Topographic Distribution of Pseudomonal Biofilm on Tympanostomy Tubes – An in vitro Model

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- Children who undergo tympanostomy tube (TT) insertion may experience post-tympanostomy tube otorrhea (PTTO), which may eventually lead to TT obstruction or dysfunction.
- Late-onset PTTO (>4 weeks after TT placement) is documented in approximately 16% of operated children and is correlated with bacterial biofilm formation, especially in children >2 years of age, the majority of patients that undergo TT insertion.
- PTTO is likely to be caused by Pseudomonas aeruginosa, Haemophilus influenzae or Staphylococcus aureus.
- We studied the topographic distribution of experimental Pseudomonas biofilm on 2 common commercial TTs.

Introduction
- Bacterial biofilms are complex, organized microbial communities, in which bacteria co-exist in a matrix of extracellular polysaccharide substance which permits both communication and diffusion of nutrients, leading to increased antimicrobial and host defense resistance.
- Research has proven that biofilms are involved in the generation of acute otitis media (AOM), and otitis media with effusion (OME).
- Pseudomonas aeruginosa has been associated with biofilms formation on tympanostomy tubes (TTs), some of them are even ciprofloxacin-resistant.

Study Aims
- To study biofilm formation on TTs and learn about the its topographic distribution. This knowledge is a crucial step in the understanding of the weakness points of TTs surface and shape, on which biofilm form.

Methods
- P. aeruginosa PAO1 experimental strain was incubated in a biofilm-forming media with sterile silicon Activent® Paparella-type TTs and Activen® Armstrong silicon to allow formation of biofilm growth. Appropriate fixation and staining were performed on the immobilized bacteria on the TT upon few hours of incubation.
- The presence and topographic distribution of biofilms on the TTs were evaluated by a scanning electron microscope (SEM).

Discussion
- We found that straight angled junctions, between the main body of the TT and the flanges in the Armstrong-type TT and the rims of the Paparella-type TT are prone to harbor biofilms.
- The topographic aspect in the TT structure that should be taken into consideration in the effort to reduce biofilm formation, which often results in post-tympanostomy tube insertion otorrhea and TT extraction.
- These sites should be changed, either through redivising the TT surface geometry itself by eliminating straight angles, or through utilizing different biofilm inhibitory materials in these vulnerable areas.
- Studies that examined antibiotic coating of TTs included “static” coating, when the TT was coated without antibiotic release, and “dynamic” coating, when antibiotics were actively released from the tube’s outer surface. These options should be weighted and tried in the sites we showed which are prone for biofilm formation.

The adaptation of global agreements in the approach to pediatric AOM cases could lead to a decrease of morbidity and related mortality of this frequent disease.