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Review Article

The Role of the Anesthesiologist in Infection Control of the Anesthesia Workplace

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Abstract

When thinking of patient infection in the operating room setting, the anesthesiologist is not the first vector that comes to mind. However; several studies have demonstrated a connection between infection and the anesthetic clinician. Many of the infections induced by the clinician are due to cross contamination, inadequate hand hygiene, and infrequent cleaning of the anesthesia machine and equipment. In order to bring attention to the problem of anesthesiologist-mediated infection, we review the current literature as well as contemporary recommendations and interventions to identify preventable infections that can occur from the anesthesiologist and their work place in the operating room. This review is to provide better awareness of this growing problem and provide a better outlet for improved patient care.

INTRODUCTION

Bacterial contamination in the operating room has been linked to notable morbidity and mortality among patients. Recently, contamination in the operating room has been under scrutiny for identification, and prevention for these events. Hospital-acquired infections are becoming frequently resistant to antibiotics [1]. The nature of the anesthesiology involves close monitoring of the patient as a whole, their vital signs, levels of consciousness, and most importantly safety [2]. The need to identify potential bacterial reservoirs and subsequent intervention is an area of significant current interest.

TRANSMISSION

Despite the adequate knowledge of nosocomial infections, hand hygiene, decontamination, and sterilization of equipment, these processes are often overlooked [3]. Contamination is influenced by many factors. One factor is through the act of coughing [4]. This most commonly occurs during extubation when the patient transitions from deep to light anesthesia. Equipment that becomes soiled is frequently placed in contact with the anesthesia machine. Laryngoscope blades are regularly contaminated with blood, which indicates infiltration of mucosal membranes. This frequently exposes the patient as well as clinician to harmful pathogens. In addition, the knurled handles of the laryngoscope have been proven to not be reliably cleaned by hands after being covered in bodily fluids or blood [5].

During the induction process of anesthesia, the clinician's gloved hands are in contact with the mouth and nose of the patient. Contact with secretions and blood is common. During this phase, the anesthesia device, ventilator, monitoring and suction apparatus's are touched. This phase of managing the patient is dynamic, making difficult to change gloves or wash hands readily. The current infection control procedures in anesthesia do not always protect the patient from indirect contact with contaminated equipment. Bailie demonstrated that the ventilator bag, vaporizer dials, and flow control knobs were the most commonly touched during induction. A policy was implemented that entailed cleaning the anesthesia equipment with detergent wipes between every case, for a period of six weeks. Cultures taken before the intervention showed that 14/78 were positive for pathogenic bacteria, while 5/77 were positive after the intervention, demonstrating a notable reduction. This result suggests that proper and frequent cleaning of the machine should become standard [1].

In one study, Loftus identified vectors for infection. Gram negative bacteria were obtained from the patient's oropharynx, the anesthesia provider's hands, and the APL dial of the machine. The top five bacteria obtained during this process were *Aceintobacter*, *Pseudomonas*, *Enterobacter*, *Moraxella*, and *Brevundimonas*. Four percent of the patients in the studied suffered from exposure to these five gram negative organisms. It was proven that these pathogens were linked to increased postoperative-30 day infection rates [6].

Even the time of the day was noted to be an important factor in this transmission. Cultures taken throughout the day also demonstrated to show an increase in organisms at the end of the day, presumably due to cleaning quality measures. With standard cleaning measures taken, pathogenic organisms can still persist. In one study by Maslyk, it was demonstrated that methicillin resistant *Staphylococcus aureus* (MRSA) was shown

to be viable and pathogenic for several days to more than one week. Identification and proper prevention with simple hygiene measures can be provided [2].

Hand hygiene has been noted to be a frequent source of transmission. Inadequate hand-cleansing techniques and missed opportunities for hand hygiene after prior contact with contaminated patients/reservoirs occur frequently. To demonstrate this, Biddle measured compliance among anesthesia providers over a four week period. Nearly 8,000 hand hygiene opportunities in a busy operating room center were observed with hygiene opportunities averaging 34-41/hr and at times peaked up to 54/hr. Failure rate among providers was a reported 82%. It could be assumed that task density attributed to these failure rates [7]. Through video observation, Dr. Rowlands also demonstrated a direct correlation between hygiene compliance rates and the bacterial contamination. As compliance decreased, infections increased and vice versa [8].

PREVENTION

Current guidelines recommend that equipment that will be in contact with and body area that is normally sterile must be sterile at the time of use, and aseptic techniques must be enforced to maintain sterility. Common equipment includes needles, catheters, intravenous tubing, connectors and syringes. Reusable equipment should be thoroughly cleaned and subjected to a proper sterilization prior to reuse. If an item's sterility is in doubt, it should not be used. Aseptic techniques should be followed during handling of sterile equipment. Equipment that does not ordinarily come in contact, or touches intact skin should be cleaned at the end of the day or when visibly contaminated. This would include blood pressure cuffs, pulse oximter probes and cables, stethoscopes, electrocardiogram cables, head straps, fluid warmers, surfaces of the anesthesia machine, exterior of monitoring equipment [9].

Routine cleaning of equipment and other surfaces that are touched frequently does not always remove pathogens from contaminated surfaces. Hydrogen peroxide vapour technology as an airborne disinfectant has been advocated to aid in decontamination [10]. Hardy demonstrated the effectiveness of HPV decontamination in an ICU setting where environmental sites in the room were isolated before and after the use of this technology. Prior to intervention and over a 3 month period, 11.2% of environmental sites were positive for MRSA. With HPV decontamination, no MRSA was isolated from the environment. It was concluded that this technology is effective short term. This application would make it ideal for an operating room setting as patient turnover is much greater compared to an ICU setting [11].

In one prospective study, anesthesia providers were given a hand sanitation device to be worn in addition to mounted dispensers on the machine. Contamination of the anesthesia work area and patient IV tubing dropped dramatically [12].

By providing a barrier to the anesthesia machine, Kannan demonstrated a reduction in bacterial load and subsequent decrease in contamination of the anesthesia work area. These kits provide a clean layout area for equipment, have a non-permeable plastic barrier for contaminated equipment, and provide organizational pouches. They also provide proper

Table 1: Summary of Hand Hygiene Recommendations.

Summary of Current Hand Hygiene Recommendations	
Why practice Hands hygiene?	• Reduces spread of germs to patients • Reduces risk of healthcare provider infection with infection from the patient
How to do hands hygiene?	1. Alcohol based sanitizer is the most effective: • Apply on hands and rub until cover all surfaces and hands feel dry. This should take around 20 seconds 2. Antiseptic soaps and detergents 3. Non-antimicrobial soaps are less effective, recommended for cleaning visibly dirty hands • Wet hands and apply the recommended amount by the manufacturer. Rub hands vigorously for 15 seconds. Rinse hands with cold water to avoid drying of the skin, and use disposable towels to dry your hands and turn off faucet
When to perform hygiene?	• Before eating • Before and after direct contact with patient • After contact with body fluids • After contact with inanimate objects surrounding the patient • When making contact from contaminated to non-contaminated area in the patient • After gloves removal • After using the restroom

Table 2: Summary of recommendations to decrease pathogenic transmission.

Pre/Post-Operative	
Equipment	**Technique**
Anesthesia Machine Surfaces	- Disinfect anesthesia machine surfaces and knobs with antiseptic between cases and at the end of each day - Wipe small surfaces with 70 percent isopropyl alcohol - Follow contamination guidelines of equipment - Mechanical barrier
Anesthesia Machine Carts	- Remove equipment from drawers, clean and disinfect drawers regularly - Place a clean cover on top of the anesthesia cart prior to use - Cover all utensils (Ex. Syringes, blades) - Disinfect surfaces with 70% isopropyl alcohol
Monitoring Equipment	- Ensure proper cleaning of monitoring devices (Ex. Pressure cuffs, pulse ox,etc)
Computer	- Proper covering and cleaning of keyboard - Routine cleaning of mouse
Intraoperative	
Hand Hygiene	- Proper education on adequate technique - Active awareness to change gloves when in contact with contaminate vectors - Available hand sanitizer on machines
Awareness	- Awareness of patient risk factors for contamination (Ex.Contact precautions, MRSA, etc) - Conscious effort to decrease contamination between patient and work station - Anticipation of potential contamination (Ex. Intubation, extubation secretions) - Easily located disposal for contaminated products

separation pouches to prevent mixing of clean and dirty material [13]. Others forms of mechanical barriers are not prevalent at current.

Altogether, the approach to decreasing contamination between the anesthesia workplace and the patient is a multifactorial process. Modest interventions have demonstrated a considerable positive impact. Refer to Table 1 and 2 for a summary of recent guidelines for hand washing and recommendations to decrease pathogenic transmission. By utilizing these interventions altogether, further research is warranted to determine how effective it is in decreasing contamination.

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