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ORIGINAL ARTICLE

Usefulness of sonication procedure in mesh infection diagnosis associated with hernia repair

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Abstract

Background The use of prosthetic meshes is a common practice in hernia repair surgery. However, infection can appear as an important complication where antibiotic selection must be directed by the etiology of the infection. In recent years, sonication has appeared as an important tool for the diagnosis of many biomaterial-associated infections. Here, we evaluated our experience with this methodology for the diagnosis of mesh infection.

Methods We retrospectively reviewed the microbiological records between 2015 and 2019 looking for sonicated meshes in the microbiology laboratory. All samples were processed according to the sonication protocol described by Esteban J et al. (J Clin Microbiol. 2008 Feb; 46 (2): 488–92).

Results 26 samples were processed during the study period. 21 of them gave a positive result for culture (11 polymicrobial and 10 monomicrobial ones). *Staphylococcus aureus* and *Candida albicans* were the commonest monomicrobial isolates (4 cases each). There were five cases of mixed gut microbiota. The median (interquartile range) UFC count was > 100,000 (50,000- > 100,000) CFU/mL.

Conclusion Sonication is a useful technique for the diagnosis of mesh infection.

Keywords Sonication · Diagnosis · Biofilm · Mesh infection

Introduction

The gold standard technique used in hernia repair surgery is prosthetic mesh implantation because it reduces hernia recurrence [1, 2]. However, despite its advantages, this procedure has some post-surgical complications, including seromas, adhesion, chronic severe pain, implant migration, intestinal obstruction and infection [1, 3, 4].

Mesh infection is one of the most important complications for the patient and it also implies an increased cost to the health-care system. The incidence rates range between 1 and 10%, depending on the type of mesh material, surgical technique used and population [2, 4–6]. The most common etiologic agents in mesh infection are *Staphylococcus aureus*, coagulase-negative *Staphylococcus*, *Streptococcus* sp., *Enterobacteriaceae* and anaerobic bacteria [1, 7]. The pathogenesis of this infection implies that the microorganism adheres to the mesh during surgical implantation, leading to biofilm formation on the biomaterial surface, altering implant integration and tissue regeneration [4, 8]. Prevention and non-surgical treatments for mesh infection are of limited efficacy, as a consequence surgical removal of the mesh is usually required to cure the patient, especially in chronic infections.

Microbiological analysis of the mesh removed from the patients is important because it acts as a reservoir for the infecting pathogen, and adequate etiological agent identification is necessary to properly manage these patients. An ideal microbiological diagnostic technique demands high sensitivity and specificity to confirm the infection [9].

The aim of the study is to evaluate the usefulness of the sonication technique, which was successfully used in other types of implants, for the etiological diagnosis of prosthetic mesh infection in abdominal hernia surgery.

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Material and methods

Removed meshes from patients with infection signs submitted for culture in our hospital between April 2015 and July 2019 were included in this retrospective study.

All prosthetic devices were processed using the sonication protocol previously described by Esteban et al. [9]. Briefly, samples were introduced in sterile plastic jars with 50 mL of sterile phosphate buffer saline (PBS) (pH 7.2–7.4) (bioMérieux, Marcy-L'Étoile, France) and were sonicated for 5 min in a low power sonicator (Hz = 50–60) (J. P. Selecta, Abrera, Spain). The sonicate was transferred into 50 mL Falcon tubes and was centrifuged at 3500×*g* for 20 min. After centrifugation, the supernatant was discharged and the sediment was re-suspended in 5 mL of PBS. Ten microliters of the sonicate was inoculated onto the following culture media: tryptic soy 5% sheep blood agar, chocolate agar, Schaedler 5% sheep blood agar and MacConkey agar (all from BioMérieux, Marcy l'Étoile, France). All plates were incubated for 7 days (except MacConkey, which was incubated only 24 h) at 37 °C under different conditions: in a normal atmosphere (MacConkey agar), 5% CO_2-enriched atmosphere (tryptic soy 5% sheep blood agar and chocolate agar) and anaerobic atmosphere (Schaedler 5% sheep blood agar). All media were examined daily for microbial growth, until they were discharged, except the anaerobic culture, which was incubated in anaerobic jars that were maintained closed for the first 48 h. A quantitative microbiological evaluation of the growth results was performed and it was expressed in colony forming units per mL (CFU/mL).

The isolated organisms were identified by matrix-assisted laser desorption ionization-time of flight mass spectrometry (MALDI-TOF MS; Vitek MS, BioMérieux, Marcy l'Étoile, France).

Results

A total of 26 prosthetic meshes were processed. 14 of them were from male patients (18/26). The average age of the patients included in this study was 62.62 ± 15.56 years and the age range was 55–64.

In 21 of them, there was a positive culture. 11 of these were monomicrobial and 10 polymicrobial. Regarding the monomicrobial infections, *Staphylococcus aureus* (4) and *Candida albicans* (4) were the most common isolated pathogens. Other isolated pathogens were *Escherichia coli* (2), *Corynebacterium striatum* (1) and *Fusobacterium nucleatum* (1). On the other hand, concerning the polymicrobial infections, there was a predominance of mixed gut microbiota (5), and other combinations such as *Morganella morganii* and *Klebsiella pneumoniae* (1), *Proteus mirabilis* and *Escherichia coli* (1), *Candida albicans* and *Klebsiella pneumoniae* (1), *Corynebacterium striatum* and anaerobes (1), *Pseudomonas aeruginosa* and anaerobes (1). The bacterial count was elevated in most cases, with the median (interquartile range) of the bacterial growth being > 100,000 (50,000- > 100,000) CFU/mL.

Discussion

This study analyzes the usefulness of the sonication technique in clinical microbiology routine as an innovative and easy procedure for the microbiological diagnosis of mesh infection.

Interestingly, among monomicrobial infections, *Staphylococcus aureus* (19.05%) and *Candida albicans* (19.05%) appeared as the most frequent isolates. *S. aureus* has been described as the leading cause of mesh infections [10, 11], together with *Staphylococcus epidermidis* [11]. This can be explained by the fact that skin/deeper surgical site infection was the cause of some mesh infections [4, 5]. The finding of *C. albicans* as a leading cause of these infections is in concordance with previous studies [12].

Meshes are relatively close to the abdominal cavity, a fact that may be an explanation of the finding of polymicrobial infections caused by gut microbiota [11]. Moreover, most of those organisms, identified at species level in the cases with only two microorganisms isolated, were also common inhabitants of the gut. According to these results, in our series, gut microbiota are the leading cause of mesh infection, and this fact must be taken into consideration for a proper antibiotic selection. The percentage of polymicrobial infections detected in this study (47.6%) is significantly higher than in previous reports (12.1%) [5] (p value = 0.0005). It could be related to the increased sensitivity of sonication for recovering more microorganisms than conventional techniques, a fact that has been previously described in other studies with other types of prosthetic devices [9, 13–15].

The main limitation of our study is its retrospective condition, which made it extremely difficult to obtain negative controls to evaluate the specificity of the technique, because only meshes from clinical cases of infection were submitted for culture.

In conclusion, sonication of the mesh is a useful and easily implementable technique that can be added to other commonly used microbiological cultures for the diagnosis of mesh infection and it could have important implications in the management of this kind of infections through a better knowledge of their etiology.

Compliance with ethical standards

Conflict of interest No conflict of interest exists for all authors regarding this work.

Ethical approval The study was approved by the ERC from our hospital.

Human and animal rights The study followed the GCP and legislation about Data Protection from our country.

Informed consent No signed consent was necessary because this work is a retrospective one.

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