Candidal Biofilm Analysis of Tracheoesophageal Puncture Prosthesis

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ABSTRACT

Objective
A polymicrobial biofilm has been implicated in nonfunctioning TEPs. The purpose was to evaluate and measure Candidal biofilms and colony forming units (CFUs) on functioning and nonfunctioning TEPs.

Methods
TEPs were prospectively collected and characterized as nonfunctioning (leaking) or functioning. Through a previously described sonication technique, planktonic species were removed and the biofilms were matured for 72 hours on Chromagar plates specific for Candidal growth. Candidal CFUs were then measured and analyzed.

Discussion
A total of 16 TEP specimens were during this study. 11 TEPs were malfunctioning and 5 were for routine replacement. There was a trend toward higher CFUs on the mature biofilms from the TEPs that were malfunctioning compared to the properly functioning TEPs. The mean Candidal CFUs/mL was 1.2 x 10⁶ versus 3.0 x 10⁵ for malfunctioning versus normal functioning TEPs respectively. This is consistent with the hypothesis that Candidal species are present in biofilms associated with TEP failure, especially with intra-luminal leakage.

Conclusions
Malfunctioning TEPs can be very bothersome to laryngectomy patient as there is a reduced ability to phonate, as well as increases their risk for aspiration of contents from the neopharynx/esophagus. Few previous studies have performed Candidal biofilm analysis on TEPs from live patients. This study illustrates there is an association of higher Candidal CFUs present in biofilms in these prosthesis. In the future, reduction or prevention of biofilm formation of Candidal species may reduce the need for frequent TEP changes.

INTRODUCTION

Speech rehabilitation after total laryngectomy is an important consideration. Many different methods have been developed including the tracheoesophageal puncture prosthesis (TEP), which acts as a one way valve to allow passage of air into the neopharynx allowing speech. Unfortunately, these prostheses are prone to leakage necessitating replacement as well as an increased risk of aspiration. Candidal species have been implicated in contributing to this leakage. Few studies on live patients have been performed to analyze the presence Candidal (specifically candida albicans) biofilms.

MATERIALS AND METHODS

This study was a prospective study performed by collecting TEPs from live patients as they presented to our Speech Pathology for either routine replacement or when the prostheses were malfunctioning. For the purposes of this study only those TEP's that were malfunctioning secondary to leakage were included. The prosthesis were collected and immediately transported to the lab space where the following protocol was performed to analyze the candidal biofilm.

Using antiseptic technique, the TEPs were rinses with 10 mL of phosphate buffered saline (PBS) to remove all external crusting. Each TEP was then placed in 10 mL of PBS. Sonication was then applied for 10 mins followed by vortexing for 30 s, further sonication for 5 mins, vortexing for 30 sec, sonication for an additional 30 sec, then final vortexing for 30 sec. Once this was complete the Candida suspension was diluted in Buttefield Buffer and spread onto CHROMagar plates. All dilutions were performed in duplicate.

The Candidal biofilms were then allowed to mature over 72 hours and using the CHROMagar identification system biofilm analysis was performed and colony forming units (CFUs) were calculated.

RESULTS

A total of 16 TEP specimens were collected during the course of this study. 11 were malfunctioning and 5 were for routine replacement. Analysis of these specimens did show that all prosthesis had mature Candidal biofilms present on all TEPs whether they were malfunctioning or not. There was a trend toward higher CFUs for Candida Albicans species on the prosthesis that were malfunctioning. For the malfunctioning group mean CFU’s/mL was 1.2 x 10⁶ versus 3.0 x 10⁵ for the normal functioning group. For the malfunctioning group the shortest length of time to change was 21 days and the longest was 89 days with a mean of 51 days. For normally functioning prosthesis the mean time length of use prior to replacement was 89 days. Results are summarized in figures below.

DISCUSSION

Based on the results of this study, there is evidence that Candidal biofilms are present on TEPs and are formed as quickly as 3 weeks. Additionally, there is a trend toward higher Candida Albicans CFU’s in those prosthesis that are malfunctioning secondary to leakage although this study had insufficient power to determine statistical significance between the two groups. It has long been hypothesized that fungal overgrowth was the primary cause of TEP malfunction, and nystatin formulations are frequently prescribed. This study shows that even after eradication of the planktonic Candida species, candidal biofilms are still present on the surface of these prosthesis and may contributing to device malfunction in the form of leakage. There was a not a direct correlation between CFU’s and length of time that prosthesis was in place when calculating CFU’s of both groups together. This suggests that there is some other process predising a certain subset of the laryngectomy population to increased fungal biofilm formation leading to malfunction. All patients in this series of patient’s received post-operative radiation; however, not all therapy was delivered at the same institution.

CONCLUSIONS

Candidal biofilms are present on both malfunctioning and normal functioning TEPs; however, there is a trend toward higher CFU’s of Candida Albicans species in those that are malfunctioning. There does not seem to be a direct correlation between the length of time prosthesis are in place and the formation of functional impairment by Candidal biofilms. There are other factors which predispose certain populations to mature candidal biofilms that impair TEP function. Developing strategies to reduce Candidal biofilms may increase the functional life of TEPs and reduce the need for frequent TEP changes for patient’s with total laryngectomy. Further study into Candidal biofilms on TEPs is warranted.

REFERENCES


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