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A Review on blood borne viral infections: Universal precautions

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Abstract

Blood borne infections are microorganisms that are carried in human blood and can cause disease in people. They are many different blood borne pathogens, syphilis, brucellosis, but hepatitis B, hepatitis C and human immunodeficiency virus. HIV can occur through occupational exposure due to precutaneous injury, mucocutaneous exposure, or blood contact with non-intact skin. Hepatitis B virus (HBV) infection is a global public health problem. It is estimated that there are 240 million HBV carriers in the world of whom roughly 600.000 DIB annually from HBV related liver disease. Viral hepatitis is a necroinflammatory liver of variable severity. Persistent infection by HBV is often associated with chronic liver disease that leads to the development of cirrhosis and hepatocellular carcinoma (HCC). Globally, hepatitis C virus (HCV) has infected has an estimated 130 million people, most of whom are chronically infected. Universal precautions are a set of guidelines that aim to protect laboratory worker and other health care worker (HCWS) from blood borne infections. Universal precautions should be followed to avoid being infected with these blood borne viral infections by those working in the Laboratories.

Keywords: *Blood Borne Viral Infections, Universal Precautions, HIV, HBV, HCV*

Blood borne viral infections

Blood borne infections are microorganisms that are carried in human blood and can cause disease in people. They are many different blood borne pathogens, syphilis, brucellosis, but hepatitis B, hepatitis C and human immunodeficiency virus are the three diseases specifically addressed in this paper (Araoye, 2002; Nwovu *et al.*,2018).

According to WHO 2003, the three common infectious pathogens known to be transmissible through occupational exposure are HBV, HCV and HIV. The risk of transmission of these pathogens to health care workers depends on the prevalence .of the disease in the patient population as well as the nature and frequency of exposures. Transmission of HBV, HCV and HIV can occur through occupational exposure due to precutaneous injury, mucocutaneous exposure (splash of blood or other body fluids into the eye, mouth or nose), or blood contact with non-intact skin. However, precutaneous injury, precisely needle stick injury is the most common form of occupational exposure and the most likely to result in infection. According to Lauer, in 2009,among 35 million health care workers worldwide, about 3 million experience precutaneous exposure to blood-borne pathogens each year 2 million to HBV, 0.9 million to HCV and 750,000 to HIV. These injuries may result in 15,000 HCV, 70,000 HEV and 1000 HIV infections and more than 90% of these infections occur in developing countries. HBV infection is a major infectious hazard

for health care workers, and 5-10% of HBV infected workers become chronically infected. Persons with chronic HBV infection are at risk for chronic liver disease (i.e. chronic active hepatitis, cirrhosis and primary hepatocellular carcinoma) and are potentially infectious throughout their lifetime. The risk of HBV infection is primarily related to the degree of contact with blood in the workplace and to the hepatitis B antigen (HBeAg) status of the source person. The risk of acquiring HBV infection from occupational exposure depends on the frequency of percutaneous and permucosal exposures to blood or body fluids containing blood. Although precutaneous injuries are among the most efficient modes of HBV transmission, percutaneous exposures probably account for only a minority of HBV infections among HCWs.

In several investigations of nosocomial hepatitis B outbreaks, most infected HCWs could not recall an overt percutaneous injury (Hatch and Greg, 2005). However, in some studies, up to one-third of infected HCWs recalled caring for a patient who was HBsAg-positive. In addition, HBV has been demonstrated to survive in dried blood at room temperature on environmental surface for at least one week. Thus, HBV infections that occur in HCWs with no history of non-occupational exposure or occupational percutaneous injury might have resulted from direct or indirect blood or body fluid exposures that inoculated HBV into cutaneous scratches, abrasions, burns, other lesions, or mucosal surfaces.

Human Immunodeficiency Virus (HIV)

HIV is a lentivrus (a subgroup of retrovirus) that causes HIV infection and acquired immunodeficiency syndrome (AIDS). AIDS is a condition in humans in which progressive failure of the immune system allows life threatening opportunistic infections and cancers to thrive. Infection with HIV occurs by the transfer of blood, semen, vaginal fluid pre-ejaculate or breast milk, within these bodily fluids, HIV is present as both free virus particles and virus within infected immune cells. HIV infects vital cells in the human immune system such as helper T cells, macrophages, and dendritic cells (Obeagu *et al.*,2017; Obeagu and Obeagu, 2015).

HIV is different in structure from other retroviruses, it is roughly spherical with a diameter of about 120mm, around 60 times smaller than a red blood cell, yet large for a virus (Berger, 1997), HIV/AIDS is a epideomiology global pandemic. As of 2012, approximately 35.3 million people are living with HIV globally, approximately 17.2 million are men, 16.8 million are women and 3.4 million are less than 15 years old, there were about 1.8 million deaths from AIDS in 2010down from 2.2million in 2005. Sub-Saharan Africa is the region most affected. In 2010 an estimated 68% (22.9 million) of all HIV cases and 66% (1.2million) of all death occurred in this region. This means that about 5% of the adult population in this area is affected. In contrast to other regions, women compose nearly 6% cases.

Mode Of Transmission

HIV is transmitted in human body fluid by three major routes:

1. Sexual intercourse through vaginal, rectal or penile tissue.
2. Direct injection with HIV contaminated drugs needles, blood or blood products.
3. From HIV infected mother to fetus in utero through intrapartum inoculation from mother to infant or during breast feeding.

According to the CDC, HIV is not spread by tears, sweat, coughing or sneezing. Nor it is transmitted via a an infected person's clothes, phones, drinking glasses, eating utensils or other objects that HIV infected people have used that are free of blood (Pantaleo, 1997).

The HIV Virus is commonly transmitted via unprotected sexual activity, blood transfusion, hypodermic needles and from mother to child.

Pathogenicity

The virus replicates inside and kills T helper cells, which are required for almost all adaptive immune response, when the CD4 hymphocyte count falls below 200 cells/ml of blood, the HIV host has progressed to AIDS, a condition characterized by deficiency of in cell-mediated immunity and the resuIting increased susceptibility to opportunistic infection and certain forms of cancers.

Hepatitis B Virus

Hepatitis B virus is a species of the genus or thohepadnavirus which is likewise a part of the hepadnaviridae family of viruses; this virus causes the disease hepatitis B.

Hepatitis B virus can lead to cirrhosis and hepatocellular carcinoma. The hepatitis B virus is

classified as the type species of the orthohepadnavirus, which contains three species: the ground squired hepatitis virus, woolly monkey hepatitis B virus and wood drink hepatitis virus. The genus is classified as part of the hepadnaviridae family, which contains two other genera, the avihepadnovirus and s second which has yet to be assigned. This family of viruses has not been assigned to a viral order.

Viruses similar to hepatitis B have been found in all apes, in old world monkey and in a new world woolly monkeys suggesting an ancient origin for this virus is primates.

The virus is divided into four major serotype based on antigenic epitopes eight genotypes (A-H) according to overall nucleotide sequence variation of the genome, the genotypes have a distribution and are used in tracing the evolution and transmission of the virus, differences between genotypes affect the disease severity, course and likelihood of complications and response to treatment and possibly vaccination.

The virus particle called the Dane particle (vision), consists of an outer lipid envelope and an icosahedral nucleocapsid core composed of protein. The nucleocapsidendoses the viral DNA and a DNA polymerase has reverse transcriptase activity similar to retroviruses.

The outer envelope contains embedded proteins which are involved in viral binding and entry into susceptible cells. The virus is one of the smallest enveloped animal virus with a vision diameter of 42nm but pleomorphic forms exist including filamentous and spherical bodies lacking a core these particles are not infections and are composed of the lipid and protein that forms part of the surface of the vision which is called the surface antigen HBsAg and is produced in excess during the life cycle of the virus.

Epidemiology

Hepatitis B virus (HBV) infection is a global public health problem. It is estimated that there are 240 million HBV carriers in the world of whom roughly 600.000 DIB annually from HBV related liver disease. The implementation of effective vaccination programs in many countries has resulted in a significant of acute hepatitis B. Nevertheless, hepatitis B remains an important cause of morbidity and mortality.

The wide range in HBV carrier rate in different parts of the world is largely related to differences in the age at injection, which is inversely related to the risk of chronicity, the rate of progression from acute to chronic HBV infection is approximately 90 a percent for perinatally acquired infection, 20 to 50 percent for infections between the age 1 and 5 years and less than 5 percent for a adult acquired infection.

Mode Of Transmission

Hepatitis B virus is transmitted through blood and infected bodily fluids, this can occur through direct blood to blood contact, unprotected sex, unsterile needle and from an infected woman to newborn during the delivery process.
Other possible routes of infection include sharing sharp instruments such as razors, tooth brushes or earrings

Pathogenicity

Viral hepatitis is a necroinflammatory liver of variable severity. Persistent infection by HBV is often associated with chronic liver disease that leads to the development of cirrhosis and hepatocellular carcinoma (HCC).
Many studies suggest that HBV is not directly cytopathic for the infected hepatocyte, for example, during the early phage of HBV infection in chimpanzees 100% of the hepatocytes may be infected without histological or biochemical evidence of liver disease. Furthermore when cellular immune responses are deficient or pharmacological suppressed, HBV can replicate at high levels in the liver of patients and in immunological tolerant HBV transgenic mice in the absence of cytological abnormalities or inflammation. Viral clearance and disease pathogenesis are largely mediated by the adaptive immune response in HBV infection. On other hand, viral persistence is characterized by a state of relative hyporesponsiveness of HBV -specific T cell to HBV.

Hepatitis C Virus

Hepatitis C virus is a small (55-65nm in size), enveloped, positive sense single stranded RNA virus of the family faviviridae. Hepatitis C virus is the cause of hepatitis C and some cancer lymphomas in human.

The hepatitis C virus particle consists of core of genetic material (RNA) surrounded by an icosahedral protective shell of protein and further encased in a lipid (fatty) envelope of hellular origin. Two viral envelope glycoproteins, El and E2, are embedded in the envelope. Hepatitis C virus has a positive sense single stranded RNA genome. The single open reading frame is translated to produce a single protein product, which is then further precessed to produce smaller active proteins.

Epidemiology

Globally, hepatitis C virus (HCV) has infected has an estimated 130 million people, most of whom are chronically infected. HCV infected people serve as a reservoir for transmission to others and are at risk of developing chronicliver disease, cirrhosis and primary hepatocellular carcinoma (HCC).

It has been estimated that HCV accounts for 27% of cirrhosis and 25% of HCC worldwide. HCV infection has likely been endemic in many populations for centuries. However the wave of increased HCV-related mobility and mortality that we are now facing is the result of an unprecedented increase in the spread .of HCV during the 20 century.

Determining the incidence of HCV infection is difficult because most infection are asymptomatic available assays do not distinguish acute from chromic or resolved infection and most countries do not systematically collect data on cases of acute disease even in surveillance systems, acute disease reporting systems under estimate the incidence of HCV infection.

For several countries, mathematical models have beer, used to infer trends in incidence which relies on the assumption that current age specific prevalence reflects the cumulative risk of acquiring infection.
However, "ABS" refers particularly to a processing step used to remove non-specific spirochetal antibodies present in normal serum.

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Pathogenicity

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Un1versal precautions

Universal precautions are a set of guidelines that aim to protect laboratory worker and other health care worker (HCWS) from blood borne infections (Bennett and Mansell, 2010). In 1987 the CDC developed universal precautions to help protect both HCWs and patients from infection with blood borne pathogens in the health care setting.

A study to assess the knowledge and compliance with universal precautions and their perceived risk of infection at the workplace in Ibadan, showed poor knowledge of and compliance with standard precautions. Some 77.5% of the respondents were aware but only 24% had the correct knowledge of the universal precautions. Knowledge was highest (36.9%) among laboratory technicians it was 10.8% among laboratory scientists and 15.4% among interns. Significantly, senior registrars had better knowledge than junior scientists. A similar study was conducted in He-He, Nigeria, on the knowledge and practice of universal precautions among qualifying medical laboratory technician students. Out of 129 students consisting of 103 medical laboratory science students and 26 medical laboratory technician students, 83 (64.3%) were familiar with the concept of universal precautions. There was a higher level of knowledge

among medical laboratory technician students, (77%) than among medical laboratory science students (61%). Knowledge of what constitutes the universal precautions was low among the students. Laboratory staff may have similar training but their behavior may vary according to their perception of risk. Some of the reasons Laboratory staffs gave for not complying with universal precautions are habit, lack of time, interference with procedures, discomfort with protective equipment, lack of supplies, carelessness, concern for costs, unexpected body fluid contact, and the possibility inciting fear in patients. The universal precautions have been in place since 1987, but there has been extensive documentation of suboptimal adherence especially in the developing countries. However, non-compliance among Laboratory staffs may vary according to workplace setting, whether rural or urban.

A study conducted among Laboratory staffs in rural north India, showed low compliance with eye protective wears. A high proportion of Laboratory staffs were not complying with needle recapping precautions. The study also showed that compliance with standard precautions was associated with being on the job for a longer period, knowledge of blood borne pathogen transmission and strong commitment to workplace safety. The study suggested that interventions to improve compliance to standard precautions among Laboratory staffs in rural north India should address knowledge and understanding as well as safety measures by the employee's organizations. Odusanya in 2003 conducted a study on awareness and compliance with universal precautions amongst Laboratory staffs in Lagos.

Percutaneous exposures are the most common route of exposure to blood-borne pathogens in the laboratory setting (Bamigboye and Adesanya, 2006). Globally sample collections are one of the most common laboratory procedures and they are often abuse! Sample collection safety practices could significantly reduce occupational risks due to blood-borne pathogens laboratory settings. For example wearing gloves as a protective barrier reduce the incidence of contamination of the hands but it cannot prevent penetrating injuries caused by needles or other sharp instruments. The application of standard precautions during patient care is determined by the nature of laboratory worker-patient interaction and the extent of anticipated blood, body fluid or pathogen exposure. For some interactions e.g.performing venipuncture only gloves may be needed but for others e.g. intubations, use of gloves, laboratory coat and face shield or mask and goggles in necessary. Standard precautions are also intended to protect the patients through ensuring that healthcare personnel do not transmit inactions agents to patients through their hands or equipment during patient care.

Identification of patients infected with blood-borne pathogens cannot be reliably made through medical history and physical examination and it is not feasible or cost-effective test all patients for all pathogens prior to giving care, standard precautions are therefore recommended for use on all patients regardless of diagnosis and treatment setting (Rampal, 2010). According to CDC 2009, the practicing of standard precautions are recommended in the following, hand washing, use of protective barriers to prevent direct contacts, safe handling and disposal of sharps and safe decontamination of instruments and other contaminated equipments.

Hand Hygiene

This has been cited frequently as the most important practice in reducing the transmit ion of infections agent in laboratory settings and it is an essential element of the standard precautions. Hand hygiene includes hand washing with both plain or antiseptic containing soap and water and the use of alcohol based products (gels, foams or rinses) which do not require the use of water (Siegel *et al.*, 2007).

Avoiding unnecessary touching to surface that is dose to the patient to prevent contamination of clean hand by environmental surfaces and transmission of pathogens from contaminated hands to surfaces. Handwashing with either a non-antimicrobial soap and water or an antimicrobial soap and water when hands are visibly dirty.

Hand hygiene should be performed

- Before having direct contact with patients.
- After having contact with blood, body fluid excretions, mucous membranes, nonintact skin or wound examination.
- If hands will be moving from a Contaminated. Body site to a clean body site during patient care.
- After removing gloves

Personnel Protect1ve Equipment (PPE)

Personnel protective equipment refers to a variety of barriers used alone or in combination to protect

mucous membrane airway, skin and clothing from contact with infections agents (Siegel *et al*, 2007). The following principle of use should be observed. PPE should be worm when the nature of the anticipated patient interaction indicates that contract with blood or body fluids may occurs. Prevent contamination of clothing and skin during the process of removing PPE.

PPE should be removed and discarded before leaving the laboratory environment (Bamigboye and Adesanya. 2006).Under standard precautions, gloves should be worn when it can be reasonably anticipated that contact with blood or other potentially infections materials, mucous membranes or potentially contaminated intact skin.

For cleaning the environment or medical equipment, disposable medical examination gloves or re-usable utility gloves should be worn. Gloves should be removed after contact with a patient and/or the surrounding environment (including medical equipment) using proper techniques to prevent hand contamination. Gloves should not be re-used because this practice has been associated with the transmission of pathogens. Gloves should be changed during patient care if the gloves have been contaminated.

Laboratory Coat

Should be appropriate for protecting the skin and preventing contamination of clothing during procedures and patient care when contact with blood, body fluid secretions or excretions is anticipated. A lab coat should be worm for direct patient contact if the patient has uncontained secretions or excretions and it should be removed and hand hygiene performed before leaving the laboratory environment (Nduka, 2012).

Month, nose and eye protection PPE should be used to protect the mucous membrane of the eyes, nose and mouth during procedures and patients care activities that are likely in generate splashes or sprays of blood, body fluids, secretion select masks, goggles, face shields and combinations of each according to the need anticipated by the task to be performed.

Conclusion

Blood borne infections are microorganisms that are carried in human blood and can cause disease in people. Universal precautions are a set of guidelines that aim to protect laboratory worker and other health care worker (HCWS) from blood borne infections. Universal precautions should be followed to avoid being infected with these blood borne viral infections by those working in the Laboratories.

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