

Prevention of endotracheal tube biofilm formation through a novel closed suctioning system in a pig model of *Pseudomonas aeruginosa* severe pneumonia

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OBJECTIVES. We tested the efficacy of a novel closed suctioning system developed to mechanically remove endotracheal tube (ETT) biofilm through high-pressure jets of sterile saline and an inflatable balloon in a pig model of severe *Pseudomonas aeruginosa* pneumonia (1).

METHODS. We studied 14 pigs (32.6±2.8 Kg). In 7 animals (control group) we performed tracheal suctioning through the KIMVENT* Closed Suction Systems (Kimberly Clark, USA); in 7 animals (study group) tracheal suctioning was carried out with the novel catheter (Airway Medix Closed Suction System, Biovo Technologies, Israel). Upon suctioning, the new catheter was advanced up to the proximal trachea to aspirate retained secretions. Then, the catheter was pulled back to the tip of the ETT and the balloon inflated to adhere against the ETT wall. Finally, the catheter was withdrawn, while saline jets and aspiration operated simultaneously to displace and remove biofilm. Upon autopsy - following 76h from intubation - the animal was extubated and the ETT longitudinally cut open. Two 1 cm-long hemi-sections of the distal part of the ETT were dissected for qualitative and quantitative analyses of representative biofilm accumulations through confocal laser and scanning electron microscopy

(CLSM and SEM). Biofilm maximal and minimal thickness were computed (ImageJ, NIH, Bethesda, MD, USA) through CLSM and SEM analysis. Biofilm area was computed through analysis of CLSM cross-section ETT images. Biofilm stage (I-IV) was assessed through SEM. During the analyses, investigators were blind to treatment allocation.

RESULTS. In the control and study group 7.9±4.7 and 7.8±3.5 tracheal aspirations/day were performed, respectively (p=0.97). 14 ETTs were analyzed through CSLM. We found, in the control group, a mean biofilm area of 4.3±0.5, vs. 3.7±0.9 log μm^2 in the study group (N:47, p=0.01). The CSLM maximal biofilm thickness in the control and study groups were 151.2±250.8 and 92.7±112.9 μm , respectively (N:47, p=0.08). The CSLM minimal biofilm thickness in the control group was 51.9±120.8 μm and 23.3±71.3 μm , respectively (N:47, p=0.01). 12 ETTs were analyzed through SEM. The SEM maximal biofilm thickness in the control and study groups were 74.6±57.2 and 53.1±57.9 μm , respectively (N:28, p=0.29). The SEM minimal biofilm thickness in the control group was 33.9±30.9 μm and 10.1±14.5 μm in the study group (N:28, p=0.01). Biofilm stage in the control group was 3.0±0.8; whereas in the treatment group was 2.3±1.3 (N:58, p=0.02)

CONCLUSIONS. During severe *P.aeruginosa* pneumonia, the novel suctioning system substantially decreases ETT biofilm formation, limiting biofilm development to the initial stages.

REFERENCES. 1) Luna CM et al. Chest 132(2):523-31.

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