Adherence of Oral Opportunistic Bacteria to Endotracheal Tubes and Cuffs

Andréia de TOLEDO, Katsuhiro KITADA, Taihei YAMAGUCHI and Takahiko OHO

Abstract: Ventilator-associated pneumonia is a major medical problem leading to high-level mortality. Prolonged endotracheal intubation frequently leads to colonization of the upper respiratory tract by opportunistic pathogens, which are commensal microorganisms inhabiting the human oral cavity. In this study, we examined the adherence of oral opportunistic bacteria to saliva-coated endotracheal tubes and cuffs, and also examined the mechanism by which a Klebsiella pneumoniae strain adheres to the saliva-coated cuff. Eight strains of oral opportunistic bacteria were examined regarding their ability to adhere to saliva-coated tubes and cuffs. An inhibition assay of the adherence of a K. pneumoniae strain and aggregation assay were performed to clarify the binding mechanism of the bacterium. Of the bacteria tested, strains of Streptococcus pyogenes and K. pneumoniae strongly adhered to saliva-coated tubes, and strains of Pseudomonas aeruginosa, K. pneumoniae, and Enterobacter cloacae adhered strongly to saliva-coated cuffs. The adherence of K. pneumoniae cells to saliva-coated cuffs was inhibited by spermidine. Both spermidine and whole saliva induced the aggregation of K. pneumoniae cells. These results suggest that oral opportunistic bacteria have the ability to adhere to saliva-coated endotracheal tubes and cuffs, and that the adherence of K. pneumoniae cells to the saliva-coated cuff is mediated by type 3 fimbriae.

Key words: Opportunistic bacteria, Adherence, Endotracheal tubes and cuffs

Introduction

The occurrence of nosocomial pneumonia, a common cause of morbidity and mortality, is increasing in intensive care units. Immunocompromised patients who require mechanical ventilation are exposed to the risk of ventilator-associated pneumonia (VAP), which leads to high-level mortality. Prolonged endotracheal intubation frequently leads to colonization of the upper respiratory tract by opportunistic pathogens, of which Gram-negative bacilli such as Pseudomonas aeruginosa, Enterobacteriaceae, and Haemophilus spp. represent 58% of the recovered organisms causing VAP. Gram-positive bacteria, including Staphylococcus aureus and Streptococcus pneumoniae, have also been implicated as causative agents. Oral bacteria present in saliva or periodontal pockets can colonize not only tooth surfaces (dental plaque or biofilm), but also the surface of the oropharynx. Immunocompromised or debilitated patients who are intubated have difficulty swallowing and often aspirate microorganisms into the oropharynx. Bacteria released from the oropharynx can migrate and form biofilm on the endotracheal tube and cuff. Some bacteria detach from the cuff surface, enter the trachea, and arrive at the bronchial tubes, causing pneumonia. As described previously, many clinical reports have examined the detection of opportunistic pathogens from patients with VAP, but few studies have demonstrated the in vitro binding of opportunistic pathogens to endotracheal tubes and cuffs.

In this study, we selected eight oral opportunistic bacteria, Enterobacter cloacae, Klebsiella pneumoniae, P. aeruginosa, Serratia marcescens, S. aureus, Staphylococcus epidermidis, S. pneumoniae, and Streptococcus pyogenes, which have been implicated as causative organisms of pneumonia, and examined their ability to adhere to a