Mgr Anna Minkiewicz-Zochniak

„Effect of low amperage electric current on bacterial biofilm reduction in cystic fibrosis patients”

Abstract

Cystic fibrosis (CF) is an inherited recessive disease caused by multiple mutations in a single cystic fibrosis transmembrane conductance regulator (CFTR) gene. CF is an inherited disease that affects multiple organs and systems. The oral cavity microbiota and oral health status of cystic fibrosis patients, especially adult patients, can serve as a substantial source of bacteria, causing respiratory infections and diseases. The literature reports that the majority of deaths in CF patients are caused by respiratory failure, pneumonia, chronic lower respiratory diseases, pulmonary heart disease and diseases of pulmonary circulation and aspergillosis. These diseases still continue to dictate the clinical course of the disease and prognosis in patients with CF.

The aim of the current study was to report the oral health status of adult patients with CF including a dental history, evaluation of the dentition and microbiological analysis. Also evaluated are the differences in the in vitro biofilm formation on the surface of biomaterials commonly used in dentistry (Ti-6Al-4V, cobalt-chromium alloy (CoCr), and zirconia – 3% mol Y2O3 (3Y – TZP, yttrium stabilized tetragonal zirconia polycrystals)) by Staphylococcus aureus isolated from patients with CF. In addition, the effects of high hydrostatic pressure (HHP) on biofilms formed by Staphylococcus aureus on smooth or rough-surfaced stainless steel were assessed. But the main aim of the study was to evaluate the effect of low amperage electric current on the formation of Staphylococcus aureus biofilms on dental implants such as titanium (Ti-6Al-4V) and zirconia ceramics (3Y – TZP) in adult patients with cystic fibrosis.

An unhygienic environment of the oral cavity and, and above all, the formation and presence of a bacterial biofilm, i.e. dental plaque, contribute to the spread of bacteria from the resulting biofilm in the oral cavity through the micro-aspiration of bacteria into the respiratory tract and play an important role in the pathogenesis of many diseases. Poor oral health may affect lung function and increase the risk of bacterial pneumonia, especially in high-risk populations, such as adults patients with cystic fibrosis. This is of key importance in the course of cystic fibrosis and is a significant clinical problem because it may be a potentially controllable risk factor for death in cystic fibrosis.

In this study, differences in the in vitro biofilm formation on the surface of biomaterials commonly used in dentistry were demonstrated. It was shown that Staphylococcus aureus adherence and growth depends on the type of material used and its surface. Bacterial biofilm formation was more weakly observed on zirconia surfaces compared to Ti-6Al-4V and cobalt-chromium alloy (CoCr), surfaces. In consequence, the selection of an appropriate biomaterial for implants may affect oral cavity infections, particularly in patients with cystic fibrosis. The study also presents findings that non-invasive methods, such as like high hydrostatic pressure and low amperage electric current, can be used for the elimination of Staphylococcus aureus. The influence of HHP on Staphylococcus aureus biofilm formation and bacteria elimination on biomaterial surfaces has been proven. In addition, the use of low amperage electric current can be used to control Staphylococcus aureus biofilm formation, remove existing Staphylococcus aureus bacterial cells, and prevent Staphylococcus aureus from adhering to the surface of the biomaterial used in implants (prosthetic treatment).

Therefore, the obtained results in this doctoral dissertation could have a significant impact on the development of guidelines for the dental management of adult CF patients. They can also be used in

the prophylaxis or dental treatment of patients with cystic fibrosis as an alternative to invasive methods of fighting Staphylococcus aureus biofilm