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Erradication of P. aeruginosa biofilm in endotracheal tubes based on lock therapy: results from an in-vitros-study

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Background: Bacterial biofilm is a key element in the development of Ventilator Associated Pneumonia (VAP) and several strategies for its prevention and treatment are mainly targeted at the elimination of internal surface biofilm of the endotracheal tubes (ETT). Data regarding the efficacy of applying antibiotic substances directly to the external surface of the subglottic space are scarce. Our objective was to assess the efficacy of antibiotic lock therapy (ALT) applied at the subglottic space of ETT to erradicate *Pseudomonas aeruginosa* biofilm in an artificially created in vitro bench top model.

Material/methods: We applied a 2-hours ALT to a 72h-mature *P. aeruginosa* biofilm in ETT using two different models: single dose (SD) and 5-days therapy (5D). We used sterile saline as the positive control (SLT). We compared cfu/ml and percentage of live cells between ALT and SLT models using conventional culture after sonication and microscopy (confocal laser scanning microscopy and scanning electron microscopy). ALT was the solution used for selective digestive decontamination (SDD) therapy composed of nystatin 2.6 MUI, tobramycin 15.6 mg/ml, and colimycin 13 mg/ml.

Results: The median (IQR) cfu counts/ml and percentage of live cells between the SD-ALT and SD-SLT groups was, respectively: 3.12×10^5 (9.7×10^4-0) vs. 8.16×10^7 (7.0×10^7-0), p = 0.05; and 53.2 (50.9-57.2) vs. 91.5 (87.3-93.9), p <0.001. The median (IQR) cfu counts/ml and percentage of live cells between the 5D-ALT and 5D-SLT groups was, respectively: 0 (0-0) vs. 3.2×10^7 (2.32×10^7-0), p = 0.03; and 40.6 (36.6-60.0) vs. 90.3 (84.8-93.9), p <0.001 (figure).

Conclusions: Ours is the first in vitro study which demonstrated by culture and microscopy that *P. aeruginosa* biofilm in ETT can be significantly eradicated after performing 5-day ALT with SDD solution in the subglottic space of the artificial model. Future studies are needed to further evaluate its efficacy combined with SDD as a prophylactic measure of VAP in patients under mechanical ventilation.

Figure 1a. Comparison of percentage of live cells between the lock therapy models

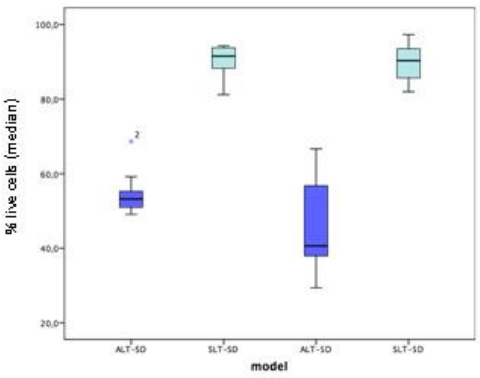


Figure 1b. Confocal laser scanning micrograph of treated and non-treated biofilms of *P. aeruginosa* recovered from the sonicate of the endotracheal tube segments

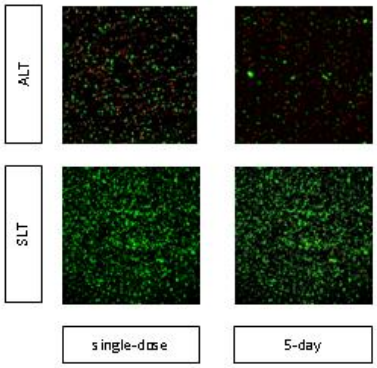


Figure 1c. Confocal laser scanning micrograph of the external surface of endotracheal tubes in the lock therapy and control groups

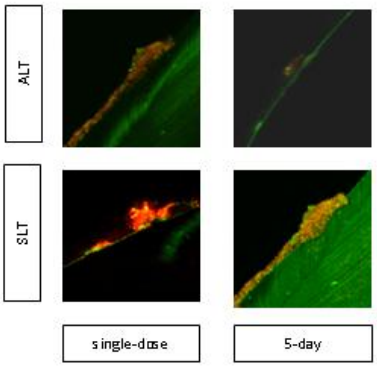
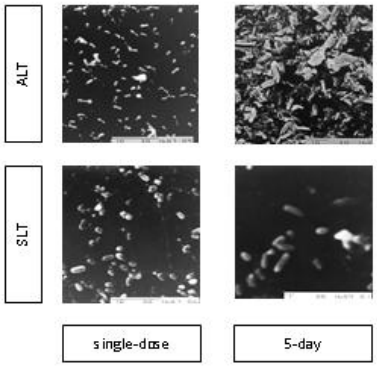


Figure 1d. Scanning electron micrographs of the external surface of the endotracheal tubes in the lock therapy and control groups



ALT, antibiotic lock therapy; **SLT**, saline lock therapy; **SD**, single dose; **5D**, 5-day.