Assessment of Bacterial Contamination of the External Surface of Anesthetic Cartridges

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Abstract

Objective: Infection control is one of the important aspects in dentistry. Oral and maxillofacial surgery is one of the most sensitive fields in dentistry in which infection control is important; a sterile surgical set is imperative. Manufacturers only guarantee the sterility of the anesthetic not the sterility of its outer surface. They recommend alcohol to sterile the outer surface (especially the diaphragm) of the cartridge. On the other hand, studies showed contamination of external surfaces in anesthetic cartridges in various amounts. Evaluation of possible microbial contamination of anesthetic cartridge surfaces was the intent of this study.

Methods: During this descriptive experimental study, random sampling was performed and 1,200 Iranian and imported cartridges were transferred to different culture media (aerobic, anaerobic and fungal). After 24-48 hours of incubation, samples were transferred to specific culture media. Cultured bacteria were stained, using the Gram staining method. The study was carried out in a 6-month period.

Results: We found 6.3 percent of aerobic cultures, 1.8 percent of anaerobic cultures and 0.7 percent of fungal cultures were contaminated by different types of microorganisms sampled from cartridges.

Conclusion: The contamination of cartridges is not ignorable and placing them directly in the sterile surgical set is not recommended.

Key words: Anesthetics, Disinfection/sterilization, Microbiology, Surfaces and cartridge.

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Introduction:

Infection control is one of the important aspects in dentistry. Oral and maxillofacial surgery is one of the most sensitive fields in dentistry in which infection control is important; a sterile surgical set is imperative. The dental anesthesia cartridge is dispensed out of its package and placed in the sterile surgical set for better and easier usage. Manufacturers only guarantee the sterility of the anesthetic not the sterility of its outer surface. They recommend alcohol to sterile the outer surface (especially the diaphragm) of the cartridge. But it can contaminate outer surface of cartridges (1, 2).

According to the fact that sterility is an absolute concept, any contamination of outer surface of anesthesia cartridge breaches this important concept and increases the probability of wound infection.

In this study, our objectives were: 1- To evaluate microbial contamination of the outer surface of these cartridges. 2- To identify contamination type (in positive cases), and 3- To compare

microbial contamination of outer surface of cartridges made in our country with imported cartridges.

Methods:

This study was a descriptive one. In this study, domestic (made in Darou Pakhsh Holding Co.) and imported (made in Septodont, Inibsa and DFL) cartridges with different batch numbers were dispensed and aerobe and anaerobe bacterial and fungal samples were taken from them.

We tried to collect samples from different batches and their expiration date was also considered.

Sample size for each culture was calculated as following with considering infection prevalence rate of 10%, Correlation *Coefficient: 0.9, and false negative: 0.2 by* Power and Sample size calculation version 2.1.31 software. Sample size was calculated approximately 200 cartridges for each group.

Thus, 1200 cartridges were collected to start the study (24 packages, 50 cartridges each, with 24 different batch numbers).

Microbial evaluating of consumed cartridges in dentistry was performed based on European Pharmacopeia (3) instructions for microbial evaluation of non-sterile products.

Then, different selective environments were used and they were produced according to the manufacturer's instructions in each stage.

To start the work, three environments including TSB, Thio and SDB were used. Totally, 100 tubes containing the afore-mentioned media were supplied each time (for example: 33 TSB tubes, 33 Thio tubes and 34 SDB tubes). Using gloves and facial masks the outer surface of blisters (5-10 cartridge shrouds) were disinfected with cetrimide-C solution; then, under aseptic conditions and under a hood, samples were dropped into the tubes. And then according to the reference, to separate putative bacteria, passages were performed from canescent tubes in differential environments.

The culture environments frequently used (Q-Lab Corp. Canada) contained the following ingredients:

SABOURAUD DEXTROSE BROTH (SDB)
TRYPTIC SOY BROTH WITHOUT DEXTROSE (TSB)
THIOGLYCOLATE FLUID MEDIUM WITH INDICATOR USP (Thio)
COLUMBIA AGAR
McCONKEY AGAR
BAIRD PARKER AGAR BASE
CETRIMIDE AGAR
SALMONELLA SHIGELLA AGAR (S.S.)
S.I.M. MEDIUM (SULFITE INDOLE MOTILITY)
TRIPLE SUGAR IRON AGAR (T.S.I.)
MR-VP BROTH
CITRATE (SIMMON'S) AGAR
UREA BROTH
LYSINE DECARBOXYLASE BROTH
TETRATHIONATE BROTH

Data analysis was performed using SPSS ver. 16.00 software. Description quantity and the quantity of any contaminations on cartridges were presented. We used chi-square test to compare contaminations between different manufacturers.

Results:

In a six–month period, 1200 dental local anesthesia cartridges were collected and dropped in culture environments. From these 1200 cartridges, 600 cartridges were Iranian and 600 were imported.

Results of aerobic cultures:

The results of aerobic cultures are shown in Table 1.

Chi-square test did not show any significant correlation between aerobic contaminations and

domestic or imported cartridges (p=0.544).
Also, Fisher's exact test did not show any correlation between aerobic contaminations with cartridge manufacturer.
But, Pearson's chi-square showed significant correlation of contamination and manufacturer (Iranian, Brazilian, and European cartridges, p=0.033). European cartridges had much lower contamination rates (just one manufacturer).

Table 1- The frequency of positive aerobic cultures

	Cartridge type	Number	Number of contaminated cartridges
Domestic production	Persocaine (Darou Pakhsh Co.)	199	(7%) 14
Foreign production	**Scandinibsa 3%**+Septanest with adrenaline **(**SEPTOJECT® (:Inibsa®+	196	(1%) 2
	Prilonest 3% (DFLBRAZIL)	202	(9.8%) 20
	total	597	(6.3%) 34

Results of anaerobic cultures:
The results of anaerobic cultures are shown in Table 2.
Statistical tests did not show any significant correlation between contaminations and manufacturer of cartridges.

Table 2- The frequency of anaerobic positive cultures

	Cartridge type	Number	Number of contaminated cartridges
Domestic production	Persocaine (Darou Pakhsh Co.)	195	(1.5%) 3
Foreign production	**Scandinibsa 3%**+Septanest with adrenaline **(**SEPTOJECT® (:Inibsa®+	198	(0%) 0
	Prilonest 3%(DFLBRAZIL)	198	(4.1%) 8
	total	591	(1.7%) 7

Results of fungal cultures:
The results of fungal cultures are shown in Table 3. In this case, just yeasts were seen on microscopic evaluations.
Again, statistical tests did not show any significant correlation between contaminations and manufacturer of cartridges.

Table 3- The frequency of positive fungal cultures

	Cartridge type	Number	Number of contaminated cartridges
Domestic production	Persocaine (Darou Pakhsh Co.)	206	(1%) 2
Foreign production	**Scandinibsa 3%**+Septanest with adrenaline **(**SEPTOJECT® (:Inibsa®+	206	0
	Prilonest 3 %(DFLBRAZIL)	200	(1%) 2
	total	612	(0.7%) 4

Discussion:

Our study demonstrated 6.3 percent of aerobic cultures, 1.8 percent of anaerobic cultures and 0.7 percent of fungal cultures were contaminated by different types of microorganisms sampled from cartridges.

The study of Lilly and Russell (1975), one of the oldest studies in this field, reported microbial contamination of the outer surface of the cartridges between 0 to 25% (4). Culture methods used in this study were not appropriate, because only one centimeter of the cartridges was cultured and the rest of them were not evaluated. In another study Basson et al (1999) evaluated the microbial load of outer surfaces of cartridges immediately after opening their boxes and cartridges that had been opened previously (5). In this study, the diaphragm and the surface specimens of the cartridges were cultured and then were incubated in the culture environments for 5 days. None of the studies found in the literature fully drowned cartridges in liquid culture and for the first time in this study we use this method.

The results of this research showed that first, microbial contamination of outer surface of cartridges is not ignorable and sometimes this contamination is very significant. Second, there was a significant difference between outer surface contamination of domestically produced and Brazilian cartridges with European cartridges. There was 7% surface aerobic contamination in domestically produced cartridges in which Salmonella paratyphi C was one of the isolated bacteria and we cannot easily ignore this type of contamination because of its oro-fecal transmission. In some studies suggested an autoclaving method(6), but it's controversial because of temperature effect on epinephrine stability (7, 8). On the other hand, contamination of cartridge itself was assessed in an study and the results demonstrated that 76% of all cartridges were polluted by blood(9).

It has been said that in most ideal surgical conditions, there is 3% (10, 11) probability of infection and with 6.3% cartridge contamination, it seems that their surface contamination correlates with infection probability of surgery.

One of the limitations in this study (because of economic and political reasons) was that it was impossible to import one factory product with different batch numbers. Thus, the number of products of one factory decreased but did not influence the value of study because of simultaneously culturing internal and imported products. The followings are suggested according to the results of this study:

1- Transmission of the data obtained from this study to Darou Pakhsh Holding Co. which is the only Iranian producer of cartridges and performing required actions to decrease outer surface contamination of its products.
2- Evaluating different disinfection methods on decreasing outer surface contaminations of cartridges.
3- Evaluating microbial contamination of cartridges' outer surface after dropping into the sterile tray (in other words, when cartridges are dropped into the tray and after contact with outer surface aluminum coat)

Conclusion:

Anaerobe and fungal contaminations are lower than aerobe contamination, but complete clearance of European cartridges was significant in this regard.

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