

Occupational Infections: A Risk for the Anesthesiologists

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SUMMARY

The environment of operating room is familiar workplace for anesthesiologists, as well as, an area replete with various kinds of occupational hazards, such as, stress,^{1,2} exposure to inhalational anesthetics^{3,4} noise pollution^{5,6} and sleep deprivation^{7,8}. In addition to these hazards there is a serious threat of occupational infections^{9,10} among anesthesiologists. Here is the review of this threat and how to identify and minimize risk, while providing optimal patient care. Though, the work environment of anesthesiologists may be hostile to some extent, they should work more safely by identifying, understanding and hence avoiding these hazards.

HEPATITIS A

25% of viral hepatitis is caused by the Type A virus. Hepatitis A is generally a self-limiting disease, and there is no chronic carrier state. It is spread by feco-oral route, either by ingestion of contaminated food / water or by person-to-person contact. Usually the outbreaks are found in institutions or schools where normal sanitary conditions breakdown. Anesthesiologists or other hospital personnel are not at increased risk for hepatitis A.

In case they are exposed to hepatitis A, they should receive immunoglobulin intramuscularly within 15 days of exposure.¹¹ Immunoglobulin provides post-exposure prophylaxis against hepatitis A through passive transfer of antibodies. Only for those healthcare workers (HCWs) who work in countries where hepatitis A is endemic,^{11,12} hepatitis A vaccine is recommended

HEPATITIS B

Infection with HBV depends on individual

activities (Table 1). Hepatitis B is an important occupational hazard for non-immune anesthesiologists who have frequent contact with blood or blood products. Based on serologic screening, the prevalence of hepatitis B in the general population is 3 to 5%, and the carrier rate is 0.2 to

Table 1 : Prevalence of hepatitis B serologic markers in various population groups

	Population group	Prevalence of serologic markers (%)	
		HBsAg	All markers
High risk	Immigrants from areas of HBV endemicity	12	70-85
	Clients in institutions for mentally retarded	10-20	35-80
	Intravenous drug abusers	7	60-80
	Homosexually active men	6	35-80
	Household contacts	3-6	30-60
	Patients on hemodialysis	3-10	20-80
Intermediate risk	HCWs with blood contact	1-2	15-30
	Prisoners (male)	1-8	10-80
	Staff of institutions for mentally retarded	1	10-25
Low risk	HCWs with no blood contact	0.3	3-10
	Healthy adults (first time blood donors)	0.3	3-5

(From: Centre For Disease Control. Recommendations for Protection against Viral Hepatitis.)

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0.9%. Survey of more than 2400 unvaccinated anesthesiologists conducted in several countries showed a mean prevalence of HBV serologic markers of 17.8% (range, 3.2-48.6%).¹³ The range of seropositive findings in anesthetists in various locations reflects the prevalence of HBV carriers in the referral population for the area. Studies conducted before the extensive usage of hepatitis B vaccine indicated that the occurrence of hepatitis B serologic markers ranged from 19 to 49% in anesthetists.

Hepatitis B infection may be asymptomatic and generally resolves without considerable hepatic damage. Fulminant hepatitis occurs in about 1% of acutely infected patients. Around 10% become chronic carriers of HBV (i.e., serologic verification present for more than six months). Half of the chronic carriers resolve their infection without major hepatic impairment within two years. Chronic hepatitis may progress to cirrhosis and hepatocellular carcinoma, in individuals with chronic infection for more than two years. The accomplishment of routine vaccination, use of recommended precautions, utilizing safety devices and post-exposure prophylaxis have significantly reduced the risk of occupationally acquired HBV infection and its complications in anesthesiologists.¹³

Through serologic testing, the diagnosis and classification of the stage of HBV infection can be made. Antibody to the surface antigen (anti-HBs) appears with resolution of the acute infection and provides lasting immunity against subsequent HBV infections. Chronic HBV carriers are likely to have hepatitis B surface antigen (HBsAg) and antibody to the core antigen. Active viral replication in hepatocytes is indicated, if there is presence of hepatitis B e antigen (HBeAg) in serum.

Anesthesiologists are at risk to acquire HBV infection as a result of accidental mucosal or percutaneous contact with blood or body fluids from infected patients. Patients more likely to have HBV include immigrants from endemic areas, homosexual men, patients on hemodialysis and users of illicit parenteral drugs.¹⁴ Since clinical history and routine preoperative laboratory tests may be insufficient for

diagnosis, carriers are frequently not identified during hospitalization. The risk for HBV infection following an accidental needle stick, is 37 to 62%, if the source patient is HBeAg-positive and 23 to 37% if HBeAg-negative. The rate of transmission is significantly less after mucosal contact with infected oral secretions than after percutaneous exposure to blood HBV, though the virus can be found in saliva. HBV is a tough virus that may be infectious for at least one week in dried blood.

Hepatitis B Vaccine: Administration of hepatitis B vaccine is the most important strategy to prevent occupational spread of HBV to anesthesiologists and other operating room personnel.¹⁴ Three doses of vaccine into the deltoid muscle results in the production of protective antibodies (anti-HBs) in more than 90% of healthy workers. Anesthesia department should have a policy for screening and educating personnel about the risk of acquiring HBV infection and should make vaccination available for them.^{14,15}

Serologic testing for anti-HBs should be undertaken within 1 to 2 months after the third dose of vaccine to ensure adequate post-vaccination immunity.¹⁴ With a second 3-dose vaccine series, protective antibodies develop in 30 to 50% of non-responders (i.e., anti-HBs <10 mIU/ml). Non-responders to vaccination, who are HBsAg-negative, remain at risk for HBV infection and should be advised regarding the need for post-exposure prophylaxis and to prevent infections.

Vaccine-induced antibodies decrease with time, and maximum titers after vaccination depend on persistence of duration of antibody. For vaccinated adults with normal immune status, periodic monitoring of antibody concentration is not recommended and routine booster doses are not essential.¹⁴

Post-exposure prophylaxis with HBV hyperimmune globulin (HBIG) is recommended, when susceptible or non-vaccinated anesthesiologist has a known exposure to a contaminated needle or to blood from an HBsAg-positive patient.¹⁴ In any

unvaccinated anesthesiologist, who sustains an exposure to blood or body fluid, Hepatitis B vaccine should be recommended.

HEPATITIS C

Hepatitis C virus leads to the majority of cases of parenterally transmitted NANBH and is a foremost cause of chronic liver disease. Although anti-HCV can be detected in most patients with hepatitis C, its presence does not correlate with progression of hepatitis or resolution of the acute infection. Also, it does not provide immunity against HCV infection.¹⁵⁻¹⁶ Marker of chronic infection and continued viral presence is the sero-positivity for HCV RNA.

TABLE 2: Healthcare Personnel with Documented and Possible Occupationally Acquired AIDS/HIV Infection, by Occupation, 1981-2006

Occupation	Documented	Possible
Nurse	24	35
Laboratory worker, clinical	16	17
Physician, nonsurgical	6	12
Laboratory technician, nonclinical	3	-
Housekeeper/maintenance worker	2	13
Technician, surgical	2	2
Embalmer/morgue technician	1	2
Health aide/attendant	1	15
Respiratory therapist	1	2
Technician, dialysis	1	3
Dental worker, including dentist	-	6
Emergency medical technician/paramedic	-	12
Physician, surgical	-	6
Other technician/therapist	-	9
Other healthcare occupation	-	6
Total	57	140

(From: Centres for disease control and prevention. HIV/AIDS Surveillance Report, 2006)

The majority of cases with acute HCV infection are without symptoms, but infected individuals have a high risk of progressing to chronic hepatitis. Around 60% of HCV-infected patients will have chronic hepatitis, and may even develop cirrhosis. Even after resolution of acute hepatitis C, HCV RNA can still be detected in more than 75% of patients.¹⁶ Combination therapy with interferon and ribavirin has been successful in treating cases of chronic hepatitis C. In preventing chronic hepatitis C in

patients with acute infection, interferon alfa-2b has also been effective.¹⁷

HCV is also transmitted through blood and sexual contact, but the rate of occupational HCV infection is less than that for HBV. Although HCV transmission has been seen in anesthesiologists, the prevalence of anti-HCV is same as found in general population. The average rate of sero-conversion after accidental percutaneous exposure is 1.8% and the major risk of occupational HCV transmission is through the exposure to blood from an HCV-positive source.¹⁴ HCV has been transmitted through exposure via non-intact skin and blood splashes to the eye. HCV in dried blood on surrounding surfaces may remain infectious for up to 16 hours. HCV does not pose a great risk for occupational transmission, though it can be found in the saliva of infected individuals.¹⁴

Use of immune globulin is no longer recommended after a known exposure to HCV. Also, there is no vaccine or effective post-exposure prophylaxis to prevent HCV infection.¹⁴ After occupational exposure, use of interferon has not been found to be an effective prophylaxis. The main strategy for protecting anesthesiologists against HCV infection is to adopt prevention of exposures. Serologic testing for anti-HCV and alanine aminotransferase, as well as, counseling should be assured at the time of the exposure and at 6 months in anesthesiologists who had a percutaneous or mucosal exposure to HCV-positive blood.¹⁴

HIV INFECTION AND AIDS

One of many pathogenic human retroviruses that produces acquired immunodeficiency syndrome (AIDS) is the human immunodeficiency virus (HIV). Between 1981 to December 2002, there have been 859,000 cases of AIDS.¹⁸ The details of Health Care Workers (Table 2) at risk of occupationally acquired HIV Infection have been documented.

The primary clinical presentation of HIV infection is mononucleosis-like syndrome with rash and lymphadenopathy. Monocyte-macrophage cells serve

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as a reservoir for the virus throughout the body, and CD4+ T cells harbor the virus in the blood. An antibody may be detected by the enzyme-linked immunosorbent assay (ELISA) within a few weeks after infection and is confirmed with more specific Western blot test. After an unpredictable period of asymptomatic HIV infection, there is an increase in viral titer and impaired host immunity, resulting in opportunistic infections and malignancies. Highly active antiretroviral therapy since 1996 has increased the average length of survival after HIV infection.

Transmission of HIV is through infected blood (transfusion or shared needles) and blood products, sexual contact (especially homosexual males) and perinatally from infected mother to neonate. Body fluids, such as Saliva, tears, and urine have a low risk for viral transmission, although the virus can be found in these fluids. Many HIV-infected anesthesiologists may not be identified by their initial diagnosis, as such.

Risk of Occupational HIV Infection: The most important source for occupational transmission of HIV in anesthesiologists is blood contact.¹⁴ The seroconversion rate following a needle stick injury to HIV-infected blood is estimated to be 0.3%,¹⁹ while after a mucous membrane exposure, it is 0.09%.²⁰ Transmission may occur through a non-intact skin, but it is less than exposure to mucous membrane.

Definite factors are responsible for an increased rate of HIV transmission after a percutaneous injury.²¹ Increased risk has been linked with noticeable blood on the device producing the injury, a deep injury, needle placement in an artery or vein, and terminal illness i.e. death from AIDS within two months in the source patient. Therefore, the risk of transmission is maximal after a deep injury with a blood-filled, large needle used in the terminal AIDS patient.

Greene et al prospectively collected data on 138 contaminated percutaneous injuries to anesthesia personnel.²² The rate of contaminated percutaneous injuries per year in an anesthesia worker was 0.42, and the average annual risk of HIV infection was

estimated to be 0.0016%.

Anesthesiologists are commonly exposed to blood and body fluids while performing invasive procedures such as tracheal intubation, arterial punctures, and insertion of venous cannula.²²⁻²⁴ The Majority of exposures are through skin or mucous membrane and can be prevented by the use of gloves and protective clothing. These measures do not prevent percutaneous exposures such as needle stick injuries, which carry a greater risk. Anesthesia personnel are likely to be injured by needles on syringes and large-bore, hollow needles such as IV catheter stylets.^{22,25} Protected needle safety devices should be used to reduce the risk of needle stick injuries. When the cost of needle stick injury investigation and medical care for infected personnel is considered, these devices may be more cost-effective.

Significant occupational risk for anesthesia workers is percutaneous injuries.²³ The Needle-stick Safety and Prevention Act of 2000 mandated that OSHA update its Blood-borne Pathogen Standard to require that exposure control plans include implementation of commercially available safety medical devices.¹⁵ Employers were also advised to maintain a "sharps" injury log to collect data to estimate exposure risks and the efficacy of safety devices.

Treatment after exposure and Prophylaxis: When anesthesia personnel are exposed to patients' blood or body fluids, the incident should immediately be reported to the employee health service of the institution. The exposed worker and the source individual should be tested for serologic evidence of HIV, HBV, and HCV infection.¹⁴ Current local laws must be consulted and confidentiality must be maintained. When the source patient is found to be HIV-positive, the employee should be retested for HIV antibodies at 6 and 12 weeks and at 6 months after exposure. During this period, the exposed employee should follow CDC recommendations for preventing transmission of HIV to patients and family members.¹⁴

It is recommended that antiretroviral post-exposure prophylaxis (PEP) be offered to anesthesia worker who has got a considerable percutaneous exposure to HIV-infected blood.¹⁴ Because protocols for chemoprophylaxis are likely to change with additional research and the introduction of new antiretroviral drugs, the most current recommendations, such as those provided on the CDC website (<http://www.cdc.gov/niosh/topics/bbp>), should be consulted prior to starting post-exposure prophylactic therapy. To be most effective, PEP should be initiated within 24 hours and continued for one month. Anesthesia worker should be informed about the toxic effects of antiretrovirals, so that he can make a decision on the risks related with PEP. Failure of PEP is usually due to large viral inoculums, delayed start or short duration of PEP therapy, use of a single agent or drug resistance.

TUBERCULOSIS

Since 1992, the incidence of tuberculosis has decreased. The majority of workers infected with tuberculosis are treated on an outpatient basis, undiagnosed patients are hospitalized to investigate for pulmonary pathology. Anesthesia personnel are particularly at risk for infection from unrecognized cases.^{26,27} Personnel with a higher prevalence of tuberculosis include (a) personal contacts of people with active tuberculosis; (b) people from places with a high incidence of tuberculosis; and (c) alcoholics, I.V.

Table 3 : Universal precautions

Barriers	Gloves, masks, eyewear as appropriate.
Needles	Do not resheath, bend, or break. Dispose of in a puncture-proof container
Dermatologic conditions	Weeping or exudative lesions as well as cuts and abrasions imply a breach in the integumentary barrier. This may increase risk if the area involved is not protected with a barrier.
Decontamination	Wash hands.
Pregnant health care workers	Be especially careful because intrauterine transmission occurs.

drug addicts and homeless people,²⁶

Transmission of *Mycobacterium tuberculosis* is by airborne particles through coughing or sneezing.

Isolation should be used for hospitalized patients suspected of having tuberculosis until they are confirmed non-transmitters by sputum examination.²⁶ Chemotherapy is the most successful way to prevent spread of tuberculosis.²⁸ Routine surgery should be postponed until infected patient has received the course of chemotherapy. If surgery is a must for patients with tuberculosis, filters should be used on the anesthetic circuit.^{26,29}

Many incidences of multidrug-resistant *M. tuberculosis* infection have been reported in various hospitals.^{27,30} Mortality associated with these outbreaks is high.

Successful prevention of spread to anesthesia workers needs early identification of infected patients and immediate isolation.^{26,29} Patients must remain in isolation until adequate treatment is administered. Patients with tuberculosis should wear face masks to prevent spread of organisms. Anesthesia workers should wear respiratory protective devices, when they perform procedures that may induce coughing, such as tracheal intubation or suctioning.²⁶ Respiratory protective devices worn should be able to filter 95% of particles 1 mm in size at flow rates of 50 liters per minute and should fit the face with a leakage rate around the seal of less than 10%.²⁶

Regular screening of employees for tuberculosis should be undertaken. When a new conversion is detected by skin testing, a history of exposure should be sought to determine the source patient. Anesthesia personnel who have been exposed to a patient with active tuberculosis should be followed by skin testing. Preventive therapy or treatment is based on the drug-susceptibility pattern of the *M. tuberculosis* in the source patient, if known.

PRECAUTIONS:

All patients and all blood and body fluid specimens must be considered to be infectious at all times.

CDC has recommended precautions¹⁴ we must follow while caring for all patients:

1. Universal precautions: (Table 3). These should be taken in all the patients, as HIV-infected people cannot be reliably identified by history and physical examination. It is more so in emergency care settings, such as trauma resuscitation when exposure to blood and body fluids is likely and the patient's infectious status is unknown.¹⁶
2. Invasive precautions: Taken in addition to universal precautions when such a procedure is to be performed. Invasive procedure is defined as any surgical entry into tissue, cavities, or an organ or repair of any trauma lesions. These include lumbar puncture, traumatic lesions, cardiac catheterization, vaginal or caesarean delivery, intravenous catheter placement and dental surgical procedures. Even insertion of nasogastric tube and endotracheal tube is labeled as invasive procedure as there is possibility of blood contamination. Use liquid-repellant gown over a repellent apron, repellent leggings and shoe covers. Consider double gloves and watch for glove tears.
3. Laboratory precautions. Blood and body fluids from all the patients must be considered infectious until proved otherwise. In addition to universal precautions, for material handling, use biologic safety hood, mechanical pipettes, needles / syringes if no other alternative, and well fitting lids. Also, decontaminate workspace after spills, clean and decontaminate equipment before transport / repair and discarded liquids / solids should be neutralized by autoclave.

Any contamination with a patient's blood must be washed with a germicidal soap as soon as practical and safe. Gloves must be worn when attending the patients. This is not necessary when anesthesiologist greets and shakes the patient's hand in the preoperative area or before induction of anesthesia. In addition to gloves, plastic eyewear or prescription glasses (preferably with side shields) are appropriate in prevention of conjunctival mucous membrane contamination.

CONCLUSION

It is concluded that while managing the patients, the anesthesiologist is exposed to a multitude of communicable disease, most of which present no significant threat to healthy people. Although the potential of infection is low, it is important to consider the possibility and take the necessary precautions. The greatest concern stems from contact with patients infected with viruses causing HIV, hepatitis B or hepatitis C. These catastrophic diseases in addition to tuberculosis must be kept in mind by anesthesiologists, while providing the patient care in emergency department, as well as in operating room.

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