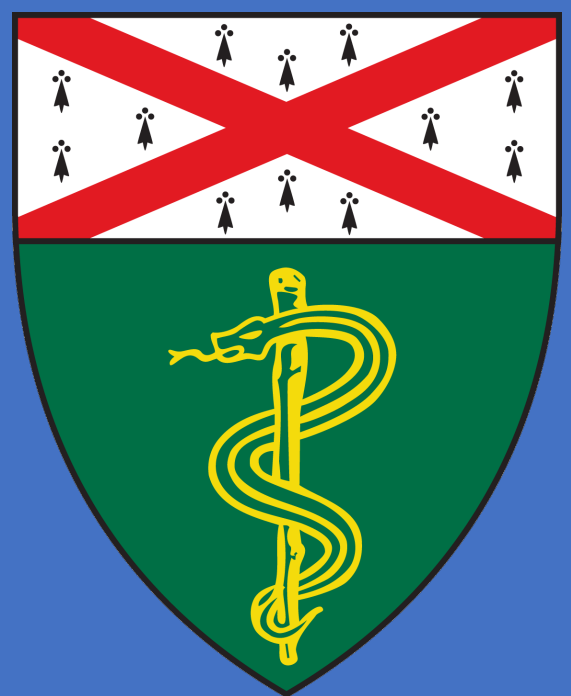




Implications of probiotics and microbiome modulation for tracheoesophageal voice prostheses



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Introduction

Tracheoesophageal prostheses (TEPs) are commonly utilized among patients who have undergone laryngectomies for life-altering speech rehabilitation. The prosthesis consists of a one-way valve that allows for exhaled air to be shunted through the esophagus when the stoma is occluded (Fig. 1).

TEP maintenance remains arduous, often requiring daily cleaning and oversight by a trained provider, often a speech and language pathologist, at regular intervals. Yeast and bacterial overgrowth can spawn biofilm formation and ultimately TEP failure. The average lifetime of such devices is 3-6 months. Antimicrobials are not without risk of side effects and incurring resistance. Our growing understanding of the interplay of commensal flora in altering a wide array of biomolecular processes, protective and pathophysiologic, have led to the inquiry of probiotic interventions in various conditions that involve biofilm formation, including combating dental caries and catheter-associated infections. Such insights have informed the study of various probiotic agents in curbing TEP degradation or failure.

Methods

Relevant MeSH terms and keywords were used to search Pubmed and Google Scholar for pertinent peer-reviewed reviews, meta-analyses, clinical studies and preclinical studies that investigated or commented on probiotic use for TEP management

Results

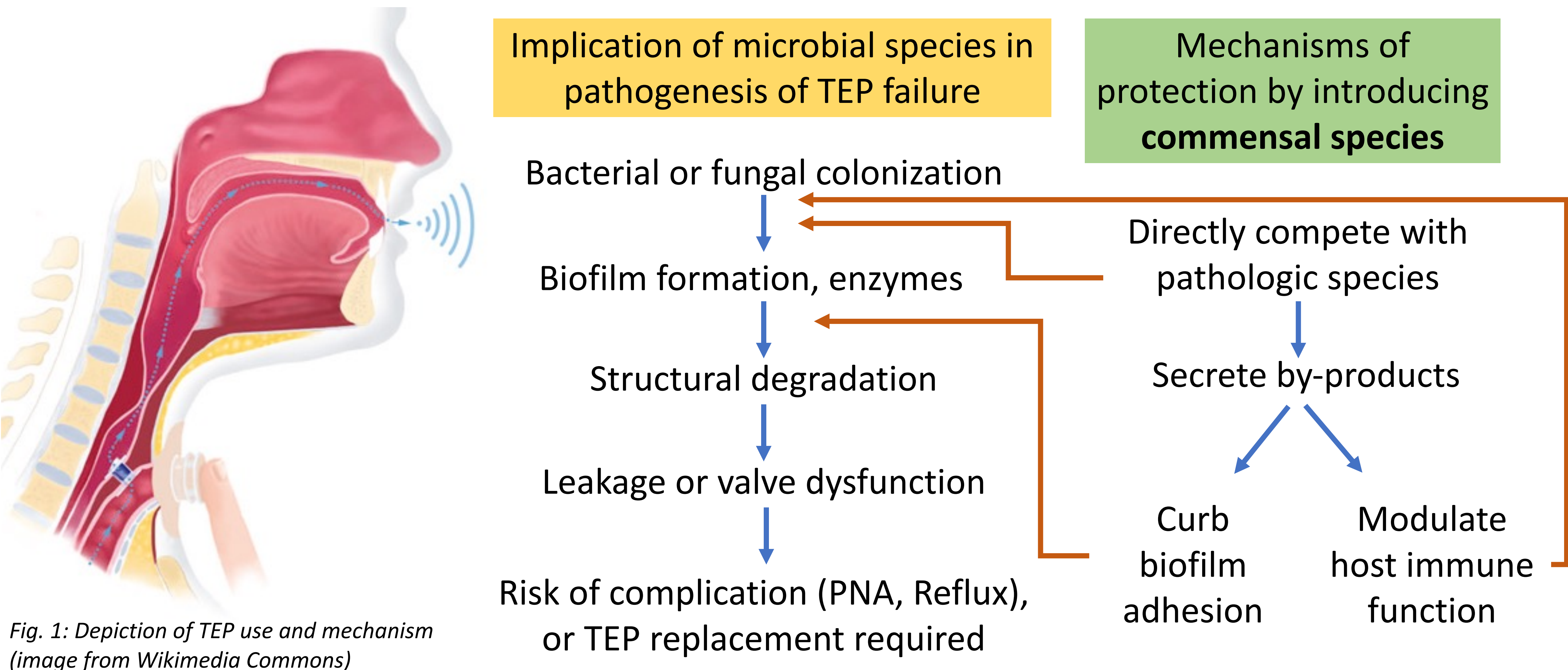


Fig. 1: Depiction of TEP use and mechanism (image from Wikimedia Commons)

Type of Study	Formulation	Probiotic strain(s)	Results	Citation
In-vitro	Isolated biosurfactant	Lactococcus lactis 53, Streptococcus thermophilus A	Biosurfactant application suppressed biofilm formation and reduced airflow resistance	Rodrigues et al, Dec 2020
In-vitro	Isolated biosurfactant	Lactococcus lactis 53	Effectively reduced bacterial and yeast load	Rodrigues et al, Dec 2004
In-vitro	Bacterial suspension	Lactococcus lactis 53	Decreased yeast/bacterial load and biofilm formation	Free et al, Oct 2001
In-vitro	Bacterial suspensions	Lactobacillus strains: (L. fermentum B54, L. rhamnosus 744, L. lactis cremoris SK11, L. casei Shirota, L. lactis 53) and Bifidobacterium infantis 420, Enterococcus faecium 603 and Streptococcus thermophilus	Lactobacillus strains reduced number of yeast harvested from voice prostheses, with the greatest effect from L. lactis 53	Van der Mei et al, Aug 2000
In-vitro	Fermented milk	Lactobacillus casei Shirota	Decreased bacterial load but not biofilm formation	Busscher et al, Apr 2000
In-vitro, in-vivo (n=18)	Fermented milk; buttermilk	Lactobacillus casei Shirota (fermented milk); Lactobacillus lactis and Lactobacillus lactis cremoris (buttermilk)	Fermented milk reduced biofilm formation for in-vitro and in-vivo, while buttermilk did not have a significant effect in-vivo	Schwandt et al, June 2005

Discussion

TEP management is complicated by microbial colonization and biofilm formation that can jeopardize prosthetic integrity and function, ultimately leading to leakage or prosthesis failure.

Existing evidence from in-vitro studies largely support the benefit of delivering commensal bacterial strains or their biosurfactant products to curb pathogen load and biofilm production. However, clinical trials are needed to evaluate their true utility in prolonging TEP lifetime. Innovations in understanding and sensing microbial interactions will offer critical insights to inform meaningful clinical intervention.

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- Figure 1: Laryngectomy 2010, CC BY-SA 3.0 <<https://creativecommons.org/licenses/by-sa/3.0/>>, via Wikimedia Commons
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