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Infection Prevention for the Anesthesia Professional: What is the Least I Should Know and How Do I Apply It to My Practice?

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Stem Case and Key Questions Content

Your local and State Health Departments identified a series of local individuals who were recently diagnosed with hepatitis C. All the affected individuals had one common theme - all had care at your health care institution in the last several months. Upon investigation, all had procedures requiring anesthesia services. The Health Department is coming next week to observe the infection control practices of your anesthesia team. In addition, the DNV (Det Norske Veritas; a U.S. hospital accreditor) will be surveying your organization in the near future. Your Chief Quality Officer has requested that your anesthesiology group prepare an action plan to review and update its infection prevention policies and to implement procedures compliant with current infection prevention recommendations. The following are issues upon which action is requested:

Safe Injection Practices
Reprocessing of Non-Disposable Anesthesia Devices & Equipment
Anesthesia Workspace Turnover
Prevention of Surgical Site Infections
US Pharmacopeia Chapter 797 Recommendations
Prevention of Occupational Transmission of Infections to Anesthesia Professionals
Your hospital administration and pharmacy has agreed to work with you to implement these strategies.

Safe Injection Practices:

What are safe injection practices? Are anesthesia professionals currently applying these recommendations to daily practice? What practices are problematic, and how can these practices be changed to prevent transmission of blood borne pathogens? How do I handle single-dose and multi-dose medication and fluid containers in the “immediate patient care area” (i.e. the usual anesthesia care setting)? What infection control practices are recommended during spinal or epidural procedures?

Hand Hygiene:

What are the recommendations for when and how hand hygiene should be performed? Are sterile gloves a substitute for hand hygiene? When is the use of an alcohol-based hand rub acceptable and when is it not?

Reprocessing Re-Useable Equipment and Devices:

What is the system used to determine the requirements for cleaning, disinfection, and

sterilization of re-useable devices (e.g., surgical instruments, bronchoscopes, laryngeal mask airways, or blood pressure cuffs)? What determines the level of sterility for the reprocessed item? Why is cleaning an important step in reprocessing, and what does cleaning accomplish?

The Anesthesia Workspace:
Are anesthesia workspace practices associated with infectious complications? What practices are recommended in the anesthesia workspace location? What is the evidence behind these practices? How do I prepare the anesthesia workspace for the next patient? Do I need to regularly disinfect my anesthesia machine? If so, how do I do this?

Surgical Site Infection:
What is the anesthesia professional's role in the prevention of surgical site infection? What is the current evidence for anesthesia practices aimed at minimizing surgical site infections?

Managing Infectious Disease Risks to the Anesthesia Professional:
What do I do if I stick myself with a used needle? What should I tell my colleague if he/she has the same?

US Pharmacopeia Chapter 797 Guidelines
What are these recommendations and how do they apply to my anesthesia practice?

Model Discussion Content
Safe Injection Practices
Injection practices are those associated with the use of needles, syringes, medication and fluid containers (e.g., ampoules, vials, bags, bottles), and infusion supplies (e.g., administration sets, ports, connectors, and flush solutions). In the past 15-20 years, investigations have documented at least one hundred and forty-four patients who were infected with hepatitis B (HBV) or Hepatitis C (HCV) viruses following anesthesia care.[1-4] Disease transmission was not associated with blood product transfusions or tissue transplantations; each was the result of either: 1) re-using a syringe and/or needle between patients; or, 2) re-using a syringe or needle to access a medication or fluid container that was subsequently re-accessed and administered to another patient.[1-4] These and other injection practices that are not in compliance with current recommendations are still reported by anesthesia professionals. [5-7]

Safe injection practices are the application of Standard Precautions to injection equipment and procedures.[8,9] Whenever a needle, syringe, medication or fluid container or infusion supply is used, the anesthesia professional must adhere to the principle that each item is intended for use on a single patient. A syringe or needle that contacts a patient's blood or body fluids or any part of the administration set connected to a patient's vascular access (intravenous or arterial) should not be re-used either for another patient or to re-access a fluid or medication container.[8,9] Re-use of a syringe and/or needle may appear to be a flagrant breach of basic infection prevention practices. Unfortunately, it is not universally understood that replacing only the needle on a contaminated syringe is not safe (i.e., does not reliably eliminate the potential for transmission of pathogens from the residual syringe contents).[8,9] Conversely, flushing a contaminated needle with saline and placing it on a new syringe is also not safe.[8,9]

Regardless of the location in which they are administered, medications in "single-use only"

containers (e.g., vials, bags) and ampoules should be discarded when empty or at the end of each case, and residual medication should not be retained for later use.[8,9]

For multiple-dose medication or fluid vials, re-access of the container for residual medication or fluid is permitted. If a medication or fluid container is re-accessed with a *used* needle and/or syringe, then contamination occurs and gross visual inspection is not a reliable means to determine its presence. Medication vials labeled for multi-dose use contain bacteriostatic and/or bactericidal agents; however, these agents cannot prevent transmission of infection after contamination from external sources and have no anti-viral action. The CDC recommends that health care professionals refrain from re-using syringes, needles and cannulae for any purpose, even to access a multi-dose medication or solution container for use for the same patient.[8] Anesthesia work areas and similarly intense "bedside" areas are termed "Immediate Patient Care Areas". In these locations, the CDC recommends procedures that provide a double layer of safety to prevent transmission of blood borne pathogens. First, as stated previously, medication and fluid containers should be accessed only by a clean, sterile syringe and needle or cannula. Second, medications and solutions, even if labeled for multiple-dose use, should be designated for single-patient-use only and be discarded when empty or at the end of each patient's anesthetic care.[8,9]

All medications and fluids used in these areas should be supplied, when possible, as single-patient-use only (single-dose) containers. If the manufacturer does not supply a medication in a single-dose container (e.g., neostigmine, succinylcholine), then the multi-dose container should be discarded after use for one patient.[8,9]

In accordance with these practices, two techniques are acceptable to administer aliquots of medication to the same patient. The entire contents of a vial (either single-dose or multi-dose) may be drawn into a sterile syringe, and then used for sequential doses for the same patient. Alternatively, when administering medication from a multi-dose use vial, sequential doses may be obtained for the same patient using a new, sterile syringe and needle or cannula for each access. The vial should then be discarded when empty or no later than the end of the case.[8,9] Medication and fluid shortages require alternative strategies that do not involve re-accessing containers in the immediate care setting (e.g., working with pharmacy to divide medication vials into aliquots in a highly-sterile laminar flow environment).

Flip-tops from vials do not prevent contamination of the rubber stopper, and the stopper should be wiped with 70% alcohol prior to needle puncture.[10]

Neuraxial Procedures

Safe injection practice recommendations also state that the proceduralist who inserts a needle (with or without a subsequent catheter) into the intrathecal or epidural space (e.g., for spinal or epidural anesthesia and/or analgesia, diagnostic lumbar puncture, myelography, injection of intrathecal chemotherapeutic agents) should wear a facemask.[8,9] The recommendation stems from investigations into cases of meningitis following lumbar puncture.[11-14] Blood and/or cerebrospinal fluid cultures obtained from the affected patients yielded streptococcal species consistent with the oropharyngeal flora of the proceduralist. Aseptic technique had otherwise been followed, and contamination of the equipment and medications had been excluded.

Hand Hygiene
Timely and effective hand hygiene is has been cited frequently as the single most important practice to reduce the transmission of infectious disease in healthcare settings.[15] "Hand hygiene" refers to either hand washing with plain or antiseptic-containing soap and water or rubbing hands with an alcohol-based product (e.g., a gel, rinse, or foam) that does not require rinsing with water. In the absence of visible soiling, approved alcohol-based hand rubs are recommended. Hand hygiene should be done before and after direct patient contact, before and after wearing gloves, after touching patient care equipment or environmental surfaces, and before and after performing invasive procedures. Gloves do not substitute or eliminate the need for hand hygiene.[15]

Reprocessing Supplies and Equipment
Many of the devices, supplies, and equipment used in anesthesia care are labeled "single-use only." After use for one patient, these items should be discarded and not re-processed for re-use. If the manufacturer's instructions indicate that reprocessing is acceptable, then the requirements for cleaning, disinfection and sterilization are based upon a classification system developed in the mid- to late-1970's -- the Spaulding Scale.[16] Medical devices are categorized based upon the risk of infection associated with their clinical use.[17]

Critical items: These are devices (e.g., syringes, needles, stopcocks, intravenous tubing, percutaneous cardiac interventional catheters, surgical instruments, urethral catheters) that penetrate the skin or are in contact with normally sterile areas (e.g., the bloodstream, tissue planes, neural sheaths, peritoneal or pleural cavity, and urinary bladder). These devices are either disposable or reprocessed by cleaning followed by sterilization techniques. All endospores, viruses, and vegetative bacteria must be destroyed.

Semi-critical items: Semi-critical items contact mucous membranes (e.g., respiratory or alimentary tract) or non-intact skin. These devices (e.g., gastrointestinal endoscopes, esophageal echocardiography and temperature probes, laryngoscope blades, endotracheal tubes, and laryngeal mask airways, nasopharyngeal and oropharyngeal airways) require at least cleaning followed by high-level disinfection. Small numbers of bacterial spores are acceptable.
Non-critical items: Devices that are in contact with unbroken skin on body surfaces (e.g., stethoscopes, blood pressure cuffs, stretcher side-rails, and the surfaces within the immediate patient care area) require intermediate or low-level disinfection.

Thorough cleaning is an important and essential first step in reprocessing equipment.[8,9,17] Cleaning (washing with a detergent or enzymatic agent) removes soil, debris, and lubricants on the external and internal surfaces of equipment. Residual debris may act as a barrier to prevent disinfectants and sterilants from contacting pathogens. Rinsing is also important because residual detergents may inactivate the chemicals used to disinfect or sterilize the items.[8,9,17] Resistance to sterilization or disinfection processes or chemicals does not bear any correlation with antibiotic resistance.

Anesthesia Workspace
Contamination of the anesthesia workspace during patient care has recently been correlated to infectious complications.[18-20] In addition, there has been an effort to supply single-use lubricants

and devices for use in the anesthesia workspace. Disposable laryngoscope handles have recently been introduced.[21]

The external components of the breathing circuit are distal to the one-way valves (e.g., the breathing bag, the corrugated expandable plastic tubing, the Y-piece, associated straight and elbow connectors, gas sampling ports and tubing, and accordion-like tubing extensions). These conduits are in close proximity to the patient and may be contaminated by secretions or exhaled droplets. If reprocessed, these items require high-level disinfection.[17] Because of the difficultly disinfecting these items and the availability of consistent high-quality disposables, reprocessing is uncommon in the U.S.

The internal parts of the anesthesia machine that are exposed to respiratory gases (e.g., the interior of the unidirectional valves, flow sensors, internal conduits, the interior of the ventilator bellows, the water traps, and the carbon dioxide absorbent chamber, the oxygen sensor) do not generally harbor or transmit infectious agents between patients, and the CDC does not recommend its routine sterilization or disinfection.[17] Rather, these components are to be replaced (if disposable), cleaned, sterilized or subjected to high-level disinfection in accordance with the manufacturer's recommendations. Manufacturers have not established time intervals for reprocessing internal anesthesia machine components; rather, a statement is made to reprocess "as necessary." Reprocessing of any particular component is deemed the responsibility of the institution, as consistent with established principles of clinical microbiology and infection control. Many institutions choose to reprocess internal components every 6 months, as to correspond with the preventative maintenance schedule.[17,22]

Cables and leads from pulse oximetry, electrocardiographic, non-invasive, and invasive hemodynamic monitors should be wiped with an intermediate-level disinfectant between cases and at the end of the day. Horizontal surfaces (e.g., the anesthesia machine, the anesthesia cart) and vertical surfaces contacted in the course of anesthesia care (e.g., control knobs, buttons, drawer handles) should also be wiped with an intermediate-level disinfectant between cases and at the end of the day.[17,22]

The CDC makes no recommendation for the routine placement of a bacterial filter within the external breathing circuit of an anesthesia machine to protect the internal components exposed to respiratory gases. When caring for patients with known or suspected tubercular disease or a viral illnesses such as measles, chicken pox, and smallpox, a bacterial filter is recommended.[22] The filter should be capable of trapping at least 95% of particles having a diameter of 0.3 microns (the measurement of the short axis of a tubercle bacterium) or greater. This means that no more than 5% of particles three-tenths of a micron in diameter or larger penetrate through the filter. The filter should be placed in the anesthesia circuit where it will protect both the machine and the ambient air from contamination (at the patient-end of the Y-piece or at the expiratory end of the corrugated breathing tubing before entry of gas through the flow sensor or the expiratory one-way valve.[17,22]

Perioperative Antibiotics

Anesthesia professionals have a role in the timing of perioperative antibiotic administration (if antibiotics are indicated). Current guidelines recommend the administration of prophylactic antibiotics within one hour of incision to maximize tissue concentrations.[23] These timing recommendations have been mandated by the Centers for Medicare and Medicaid Services as

part of the Surgical Care Improvement Project. Hawn and colleagues[24] recently challenged the relationship of this "black and white" timing rule to improved outcomes.

Because some drugs require 60 minutes for infusion and have relatively long serum half lives; vancomycin and fluoroquinolones may be administered up to two hours prior to incision. Perioperative prophylactic antibiotics exert bactericidal action only when therapeutic concentrations are maintained within the tissues. Periodic re-dosing is required to sustain the therapeutic effects of preventative antibiotics. When the duration of an operation is expected to exceed the time in which therapeutic levels of the antibiotic can be maintained, the anesthesia professional must determine a re-dosing time interval based upon the approximate serum half-life of the drug, the tissue levels achieved in normal patients by the initial dosage, and the approximate minimum concentration for bacteriocidal action. The re-dosing interval for cefazolin is estimated to be 3 to 4 hours. Since the serum half-life of cefazolin is 1.8 hours in normal adults, this represents approximately twice the half-life of the drug.[22,23]

Intraoperative Normothermia

A randomized, controlled study of 200 patients undergoing colorectal surgery found that those treated with measures (forced-air convection surface warming and fluid warmers) to maintain core temperature around 36.5°C had a significantly lower SSI rate than those provided normal intraoperative thermal care.[25] Current recommendations are that all perioperative patients undergoing general or neuraxial anesthesia have active warming measures deployed with the objective of maintaining a body temperature equal or greater than 36ºC (96.8° F) at the end of surgery. Currently, this recommendation has been implemented as part of SCIP. The relationship of this mandate to clinical outcomes has also come into question.[26]

Perioperative Blood Glucose Management

A 1997 retrospective study showed that perioperative hyperglycemia (glucose greater than 200 mg/dL) was associated with a greater risk of SSI in patients undergoing cardiovascular surgery.[27] In addition, proactive preoperative glucose control (hemoglobin A1c less than 7%) was associated with fewer infectious complications following major non-cardiac surgery.[28] Recent studies have indicated that perioperative patients subjected to "tight control" (glucose 80-120 mg/dL) suffer outcomes equivalent or worse than those managed with conventional glucose control (glucose less than 180 mg/dL).[29] Maintaining perioperative glucose levels below 180-200 mg/dL may be beneficial, but the evidence does not support aggressive glucose control.

Transmission of Disease from the Patient to the Anesthesia Professional

Anesthesia professionals are at a relatively high risk for needle stick injuries as compared to health care personnel in other medical and nursing disciplines. Unfortunately, healthcare personnel may not report many of these needle stick injuries because they may downplay the risk, do not wish to take the necessary time, or fear stigmatization and professional consequences.[30] This is harmful because timely post-exposure prophylaxis is effective to prevent disease after percutaneous exposure. From a practical standpoint, the transmission of human immunodeficiency virus (HIV), hepatitis B virus (HBV), and hepatitis C virus (HCV) are of greatest importance.[31,32]

The greatest risk of transmission of a blood borne infection with HIV, HBV or HCV is from a blood-contaminated percutaneous injury with a blood-filled hollow bore needle.[9] Efforts to

reduce the risk of sharps injuries to healthcare personnel include safety-engineered devices and modifications of work practices. Many devices designed to reduce the risk of needle stick injury are available; these include but are not limited to needleless devices (e.g., stopcocks, needleless access ports and valves), needle products with needle stick protection safety features (e.g., self-sheathing needles, safety intravenous catheters, and recessed needles), and scalpels with safety activated blade covers.

Re-capping needles with a 2-handed technique (where the needle is directed towards the hand holding the cap) is strongly discouraged as it is one of the most common causes for accidental contaminated needle stick injury among healthcare personnel.[9,30] Puncture-resistant, leak-proof containers for disposal of used needles and syringes, scalpel blades and other sharp items should be located as close as is feasible to the immediate area where sharps are used. Convenient access to these containers will enable the prompt disposal before re-capping or removing the needle from the syringes.

The injury rate for straight suture needles is more than seven times the rate associated with conventional instrument-held curved suture needles.[9] When suturing, anesthesia professionals should use a curved needle with a needle holder rather than a straight needle held by hand, and use forceps rather than fingers to hold tissues when suturing or cutting. Double gloving offers significantly reduced perforations to the innermost gloves, and may decrease the risk of infection by decreasing the inoculum size from some types of needle stick injuries.[9]
After a needle stick injury, the affected area should be rinsed and washed thoroughly with soap and water. Unless the source is known to be negative for HBV, HCV, and HIV, post-exposure prophylactic measures should be initiated. Timeliness is important; if anti-HIV medications are indicated, then, for optimal effectiveness, they should be taken within hours, as delays lead to significant decline in the effectiveness. Following preventative medication, if indicated, the needle stick recipient should then have blood tests drawn to determine his/her baseline serologic status; recipients that have been HBV immunized should have hepatitis B surface antibody titers drawn. Unless already known, the infectious status of the source individual should also be determined.[9,31,32]

Hepatitis B carries the greatest risk of transmission. In non-immunized recipients, appropriate and timely (within 24 hours of exposure) provision of hepatitis B immune globulin and initiation of the hepatitis B vaccination series provides an estimated 75% protection from HBV infection.[9,31,32]

Immunoglobulin therapy for hepatitis C prevention is not effective and is not recommended. In the absence of a currently available post-exposure prophylactic treatment, recommendations for post-exposure management for the recipient are early identification of disease. Theoretically, prompt treatment with anti-viral agents when HCV ribonucleic acid first becomes detectable might prevent the development of chronic infection.[9,31]

On average, the risk of acquiring HIV infection after an accidental percutaneous exposure to blood from a known HIV-infected patient is about 0.3 percent.[32] If the source patient is known or suspected to have HIV infection, the anti-retroviral medications should be administered as soon as possible. The selection of a drug regimen for HIV post-exposure prophylaxis must balance the risk for infection against the potential toxicities of the agent(s) used. Anti-retroviral medications used for this indication frequently have side effects (e.g., nausea, fatigue, rash);

drug interactions are common and may be serious. The risk of preventative pharmacologic treatment may outweigh the benefit. HIV post-exposure prophylactic regimens change periodically; check the CDC website or consult a local expert for the most up to date guidelines.[32,33]

The CDC lists immunizations strongly recommended for health care personnel.[34] Implementation of the US Pharmacopeia Chapter 797 rules in a non-pharmacy environment is a matter of ongoing discussion. The latest information associated with this issue will be discussed. Primarily, we will discuss the time at which medications and fluids prepared in advance should be discarded and the use of pre-filled syringes.

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