ABSTRACT

Health care workers are exposed to blood-borne pathogens, mainly human immunodeficiency virus, hepatitis B virus and hepatitis C virus. Infection by these viruses leads to chronic or fatal illnesses which are expensive and difficult to treat. Individuals who harbour these viruses may be asymptomatic and hence all patients should be assumed to harbour a blood-borne pathogen. All health care workers should take adequate precautions (a set of guidelines termed 'universal precautions'). Methods of preventing transmission of blood-borne pathogens include vaccination against hepatitis B virus, following universal precautions and taking adequate post-exposure prophylaxis.


INTRODUCTION

Health care workers are at risk of exposure to blood-borne pathogens, mainly human immunodeficiency virus (HIV), hepatitis B virus (HBV) and hepatitis C virus (HCV). This article reviews these blood-borne pathogens and the methods of preventing their transmission.

HIV, HBV and HCV have gained importance because many infected individuals may remain asymptomatic for long periods of time during the course of infection before they develop disease recognized by clinical or laboratory abnormalities. Moreover, these three agents are associated with chronic and potentially fatal diseases. This means that health care workers must take precautions when interacting with all patients, and consider them to be potentially infected with one or more of these pathogens.

The prevalence of these viruses in the general population in India is given in Table I.1-16 The prevalence is higher in high-risk groups,17-19 such as patients who have received multiple transfusions, commercial sex workers, heterosexuals/homosexuals with multiple partners, professional blood donors, intravenous drug abusers and patients undergoing haemodialysis.

Fluids that are considered to be infectious are blood, semen, vaginal secretions, and cerebrospinal, pleural, pericardial, peritoneal and amniotic fluids.20-23 Sweat, saliva, faeces, urine, vomitus, tears, nasal secretions and breast milk are not considered potentially infectious unless they are visibly contaminated with blood.20 The most common mode of transmission is through needle-stick injuries.24-28 Percutaneous injuries (caused by scalpels, suture needles, wires and drills), mucosal splashes and contamination of abraded skin are other modes of acquiring infection by blood-borne pathogens.29

The risk factors for transmission of blood-borne pathogens include injury caused by a hollow large-bore needle, deep injury, needle that had been in the patient’s artery or vein, needle visibly contaminated with blood, concurrent viral infection, inflammation at the site of injury, high viral load and inadequate first aid.24,30-33 The rates of seroconversion after exposure to HIV, HBV and HCV following an injury with a hollow needle are given in Table II.24,30,32,34-39 The rate of seroconversion to HIV following a mucosal exposure is 0.09%.24 There is a 0.009%–0.09% chance of transmission of HIV following an injury with a suture needle.30

The rate of seroconversion in the case of HIV is lower than that of the other two viral diseases. This is because the number of viral particles per millilitre of blood is 107–1010 in hepatitis B, 106 in hepatitis C, whereas it is only 10–10 000 in HIV.24,30,36

PREVENTING TRANSMISSION

Treatment for infection caused by the major blood-borne pathogens is expensive, difficult and sometimes virtually impossible. However, prevention of infection is possible by relatively simple measures.

Vaccination

The most effective method of preventing HBV transmission is through vaccination. Hepatitis B vaccination should be mandatory for all health care workers. This is believed to provide over 95% protection.37 Currently, there are no effective vaccines against HCV and HIV.

Reducing the risk of exposure to infection

In 1983, the Centers for Disease Control (CDC), Atlanta, instituted a set of guidelines (termed ‘universal precautions’) for patients known to harbour blood-borne pathogens. With the increase in prevalence of these pathogens, these guidelines were extended in 1987 to all patients, irrespective of their serological status.

| Table I. Prevalence of blood-borne pathogens in the general population in India |
|-----------------------------|------------------------|
| Organism                    | Prevalence (%)         |
| Human immunodeficiency virus| 0.3–7.2                |
| Hepatitis B virus           | 1.0–15.8               |
| Hepatitis C virus           | 0.3–1.8                |

| Table II. Rates of seroconversion following injury with a hollow needle |
|-----------------------------|------------------------|
| Agent                       | Transmission rate (%)  |
| Human immunodeficiency virus| 0.3–0.4                |
| Hepatitis B virus*           | 6–37                   |
| Hepatitis C virus            | 6–14                   |

* The rate of transmission depends on the presence of HBsAg, which is associated with higher rates of transmission.
These universal precautions are based on three cardinal principles. All the following are considered infectious:

1. Patients
2. Body fluids
3. Sharps and used equipment.

These precautions involve a few simple steps and call for an organized method of dealing with blood and body fluids, in order to prevent exposure to these pathogens. Exposures cannot be predicted and precautions are to be taken even though a procedure seems to harbour no risk.

**Handwashing.** Hands should be washed with detergent and water whenever contaminated and after removing gloves. This should be done even if the gloves seem intact because gloves may have soft spots through which fluids may permeate.

**Protective equipment.** Gloves should be worn while performing any procedure that may involve contact with blood and body fluids. While wearing gloves, handling of common articles such as pens, charts, etc. should be avoided. Other protective equipment include goggles, masks, impervious aprons, caps and shoe covers. A summary of the protective equipment required for common procedures is given in Table III.

**Handling of sharps.** Utmost care needs to be exercised while performing procedures with sharp instruments. Most needle-stick injuries are caused by hollow needles. Needles, once used, should not be recapped or bent. They should be discarded into a puncture-proof container immediately after use. These containers should be located in all areas of patient care, preferably at sites where procedures are performed.

Other measures that decrease the chances of percutaneous injury include using an instrument to hold tissues while suturing, using an instrument to hold a needle while adjusting it in the needle holder, and using a container to pass sharp instruments during surgery (instead of hand-to-hand passing of sharps).

**Spills.** In the case of spillage of blood or body fluids, these should be covered with an absorbent material and kept in contact with a disinfectant (1% sodium hypochlorite, a 1:100 solution of household bleach or 7% lysol) for 30 minutes and then mopped dry.

**Handling specimens in the laboratory.** Care should be taken while procedures are performed in the laboratory to minimize aerosol production. Work surfaces should be decontaminated following a spill of blood or body fluids. Procedures that are known to be dangerous to the health care worker, such as mouth pipetting, should not be undertaken.

**Linen.** Soiled linen should be handled as little as possible and transported to the laundry in leak-proof containers, decontaminated and then washed in a machine.

**Infectious waste disposal.** Waste should be segregated at the point of generation and transported without pilferage, and disposed of after decontamination and/or mutilation.

**POST-EXPOSURE PROPHYLAXIS**

Immediately after a percutaneous injury, the area should be washed with soap and water or an antiseptic. For conjunctival exposure, the eye needs to be flushed with water. After obtaining consent and assuming confidentiality, blood from the index case is tested for HIV antibodies, hepatitis B surface antigen (HBsAg) and HCV antibodies. The blood of the health care worker is tested for HIV antibodies and the titre of HBs antibodies is estimated.

**Hepatitis B virus**

If the index case is positive for HBsAg, the treatment depends on the antibody titre of the health care worker. If the antibody titre is less than 10 mIU/ml, hepatitis B immunoglobulin and a dose of hepatitis B vaccine is recommended. This can reduce the risk of seroconversion by 90%. In those with anti-HBs antibody levels between 10–100 mIU/ml, a booster dose of vaccine is recommended, whereas in those with antibody titre >100 mIU/ml, no immunoprophylaxis is required.

**Human immunodeficiency virus**

If the index case is HIV positive, the risk of transmission is assessed and post-exposure prophylaxis consisting of either a 2- or a 3-drug regimen is given for 4 weeks. The drugs used are nucleoside reverse transcriptase inhibitors (zidovudine and lamivudine) and a protease inhibitor (indinavir or nelfinavir). Zidovudine has a 81% protective effect against transmission of HIV.

The 2-drug regime consists of zidovudine (azidothymidine) 300 mg twice a day or 200 mg thrice a day and lamivudine 150 mg twice a day. If there is an increased risk of transmission, either indinavir (800 mg every 8 hours) and nelfinavir (750 mg twice a day) is added. The health care worker is asked to come for follow up testing for HIV antibodies at 6 weeks, 12 weeks and 6 months after the exposure. In 95% of cases, seroconversion occurs within 6 months following the exposure. A summary of the post-exposure immunoprophylaxis for HBV and chemoprophylaxis for HIV is given in Table IV.

The major side-effects of these drugs are nephrolithiasis, hepatitis and pancytopaenia. Monitoring the toxicity of these drugs is done at the time of initiation of post-exposure prophylaxis and 2 weeks later, by performing complete blood counts, liver function tests and renal function tests.

If the index case is unknown or is negative for HIV (there exists the possibility of the index being in the window period), post-

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**Table III. Summary of protective equipment required for common procedures**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Protective equipment required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vascular access</td>
<td>Gloves Yes, Goggles No, Mask No, Apron* No, Protective footwear No</td>
</tr>
<tr>
<td>Intubation</td>
<td>Gloves Yes, Goggles No, Mask No, Apron* Yes, Protective footwear Yes</td>
</tr>
<tr>
<td>Delivery</td>
<td>Gloves Yes, Goggles Yes, Mask Yes, Apron* Yes, Protective footwear Yes</td>
</tr>
<tr>
<td>Lumbar puncture</td>
<td>Gloves Yes, Goggles Yes, Mask Yes, Apron* No, Protective footwear No</td>
</tr>
<tr>
<td>Ascitic/pleural tap</td>
<td>Gloves Yes, Goggles Yes, Mask No, Apron* No, Protective footwear No</td>
</tr>
<tr>
<td>Endotracheal suction</td>
<td>Gloves Yes, Goggles Yes, Mask Yes, Apron* Yes, Protective footwear Yes</td>
</tr>
<tr>
<td>Handling specimens</td>
<td>Gloves Yes, Goggles Yes, Mask Yes, Apron* No, Protective footwear No</td>
</tr>
<tr>
<td>Cleaning spills</td>
<td>Gloves Yes, Goggles No, Mask No, Apron* No, Protective footwear Yes</td>
</tr>
</tbody>
</table>

* Plastic apron or impervious gown to prevent contamination of the skin
exposure prophylaxis should be initiated after evaluation of each individual case. The health care worker is advised follow-up testing of HIV antibodies till 6 months after the exposure.

Post-exposure prophylaxis cannot be implemented unless a system exists for reporting injuries, performing the necessary tests and administering prophylaxis. At our institution, adequate post-exposure prophylaxis could only be satisfactorily implemented after a system was put in place for 24-hour reporting of injuries, laboratory testing of the index patient and health care worker, and ready access to prophylactic drugs, immune globulin and vaccines. We believe that such a system is essential for every hospital providing care to high-risk patients.

CONCLUSION

Exposure to blood-borne pathogens in the health care setting is a reality that one has to accept. Since most patients who harbour infectious blood-borne pathogens are asymptomatic, taking precautions selectively for patients with known infection is not the optimal method of preventing transmission. The three major pathogens—HIV, HBV and HCV—are associated with chronic, potentially fatal disease. A vaccine is available only for preventing HBV infection. The only way by which the transmission of these pathogens can be prevented is by adopting effective precautionary measures. These precautions have to be taken for all patients universally. This calls for provision of adequate infrastructure, constant education of all levels of health care workers in adopting the universal precautions and a system of reporting and administration of post-exposure prophylaxis.

REFERENCES


Table IV. Post-exposure immunophrophylaxis for HBV and chemoprophylaxis for HIV

<table>
<thead>
<tr>
<th>Result of investigation</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The index case is HBSAg positive:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Health care worker</strong></td>
<td></td>
</tr>
<tr>
<td>1. Antibody &gt;100 mIU/ml</td>
<td>Reassure the health care worker</td>
</tr>
<tr>
<td>2. Antibody negative or &lt;100 mIU/ml</td>
<td>Hepatitis B vaccine and hepatitis B immunoglobulin (0.6 ml/kg) should be given</td>
</tr>
<tr>
<td>3. Antibody between 10–100 mIU/ml</td>
<td>Booster dose of vaccine to be given</td>
</tr>
<tr>
<td><strong>The index case is HBSAg negative:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Health care worker</strong></td>
<td></td>
</tr>
<tr>
<td>1. Antibody &gt;100 mIU/ml</td>
<td>Reassure the health care worker</td>
</tr>
<tr>
<td>2. Antibody negative or &lt;100 mIU/ml</td>
<td>Hepatitis B vaccination is to be given</td>
</tr>
<tr>
<td><strong>The index case is positive for HIV:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Zidovudine 300 mg twice a day</td>
</tr>
<tr>
<td></td>
<td>Lamivudine 150 mg twice a day</td>
</tr>
<tr>
<td></td>
<td>Indinavir 800 mg or Nevirapine 750 mg thrice daily is added to the above if there is an increased risk of transmission</td>
</tr>
</tbody>
</table>

HBSAg hepatitis B surface antigen HIV human immunodeficiency virus


