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Major article

# Laryngoscopes: Evaluation of microbial load of blades

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***Background:*** Laryngoscope blades were analyzed, and the presence of blood, bodily fluids, and microorganisms was verified, indicating their potential as a source of cross contamination during clinical usage. The way in which the blades are cleaned and disinfected in daily practice may place the patient and health care team at risk. The aim of this study was to determine the bacterial and fungal load on this equipment.
***Methods:*** Descriptive cross-sectional study. A total of 83 laryngoscope blades, ready for use, were analyzed for their bacterial and fungal load at 2 university hospitals.
***Results:*** The microbiologic analysis revealed the presence of microorganisms in 76.2% of cases at institution 1 and 92.7% of cases at institution 2, with microbial loads >$10^1$ colony forming units in 31.2% and 44.7% of cases, respectively. At both institutions, potentially pathogenic microorganisms were found, including *Candida* sp, *Staphylococcus aureus*, *Enterococcus faecalis*, *Streptococcus agalactiae*, extended-spectrum β-lactamase–producing *Klebsiella pneumoniae*, multiresistant *Acinetobacter baumannii*, *Pantoea* sp, *Enterobacter gergoviae*, *Escherichia coli*, and *Proteus mirabilis*.
***Conclusions:*** These results indicate that the use of laryngoscope blades at these 2 institutions present a potential risk. Based on these findings, action needs to be taken so a higher level of safety can be offered to patients and health care professionals who have direct contact with this equipment.


When laryngoscope blades make contact with the oral cavity and larynx, the mucosa can be traumatized, favoring the migration of pathogens to the lungs, particularly if the blade is contaminated. The potential risk has been demonstrated since the 1970s[1] and continues to be highlighted today.[2-8]

However, the lack of any systematic collection of data, the heterogeneity in the stages of the laryngoscopy procedure, the lack of efficient verification of the complete removal of microorganisms, and the lack of homogeneity in the practices described in the existing guidelines highlight the need for a scientific investigation seeking evidence that can yield solutions which enhance patient safety. These procedures should be conducted based on scientific evidence.

Therefore, the following hypothesis was established: laryngoscope blades, ready for use, are potential sources of contamination.

The aim of this study was to determine the bacterial and fungal load present on laryngoscope blades that are ready to be used on patients. In addition, the physical condition of the equipment, its storage, and the presence of residues not suggestive of blood on the surface were investigated.

## METHODS

A descriptive cross-sectional study approved by the local committee for ethics in research (process no. 006/2011) was carried out.

The sample was comprised of laryngoscope blades made of tin chromate and stainless steel, with a support handle with a knurled finish. The blades are interchangeable (straight or curved), and the sizes vary between 00 and 4, with a bulb (3.0 V) on the end, which is activated automatically when the blade is fitted onto the handle. The blade is introduced into the patient's mouth to illuminate the tracheal area in order to carry out the procedure.

As an inclusion criterion, the blades had to be at the different selected locations, ready for use, at the time of data collection. Blades that were in use or were undergoing the cleaning process were excluded.

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The study was carried out at 2 university hospitals. Institution 1 is a hospital specializing in women's health, with 142 beds. Institution 2 is a general hospital with 397 beds. The laryngoscopes studied were collected from the following sections in institution 1: surgical center, obstetrics center, and neonatal intensive therapy unit. In institution 2 they were from the following sections: adult and children's emergency units, surgical center, pediatric intensive therapy unit, emergency clinical ward, trauma clinical ward, gastro-surgical ward, gastro-clinical ward, and infectious diseases ward. These sections were selected because they regularly examine patients using laryngoscopes.

At the 2 institutions studied, the equipment is cleaned with water, soap, and 70% alcohol, which is considered a low level of disinfection, following the recommendation of the Brazilian Healthcare Service Regulatory Agency.[9]

To allow the analysis of all available blades in sections of higher use turnover in both hospitals only once, it was established a convenience sampling method. The collection of samples on the blades, ready for use, was carried out without prior notification to the sections on the date of the procedure. All blades were subjected to the same methodology for the recovery of the microbial load. After collecting the sample, the researcher disinfected the equipment and put it back for future use. This procedure could change the level of contamination typically found on the blades. For this reason, the collection was performed only once on all equipment, to avoid interference in the recovery of the microbial load process.

The sample size comprised all of the laryngoscope blades ready for use at the time of data collection, within a period of 5 months. Before the collection of samples began, data related to the physical and storage conditions of the equipment were collected; for instance, the state of the coating and the presence of rust on the surface.

The methodology used to determine the microbial load, restricted to bacteria and fungi, was based on procedures previously described by Nystrom[10] and Vilas-Boas et al.[11] The laryngoscope blades were removed by applying an aseptic technique and placed in sterilized plastic packaging in ethylene oxide, adding 250 mL of distilled water. They were then placed in an orbital shaker at 120 rpm for 10 minutes, the time required for the detachment of particles. The rinse water obtained was filtered in a laminar flow cabinet through a filter (Merck Millipore, São Paulo, Brazil), with a 0.22-μm cellulose membrane (Millipore) connected to a compressor with a vacuum pressure of 420 mmHg. After filtration, the membrane was placed on the surface of a Petri dish containing blood agar (Columbia Agar 5% Blood; bioMérieux, Marcy l'Etoile, France) using sterilized tweezers. The plates were maintained in an incubator at 35°C-37°C for up to 5 days, if no microbial growth occurred. Once microbial growth was detected on the membrane, the plates were analyzed for microbial identification and counts.

The colonies growing on the membrane surface were analyzed from the quantitative point of view, both macro- and microscopically.[12] The colonies were then submitted to manual or automatized (VITEK; bioMérieux) biochemical tests appropriate for genera and species identification.

The data were analyzed to calculate the descriptive statistics of the variables. A significance level of 5% was adopted for all of the data obtained, determined using SPSS for Windows Version 17.0 (SPSS, Chicago, IL).

## RESULTS

Samples were collected from 83 laryngoscope blades: 42 (50.6%) from institution 1 and 41 (49.4%) from institution 2 (Table 1).

The physical and storage conditions of the blade, the presence of residue not suggestive of blood on the surface of the blade, and the presence of particles in the microbiologic rinse water were registered.

**Table 1**
Distribution of locations where laryngoscope blades were collected, Campinas, 2011

| Location | n | % |
|---|---|---|
| Institution 1 | 42 | 50.64* |
| Surgical center | 21 | 50.0 |
| Obstetrics center | 15 | 35.7 |
| Neonatal intensive therapy unit | 6 | 14.3 |
| Institution 2 | 41 | 49.44* |
| Surgical center | 8 | 19.5 |
| Pediatric intensive therapy unit | 8 | 19.5 |
| Adult emergency unit | 6 | 14.6 |
| Emergency clinical ward | 4 | 9.8 |
| Trauma clinical ward | 4 | 9.8 |
| Infectious diseases ward | 4 | 9.8 |
| Children's emergency unit | 3 | 7.3 |
| Gastro-surgical ward | 3 | 7.3 |
| Gastro-clinical ward | 1 | 2.4 |

*% of total sampling quantity.

In relation to the blade storage conditions, blades were found either exposed without protection, wrapped in clean cotton dressing or other clean material, or kept inside a plastic container with individual protection or in individual plastic packages.

At institution 1, microorganisms were recovered from 76.2% (n = 32) of the samples collected: 56.3% (n = 18) from the surgical center, 40.6% (n = 13) from the obstetrics center, and 3.1% (n= 1) from the neonatal intensive therapy unit. In addition, it was observed that 96.9% (n = 31) of these blades were wrapped in clean cotton dressing, 87.5% (n = 28) had an intact covering, and 93.8% (n = 30) did not show areas of oxidation. There were suspended particles in the microbiologic rinse water for 18.8% (n = 6) of the positive samples.

At institution 2, microorganisms were recovered from 92.7% (n = 38) of the samples collected: 15.8% (n = 6) from the surgical center, 18.5% (n = 7) from the pediatric intensive therapy unit, 15.8% (n = 6) from the adult emergency unit, 10.5% (n = 4) from the emergency clinical ward, 10.5% (n = 4) from the trauma clinical ward, 10.5% (n = 4) from the infectious diseases ward, 7.9% (n = 3) from the children's emergency unit, 7.9% (n = 3) from the gastro-surgical ward, and 2.6% (n = 1) from the gastro-clinical ward. Of these, it was observed that 89.5% (n = 34) of the blades had an intact covering, and there were no areas of oxidation in 81.6% (n = 31). Regarding the storage conditions, 50% (n = 19) of the blades that contained microorganisms had no protection, 28.9% (n = 11) were stored in a plastic container, and 21.1% (n = 8) were wrapped in clean cotton material. Suspended particles were observed in 50% (n = 19) of the blade rinse water samples (Fig 1).

### *Bacterial and fungal load*

The microorganisms found were grouped into potential contaminants (either environmental or from mucosa) and potential pathogens because of their association with hospital and community infections and their virulence factor (Fig 2). At institution 1, 78.1% (n = 25) of the microorganisms recovered were classified as potential contaminants, and 21.9% (n = 7) were classified as potential pathogens. At institution 2, potential contaminants represented 57.9% (n = 22) of the samples, and potential pathogens represented 42.1% (n = 16). Notably, the multiresistant bacteria *Acinetobacter baumannii* and *Klebsiella pneumoniae*, which produce the enzyme β-lactamase (ESBL), were among them.

In relation to the microbial load, the samples collected from institution 1 showed a growth of 1-10 colony forming units (CFU) for 68.8% (n = 22) of the samples, 11-100 CFU for 18.8% (n = 6) of the