

Methods Used for the Decontamination of Laryngoscopes and Their Utilization Rates in Turkey

Ülkemizde Laringoskop Dekontaminasyonunda Kullanılan Yöntemler ve Tercih Oranları

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ABSTRACT Objective: The decontamination of laryngoscopes is of great importance in anesthesia practices. In our study, we aimed to investigate the methods used for the decontamination of laryngoscopes and their effectiveness in Turkey. **Material and Methods:** After ethical committee approval, structured surveys consisting of 8 multiple-choice questions were distributed to anesthesia practitioners working in various hospitals of our country at the Turkish Anesthesia and Reanimation Congress and the data obtained were evaluated statistically. **Results:** In Turkey, the utilization rate was found as 63.9% for illuminated laryngoscopes, 7.2% for fiber-light laryngoscopes, while 28.9% for both laryngoscopes. Of 180 hospitals, 82.8% were found to use the disinfection process as a method of decontaminating, while 17.2% use the sterilization process. In addition, 98.3% of the physicians were found to perform mechanical cleaning before these procedures. Chemical sterilization was the most preferred method with a ratio of 44.4%, followed by ethylene oxide and autoclave with a ratio of 10.6% and 9.4%, respectively. The most widely used type of disinfecting material was glutaraldehyde (36.1%), followed by polyvinylpyrrolidone iodine (30.6%), benzalkonium chloride (18.3%) and sodium hypochlorite (10%). The duration of disinfection process was found as ≥ 30 minutes (24%), 20 minutes (18.9%), and 10 minutes (21.7%). **Conclusion:** We concluded that 98.3% of the disinfection procedures that are carried out in Turkey are preceded by an efficient and accurate mechanical cleaning, and glutaraldehyde is the most preferred high-level disinfectant. As a result, we hope our research will be useful as a reminder for anesthesia specialists to make the necessary controls for the fulfillment of disinfection and sterilization procedures in our country in accordance with universal usage principles.

Key Words: Laryngoscopes; decontamination; disinfection; sterilization; disinfectants

ÖZET Amaç: Laringoskopların dekontaminasyonu ve yeniden kullanıma hazır hale getirilme süreçleri anestezi uygulamaları içinde büyük öneme sahiptir. Çalışmamızda, ülkemiz hastanelerinde laringoskop dekontaminasyonunda kullanılan yöntemlerin ve etkinliklerinin araştırılması amaçlanmıştır. **Gereç ve Yöntemler:** Etik kurul onayından sonra, Türk Anesteziyoloji ve Reanimasyon Kongresi'nde, ülkemiz hastanelerinde görevli anestezi hekimlerine 8 adet çoktan seçmeli sorudan oluşan anket formları dağıtılmış, elde edilen veriler istatistiksel olarak değerlendirilmiştir. **Bulgular:** Ülkemizde sırasıyla %63,9 ampüllü laringoskop, %7,2 fiberlight laringoskop, %28,9 oranlarında her iki laringoskop birlikte kullanılmaktadır. 180 hastanenin %82,8'inin dekontaminasyon yöntemi olarak dezenfeksiyonu, %17,2'sinin ise sterilizasyonu kullanmakta olduğu, hekimlerin %98,3'ünün de bu işlemlerden önce mekanik temizlik yaptığı saptanmıştır. %44,4'lük oranla en fazla kimyasal sterilizasyon, %10,6 etilen oksit, %9,4 otoklav ve %1,1 oranında kaynatma yöntemi tercih edilmektedir. Dezenfektan çeşidi olarak en sık kullanılan glutaraldehiti (%36,1), %30,6 oranında polivinil pirlidon iyot, %18,3 benzalkonyum klorid, %10 sodyum hipoklorit izlemektedir. Dezenfeksiyon işleminin süresi, %24 oranında 30 dakika ve üzerinde, %18,9 oranında 20 dakika, %21,7 oranında ise 10 dakikaydı. **Sonuç:** Ülkemizde dezenfeksiyondan önce %98,3 oranında etkin ve doğru biçimde mekanik temizlik yapıldığı ve yüksek seviyeli dezenfektan olarak en çok glutaraldehitin tercih edildiği tespit edilmiştir. Sonuç olarak, laringoskopların dezenfeksiyonu ve sterilizasyonunun, ülkemizde evrensel kullanım ilkeleri doğrultusunda uygulanabilmesi için, anestezi uzmanlarına gereken denetimleri yapmalarını hatırlatmak açısından araştırmamızın yararlı olacağını umuyoruz.

Anahtar Kelimeler: Laringoskoplar; dekontaminasyon; dezenfeksiyon; sterilizasyon; dezenfektanlar

To protect patients against potential pathogens and to provide safe conditions are of the duties of anesthesiologists. Measures to avoid the transmission of organisms from patient to patient or between patients and anesthesiologists have an important place in the practice of anesthesia. Although the decontamination of laryngoscopes and to make them ready to reuse are very frequently applied in the practice of anesthesia, there is enough data on practitioners' awareness, knowledge and method selection. Although there are a number of publications in the literature regarding contamination of endoscopes, a few reports are available on cross-infections associated with the repetitive use of laryngoscopes.¹⁻³ However, laryngoscopes bear moderate to severe risk of cross-infection, since they frequently contact with non-mucous membranes and blood.^{4,5} In the present study, it was aimed to investigate the preferred methods of cleaning of laryngoscopes and preparation for reuse and the details about such methods in different hospitals in our country.

MATERIAL AND METHODS

After ethical committee approval, structured surveys (Table 1) consisting of 8 multiple-choice questions were distributed to anesthesia practitioners working in various hospitals of our country at the Turkish Anesthesia and Reanimation Congress.

After giving oral and written information, the consents of the physicians recruited in the study were provided. All the applications were carried out by the same research assistant physician working at the Department of Anesthesiology and Reanimation using face to face interview technique, and answers were documented by physicians. A total of 180 different hospitals' data regarding methods of decontamination of laryngoscopes could be gathered. Analyzing the data obtained, percentage, mean, standard deviation, frequency and cumulative average parameters were used. The significance level of p value was set at 0.05 for the analysis of all statistical data.

RESULTS

The number of physicians who participated in the survey was 180, 111 of them were working at state hospital, 43 of them were at university hospital and 26 of them were at private hospital.

In Turkey, the utilization rate was found as 63.9% for illuminated laryngoscopes, 7.2% for fiber-light laryngoscopes, while 28.9% for both laryngoscopes (Table 2).

Of 180 hospitals, 82.8% were found to use the disinfection process as a method of decontaminating, while 17.2% use the sterilization process. In addition, 98.3% of the physicians were found to perform mechanical cleaning before these procedures.

The percentage of physicians who carry out the mechanical cleaning of the blades by brushing with a detergent under running water was 52.2%, while 17.8% by brushing under running water, 13.3% by hand wash only, 4.4% by brushing with detergent or disinfectant without running water, and 3.9% by rinsing in running water only. The percentage of physicians who marked the option of "wiping out" was 2%, whereas 1.1% marked "washing with a machine."

Chemical sterilization was the most preferred method with a ratio of 44.4%, followed by ethylene oxide, autoclave and boiling with a ratio of 10.6%, 9.4% and 1.1%, respectively (Table 3).

Types of disinfectant used are glutaraldehyde (36.1%), polyvinylpyrrolidone iodine (30.6%), benzalkonium chloride (18.3%), sodium hypochlorite (10%), peracetic acid (2.2%), peracetic acid (2.2%), phenolic compounds (1.1%), and ethanol/isopropyl alcohol (0.6%).

The percentage of physicians who were observed to carry out the disinfection process by keeping the blades in disinfecting material for a while was 75.6%. The duration of disinfection process was found as ≥ 30 minutes (24%), 20 minutes (18.9%), and 10 minutes (21.7%).

TABLE 1: The poll forms containing 8 multiple choice questions have been answered by doctors.**The Methods Used For The Disinfection And Sterilization Of Laryngoscope Blades**

Physician's name and surname:

The institution:

1. What is the type of laryngoscopes you use?

- Fiber-light
 Illuminated
 Both

2. Which method do you use for the decontamination of laryngoscopes?

- Sterilization
 High-level disinfection
 Mid-level disinfection
 Low-level disinfection

3. Do you perform the mechanical cleaning of the blades?

- Yes
 No

4. If yes, how is it performed?

- Wiping out
 Hand wash
 Rinsing in running water only
 By brushing with detergent or disinfectant without running water
 By brushing under running water
 By brushing with detergent under running water
 Washing with a machine
 Other...

5. Please specify the method and duration of sterilization?

- Autoclave
 Ethylene oxide
 Chemical sterilization (please specify the name of disinfectant and the duration of the process)
 Boiling
 Other...

6. If the disinfection process is applied - which of the following disinfectant do you use?

- Glutaraldehyde (e.g. Cidex, etc.).
 Sodium Hypochlorite
 Peracetic acid (e.g. Nu-Cidex)
 Hydrogen peroxide
 Phenol compounds
 Benzalkonium chloride (e.g. Salvo, Klorheksol)
 Ethanol / isopropyl alcohol
 Polyvinylpyrrolidone iodine (e.g. Batikon, Betadine)

7. How do you apply the disinfection procedure?

- Wiping with sterile gauze
 Immersing in a disinfectant
 Keeping in a disinfectant for a while
 Other...

8. What is the duration of disinfection process?

- 10 min
 15 min
 20 min
 30 min
 1 h
 Other...

TABLE 2: Type of laryngoscopes.

	Number	(%)
Fiber-light	13	7.2
Illuminated	115	63.9
Both	52	28.9
Total	180	100

TABLE 3: The method of sterilization.

	Number	%
Autoclave	17	9.4
Ethylene Oxide	19	10.6
Chemical Sterilization	80	44.4
Boiling	2	1.1
Other	62	34.4
Total	180	100.0

DISCUSSION

We have determined the preferred methods of decontamination of laryngoscopes and the details about such methods via face to face interview with anesthesia practitioners working in 180 different hospitals of Turkey. 65% of the physicians were found to prefer high level disinfecting material with a highest ratio for glutaraldehyde. The ratio of about 56% for the option of disinfection period of less than 20 minutes showed that high-level disinfection standard was not met adequately.

Disinfection is the process of the elimination of the majority of pathogenic microorganisms except for bacterial spores from inanimate objects, which is typically performed with liquid chemical substances or pasteurization.^{6,7} Sterilization is defined as the destruction of vegetative and spore-forms of all microorganisms coexisting with any substance or object.⁸

Instruments that contact mucous membranes but do not penetrate into the body (flexible fiberoptic endoscopes, laryngoscope blades, etc.) are referred to as semi-critical instruments. The disinfection of these instruments is intended to kill all microorganisms except bacterial spores. High-level disinfection is a minimum practice

recommended by Centers for Disease Control (CDC) guidelines that has been designed to make semi-critical tools reusable, which is a proven activity level against bacterial spores that represents its most important feature.⁹ *Food and Drug Administration (FDA)* stated that a 20-minute contact with a sterilizer disinfectant at 20 °C following the standard cleaning protocol is sufficient to achieve high-level disinfection.^{10,11}

Laryngoscopes have the potential to cause the spread of human immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis C virus (HCV) and non-conventional infectious agents.^{5,12,13} Therefore, Environmental Protection Agency (EPA) recommends the same manner of decontamination procedures.¹⁴ There are two-publications on cross-infections caused by re-use of laryngoscopes.^{1,2} Both publications have discussed inadequate cleaning of neonatal laryngoscope blades. The infected materials on blades have been implicated in the spread of *Pseudomonas aeruginosa*. Abramson et al. have observed that 19 of 45 blades were contaminated (Gram (-) microorganisms including most of *Streptococcus* and *Pseudomonas* species).⁴ There are marked differences between illuminated and fiber-light blades in terms of decontamination, and fiber-light blades are advantageous in terms of mechanical cleaning. The first question of our survey, "What is the type of laryngoscope you use?" was answered as "illuminated laryngoscopes" by 64% of the physicians (Table 2). However, another survey study conducted in Turkey in 2001 revealed a rate of 86% for illuminated blades, which shows the increased use of fiber-light laryngoscopes over a period of 8 years in Turkey.¹⁵ However, a telephone survey conducted in the Netherlands in 2001 revealed that 87% of hospitals used fiber-light laryngoscopes.¹⁶

The second question of our survey, "Which method do you use for the decontamination of laryngoscopes?" was answered as "disinfection" by 83% of the physicians and as "sterilization" by 17% of the physicians. In this case, it should be known that high-level disinfection is recommended for laryngoscopes, which are one of the semi-critical

instruments, in CDC guidelines.^{10,11} The most important characteristic of this application is to destroy bacterial spores.

The third question of our survey “Do you perform the mechanical cleaning of the blades?” was answered as “yes, before sterilization and disinfection procedures” by 98% of the physicians. The study conducted in 2001 in Turkey demonstrated a ratio of 80% for manual cleaning and 20% for cleaning by machine before the decontamination procedure. According to the survey conducted in the Netherlands, standard cleaning is performed by manual cleaning with a ratio of 78% and by cleaning machines with a ratio of 22%.¹⁶ The equipment should be cleaned directly for an effective cleaning; all of the organic substances, sediments and debris should be removed. These materials must be eliminated using the mechanical action of water, detergent or enzymatic products.^{17,18} Subsequently, sterilization or disinfection can be applied. The majority of physicians recruited in the present study comply with the theoretical basis for CDC guidelines by correctly applying this procedure. *Association for Professional in Infection Control (APIC)* and *American Society of Anesthesiologists (ASA)* approve the detailed and careful mechanical cleaning at any time prior to disinfection and recommend keeping the blades in 70% ethanol for 5 minutes for high-level disinfection and sterilization.¹⁶ Kato et al.¹⁸ evaluated the use of detergents for disinfection of bronchoscopes and demonstrated that the number of colonies of microorganisms decreases from $10^{(-3)}/\text{mL}$ to $10^{(-4)}/\text{mL}$ by decontaminating after cleaning with water and benzalkonium chloride. In addition, the waiting time in a disinfectant was reduced up to 60 seconds.

The fourth question of the survey “How do you conduct the mechanical cleaning?” was answered as “by brushing with detergent under running water” by approximately 52% of physicians and as “by brushing under running water without detergent” by 18% of the physicians. The study conducted in 2001 in Turkey showed that mechanical cleaning was performed by brushing under running water with a ratio of

20%.¹⁵ In the Netherlands, mechanical cleaning was observed to be performed by brushing under running water with a ratio of 88%.¹⁶ In England, Esler et al.¹⁹ revealed that 10% of the physicians carry out disinfection by only washing with detergent, whereas the other studies concluded that methods such as mechanical cleaning, brushing, and immersing in alcohol, Cidex and hydrogen peroxide are used. In our country, importance has been placed to the mechanical cleaning from 2001 up to this day, and mechanical cleaning was carried out efficiently and accurately by the majority of physicians.

The fifth question of the survey, “Please specify the method and duration of sterilization?” was answered as “Chemical sterilization” by 44% of the physicians (Table 3). The sixth question, “If the disinfection process is applied-which of the following disinfectant do you use?” was generally answered as “glutaraldehyde” and “polyvinylpyrrolidone iodine”, followed by ethylene oxide (11%), autoclave (10%) and boiling which had the lowest utilization rate, between about 20 minutes and 3 hours, whereas some physicians did not specify the duration of use. However, the survey conducted in Turkey in 2001 revealed that 72% of hospitals frequently used a chemical disinfectant and 50% applied autoclave sterilization.¹⁵ The survey in the Netherlands showed that the machine decontamination was routinely used in 30 (22%) of 139 hospitals. In 3 of these hospitals, the blades were first subjected to plasma sterilization at 93°C for 60 minutes and then autoclaved at 134°C for 3.5 minutes. The remaining 27 hospitals (19.4%) did not use any method of sterilization. The same survey showed that enzymatic materials were commonly used in routine practice for mechanical cleaning in all hospitals, and alcohols (ethanol 70%, isopropylalcohol 60%) were frequently preferred as a disinfectant.¹⁶ According to the survey conducted in England, 41% of the hospitals used autoclaving, and the autoclave was preferred when considering a high risk.¹⁹ Sterilization with pressurized steam is one of the methods of sterilizations, which is performed by using an autoclave. While this method is preferred

for sterilization of the illuminated laryngoscopes, repetitive sterilization procedures in an autoclave dramatically reduce the light intensity of fiberoptic laryngoscopes.¹⁶ In addition, it would be unnecessary and expensive to operate an autoclave for a single laryngoscope.

Ethylene Oxide (EO) is the most appropriate method of sterilization of sensitive materials that cannot be sterilized by high temperature and pressure. EO is a powerful antimicrobial agent that destroys all known viruses, bacteria and bacterial spores.¹⁶ It is an effective method, but is also expensive and requires simultaneous sterilization of more than one blade. According to our survey results, mid-level disinfectants were observed to be preferred more frequently in the Netherlands. Mid-level disinfection does not kill spore-forming bacteria such as *C. difficile*.⁷ However, considering the selected methods of our study, 65% of the physicians were found to prefer high-level disinfecting material with a highest ratio for glutaraldehyde. Therefore, laryngoscopes should be considered as semi-critical instruments and high-level disinfectants should be preferred for their decontamination.⁵

The 7th question of our survey was “How do you apply the disinfection procedure?” which was answered as “keeping the blades in a disinfectant for a while” by 76% of the physicians. In the survey conducted in 2001 in Turkey, the majority of physicians indicated that they performed the disinfection procedure by keeping the blades in a disinfectant for a while.¹⁵ Muscarella, emphasized the need for keeping the laryngoscope and its components in a disinfectant at a temperature for a period of time needed to obtain high level disinfection in accordance with the reuse principles of flexible laryngoscopes, and reported that keeping the cover of the cuvette closed during this period would protect the environment from the fume and the side effects of disinfectants.²⁰ Cleaning the surface of the instruments with a 70% alcohol provides mid-level disinfection.¹⁶ In light of this data, the majority of our physicians prefer the correct method, while 24% were determined to not reach even the mid-level disinfection.

The last question “What is the duration of disinfection process?” was answered as ≥ 30 minutes by 24% of the physicians whereas 56% answered as < 20 minutes. In this case, the standard for high-level disinfection cannot be met in a significant portion in our country. When using a 2% glutaraldehyde at room temperature, the time required for complete killing of microorganisms including resistant mycobacteria is at least 20 minutes.⁶⁻¹⁵ Immersion of laryngoscopes in 70% alcohol solution for more than 5 minutes provides mid-level disinfection, but not high-level disinfection. According to *Environmental Protection Agency (EPA) and CDC* guidelines, glutaraldehyde, chlorinedioxide, hydrogen peroxide or peracetic acid can be used as high level disinfectants for the sterilization of heat-sensitive semi-critical instruments.²¹ The immersion period is envisaged to 30 minutes.³

Effective methods of decontamination of laryngoscopes used in many hospitals in Turkey but we found that there is some wrong practices related to disinfection and sterilization.

Although allied health personnel assigned to disinfection and sterilization in Turkey, in intensive pace of work these allied health personnel and disinfections of sterilization levels can't be controlled enough. This is very important to take measures for decontamination for our country.

The patients who will return the health with operation, are at risk of getting hospital-acquired infection, because of the failure to provide adequate disinfection of laryngoscopes with the correct procedure. For this reason decontamination and making it ready for use again of laryngoscopes have a great importance in anesthesia administration. Consensus on this issue by international organizations, improved procedures and the rules should be applied respectively.

As a result we consider that; our study will be useful in our country to remind anesthesia practitioners for making the necessary controls for the implementation of disinfection and sterilization of laryngoscopes, in accordance with the principles of universal use.

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