).

Hepatitis may also be caused by other systemic pathogens which do not have the liver as primary or only target of replication such as cytomegalovirus, yellow fever virus and *Leptospim* bacteria. Liver cell damage and jaundice may also be caused by toxins such as excess alcohol.

With regard to water quality analysis, hepatitis viruses share the important feature of not readily causing a cytopathogenic effect (CPE) in presently available cell culture systems, which implies that they are not detectable by conventional cell culture propagation procedures used for viruses like reo, polio and coxsackie. The hepatitis D virus is even a defective virus, which can only replicate with the assistance of the hepatitis B virus (Taylor, 1996). Also, hepatitis viruses are highly host-specific, which implies that few if any conventional laboratory animals can to a meaningful extent be used for research on most hepatitis viruses.

Since the clinical symptoms caused by hepatitis viruses may appear similar, and some of the viruses only emerged on a large scale in recent years, the first distinction of different aetiological agents was accomplished only in the 1960s. The first two hepatitis viruses to be distinguished, were simply designated A and B, because at that time there was no indication of more. As new hepatitis viruses were discovered, the alphabetical nomenclature was retained. At this stage the range has already reached G, and there are indications of more hepatitis viruses. Unfortunately, this non-descriptive system of alphabetical nomenclature is confusing to the uninformed. The nomenclature of the viruses is abbreviated as HAV to HGV for hepatitis A to G viruses.

Hepatitis viruses are divided into two basically different groups, some distinctive features of which are summarised in Table 1. One group is referred to as enteric hepatitis viruses, consisting of HAV, HEV and HFV. These viruses are primarily transmitted by the faecal-oral route, i.e., by water and food, and will in this paper be referred to as "water-borne hepatitis viruses". The second group consists of parenterally transmitted or blood-borne hepatitis viruses, including HBV, HCV, HDV and HGV. These viruses are primarily transmitted by blood and blood products, as in medical transfusion, as well as sexual intercourse, contaminated medical instruments like syringes and needles, and even by tattooing and insect bites. There is no evidence that blood-borne hepatitis viruses are of meaningful concern to water quality. HBV would seem to be inactivated by enzymes produced by bacteria in the gastro-intestinal tract and environmental waters

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