REVIEW ARTICLE

Infection Control in Anaesthetic Equipment

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INTRODUCTION:

In order to ensure that the practice of anaesthesia is as safe as possible for patients, anaesthetists and other healthcare workers, it is imperative that infection risks to all parties be minimized.1,2 Anaesthetic equipment is a potential vector for transmission of disease. Insufficient care has been applied in the past in decontaminating and sterilizing items for reuse3; whereas it has been shown that anaesthesia equipment may be exposed to potentially infectious material during ordinary use. 4 Items of anaesthetic equipment may become contaminated either by direct contact with patient's skin, mucous membranes, secretions, blood or by handling by staff. Contamination is not always visible and all used pieces of equipment must be assumed to be contaminated and disposed of, or if reusable, undergo a process of decontamination.5 Improper handling of used equipment or breaks in infection control techniques is also responsible for contamination. Although documented transmission of infection through this source is rare, if proper procedures are not followed, it is possible for contaminated anaesthesia equipment to transmit infection to patients.6

Measures to protect patients against acquiring infections through anaesthesia procedures need to address:

1. Invasive procedures associated with risks:

a. Vascular cannulation
b. Central vascular cannulation
c. Regional anaesthesia

2. Airway management associated with risks or potential risks:

a. Devices to be sited in the upper airway
b. The breathing circuits
c. Sampling lines for side stream gas analysis
d. Carbon dioxide absorbers
e. Ventilator circuits and bellows
f. Flexible laryngoscopes and bronchoscopes

In both situations appropriate levels of sterility, disinfection or decontamination are to be applied to all equipment used.[7]

DECONTAMINATION

Decontamination is a combination of processes including cleaning, disinfection and/or sterilization used to make a reusable item safe to be handled by staff and safe for further use on patients. Effective decontamination of reusable devices is essential in reducing the risk of infection.8

DECONTAMINATION PROCESSES:

Decontamination processes include the following four categories, which are employed for specific purposes;

1. Cleaning:

- It is the removal of foreign material from an item.
- This usually involves washing with a detergent to remove contamination followed by rinsing and drying.
- All organic debris e.g. blood, tissue or body fluids must be removed before disinfection or sterilization, as its presence will inhibit disinfectant or sterilant contacting microbial cells. Cleaning prior to sterilization is of the up most importance in the effectiveness of decontamination procedures in reducing the risk of transmission of certain diseases.

2. Low Level Disinfection:

- It kills most vegetative bacteria (except TB and endospores), some fungi and some viruses. The

agents commonly used for low level disinfection are:

a. Sodium hypochlorite
b. 70% alcohol,
c. Chlorhexidine

3. High Level Disinfection:

- It kills vegetative bacteria (not all endospores), fungi and viruses.
- With sufficient contact time (often several hours) these high level disinfectants may produce sterilization.

a. Glutaraldehyde
b. Peroxyacetic acid

4. Sterilization:

- This process kills all bacteria, fungi and viruses.
- A sterile item should be completely free of all micro-organisms
- Autoclaving gives the desired results.

The choice of equipment and/or the level of cleanliness/ disinfection/ sterility required of reusable items may be assessed against the degree of risk posed to patients of transmission of infection during any procedure in which the equipment is employed.[9]

Based upon the risk factor, the devices /equipment can be classified in three degrees; in a descending order these are;

(1) High Risk - device that will penetrate skin or mucous membranes; enter the vascular system or a sterile body space.
   - o Requires sterilization

(2) Intermediate Risk - device that will be in contact with intact mucous membranes or may become contaminated with readily transmissible organisms.
   - o Requires sterilization or high level disinfection

(3) Low Risk - device contacts intact skin or does not contact patient directly
   - o Requires low level disinfection/cleaning

Classification Of Anaesthetic Equipment According To The Level Of Disinfection:

Anaesthetic equipment can be classified into four classes according to the requirement of disinfection;

A. Equipment requiring sterility
B. Equipment requiring high-level disinfection
C. Equipment requiring cleaning
D. Single-use equipment

A. Equipment requiring sterility:

Equipment that will enter or contact any body area that is normally sterile must be sterile at the time of use, and aseptic techniques must be employed to maintain sterility.

The examples are:

a. Vascular needles and catheters
b. Regional block needles and catheters
c. Syringes
d. Urinary catheters

It is mandatory that sterility is assured at the time of use of theseitems. If an item's sterility is in doubt, it s hould not be used.10 It is also important that to avoid introduction of pathogens into sterile areas, aseptic techniques must be followed while handling and using sterile equipment.[11]

B. Equipment Requiring High-level Disinfection

Equipment that will contact mucous membranes but would not ordinarily penetrate body surfaces should be free from contamination but need not be sterile. High-level disinfection will suffice for these items.

Some examples of this equipment include:

a. Laryngoscope blades
b. Oral and nasal airways
c. Face masks
d. LMAs
e. Breathing circuits and connectors
f. Self-inflating resuscitation bags
g. Esophageal stethoscopes
h. Esophageal/nasopharyngeal/rectal temperature probes
   - o Condensate that collects in the tubing of breathing circuits should periodically be drained away and discarded.[12]
   - o Endotracheal and endobronchial tubes

should be kept free from contamination until the time of use.

- Stylets and suction catheters for use with these tubes should also be free from contamination.
- Reusable items should be rinsed to remove blood and secretions as soon as possible after use. Reusable items must be decontaminated prior to reuse by thorough cleaning, followed by either a sterilization process or high-level disinfection.[13]

C. Equipment requiring cleaning:

Equipment that does not ordinarily touch the patient or that touches only intact skin should be cleaned with a disinfectant at the end of the day and whenever visibly contaminated.

This equipment includes:

a. Noninvasive blood pressure cuffs and tubing
b. Pulse-oximeter probes and cables
c. Electrocardiographic cables
d. Skin temperature sensors
e. Blood warmers
f. The exterior of the anesthesia machine
g. The exterior of monitoring equipment
h. Equipment carts
i. Operating room shoes
   - Horizontal surfaces (e.g., anesthesia machines and equipment carts) are more prone to contamination during use and should be cleaned after each procedure.
   - All surfaces of monitors should be cleaned on daily basis or when visibly contaminated.
   - Operating table should be cleaned after each operation.
   - Frequently used knobs of anaesthesia machines (e.g., pop-off valves, flow controls and vaporizers etc.) also should be cleaned regularly.

D. Single-use equipment:

Where appropriate, single use disposable equipment overcomes the difficulties encountered with reuse and decontamination procedures.

Following items are recommended for single use only:

a. Face masks and caps
b. Suction catheters
c. Oxygen masks and tubings
d. Temperature probes
e. Airways and tracheal tubes
f. Most of the anaesthesia equipment requiring sterilization is 'single-use' equipment.
   - Reuse of most disposable equipment will require sterilization or disinfection of the items.
   - The chemical disinfection or sterilization processes may damage or weaken the integrity of the single-use (disposable) item making it unsafe for reuse.
   - The main drawbacks of single-use equipment are cost, storage and safe disposal.

INDIVIDUAL ITEMS:

1. Laryngoscopes:

- Laryngoscopes are known to become contaminated during use and can become a source of cross-infection. Blades are often contaminated with blood indicating penetration of mucus membranes which places these items into a high risk category.[14]
- Proper cleaning of laryngoscope blades is of great importance prior to decontamination/sterilization particularly of residue around light sources or articulated sections.[15]
- Laryngoscope handles also become contaminated with micro-organisms and blood during use and they should be regularly washed/disinfected and, if suitable, periodically sterilized.

Great care should be shown when handling laryngoscopes, gloves should be worn during intubation and after use laryngoscopes should be placed in a designated receptacle to prevent contamination of pillows and drapes.[16]

2. Tracheal tubes, LMA and airways:

- These may be viewed as intermediate risk items. There is evidence that these are often contaminated with transmissible organisms. They are also frequently contaminated with blood indicating that mucous membranes are often breached during insertion.[17]

- It is recommended that oral, nasopharyngeal and tracheal tubes should be provided on a single patient use basis.
- Reusable laryngeal mask airways to be resterilised for a maximum of 40 uses.[18]

3. Internal components of the anaesthesia machine:

- Routine sterilization/disinfection of the internal components of the anaesthesia machine (e.g., gas outlets, gas valves, pressure regulators, flow meters and vaporizers) is not necessary or reasonably feasible.
- Unidirectional valves and carbon dioxide absorber chambers should be cleaned and disinfected periodically.
- Routine bacterial culture monitoring of the internal components of the anesthesia machine is not recommended.

4. Sampling lines for side stream gas analysis:

- These need not ordinarily be sterilized before reuse because of the one way flow of gas through them.
- Sampled gas from a capnograph or other such measurement device should not be returned to the anaesthetic circuit unless it is first passed through a bacterial/ viral filter.

5. Carbon dioxide absorbers:

- When a filter is used in the circuit sterilization of the carbon dioxide absorber prior to every case is not necessary nor with most models is it practicable although disposable versions and models capable of being sterilized are available.

6. Anesthesia ventilator tubing and bellows:

- These should be cleaned and disinfected at regular intervals.
- Anesthesia ventilators are thought to represent a low risk for infection transmission and need not undergo cleaning and disinfection following each use.

7. Lensed equipment:

- Lensed equipment including flexible fiberoptic endoscopes requires special processing to avoid damaging the instrument during cleaning and disinfection/sterilization. Since suction and other working channels of flexible endoscopes may become contaminated with organic material during use, it is important that the lumens be rinsed as soon as possible after use and thoroughly cleaned of organic debris before disinfection/sterilization.[19]
- Endoscopes that contact only mucous membranes should receive at least high-level disinfection, while those that enter sterile body spaces should undergo sterilization.[20]

8. Miscellaneous items:

- There is some controversy regarding safe reuse of anaesthetic breathing circuits.
- Use of new breathing circuit for every new case can be very costly.
- If visibly contaminated or used for highly infectious cases (e.g. tuberculosis) the circuits should be safely discarded.
- No attempt should be made to actively reprocess these items.
- Bacterial filters should be placed between the patient and the breathing system (a new filter for each patient).[21]
- Reports that hepatitis C (HCV) may be transmitted via anaesthetic breathing circuits and the emergence of resistant tuberculosis justifies using a new bacterial/viral filter between each patient and the breathing system.[12]
- There is evidence that pleated hydrophobic filters have a better filtration performance than most electrostatic filters.[22]

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