Investigation of the presence of biofilms in patients with cochlear implant by scanning electron microscopy

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Abstract

Biofilms are organized microbial communities that are playing an increasing role in otolaryngologic diseases such as chronic or recurrent otitis media, cholesteatoma, adenoiditis or tonsillitis. Moreover, biofilm infection may also be a problem in the prosthetic device. Development of biofilm formation may be due to the device itself, host, or both. They are difficult to eradicate owing to their resistance to immunologic defense mechanisms and antibiotics. Various cultural techniques are available to detect biofilm-producing microorganisms, but the use of electron microscopic methods may offer detailed insight into the ultrastructure of biofilm and their environment. Despite this, limited data are available from this area. Cochlear implants are highly acceptable rehabilitation method in the person with severe to profound hearing loss. Although the complication rate of the cochlear implantation is very low, biofilm formation is considered as a main reason of the flap problems or local infection in this patient.

In this project, our objective is to investigate the evidence of biofilms in patients who underwent surgery for cochlear implantation. For this purpose, specimens were taken during the surgery (42 tissue samples; 21 mastoid and 21 middle mucosa). Our findings support the hypothesis that biofilms may play a significant role in otolaryngologic infections. 12 of the 21 patients (% 57) with cochlear implant demonstrated findings of a biofilm. However, bacterial microcolonies were not evenly distributed over the entire surface of the specimen, but rather located in some parts of the specimen, mostly located in small depressions between cells of normal-appearing mucosa. For the biofilm studies with SEM, high magnifications are very important. Sometimes, for the samples which seem to be negative at low magnifications, as magnification was increased, biofilm presence was encountered. On the contrary, sometimes, for the samples which seem to be positive at low magnifications, as magnification was increased, rough surface structure of tissue or erythrocytes were observed. Nevertheless, further investigations should be performed in order to determine that whether biofilm formation may be an important factor in the pathogenesis of these infections.

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Fig. 1: Figure 1. Scanning electron micrograph of middle ear tissue covered with biofilm. All specimens were removed from patients with cochlear implant.

Fig. 2: Figure 2. Higher magnifications of same picture. Arrows indicate the extracellular material connected to the bacteria.

Fig. 3: Figure 3. This image shows a mastoid tissue sample of same patient. Arrow indicate the biofilm.

Fig. 4: Figure 4. This image shows the surface of a middle ear of a patient with cochlear implant. The specimen was used as a control in our study. Note the relatively smooth surface and lack of organisms.