Infection Control

Synopsis from the ASA Recommendations for Infection Control for the Practice of Anesthesiology (Third Edition, 2011)*

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Introduction

Recognition of the importance of infection-control risks in health care settings is a major element in endeavors to enhance the quality of medical care. It is estimated that 5 to 10 percent of the hospitalized patients in the U.S. acquire one or more health care-associated infections (HAIs), which are a contributory cause in more than 90,000 deaths and result in excess health care expenditures of $4.5–$5.7 billion a year. The four most prevalent infections, responsible for greater than 80 percent of HAIs, are: urinary tract infections (35 percent of cases, generally catheter-associated); surgical site infections (20 percent of cases, but accounts for one third of the costs associated with HAIs); bloodstream infections (15 percent, the majority being intravascular-catheter-related); and pneumonia (15 percent, usually ventilator-associated, but to which is attributed 25 percent of HAI-associated mortality). Significantly, the etiologic organisms in 70 percent of these infections are resistant to one or more antibiotics. *However,* appropriate anesthesia practices can reduce the incidence of infection related to these and other causes of HAI.

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The ASA Task Force on Infection Control has analyzed the current scientific data and national guidelines on infection control. Its synopsis of this data is intended to inform us of those practices that have been shown to alter the incidence of infection transmission in health care settings. In recognition of the infectious risks to both the patient and the anesthesiologist, the document is organized into

two broad categories: the prevention of occupational transmission of infection to the anesthesiologist and the prevention of HAI in patients.

Prevention of Occupational Transmission of Infection to Anesthesiologists

Preventing accidental needle-sticks and other sharp-object injuries

Injuries to anesthesiologists from needles and other sharp objects have been associated with transmission of human immunodeficiency virus (HIV), hepatitis B virus (HBV), and hepatitis C virus (HCV). The greatest risk of transmission of blood-borne infections is from a blood-contaminated percutaneous injury with a hollow-bore needle. The degree of risk depends on the type of pathogen and the quantity of the viral inoculum. Higher viral titers in the source patient pose a greater risk of transmission. For HIV, this occurs with acute or terminal illness. For HBV, hepatitis B e-antigen or precore mutant positive blood is associated with far higher transmission rates. For HCV, the risk is increased with higher HCV RNA titers. An elevated risk for transmission of all three of these viruses occurs with deep injury and/or one involving a needle that had been intravascular in the source patient's vein or artery (a hollow-bore needle). For HIV, there is data that correlates the presence of visible blood on the sharp device with an increased risk.

The cumulative risk of occupational infection with blood-borne pathogens depends on the 1) number and type of exposures to patients' blood or body fluids; 2) prevalence of infected patients; and 3) risk of infection transmission after each pathogen-contaminated exposure.

To minimize the risk of transmission from sharp devices, it is recommended that contaminated needles never be bent, recapped, or removed from syringes unless such action is required by a specific procedure or has no feasible alternative. If a needle must be recapped, a mechanical device or a "one-handed" technique should be utilized, but perforation of the cap by the needle is possible with either recapping technique. A puncture-resistant leakproof container for the disposal of used needles, syringes, scalpel blades, and other sharp items should be located *as close as is feasible* to the immediate area where the sharps are used. Sharps containers must be sealed and replaced before becoming completely filled.

The injury rate for straight suture needles is more than seven times the rate associated with conventional instrument-held curved suture needles. Use a curved needle with a needle holder for suturing rather than holding a straight needle by hand, and avoid holding patient tissues with fingers when suturing or cutting. Double gloving offers increased protection from penetrating injuries to the hands, as the innermost gloves reduce perforation of the skin. The use of gloves may also

decrease the risk of infection by decreasing the inoculum size from some types of needle-stick injuries.

Blood-borne Pathogens—HBV, HCV, HIV

Recommendations

- Unless otherwise contraindicated, all anesthesiologists should be vaccinated and have documented immunity to HBV. The table at right, on protection conferred by immunization as a function of the number of doses, is from the Centers for Disease Control and Prevention (CDC).

Protection* by Age Group and Dose

Dose	Infants †	Teens and Adults §
1	16% - 40%	20% - 30%
2	80% - 95%	75% - 80%
3	98% - 100%	90% - 95%

*Anti-HBs antibody titer of 10 mIU/mL or higher

†Preterm infants less than 2kg have been shown to respond to vaccination less often

§Factors that may lower vaccine response rates are age 40 years or older, male gender, smoking, obesity, and immune deficiency

- Serologic testing for evidence of conversion should be performed one to two months after the third dose of the HBV vaccination process. Non-responders to the first series have a 30 to 50 percent chance of responding to a second series.

- Strict adherence to standard precautions and sharps safety is required at all times.

- Should an exposure incident occur, immediate evaluation for postexposure prophylaxis (PEP) and follow-up care should be sought.

Rationale: HBV

The CDC estimated in 2006 that there were 1.25 million individuals in the U.S. chronically infected with HBV. The risk of infection after an exposure varies with viral titer, volume of inoculum and site of exposure. Transmission may occur via percutaneous injury, mucous membrane exposure, or contact with non-intact skin. With a sharps injury, larger quantities of blood are transmitted when the device is visibly contaminated with blood, the needle was previously in the vasculature of the source patient (especially hollow-bore needles), and when a deep injury is sustained. When a sharp injury occurs through a glove, the amount of blood on the external surface of the device may be reduced by 46 to 86 percent. Transmission might also occur through contact with contaminated environmental surfaces, as HBV has been found to remain infective on such surfaces for over seven days.

Body fluids that have titers that may result in transmission are blood, semen, vaginal secretions, and cerebrospinal, synovial, pleural, peritoneal and amniotic fluids. Those that have a titer too low to pose a significant risk of transmission, unless contaminated with blood, are feces, nasal secretions, saliva, sputum,

sweat, tears, urine and vomitus. Blood has a 100- to 1,000-fold higher titer than the aforementioned fluids.

The risk of seroconversion to HBV pursuant to a percutaneous injury with source blood that is HBsAg positive is 22 to 31 percent. For blood that is HBeAg or precore mutant positive, the risk is 37 to 62 percent. The presence of HBeAg and the precore mutant are correlated with active viral replication and infectivity.

The prevalence of HBV infection among health care workers (HCWs) was 10-fold higher prior to the recommendation for vaccination. The seroprevalence among HCWs is now no higher than that of the general population.

Anyone without a documented adequate response to the HBV vaccine series should receive PEP after a significant exposure. PEP includes one to two doses of human immune globulin (HBIG) with or without the HBV vaccine. For current recommendations, you are referred to http://www.nccc.ucsf.edu/ hiv_clinical_resources/pep_guidelines/ (please note that this valuable website has PEP recommendations for HBV, HCV and HIV).

Rationale: HCV

In 2006, approximately 3.2 million people in the U.S. had chronic HCV infection. The modes of transmission for HCV are the same as those for HBV (see above). Ex vivo survival of HCV is not well defined, but is shorter than HBV, with infectivity declining within hours on environmental surfaces. The risk of acquiring HCV after a percutaneous injury is 1.8 percent (range 0.3 to 7 percent).

After seroconversion, only 15 to 25 percent will clear the virus spontaneously. Of those who develop chronic hepatitis, 20 percent will develop cirrhosis over the following 20 to 30 years, and 1 to 2 percent of those will be diagnosed with hepatocellular carcinoma!

Although at this time no specific PEP has been documented to be effective for HCV, it is recommended that evaluation be sought after HCV exposures to assess baseline liver function and determine treatment options if seroconversion should occur. Some promising treatment regimens for acute infection have resulted in a sustained virologic response (absence of HCV RNA for six months after completion of the treatment). A combination of interferon and ribavirin is given for 48 months in one of these regimens.

Rationale: HIV

The CDC estimates that in 2003 about 1.1 million people were living with HIV in the U.S., and that 56,300 new infections were occurring each year. Modes of transmission are the same as those for HBV and HBC (see above). The risk of

conversion from a percutaneous HIV exposure is 0.3 percent, while the risk of a mucous membrane exposure is 0.09 percent. HIV titers vary with the stage of the disease and treatment. Viral titers are highest during the viremic period of acute infection and with advanced disease. Rates of seroconversion are directly proportional to the viral load.

The efficacy of PEP for HIV infection is based on viral pathogenesis. In the first 24 hours after exposure, HIV infects the dendritic-like cells, after which the virus migrates to regional lymph nodes where it is detectable after 24 to 48 hours. The virus is detectable in peripheral blood within five days. The decrease in seroconversion after PEP is estimated to be from 50 to 81 percent.

The treatment of HIV includes five classes of drugs: nucleoside reverse transcriptase inhibitors; nucleotide reverse transcriptase inhibitors; non-nucleoside reverse transcriptase inhibitors; protease inhibitors; and single fusion inhibitors. PEP is complex and has evolved over time. A two-drug regimen taken for four weeks is generally recommended for PEP. Evidence suggests that standard PEP may be less effective when the source-patient viral strain shows antimicrobial resistance. However, because it takes one to two weeks to carry out resistance testing, it generally does not influence initial PEP. For the latest recommendations, refer to http://www.cdc.gov/hiv/resources/guidelines/index.htm and http://www.nccc.ucsf.edu/hiv_clinical_resources/pep_guidelines/ (please note that this valuable website has PEP recommendations for HBV, HCV and HIV).

Prevention of HAI in Patients

Recommendations

Hand washing with soap, whether or not antimicrobial, should be performed whenever there is visible contamination with blood or body fluids. Alcohol-based hand rubs are recommended for hand hygiene when there is no visible contamination. Spore-forming organisms such as *Clostridium difficile* and *Bacillus anthracis* are poorly inactivated by waterless hand hygiene products and require the physical action of washing and rinsing for removal.

The wearing of artificial nails during direct patient care is discouraged in ORs or ICUs. Nail polish may be worn if it is not chipping or peeling. Rings should be removed prior to performing a surgical hand scrub.

Indications for hand hygiene include:
- Before and after direct contact with patients
- Before donning sterile gloves

- After contact with body fluids, non-intact skin, mucous membranes, wound dressings

- When hands that have contacted a contaminated body area will subsequently contact a clean site

- After contact with high-touch environmental surfaces in the vicinity of the patient

- After removal of gloves (hands are considered contaminated after glove removal because of the potential for glove failure and self-contamination)

- Before eating

- After using the restroom

Gloves should be worn whenever any contact with blood, body fluids, mucous membranes, non-intact skin, or other potentially infectious material is anticipated. Gloves are not intended for reuse as removal of microorganisms and integrity cannot be ensured.

Rationale

Hand washing is one of the most effective infection-control practices to protect both patients and health care workers from colonization and/or infection. Hands carry a relatively high count (3.9 x 104 to 4.6 x 106 colony-forming units) of resident and transient bacteria. Dermatitis increases bacterial counts and decreases compliance with hand hygiene. Many products do include compounds to reduce dermal irritation. Subungual areas have the highest bacterial concentrations and are frequently colonized with coagulase-negative *Staphylococcus,* gram-negative rods, *Corrynebacteria,* and yeasts. For effective hand hygiene, the use of alcohol-based hand products is faster than hand washing with soap and water.

There is a direct correlation between contamination of environmental surfaces in the OR and positive cultures on the internal surface of intravenous stopcocks. Patients with positive stopcock cultures have a higher incidence of postoperative infections and mortality. Positive cultures in anesthetizing locations were most common on the adjustable-pressure limiting valve and anesthetic dial.

The OR has unique infection-control issues compared with other clinical care areas. OR personnel care for a single patient for prolonged periods of time. Consequently, microorganisms may be transmitted via two mechanisms: contamination of normally sterile sites with a patient's own bacteria; and transmission of bacteria to subsequent patients by microbes that have contaminated environmental surfaces during a previous case. Although equipment is cleaned between cases, not all bacteria will be eliminated,

necessitating efforts to minimize environmental contamination. Thus, gloves that have been used during patient care should be removed prior to touching equipment. However, this may be in conflict with the requirement to perform hand hygiene upon removal of gloves. There are, indeed, times when gloves should be removed before touching environmental surfaces and when there is inadequate time to perform hand hygiene—as, for example, immediately after intubation when anesthetic gases and ventilator need adjustment. In these circumstances, hand hygiene should be performed as soon as patient safety allows. Alternatively, *double gloves* can be worn and the outer glove removed prior to touching environmental surfaces.

The wearing of gloves, however, is not a substitute for hand hygiene as there are both a measurable level of glove leakage (from manufacturing defects or damage during use) and self-contamination during removal. The pre-use glove leakage rate ranges from 1 to 4 percent, while the post-use rate ranges from 1.2 to 53 percent with surgical gloves performing better than examination gloves. The incidence of positive hand cultures after glove use and removal ranges from 2.2 to 34 percent, thus emphasizing the essential role of hand hygiene in infection control.

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