

ASSESSMENT OF MICROBIAL CONTAMINATION IN SURGICAL INSTRUMENT IDENTIFICATION TAPES AND RESINS

Avaliação da contaminação microbiana em fitas e resinas identificadoras de instrumental cirúrgico

Evaluación de la contaminación microbiana en cintas y resinas identificadoras de instrumental quirúrgico

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ABSTRACT: Objective: To assess the sterility of colored tapes and resins used to identify surgical instruments. **Method:** We conducted an experimental laboratory study, which used a sample of 140 different stainless-steel surgical instruments, identified with tape or resin, voluntarily donated by Central Sterile Services Department to this research. The samples were inoculated directly into trypticase soy broth (TSB) and sodium thioglycolate and incubated for 14 days. **Results:** We found positive growth in three tape samples and none in resin samples. **Conclusion:** Identification tapes harbored microorganisms in the instruments assessed, possibly protected by biofilm.

Keywords: Surgical instruments. Sterilization. Foreign bodies. Biofilms.

RESUMO: Objetivo: Avaliar a esterilidade de fitas coloridas e resinas utilizadas como identificadores em instrumentos cirúrgicos. **Método:** Foi realizado um estudo experimental, laboratorial, que utilizou uma amostra de 140 instrumentos cirúrgicos diversos, de aço inoxidável, identificados com fita ou resina, doados voluntariamente por Centros de Material e Esterilização para a presente investigação. As amostras foram inoculadas diretamente em *trypticase soy broth* (TSB) e em tioglicolato de sódio e incubadas por 14 dias. **Resultados:** Foi observado crescimento positivo em três amostras de fita e nenhum crescimento foi observado nas amostras de resina. **Conclusão:** Marcadores de instrumental do tipo fita albergaram microorganismos nos instrumentais avaliados, possivelmente protegidos por biofilme.

Palavras-chave: Instrumentos cirúrgicos. Esterilização. Corpos estranhos. Biofilmes.

RESUMEN: Objetivo: evaluar la esterilidad de las cintas de colores y las resinas utilizadas para identificar los instrumentos quirúrgicos. **Método:** Realizamos un estudio de laboratorio experimental, que utilizó una muestra de 140 instrumentos quirúrgicos de diferentes aceros inoxidable, identificados con cinta o resina, donados voluntariamente por el Departamento Central de Servicios Estériles para esta investigación. Las muestras se inocularon directamente en caldo de cultivo de soja tripticasa (TSB) y tioglicolato de sodio y se incubaron durante 14 días. **Resultados:** Encontramos un crecimiento positivo en tres muestras de cinta y ninguna en muestras de resina. **Conclusión:** las cintas de identificación albergaban microorganismos en los instrumentos evaluados, posiblemente protegidos por biofilm.

Palabras clave: Instrumentos quirúrgicos. Esterilización. Cuerpos extraños. Biopelículas.

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INTRODUCTION

The Central Sterile Services Department (CSSD) is a functional unit that reprocesses medical devices (MD) and should provide them safely for virtually all health service units¹, particularly the Operation Room (OR), its main and largest consumer. In this regard, one of the main challenges in the management and control of surgical instruments consists of identifying them to optimize internal processes and save time.

The visual identification of surgical instruments in the CSSD aims to determine in which set or tray a given instrument belongs, facilitating the separation, assembling, and count at the time of preparation, allowing even less experienced professionals to carry out these procedures. Different resources² are available to create markers, from the simplest and low-cost to the more technological, which consequently are more expensive.

Radio-frequency identification (RFID) and a Data Matrix code³ are modern technologies that have a high acquisition cost, as they depend on equipment and software to perform the reading. As an alternative, the CSSD team can put tapes or resins, both colored, on surgical instruments to facilitate their immediate visual identification. These options are widely adopted due to their practicality and lower cost.

Although their advantages are recognized, we should consider some aspects about the safety of their use, as publications available in the scientific literature that evaluate this issue are too scarce and old to allow the CSSD manager to make a safe decision. The main question is whether microbial growth occurs under the colored tape or resin.

Thus, we developed the present study to assess the sterility of colored tapes and resins used to identify surgical instruments, in order to aid the CSSD manager in deciding the best method to use as instrument marker and ensure patient safety.

OBJECTIVE

To assess the sterility of colored tapes and resins used to identify surgical instruments.

METHOD

We conducted an experimental laboratory study, using a purposive sample of 140 different stainless-steel surgical

instruments. Among them, 120 were identified with tape and 20 with resin.

We asked for donations of instruments identified and used in CSSD for at least a year (both the instrument and identification) to ensure that the reprocessing practice was reproduced in the experiment. We received numerous types of instruments (anatomical forceps, Kelly forceps) with resins and tapes both new and worn and peeling. Two experimental groups were created: "tape" and "resin."

In a biosafety cabinet (class II, Veco), fully equipped (long sleeved laboratory coat, cap, sterile gloves, and mask), and following the aseptic technique, we used a sterile scalpel to remove samples from each instrument, previously sterilized in saturated steam under pressure (134°C for 5 minutes) and sealed in sterilization pouches. To compose the experimental group, a random part of the samples was inoculated directly into 50 mL of trypticase soy broth (TSB; Difco™ BD, France) and another into 50 mL of sodium thioglycolate (Probac do Brasil®, Brazil). Next, the samples were incubated for 14 days in an oven at 36±2°C, with daily readings to search for microbial growth, characterized by media turbidity.

The positive control group consisted of 30 identification tapes and 30 identification resins extracted from study groups, intentionally contaminated after staying 24 hours in a suspension of *Serratia marcescens* (ATCC 14756) at 10⁶ CFU/mL, prepared in a TSB culture medium. After contamination, the samples were placed in test tubes with TSB and incubated in an oven at 36±2°C for 72h, with daily readings to search for microbial growth. The purpose of the positive control group was to confirm the possibility of aggregation and survival of microorganisms on the surface of the samples.

RESULTS

Three samples presented positive growth in the tape group, two in TSB medium and one in sodium thioglycolate medium. We found no growth in samples of the resin group. Table 1 shows the identification of microorganisms of each sample. The positive control group revealed microbiological growth in all tape and resin samples.

DISCUSSION

Despite only samples of the tape group having microorganisms recovered, this study – with non-controlled

sample representativeness – did not allow us to conclude that resin is more secure than adhesive tape for instrument identification. The growth of *S. marcescens* in the positive control group of resin samples confirms that this material can harbor microorganisms, negating the hypothesis that it prevents adhesion. Possibly, the small sample size is a limitation.

Initially, the study only intended to identify the possible microbial contamination of surgical instrument markers but was confronted with most samples presenting some degree of damage, such as partial peeling and breaks. This finding added the risk of foreign bodies in the cavities of surgical patients to the risk of contamination of these identifications.

Regarding tapes, new markings are usually firmly fixed to the surface of the instrument. However, they tend to peel off after successive processing – including mechanical action, contact with chemicals, and high temperatures –, promoting an environment conducive to the accumulation of organic matter, which could lead to sterilization failure, justifying the three samples with positive growth in this study, two of them with genus capable of sporulating in adverse conditions (*Bacillus*). The instruments evaluated in this experiment had more than one year of use, with no control of the number and quality of processing.

Among the microorganisms recovered, coagulase-negative *Staphylococcus* is usually found in human skin and clinical samples, representing an important agent of health care-associated infections (HCAI), for its presence in biofilms formed in MD, such as catheters^{4,5}. The thermolability of the vegetative microorganisms recovered allows the inference that the biofilm formed in the samples must have protected them from the sterilization action. *Bacillus subtilis* is found in soil and water and can also cause opportunistic infections⁶.

Table 1. Number of positive samples and identification of the microorganisms isolated, according to culture media and sample type.

Instrument markers	Tapes		Resins	
	TSB	STG	TSB	STG
Culture media	TSB	STG	TSB	STG
Positive/tested samples	2/60	1/60	0/10	0/10
Microbial identification	<i>Bacillus subtilis</i> CoNS	<i>Bacillus sp</i>	–	–

TSB: trypticase soy broth; STG: sodium thioglycolate; CoNS: coagulase-negative *Staphylococcus*.

Although surgical instrument tapes facilitate and expedite the preparation of surgical sets due to the immediate visual identification, their use is also related to surgical site infections (SSI). In 1983, four out of six patients undergoing oral surgery developed abscess 4 to 13 days into the postoperative period. The microorganism identified in the infection site was the *Staphylococcus epidermidis*, the same one found in tapes that marked the instrument used, with the same sensitivity pattern to antibiotics. Removing the tapes from the instrument coincided with the end of the outbreak⁷.

A 1993 study challenged the saturated steam sterilization in flashcycle (135°C for 3 minutes) by using disks impregnated with *Bacillus stearothermophilus* spores extracted from biological indicators and adhered to the metallic surface of the instrument under an identification tape. The microorganism test was not recovered at the end of the experiments⁸, but it is noteworthy that the authors did not use organic matter as a contaminant.

Any factor that hinders the cleaning will increase the risk of accumulation of organic matter, which is not always noticed. Organic waste found in orthopedic cannulas containing *Staphylococcus epidermidis* was considered the cause of sterilization failure in the cannulas used in two patients submitted to surgeries and infected by the same microorganism isolated in the instrument⁹. Another report on an infection outbreak identified *Staphylococcus* recovered from the knees of patients who underwent orthopedic surgeries and found the same microorganism and organic waste inside the cannulas used in the surgeries. Although there are no studies that can confirm that the microorganism came from the same strain, the authors credited the outbreak to cleaning and sterilization failures¹⁰. The last report refers to an outbreak of *Pseudomonas aeruginosa* that survived sterilization in instruments for orthopedic surgeries, due to the organic matter adhered to them. DNA analyses allowed the authors to relate the strains isolated from patients to the ones retained in the waste found in the instrument¹¹.

We could also observe the fragmentation of the resin in many instruments used as samples in this experiment, confirming the concern with the peeling of markers during the surgical act. Additionally, when the resin falls or is removed from the instrument, the place worn from the application hinders the cleaning and could enable the formation of biofilm.

The successive processing of these markers can also wear them, evidenced by the peeling and fragmentation observed

in both types of identification in the samples of this study. Tapes and resins can accidentally fall, and the surgical team might not notice it during the surgical act^{7,12}, resulting in the called “retained surgical items”, topic of guidelines aimed at surgical patient safety^{13,14}.

Even in a small volume, any item forgotten or that inadvertently falls and remains unnoticed inside the operative cavity or wound of a patient can lead to damage, such as infections and even death^{14,15}, and, although rare, this event is considered a preventable error that can cause harm¹³. Given that both tapes and resins can peel off and fall during surgery and that, as demonstrated here, they can be contaminated, the use of these markers is worrying.

The protocol for the safe use of identification resins and tapes should contain expiration dates to change these resources. Removing defective materials or those that can put patient safety at risk is recommended and must be rigorous¹⁶. Despite this variable being little explored in the experimental design used, the regular replacement of tapes is a premise for the safe use of this resource.

The Standard Operating Procedure (SOP) for inspection of surgical instruments should include, at the time of instrument preparation after cleaning, checking the adhesion of all visual markers used. In addition, CSSD must implement a routine to exchange markers and remove any instrument with damaged identification or signs of peeling or dirtiness.

Manufacturers of these instrument markers should be involved in the definition of dates for periodic preventive replacement.

The current resources available are restricted to colored tapes and resins, as advanced technologies that innovated the marking of surgical instruments with optical reading are targeted at control management of misplaced items and not at assisting CSSD workers in visually identifying instruments when assembling surgical boxes. In this regard, this study identified the need for new technologies that replace the current ones and comply with the worldwide guideline for safe surgery, proposed by the World Health Organization (WHO)¹⁷.

The results of this research indicated that, at the moment, the resources for instrument marking, be them tapes or resins, require discipline to ensure their safe use, that is, rigorous review of their integrity and adhesion to the surface of the instrument to minimize the risk of contamination.

CONCLUSION

The study showed that surgical instrument identification tapes could protect microorganisms from sterilization. Despite the lack of microorganisms in resin markers, their samples presented peelings and damages, which also put patient safety at risk. Determining best practices related to the care given to surgical instruments is essential to make surgeries safer.

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