CHAPTER 11

ACCIDENTAL OCCUPATIONAL EXPOSURE

Abstract

Virtually all health care providers and hospital workers who are likely to come in contact with infected blood or body fluids are at high risk of accidental occupational exposure to HBV or HIV. Preventive measures include hand washing, using personal protective barriers, safe handling of sharps and their decontamination and disposal, and immunisation against hepatitis B. The guiding principle is to presume that all specimens, all patients or clients are potentially infected, unless proved otherwise. In case of accidental occupational exposure, the site of exposure is treated, spills are decontaminated, the incident is reported to the concerned authorities and the exposed person is tested for hepatitis B/C and HIV infection, after counselling and informed consent. Post-exposure prophylaxis (PEP) is available against HBV and HIV, while there is no specific PEP for exposure to hepatitis C virus (HCV). During the follow-up period, persons exposed to HBV or HIV must not donate blood, semen, or body organ for transplant, should avoid pregnancy and abstain from sexual intercourse or use latex condom every time during sexual intercourse. Persons receiving PEP ought to be monitored for drug toxicity. Specialist opinion on PEP is available on the Internet.

Key Words

Exposure code, HIV status code, Post-exposure prophylaxis, Risk of HIV infection, Universal biosafety precautions, Window period

11.1 – INTRODUCTION

As compared to the general public, health care providers and hospital workers are occupationally exposed to an over-abundance of pathogens. Diverse type of pathogens can be potentially transmitted through infected blood and body fluids. These include hepatitis viruses B, C, D, and G, HIV-1 and HIV-2, cytomegalovirus (CMV), Epstein–Barr virus (EBV), *Plasmodium*, *Treponema pallidum*, viruses causing haemorrhagic fevers such as dengue, *Brucella*, *Yersinia pestis*, *Mycobacteria*, and slow viruses (NACO, Training Manual for Doctors). Currently, the main concern is the prevention of accidental occupational exposure to HIV because of fear, stigma, social and economic cost associated with HIV infection, and non-availability of an effective preventive vaccine or cure creates apprehension in the mind of an exposed health care provider. Even if a

patient's ELISA report is "negative", he or she may still harbour the virus during the "window period". Normally, antibodies that are produced by the human body in response to other infections try to neutralise the pathogen. But, in the case of HIV infection, anti-HIV antibodies do not neutralise HIV. Hence, HIV-positive individuals will remain infectious to others for the rest of their lives (Mehta & Rodrigues, 1996; WHO, 1996).

The sources of exposure are blood and body fluids, infected human organs, tissues, specimens, *percutaneous* accidental injuries with contaminated sharp instruments or needle stick injuries leading to inoculation of blood or body fluids, and contaminated equipment. *Mucocutaneous* accidental occupational transmission may occur by contamination of mouth, conjunctiva, wound (breached skin), abrasion, scratches, and dermatitis (NACO, 2002).

Virtually all health care providers and hospital workers who are likely to come in contact with infected blood or body fluids are at high risk of accidental occupational exposure. This high-risk group includes:

(a) All health care providers such as physicians, surgeons, nurses, and midwives
(b) Persons handling infected, or potentially infected blood, body fluids, excretions, and secretions (microbiologists, pathologists, laboratory workers, and sweepers)
(c) Those who handle or embalm dead bodies, perform autopsies (autopsy workers, forensic experts, pathologists, anatomists, and embalmers)

11.2 – RISK OF HIV INFECTION

In case of exposure through wounds, skin, mouth, or conjunctiva, called *mucocutaneous exposure*, the risk of HIV infection is 0.3 per cent. Exposure through needle stick, sharps, called *percutaneous exposure* carries a risk between 0.25 and 0.3 per cent. Among HIV-infected individuals, *typical progressors* are relatively more infectious in seroconversion stage and terminal stage of the disease. In comparison, the risk of acquiring hepatitis B infection varies from 9 to 30 per cent, since carriers of HBV may have 10 million to 1 billion infectious virons per mL of blood. The risk of hepatitis C virus (HCV) infection is 3–10 per cent for accidental occupational exposures. This lower risk of HIV infection is because HIV-infected persons have only about 100–10,000 infectious virons per mL of peripheral blood (NACO, 2002; Mehta & Rodrigues, 1996). Longitudinal studies on 1,074 accidental needle stick exposures revealed three seroconversions. Contamination of mucous membrane or skin did not result in seroconversion in 104 cases. In a progressive study following 870 needle stick injuries or cutting injuries, four persons (0.46 per cent) tested HIV seropositive (Mandlebrot *et al*., 1990).

11.2.1 – Model for Calculating Risk

The probability of acquiring HIV infection during a surgical operation can be calculated by a hypothetical model:

P_1 = probability of surgeon acquiring HIV infection = 0.46 per cent
P_2 = probability of surgeon getting an injury = 10 per cent
P_3 = probability of patient having HIV infection = 1 per cent
P = probability of acquiring HIV in one surgical operation = $P_1 \times P_2 \times P_3$ = 0.0000046 per cent
If the surgeon performs 200 surgeries in 1 year, the probability = $1(1 - P) \times 200$ = 0.09 per cent
The cumulative probability in a career of 30 years would be 2.72 per cent (Raahave & Bremmelgaard, 1991).
In a study conducted in Amsterdam, the 30-year cumulative risk was estimated at 0.0012 for a surgeon who performs about 500 surgeries (Leentvaar *et al.*, 1990).

11.2.2 – Reliability of Risk Estimates

Risk estimates are based on studies conducted in industrialised countries and therefore, extrapolation of risks must be treated with extreme caution. In the *developing countries*, accidental occupational exposure may be relatively more common due to lack of training of health care providers in "universal biosafety precautions", carelessness, even among those who have been trained, presence of many undiagnosed HIV-infected persons who are not routinely screened for HIV particularly before emergency surgeries, and likelihood of false negative HIV tests during the "window period" (NACO, 2002; Mehta & Rodrigues, 1996). The prevalence of HIV infection varies geographically. Injuries occur in up to 10 per cent of surgical procedures. During emergency surgeries, there is greater likelihood of accidental injury occurring to any member of the surgical team (Mehta & Rodrigues, 1996).

11.3 – PREVENTION

Practising "universal biosafety precautions" (also called "universal work precautions") can prevent accidental occupational exposure. The guiding principle is to *presume that all specimens, all patients or clients are infected (or potentially infected), unless proved otherwise*. Prevention holds the key to avoiding occupational HIV transmission (NACO, 2002; WHO, 1996; CDC, 1997, 1998; UK Health Department, 1990). The methods for prevention are discussed in Chapter 7.

11.4 – MANAGEMENT OF ACCIDENTAL EXPOSURE

Accidental occupational exposure should be treated as an *emergency*. This is because some persons who have had such an exposure may require post-exposure prophylaxis (PEP) with antiviral drugs. Since PEP should be started within 2 hours of exposure and *not* later than 72 hours of exposure, sufficient stocks of "starter packs" of PEP drugs should be available for all 24 hours.

11.4.1 – Immediate First Aid: Dos and Don'ts

Needle Stick or Percutaneous Exposure: (a) Do not put the pricked finger into your mouth. This may be done as a reflex and can be dangerous; (b) Encourage bleeding from the wound by squeezing; (c) Wash with soap and plenty of water; and (d) Apply any antiseptic. It is not necessary to use antiviral agents for wound care. Caustic agents such as household bleach should *never* be used for wound care (www.uchsc.edu/sm/aids; NACO, 1999).

Splashes to Nose, Mouth, or Skin: Wash area around the splash with plenty of water.

Splashes to Eyes: Irrigate eyes with clean water, saline, or sterile irrigating fluids.

11.4.2 – Immediate Decontamination of Spills

11.4.2.1 – Procedure

(a) Wear latex, vinyl, or India rubber gloves before decontamination.
(b) Cover the spill with absorbent material (cotton, gauze, absorbent tissue paper).
(c) Pour disinfectant *over* absorbent material and *around* the spill, leave for 30–60 min.
(d) Clean surface with fresh absorbent material, and dispose it off in a special container for contaminated waste.
(e) Sweep broken glass, etc. with a brush into special container for contaminated waste.
(f) Wipe the surface (spillage area) once again with disinfectant (NACO, 1999; CDC, 1997).

11.4.3 – Immediate Reporting

The health care providers should report all the spills of blood or body fluids and accidental occupational exposures immediately to supervisory staff, who will inform the Hospital Infection Control Officer (HICO) and HICC. All cases of accidental occupational exposure should be reported by hospital authorities to designated state health authorities. Designated hospital officials should maintain written record of all accidental exposures in the format given below:

(a) *Details for identification* – name, age, gender, designation, and employee number.
(b) *Details of accidental occupational exposure* – date, time, place of exposure, exposure code (EC), and HIV status code (HIV SC).
(c) *History of the incident* – date of injury, date of reporting, site and depth of injury, nature of injury (needle stick, laceration, sharp cut, splash of fluids, splattered glass, etc.).

(d) *Action taken report* – action taken in emergency or casualty, dates of immunisation with hepatitis B vaccine or immunoglobulin, dates of estimation of anti-hepatitis B antibody titre with titre levels, dates of estimation of hepatitis B antigen titre with titre levels, and dates of HIV tests by ELISA technique with reports.

11.4.4 – Evaluating the Exposure

Evaluation of exposure is based on EC and HIV SC.

11.4.4.1 – Exposure Code (EC)

NO EXPOSURE: Intact skin only.
EC-1: Breached skin or mucous membrane, *low-volume* exposure (few drops of body fluid, short duration of exposure).
EC-2: Breached skin or mucous membrane, *high-volume* exposure (many drops of body fluid, major splash, long duration of exposure).
EC-2: Percutaneous, *less severe* exposure (solid needle, superficial scratch).
EC-3: Percutaneous, *more severe* exposure (hollow bore needles, deep puncture, visible blood on sharp instrument, needle used on patient's artery or vein).

11.4.4.2 – HIV Status Code (HIV SC)

HIV-Negative: HIV-negative patient
HIV SC-1: HIV-positive patient, *low-titre* exposure (asymptomatic, high CD4 count).
HIV SC-2: HIV-positive patient, *high-titre* exposure (advanced AIDS, high viral load, low CD4 count).
HIV SC UNKNOWN: HIV status of patient or source is unknown.

11.4.4.3 – Base-line tests

Susceptibility of the exposed person to blood-borne pathogens is determined by baseline tests for hepatitis B surface antibody, anti-HCV, and HIV antibody, preferably within 72 hours (www.uchsc.edu/sm/aids).

11.4.4.4 – Factors determining risk of infection

Factors Related to Exposure: Type of exposure (mucocutaneous or percutaneous), depth of injury, quantity of blood or body fluids involved, duration of exposure, viral load in patient's blood at the time of exposure, and timeliness and dosage of PEP (if determined to be required).

High-risk Departments: haemodialysis unit, pathology or microbiology laboratory, surgical or trauma or emergency or intensive care units, blood bank, oral surgery or dentistry, obstetrics and gynaecology, and skin and STIs department.

Factors Related to Procedures: per vaginal (PV) and per rectal (PR) examinations; invasive diagnostic and therapeutic procedures; wound dressing; operation

theatre procedures; handling blood, body fluids, and tissues; waste disposal, cleaning and house keeping; faulty procedures in Central Sterile Supplies Department (CSSD), post-mortem examination, and embalming.

Unless blood is *visible*, exposure to nasal discharge, saliva, sputum, stool, sweat, tears, urine, and vomitus does *not* pose a risk of transmission of blood-borne pathogens. Exposure to the following body fluids may pose a *significant* risk of transmission of blood-borne pathogens – blood, CSF, amniotic fluid, semen, cervicovaginal secretions, synovial fluid, peritoneal fluid, pleural fluid, and pericardial fluid.

11.4.4.5 – Step 5 Evaluate the exposure source

1. *If the source patient is known and can be tested* – After obtaining the source patient's informed consent and pre-test counselling, test for markers of HBV, HCV, and HIV infection.
   (a) If HBsAg positive, consider test for presence of HbeAg.
   (b) If HCV antibody positive, consider testing for HCV viral load.
   (c) And if positive for HIV antibody, HIV viral load and clinical status should be considered (www.uchsc.edu/sm/aids).
2. *If the source patient is known, but cannot be tested* – consider medical diagnosis, clinical symptoms, and history of high-risk behaviour in patients receiving haemodialysis, or blood transfusion, IDU, MSM, prison inmates, refugees, immigrants from highly endemic areas and other vulnerable groups such as mentally handicapped persons.
3. *If the source patient is not known* (e.g. exposure from needle in sharps container) – evaluate the likelihood of high-risk exposure based on the prevalence of blood-borne pathogens in the community or in the health facility. Do not test used needles and other sharp instruments for blood-borne pathogens since the reliability of these findings is not known (www.uchsc.edu/sm/aids).

11.4.4.6 – Step 6 Counselling and testing

Pre-test counselling should be provided *before* collecting the first sample of blood for laboratory tests and/or initiating PEP (NACO, 2002). The possible risks and benefits of PEP and details about follow-up are to be explained to the exposed person. Possible risks include side effects of ARV, and likelihood of seroconversion despite early initiation of PEP (Mitchell *et al.*, 1997; Wig, 2002).

11.4.4.7 – Step 7 Disease-specific Post-Exposure Prophylaxis (PEP)

PEP AGAINST HEPATITIS B INFECTION: Exposed persons *not* previously vaccinated against hepatitis B, should receive hepatitis B immunoglobulin 0.06 mL per kilogram body weight, administered intramuscularly along with a primary course of hepatitis B vaccine. Exposed persons who have been previously vaccinated against hepatitis B should receive a booster dose of hepatitis B vaccine (NACO, Training Manual for Doctors).

PEP against HCV: At present, there are no recommendations for PEP against HCV. Exposed persons to receive counselling, testing, and follow-up as for HIV exposures (www.uchsc.edu/sm/aids).

PEP against HIV: Most occupational exposures do not lead to HIV infection. The physician should carefully consider risks of acquiring HIV infection and possible side effects (toxicity) due to antiviral drugs used in PEP. For exposures with lower risk of infection, it is not advisable to start PEP (NACO, 2002). Delay in obtaining information on the source patient should not delay initiation of PEP since modifications can be made later, if necessary (www.uchsc.edu/sm/aids). Ideally, PEP should be started within 2 hours of exposure and not later than 72 hours of exposure. Hence, adequate stocks of PEP drugs (called "starter packs") should be available all 24 hours. If PEP is recommended, the following baseline investigations must be carried out *within* 72 hours and should be repeated 2 weeks later – complete blood count, urine analysis (for those receiving indinavir), renal function tests, and liver function tests (www.uchsc.edu/sm/aids).

The *basic* or *expanded* regimen may be prescribed, based on EC and HIV SC to select cases. The optimal duration of treatment is *unknown*. If the exposed person tolerates the antiviral drugs, the PEP is given for 4 weeks (NACO, 2002; www.uchsc.edu/sm/aids). The exposed person is informed about signs and symptoms of acute retroviral syndrome (flu-like syndrome), the need to report for additional tests at the onset of symptoms (www.uchsc.edu/sm/aids), and possible side effects of ARV drugs used in PEP. Only a physician or specialist in HIV medicine should determine the need for PEP (Mitchell *et al*., 1997).

The Centers for Disease Control and Prevention, Atlanta, USA, has recommended schedules for PEP for health care providers accidentally exposed to HIV. The basic two-drug regimen comprises ZDV 200 mg thrice daily for 4 weeks with lamivudine (3TC) 150 mg twice daily for 4 weeks. The expanded three-drug regimen (advised if the source patient has advanced HIV disease) consists of ZDV 200 mg thrice daily for 4 weeks, 3TC 150 mg twice daily for 4 weeks, and nelfinavir 750 mg thrice daily for 4 weeks. In India, indinavir is used in the expanded regimen in a dose of 800 mg thrice daily for 4 weeks in place of nelfinavir.

11.4.4.8 – Follow-up

After Exposure to HBV: Test for anti-hepatitis B surface antigen 1–2 months after the last dose of vaccine. Anti-hepatitis B surface antigen cannot be determined up to 6–8 weeks after administration of hepatitis B immunoglobulin (www.uchsc.edu/sm/aids). During follow-up, the exposed person is to receive psychological counselling if needed. He or she must observe the following precautions strictly: (a) not to donate blood, semen, or body organ for transplant; (b) to avoid pregnancy; and (c) to abstain from sexual intercourse, or use latex condom every time during sexual intercourse (www.uchsc.edu/sm/aids; NACO, 2002; Mitchell *et al*., 1997).

After Exposure to HCV: (a) Tests for anti-HCV antibody and liver enzymes are to be repeated for at least 4–6 months after exposure. Anti-HCV enzyme immunosorbent assays are to be confirmed by supplemental tests. (b) HCV RNA is tested for at least 4–6 weeks post-exposure. Caution should be exercised due to occurrence of false positive results. (c) During the 4–6 month follow-up period, the exposed person must refrain from donating blood, semen, or body organ for transplant. Changes in sexual activity, pregnancy, breastfeeding, or professional activities are *not* recommended. Mental health counselling is to be offered, if necessary (Mitchell *et al*., 1997).

After Exposure to HIV: Blood test for HIV antibody should be done *immediately* after exposure, 6 weeks later, followed by 12 weeks, 6 months, and 12 months after exposure (NACO, 2002). The exposed health care provider ought to be followed up for the next 6 months for fever, pharyngitis, malaise, skin rash, lymph node enlargement, myalgia, and arthralgia (NACO, 2002; Burke *et al*., 1993). The occurrence of illness being suggestive of acute retroviral syndrome, test for HIV viral load (www.uchsc.edu/sm/aids). Extended follow-up for 12 months is recommended if the source patient is co-infected with HIV and HCV (www.uchsc.edu/sm/aids). During the entire follow-up period, the exposed person is to be counselled to observe the following precautions strictly: (a) not to donate blood, semen, or body organ for transplant; (b) to avoid pregnancy; and (c) to abstain from sexual intercourse, or use latex condom every time during sexual intercourse (www.uchsc.edu/sm/aids; NACO, 2002; Mitchell *et al*., 1997). If the person is HIV negative, 1 year after the accidental exposure, it means that he or she is *not* infected. PCR can give results even at the end of second or fourth week of exposure (NACO, 2002).

11.5 – SEEKING SPECIALIST OPINION

In addition to seeking opinion of specialists in HIV medicine, doctors can avail of information from the Internet (www.uchsc.edu/sm/aids). Some of these sources are

- National Clinicians' PEP Hotline (PEPline) – www.ucsf.edu/hivcntr
- Mountain Plains E-mail Clinical Consultation Service for HIV Infection – hiv-consultation@uchsc.edu
- HIV/AIDS Treatment Information Service – www.hivatis.org
- Needlestick! – www.needlestick.mednet.ucla.edu
- Hepatitis Hotline – www.cdc.gov/hepatitis

Indications for seeking specialist opinion

1. *Delayed reporting after exposure* – later than 24–36 hours (www.uchsc.edu/sm/aids).
2. *Unknown source of infection* – for example, needle in sharps container. Use of PEP is determined on case-by-case basis, considering severity of exposure and epidemiological likelihood of HIV exposure. Needles or other sharp instruments should not be tested for HIV (www.uchsc.edu/sm/aids).

3. *Known or suspected pregnancy in exposed person* – PEP must not be denied solely on the basis of pregnancy. The ARV agents that are currently approved for use in pregnancy may be prohibited if new information emerges (www.uchsc.edu/sm/aids). ZDV should be cautiously used in first trimester of pregnancy (Lewin *et al*., 1997). The physician should carefully consider the risks before recommending PEP to a pregnant health care provider (NACO, 2002). It is better to consult a standard protocol.
4. *Known or suspected resistance of source patient's virus to certain ARV* – Select alternate drugs. The influence of drug resistance on the risk of transmission is not known. At the time of exposure, drug resistance testing of source patient's virus is not recommended (www.uchsc.edu/sm/aids).
5. *Toxicity of PEP regimen* – Nausea, diarrhoea, and headaches are common symptoms, which can be managed without changing the PEP regimen. Seek specialist opinion if the adverse effects are difficult to manage. Usually, dosage intervals may be modified (e.g. giving a lower dose of the drug more frequently) to relieve the symptoms (www.uchsc.edu/sm/aids).
6. *Expanded regimens* – Use of nevirapine, a protease inhibitor, has been associated with severe toxicity in exposed health care providers. It is advisable to seek expert opinion when using this drug or when considering dual protease inhibitor therapy (www.uchsc.edu/sm/aids).

REFERENCES

Burke R.A., Garvin G.M., and Sulis C.A., 1993, Infection control and risk reduction for health care workers in HIV infection – a clinical manual, 2nd edn. Boston: Little Brown.

Centers for Disease Control and Prevention (CDC), 1997, Perspectives in disease prevention and health promotion. update – universal precautions for prevention of transmission of HIV, hepatitis B and other blood borne pathogens in health care settings. Morb Mort Wkly Rep Suppl 37(24): 377–388.

Centers for Disease Control and Prevention (CDC), 1998, Recommendations for prevention of HIV transmission in health care settings. Morb Mort Wkly Rep Suppl (2S).

Leentvaar K.A., *et al*., 1990, Needle stick injuries, surgeons, and HIV risks. Lancet 335: 546–547.

Lewin S.R., Crowe S., Chambers D.E., and Cooper D.A., 1997, Antiretroviral therapies for HIV. In: Managing HIV (G.J. Stewart ed.). North Sydney: Australasian Medical Publishing Company Limited.

Mandlebrot D.A., *et al*., 1990, A survey of exposures, practices, and recommendations of surgeons in the care of patients with human immuno-deficiency virus. Surg Gynae Obs 171(2): 99–106.

Mehta A. and Rodrigues C., 1996, HIV and the surgeon. New Mediwave 5: 38–44.

Mitchell D.H., Sorrell T.C., and McDonald P.J., 1997, HIV control in medical practice. In: Managing HIV (G.J. Stewart, ed.). North Sydney: Australasian Medical Publishing.

Mountain Plains AIDS Education and Training Center. A quick guide to post-exposure prophylaxis in the health care setting. University of Colorado, Denver, USA. www.uchsc.edu/sm/aids

National AIDS Control Organisation (NACO), 1999, Manual for control of hospital associated infections – standard operative procedures. New Delhi: Government of India.

National AIDS Control Organisation (NACO), 2002, Specialists' training and reference module. New Delhi: Government of India.

National AIDS Control Organisation (NACO), Training manual for doctors. New Delhi: Government of India.

Raahave D. and Bremmelgaard A., 1991, New operative technique to reduce surgeons' risk of HIV infection. J Hosp Infect 18 Suppl A: 177–183.

UK Health Department, 1990, Guidance for clinical health care workers: protection against infection with blood-borne viruses. Recommendations of the Expert Advisory Group. London: Her Majesty's Stationery Office. www.uchsc.edu/sm/aids

WHO, 1996, Guidelines for preventing HIV, hepatitis B virus and other infections in the health care setting. New Delhi: SEARO.

Wig N., 2002, Anti-retroviral therapy – are we aware of adverse effects? JAPI 50: 1163–1171.