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The role of microbial biofilm in ventilator-associated pneumonia

L. M. BYERS, C. G. ADAIR, S. P. GORMAN, D. S. JONES AND C. E. GOLDSMITH*

*Pharmaceutical Devices Group, School of Pharmacy, The Queen's University of Belfast, Medical Biology Centre, 97 Lisburn Road, Belfast BT9 7BL, and *Department of Bacteriology, Belfast City Hospital, Lisburn Road, Belfast*

The incidence of nosocomial pneumonia in patients undergoing artificial ventilation in the intensive care unit (ICU) setting may be as high as 80%. Factors which have been considered as the cause of, or contributing to nosocomial pneumonia include agents used for the prophylaxis of stress-ulceration and, more recently, the formation of microbial biofilm on endotracheal (ET) tubes used in artificial ventilation. It has been proposed that biofilm may dislodge from the ET tube, be carried further into the lung, thus giving rise to pneumonia. As yet, no direct evidence has been published linking the ET tube and microbial biofilm with nosocomial pneumonia. Therefore the aim of this study, was to determine if microbial biofilm on the ET tube is a causative factor in the development of ventilator-associated pneumonia.

Forty patients (age range 17-82 years) admitted to ICU were entered into the study. Twenty patients had ventilator-associated pneumonia and twenty without pneumonia were used as controls. The median duration of intubation (±SD) was 6±4 days in patients with pneumonia and 3±2 days in the control group. Samples of tracheal secretions were taken during ventilation for bacteriological culture. Following extubation, ET tubes were examined for biofilm and the microorganisms entrained on the surface identified.

Microbial biofilm was observed on all ET tubes from both patient groups and adhered isolates included Enterococcus sp., enteric Gram-negative bacilli (EGNB), coagulase-negative staphylococci (CNS), *Staphlococcus aureus*, *Pseudomonas aeruginosa* and Candida species. Fifty percent of the patients with pneumonia had the same pathogen isolated from both the ET tube and tracheal secretions. Analysis (Fischer exact probability test) indicated that there was a significant ($p<0.005$) association between these pairs of microorganisms. However, in control patients no such pairs of pathogens were isolated.

Table 1. Numbers of potentially pathogenic isolates recovered from endotracheal tube biofilm and tracheal secretions.

	Biofilm		Tracheal	
	Pneumonia	Control	Pneumonia	Control
P.aeruginosa	4	-	4	-
EGNB	4	2	5	3
Enterococcus	2	2	2	-
S.aureus	5	2	7	-
CNS	-	4	-	1
Candida spp.	4	1	2	-

Results from this investigation (Table 1) indicate that the ET tube biofilm, as a reservoir for infecting pathogens, may result in the transmission of microorganisms from the ET tube to the airways. This may lead to the colonisation and proliferation of the aspirated biofilm, and the development of nosocomial pneumonia in the already debilitated ICU patient. The observation that certain patients developed pneumonia, while others did not probably reflects the multi-factorial aetiology of this hospital-acquired complication. Efforts should, therefore be directed to minimising this nidus of infection by reducing the adherence of microorganisms to the ET tube.

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