Infection control in anaesthesia in regional, tertiary and central hospitals in KwaZulu-Natal. Part 2: Equipment contamination

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Abstract

Objectives: Contaminated anaesthetic equipment has been implicated in the nosocomial transmission of infection. The aim of this study was to determine the prevalence of blood (occult or visible) and/or visible organic material contamination of anaesthetic equipment deemed to be ready for use in theatres in regional, tertiary and central hospitals in KwaZulu-Natal.

Design: All hospitals that were classified as regional, tertiary and central hospitals on the KwaZulu-Natal Department of Health website were visited (n = 15). Laryngoscope blades and handles, Magill's forceps, nasopharyngeal temperature probes and suction bowls were inspected for visible blood and/or organic matter. Those items that were not visibly contaminated were further tested for occult blood using the blood detector in urinalysis reagent strips.

Setting and subjects: All hospitals that were classified as regional, tertiary and central hospitals on the KwaZulu-Natal Department of Health website were visited (n = 15).

Results: The percentages of contamination with blood (occult or visible) and/or visible organic material of all examined laryngoscope blades, laryngoscope handles, Magill's forceps, nasopharyngeal temperature probes, and suction bowls, were 80% (45.5-100%), 74% (42.8-100%), 50% (0-100%), 80% (0-100%) and 90% (0-100%), respectively.

Conclusion: The contamination of ready-for-use anaesthesia equipment was extremely high. In light of the high prevalence of many infectious diseases in KwaZulu-Natal, and in particular human immunodeficiency virus, hepatitis B and tuberculosis, urgent tackling of the issue of reuse of contaminated equipment is critical.

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Introduction

Contaminated anaesthetic equipment has been implicated in nosocomial transmission of infection. In 2011, a coroner's report found that "a failure to decontaminate a laryngoscope handle appropriately between each patient use" culminated in a patient's death from septicaemia.[1] The laryngoscope has also been implicated in the nosocomial spread of methicillin-resistant *Staphylococcus aureus*.[2] Foweraker has reported on four patients with *Pseudomonas aeruginosa* infections, one of whom died of septicaemia. The source of the infection was attributed to the laryngoscope blade and to a breakdown in the decontamination procedure.[3] Furthermore, cases of neonatal listeriosis have been linked to a dirty laryngoscope, suction catheter and Ambu® bag, while an outbreak of *Serratia marcescens* in a neonatal intensive care unit prompted a review of the decontamination of laryngoscopes.[4,5]

Laryngoscope blades and handles, Magill's forceps, nasopharyngeal temperature probes and suction bowls are commonly used anaesthetic instruments. Suction bowls are water-filled containers that are used for clearing anaesthetic suction catheters or Yankauers®. In light of the high prevalence of infectious diseases in KwaZulu-Natal, this study was undertaken to determine the prevalence of blood (occult or visible) and/or visible organic material contamination of ready-for-use anaesthetic items in theatre complexes in regional, tertiary and central hospitals in KwaZulu-Natal.

Materials and Methods

Approval was obtained from the Biomedical Research Ethics Administration and the Postgraduate Education Committee of the University of KwaZulu-Natal, the KwaZulu-Natal Department of Health, and the respective hospital managers. This observational study was conducted at all hospitals that were classified as regional, tertiary and central hospitals on the KwaZulu-Natal Department of Health website (15 in total).[6] This included one central, two tertiary and 12 regional level hospitals. No advance notice of the visits was given to any operating theatre personnel in order to prevent any changes being made to routine practice.

Only cleaned equipment that was deemed to be ready for use was analysed. Laryngoscope blades and handles, Magill's forceps, nasopharyngeal temperature probes and suction bowls were inspected for visible blood and/or organic matter. If the equipment was not visibly contaminated with blood or organic material, it was further tested for occult blood using a urinalysis strip. Sterile saline drops were applied to the surface of the equipment, and the blood reagent area of a Mission™ Urinalysis Reagent Strip (urine dipstick) was subsequently applied to the wet surface of the piece of equipment. Alternatively, if the surface was not suitable for the direct placement of the urine dipstick (narrow, angled or corrugated), the instrument was swabbed with a cotton earbud moistened with sterile saline, which was then applied to the blood reagent area of the urine dipstick. This test was based on the peroxidase-like activity of haemoglobin. The development of green spots or a colour change to green on the reagent area within 60 seconds was considered to be significant.[7]

To avoid duplication, when an item had both visible blood and/or organic material contamination, it was included in the visible blood category. All identified equipment for the purposes of the study (that which was ready for use) was examined in order to reduce selection bias.

Results

The results are shown in Tables I-V. Each table shows the number of the respective examined items at each hospital and the total number of respective examined items in the province, together with the contaminated number and the percentage of contamination (blood or visible organic material). The hospitals were allocated letters to ensure anonymity.

Discussion

The levels of blood and visible organic material contamination of these ready-for-use items were unacceptably high, implying inadequate decontamination.

Laryngoscope blades, Magill's forceps and nasopharyngeal temperature probes have traditionally been classified

Table I: Laryngoscope blade contamination

Hospital	No of blades examined	No of visibly contaminated blades		No of blades not visibly contaminated, but positive for occult blood	Total no of contaminated blades	% contamination (blood and/or visible organic material) of all blades
		Blood ± organic material	Organic material only			
A	11	0	1	5	6	54.5
B	5	0	0	4	4	80
C	8	2	0	3	5	62.5
D	10	0	7	2	9	90
E	7	0	7	Not tested	7	100
F	18	1	9	2	12	66.7
G	19	1	15	2	18	94.7
H	9	1	7	1	9	100
I	10	0	8	1	9	90
J	19	1	12	5	18	94.7
K	11	1	0	4	5	45.5
L	5	0	1	4	5	100
M	4	0	1	2	3	75
N	6	0	2	3	5	83
O	5	0	nil	3	3	60
Total	**147**	**7**	**70**	**41**	**118**	**80**

Table II: Laryngoscope handle contamination

Hospital	No. of handles examined	No of visibly contaminated handles		No of handles not visibly contaminated, but positive for occult blood	Total no of contaminated handles	% contamination (blood and/or visible organic material) of all handles
		Blood ± organic material	Organic material only			
A	7	1	0	4	5	71.4
B	4	1	0	2	3	75
C	4	2	0	1	3	75
D	5	1	0	3	4	80
E	4	0	0	4	4	100
F	6	1	1	3	5	83.3
G	6	1	0	3	4	66.7
H	7	0	0	3	3	42.8
I	6	0	1	4	5	83.3
J	12	1	0	7	8	66.7
K	6	1	0	3	4	66.7
L	3	0	0	2	2	66.7
M	3	1	0	2	3	100
N	3	0	0	3	3	100
O	4	0	0	3	3	75
Total	**80**	**10**	**2**	**47**	**59**	**74**

Table III: Magill's forceps contamination

Hospital	No of Magill's examined	No of visibly contaminated Magill's		No of Magill's not visibly contaminated, but positive for occult blood	Total no of contaminated Magill's forceps	% contamination (blood and/or visible organic material) of all Magill's forceps
		Blood ± organic material	Organic material only			
A	6	0	0	6	6	100
B	2	0	0	0	0	0
C	2	0	0	0	0	0
D	4	0	0	1	1	25
E	2	0	0	0	0	0
F	6	0	1	0	1	16.7
G	3	1	0	0	1	33.3
H	3	0	0	0	0	0
I	4	0	1	0	1	25
J	4	0	3	1	4	100
K	4	1	0	0	1	25
L	6	0	1	4	5	83.3
M	3	2	0	0	2	66.7
N	1	0	0	1	1	100
O	4	0	1	3	4	100
Total	**54**	**4**	**7**	**16**	**27**	**50**

Table IV: Nasopharyngeal temperature probe contamination

Hospital	No of NPTPs examined	No of visibly contaminated NPTPs		No of NPTPs not visibly contaminated, but positive for occult blood	Total no of contaminated NPTPs	% contamination (blood and/or visible organic material) of all NPTPs
		Blood ± organic material	Organic material only			
A	2	0	2	0	2	100
B	*				-	-
C	**				-	-
D	3	0	0	3	3	100
E	2	0	0	2	2	100
F	2	0	0	0	0	0
G	2	0	0	1	1	50
H	**				-	-
I	2	1	0	1	2	100
J	7	0	0	6	6	85.7
K	2	0	0	1	1	50
L	**				-	
M	2	0	0	2	2	100
N	*				-	
O	1	0	0	1	1	100
Total	**25**	**1**	**2**	**17**	**20**	**80**

NPTPs: nasopharyngeal temperature probes, * Item in use, or not cleaned, ** Item not used at this hospital

Table V: Suction bowl contamination

Hospital	No. of suction bowls examined	No of visibly contaminated suction bowls		No of suction bowls not visibly contaminated, but positive for occult blood	Total no of contaminated suction bowls	% contamination (blood and/or visible organic material) of all suction bowls
		Blood ± organic material	Organic material only			
A	3	0	2	1	3	100
B	1	0	0	0	0	0
C	3	1	2	Not tested	3	100
D	6	3	2	1	6	100
E	**				-	
F	**				-	
G	3	0	3	0	3	100
H	*				-	
I	*				-	
J	1	0	0	0	0	0
K	3	0	1	2	3	100
L	4	0	4	Not tested	4	100
M	4	0	1	2	3	75
N	2	0	0	2	2	100
O	1	0	0	1	1	100
Total	**31**	**4**	**15**	**9**	**28**	**90**

* Item in use or not cleaned
** Item not used at this hospital

as "semi-critical" items, as it has been argued that they make contact with, but do not generally penetrate or breach, mucous membranes.[8,9] Bleeding in the mouth following routine laryngoscopy is well described.[10] Furthermore, the high levels of blood contamination found in this study after "cleaning" laryngoscope blades, Magill's forceps and nasopharyngeal temperature probes implies penetration of, and not merely contact with, mucosal tissue. Furthermore, use during dental, maxillofacial and otorhinolaryngology surgery also results in significant blood contamination. Therefore, it is suggested that these items should be considered to be "critical items", rather than "semi-critical" ones, especially in countries with high endemic levels of human immunodeficiency virus (HIV) and hepatitis B infection. Critical instruments are defined as items that penetrate sterile tissue, enter the vasculature, or have contact with bone or blood.[9] If such instruments are contaminated and reused, they pose a high risk of transmission of infection. Therefore, they are either single-use items or decontaminated by sterilisation after each use. Semi-critical instruments contact mucous membranes or nonintact skin and require at least high-level disinfection or sterilisation for decontamination. This concern is reiterated by the Association of Anaesthetists of Great Britain and Ireland in their 2008 guideline, where reusable blades were reclassified as "high-risk or critical items" requiring sterilisation after each use.[11]

The laryngoscope handle and suction bowl do not come into direct contact with the patient's oral mucosa. However, the laryngoscope handle may become contaminated by the tip of the blade, which often touches the handle when the blade is folded in the "off" position (Figure 1). Therefore, this contact point poses as a potential route for patient-to-patient transmission of blood and organisms from the oropharynx.[12-16] The handle can also be contaminated by the clinician's gloves, direct contact with surfaces or other anaesthetic equipment, as well as indirect contact from splashes or air-borne pathogens. Microorganisms can then be transmitted to subsequent patients when the clean blade touches the handle, or when the anaesthesia provider's gloves touch a contaminated handle. The suction bowl and water become contaminated with oral secretions, blood or vomitus each time the anaesthetist dips the suction catheter into the water. The presence of blood and organic material contamination on ready-for-use laryngoscope handles and suction bowls is a potential risk to patients.

The presence of blood contamination from prior patients may facilitate the nosocomial transmission of hepatitis B virus, HIV or other blood-borne pathogens, the risk of which is difficult to ascertain owing to the paucity of documented cases and ethical constraints in performing such studies. However, percutaneous injury and mucosal membrane contact with blood, tissue or other body fluids that are

Figure 1: Contact point between the laryngoscope blade and the handle

potentially infectious, are defined as exposure that places patients at risk of acquiring HIV infection. In retrospective case-control studies, increased risk of HIV infection was associated with exposure to a large quantity of blood from the source, a device visibly contaminated with the patient's blood, and a deep injury.[17] Other factors include the source patient having acquired immune deficiency syndrome (AIDS), reflecting higher viral loads and injury with a hollow-bore needle. HIV transmission studies, including post-exposure prophylaxis studies, have linked large quantities of blood from the source patient, vast surface area contact, trauma and breach of the mucosa, high viral loads and AIDS with a higher risk of transmission. Furthermore, hepatitis B is approximately 100 times more transmissible than HIV.[17] Our findings, when taken into consideration with the prevalence of these diseases in our setting and evidence from transmission studies, suggest that the potential transmission of these viruses from contaminated anaesthetic equipment are of significant concern.

To our knowledge, no prior work has highlighted the Magill's forceps, nasopharyngeal temperature probe or suction bowl as potential vectors for disease transmission. Our study is limited by a lack of bacteriological studies. Therefore, any negative result did not exclude significant, non-visible and non-blood contamination of anaesthetic equipment. Furthermore, some of the tested equipment may not have been used recently, leading to a lower detected contamination. This may account for the lower detected contamination of Magill's forceps, compared with that of the other items. Magill's forceps are not used as frequently as the other items, and may not be used at all during a typical day in theatre. A further limitation was use of the blood reagent area of the urinalysis strip in detecting occult blood on the equipment. The reagent area is designed as a screening test for occult blood in urine and has a sensitivity of 91-100% and a specificity of 65-99%.[18] Therefore, when these limitations are taken into consideration, it is possible that this study may have in fact underestimated contamination of these items.

Conclusion

Contamination of ready-for-use laryngoscopes, Magill's forceps, nasopharyngeal temperature probes and suction bowls with blood and visible organic material is extremely high. In the light of the high prevalence of many infectious diseases, in particular, HIV, hepatitis B and tuberculosis, in KwaZulu-Natal, urgent address of these issues is critical.

Conflict of interest

There was no conflict of interest.

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