



Contamination of laryngoscope handles[☆]

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Summary Despite use of sterile or disposable laryngoscope blades for each patient, disinfection of laryngoscope handles does not routinely occur, and these devices present a potential route of transmission of pathogens between patients and staff. A total of 192 specimens from 64 laryngoscope handles deemed 'ready for patient use' in the anaesthetic rooms of 32 operating theatres were semiquantitatively assessed for bacterial contamination. A further 116 specimens from 58 of the handles were tested for occult blood contamination. One or more species of bacteria were isolated from 55 (86%) of the handles, and included organisms such as enterococci, meticillin-susceptible *Staphylococcus aureus*, Klebsiella and acinetobacter. Cultures did not yield any anaerobes, fungi, meticillin-resistant *Staphylococcus aureus*, vancomycin-resistant enterococci or multiply-resistant Gram-negative bacilli. No occult blood contamination was demonstrated. Although the majority of organisms isolated were not pathogenic, their presence indicates the potential for transmission of pathogens from laryngoscope handles. Strategies to address contamination of handles include revision of procedures for disinfection and storage prior to use, introduction of disposable handles or sheaths, and re-design of handles to eliminate knurled surfaces and contact points.

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Introduction

Unlike laryngoscope blades, laryngoscope handles do not come into direct contact with the patients' oropharynx during use and there are no clear local

or national guidelines for decontamination of laryngoscope handles. In our hospital, these items are generally sprayed with chlorhexidine spray or wiped down with detergent or alcohol wipes and allowed to dry after each use; or in the case of severe contamination, they are autoclaved. Several decontamination techniques which are currently widely used have been shown to be inadequate.^{1,2}

Previous studies have demonstrated widespread contamination of laryngoscope handles with pathogenic and non-pathogenic bacteria, blood, and both.^{2–6} The presence of these contaminants demonstrates the clear potential for transmission of pathogens, and presents a risk to both patients and staff.^{3,7} Of particular concern is the potential for transfer of meticillin-resistant *Staphylococcus aureus* (MRSA), and the prions implicated in Creutzfeld–Jakob disease; whereas contamination with blood suggests potential for transmission of bloodborne pathogens such as hepatitis B virus and human immunodeficiency virus.^{6,8}

Each anaesthetic room in our hospital's operating department contains at least two laryngoscope handles which are designated 'ready for use', and these are stored in trays on shelves or on the anaesthetic machines. They are not packaged, and may therefore become contaminated by direct contact with surfaces, other anaesthetic equipment and the hands of the anaesthetist, as well as by indirect contact from splashes or airborne pathogens.^{1,3} Laryngoscope handles are traditionally knurled to provide a surface with a good grip; however, the fissures in this surface may harbour pathogens.⁷

When the blade is extended for use, an electrical contact is made by a mechanism in the top of the handle and the light source is switched on. Before and after use, the blade is folded along the length of the handle to switch the light source off (Figure 1, inset). In most designs of laryngoscope, the tip of the blade contacts an area on the lower third of the handle ('contact point') when in the 'off' position. This contact point therefore presents a potential route for patient-to-patient transmission of blood and organisms from the oropharynx.^{1,3,7}

The objective of this study was to identify the extent and nature of contamination on the handles of laryngoscopes that were considered to be clean and ready for use in the anaesthetic rooms within the operating department of our hospital. Secondary objectives were to investigate whether the extent and nature of contaminants were associated with different regions of the laryngoscope handle, or with the type of surgery (e.g. gastrointestinal, orthopaedic, obstetric) performed in the adjoining operating theatre.

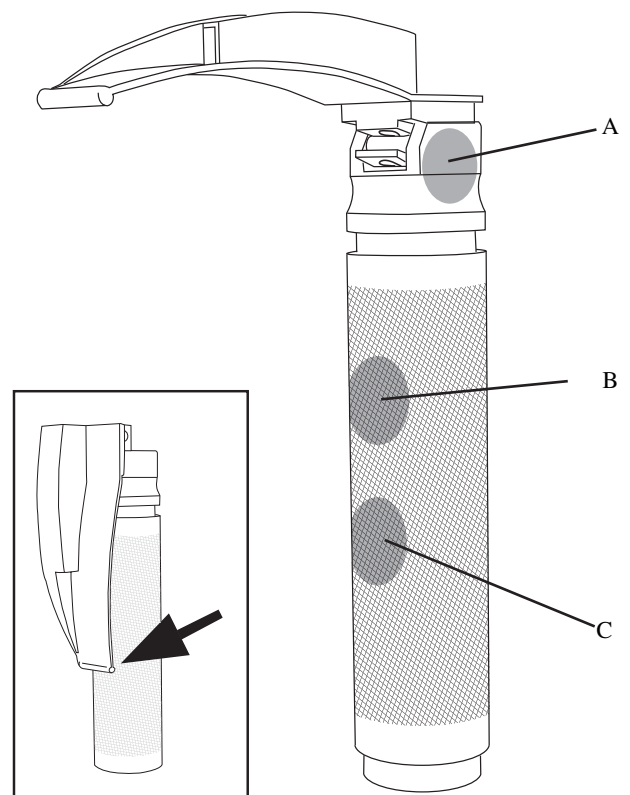


Figure 1 Three sampling sites (A–C) on each of 64 'ready for use' laryngoscope handles. Inset: how the tip of laryngoscope blade contacts handle at site C when in closed position between uses.

Methods

Research approval was obtained from the Trust's Research Committee. As this was an observational study involving medical equipment and no randomisation, clinical intervention, patient identifiable data or consent, a letter of exemption was provided by the hospital's Research Ethics Committee.

Sample collection was carried out in the middle of the operating day (14:00–16:00) on two consecutive days (17 and 18 November 2008) from all theatres in the Trust that were in use. No advance notice was given to operating theatre personnel in order to prevent any changes to routine practice. All laryngoscope handles on one site were studied on the first day of data collection; and all those on the other site on the second day.

Samples were taken from all laryngoscope handles that were designated as 'ready for use' in each anaesthetic room. Laryngoscope handles that were in use or had just been used on a patient were excluded. The investigators who collected the samples (D.W., J.D.) donned a pair of fresh

sterile gloves when taking each sample and adopted a minimal/‘no touch’ technique.

Sterile paper templates with a circular hole of 2 cm diameter were used to define a consistent area of 3.14 cm² from which sampling occurred. A fresh template was used for each sample and was immediately disposed of after use.

Samples were taken from three sites on each handle (Figure 1): (A) the smooth metal surface at the side of the hook mount; (B) the knurled metal surface in the upper third of the handle; (C) the knurled metal surface in the lower third of the handle, at the contact point.

A calcium alginate-tipped swab was moistened with an ampoule of sterile saline, and the area within the template on site A was swabbed. The swab was immersed in a bijoux bottle containing 3 mL of brain–heart infusion (BHI) broth, and snapped at the mouth of the bottle so that the swab could be retained in the bottle when its lid was replaced. This sequence was then repeated at sites B and C respectively.

Sites B and C were then swabbed for a second time to test for occult blood contamination. Again alginate swabs were moistened with sterile saline and used to swab the area within each template. However, rather than being immersed in BHI broth, the swabs were this time placed back into their own individual sterile containers. Due to resource limitations, only 116 samples (from sites B and C of the first 58 handles) were assayed for occult blood contamination.

A unique sequential alphanumeric code was assigned to each sample and correlated with the data collection pro-forma which recorded the date and time of sample collection, site on the laryngoscope handle from which the swabs were taken, anaesthetic room number, type of surgery performed in the adjacent operating theatre on the day of collection, and site within the Trust (i.e. one of two hospital sites).

The investigators who performed the laboratory analysis (N.B., C.J.) did not participate in sample collection and were blinded to the alphanumeric coding system used to identify the samples until the assay had been completed.

On reaching the laboratory, the BHI broths were shaken vigorously in order to remove as much microbial material as possible from the swab. A sterile 1 mL Pasteur pipette was used to remove about 0.25 mL from the first broth; and by depositing a single free-falling drop on to each, one chocolate (CHOC) agar plate and one fastidious anaerobic agar with 5% horse blood (FHB) plate were inoculated. A 5 µg metronidazole disc was placed in the pool of inoculum on the FHB plate,

and the whole process was repeated for each of the broth samples.

In addition to the 192 sample broths, three control BHI broths were also cultured on both CHOC and FHB agar. *Haemophilus influenzae* NCTC 11931 and *Clostridium sporogenes* NCTC 532 acted as aerobic and anaerobic positive controls respectively. A third broth which had been inoculated with an unused sterile calcium alginate-tipped swab acted as a negative control for the study.

Both the BHI broths and CHOC agar plates were incubated in an atmosphere of 5% CO₂ at 37 °C for a period of 48 h. The FHB plates were incubated anaerobically at 37 °C for the same period of time. Following incubation the CHOC and FHB plates were examined for microbial growth, and the extent of any growth recorded semiquantitatively as being scanty, light, medium or heavy. Scanty growth was defined as being <5 colonies of a given organism per plate, light defined as being 5–10, medium 11–20, and heavy as being >20 colonies. All organisms that were isolated were then identified by routine laboratory methods and further using a Microflex™ LT MALDI-TOF mass spectrometer (Brüker Daltoniks, Bremen, Germany).

All samples underwent enrichment for 48 h in BHI broth, and were then re-cultured on CHOC and FHB agar plates. These plates were subsequently examined and any additional microbial growth was identified and recorded as above.

The alginate swabs used to sample sites B and C for occult blood were removed from their sterile containers and rubbed into the areas designated I and II on a Hema-Screen™ slide. The presence of occult blood at a concentration of >0.6 mg/g was indicated by the appearance of a blue colouration on the test paper, while a lack of blue colouration indicated a negative result; both a positive and negative control were incorporated into the slide.

All results were presented using descriptive statistics.

Results

All of the laryngoscope handles tested were of the Heine or Penlon ‘Premiere’ designs. Both designs had knurled surfaces, and the blade tips contacted the lower third of the handles when in the folded ‘off’ position.

One or more species of bacteria were isolated from 55 (86%) of the handles: 9 (14%) showed no growth, 19 (30%) one species, 18 (28%) two species, 11 (17%) three species, 5 (8%) four

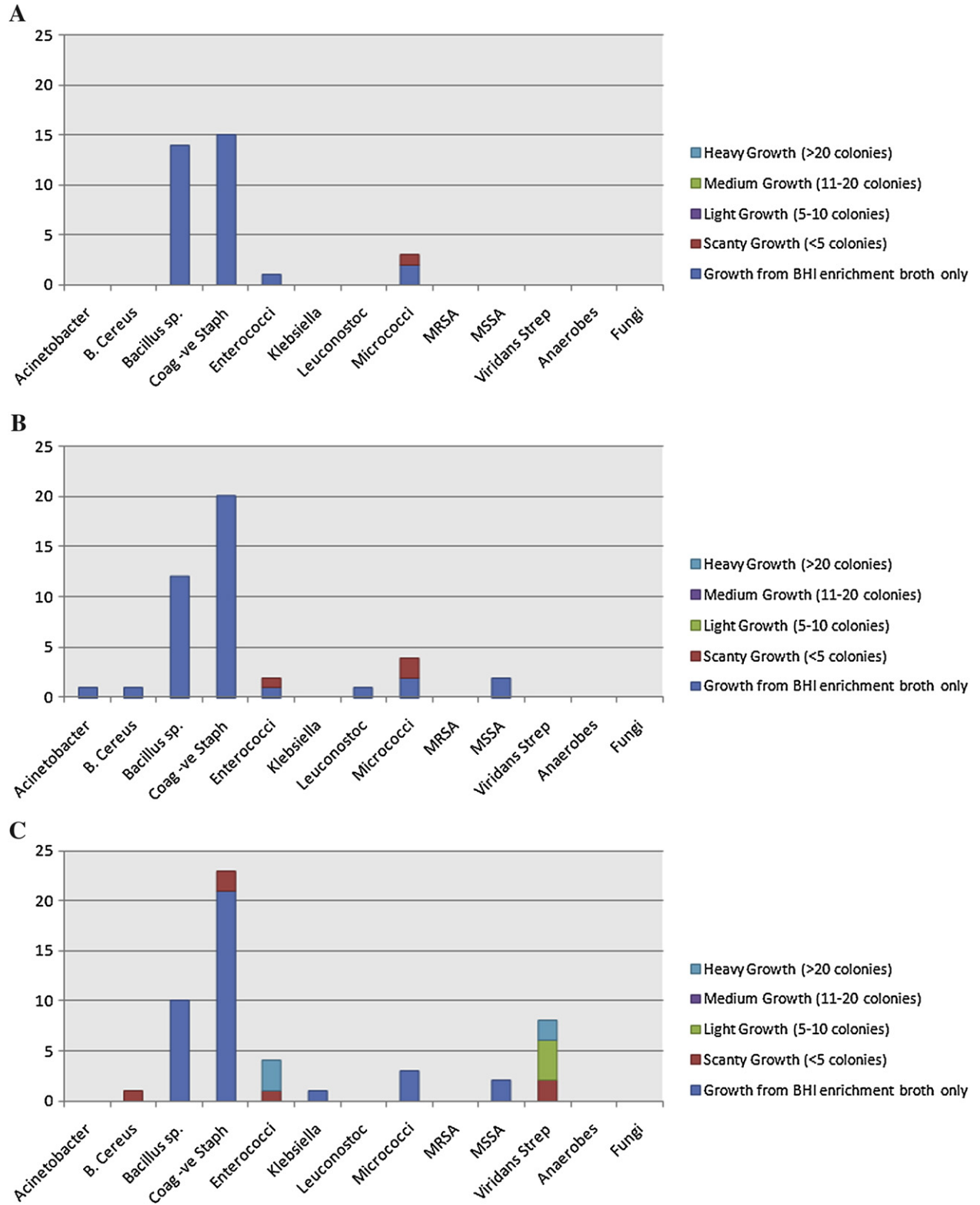


Figure 2 Nature and extent of contamination at the three sampling sites A–C (see Figure 1) on each of 64 ‘ready for use’ laryngoscope handles. MRSA, methicillin-resistant *Staphylococcus aureus*; MSSA, methicillin-susceptible *Staphylococcus aureus*; BHI, brain–heart infusion.

species, and 2 (3%) five species. Isolates included potential pathogens such as enterococci, methicillin-susceptible *Staphylococcus aureus* (MSSA), klebsiella and acinetobacter. The cultures did not yield any anaerobes, fungi, MRSA, vancomycin-resistant enterococci or multi-resistant Gram-negative bacilli, and no occult blood contamination was demonstrated at a concentration of >0.6 mg/g.

In all, 192 samples yielded 99 positive cultures, many of which were polymicrobial. A total of 128 different organisms were isolated, comprising 35 different species of bacteria, of which site A: 33 (25%); site B: 43 (34%); site C: 52 (41%) (Figure 2). Site C was the only site to demonstrate heavy contamination, and the only site from which *Streptococcus viridans* was isolated.

There was no association between the extent or type of organisms grown from the handles and the anaesthetic room number, type of surgery performed in the adjacent operating theatre, or hospital site.

Discussion

Contamination with aerobic bacteria was demonstrated on the majority of handles studied. Fortunately only a small number of the bacterial colonies demonstrated were pathogenic; however, we suggest that if non-pathogenic organisms can be transmitted via this route, there is potential for more obvious pathogens such as MRSA to be transmitted in the same manner.⁴ Our cultures grew isolates such as MSSA and other organisms, which have been implicated in hospital-acquired infection and could cause illness in immunocompromised patients.

An effective high level disinfection procedure should be developed and adopted nationally. Choice of strategies to prevent cross-infection will be influenced by cost-benefit analysis, but include the use of newly sterilised laryngoscope handles for each case, high level disinfection of handles between each case, disposable 'single use' laryngoscope handles and laryngoscopes and disposable sheaths to cover laryngoscope handles.^{1,3,9} Design of laryngoscope handles to incorporate bacterostatic agents (e.g. silver ions) may also reduce infection risk.

Nine (14%) of handles were contaminated with *Bacillus cereus* and a further two (3%) of handles were contaminated with micrococci. Since these organisms are spread via the airborne route, we suggest that laryngoscope handles should be kept in sealed packaging prior to use, and not left

exposed to the environment on working surfaces or shelves as at present. Spore-forming airborne bacteria (e.g. clostridia and bacillus) may be resistant to decontamination with alcohol. Our hospital's policy of using alcohol wipes to decontaminate laryngoscope handles could select for these organisms, and may contribute to our finding that 38 of the 128 (30%) organisms isolated were *B. cereus* or other *Bacillus* spp.

The most common organism found at all three sample sites was coagulase-negative staphylococcus. This was most probably from the hands of the staff, and emphasises the need for staff to wear gloves and adhere to hand hygiene protocols in clinical areas.

A greater range of species and heavier growth were found on the knurled (B, C) compared with smooth (A) regions of the handle, suggesting that knurled surfaces may harbour more bacteria than smooth surfaces. This may reflect increased handling at this point, or may demonstrate that the knurled grooves are difficult to clean and therefore form a potential reservoir for pathogens. Laryngoscope handles should be re-designed so that a good grip may be achieved without the need for a fissured surface. This could be achieved through a combination of ergonomic handle design and a polymer coating which is macroscopically smooth but offers a high coefficient of friction.

A greater range of species and heavier growth were found on the knurled surface at the contact point (C), where the tip of the laryngoscope blade made contact with the handle between uses, compared with smooth (A) and knurled (B) regions elsewhere on the handle. Significantly, the contact points (C) were the only regions of the handles from which oral flora (*S. viridans*) were grown, highlighting this as a potential route for transmission of bacteria and prions from the oropharynx (tonsils) of one patient to another. The blade mount mechanism should be re-designed so that the tip of blade does not make contact with handle when folded in the 'off' position.

Future studies could be performed to evaluate the efficacy of these interventions in reducing the bacterial contamination rate, and these studies could be repeated at appropriate intervals as further research or audit to maintain standards.

All of the occult blood tests were negative. This may represent an absence of blood contamination on the handles, or inadequate sensitivity of the detection methods employed. Another possibility is that sites B and C were swabbed for microbial contamination prior to sampling for occult blood, and this process may have removed any occult

blood from the handles, resulting in negative test results.

In conclusion, we have demonstrated that it is possible for laryngoscope handles to function as a potential vehicle for transmission of infection. In particular, an area of contact on the handle between the laryngoscope blade tip and handle can act as a means of contaminating subsequently attached sterile blades prior to their insertion into the mouth. We propose that national guidelines should be developed to standardise the cleaning methods used for laryngoscope handles, and that handles be designed so that the tip of an attached laryngoscope blade cannot make contact with the handle when in the folded state.

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Conflict of interest statement

All authors have no competing financial interests in this study; however, D.W. and J.D. wish to declare that they are unpaid directors of a non-trading university spinout company (ShakerScope Ltd) which specialises in medical equipment design.

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