ASSESSMENT OF AN ENDOTRACHEAL TUBE CLEANING CLOSED-SUCTIONING SYSTEM BY MICRO COMPUTED TOMOGRAPHY: PRELIMINARY CLINICAL DATA

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Introduction. Using micro computed tomography (MicroCT), we assessed the effectiveness of a cleaning closed-suctioning-system (CSS) to remove secretions from the endotracheal tube (ETT) lumen. Biofilm growing within the ETT (Fig.1) soon after intubation, increases patient's risk to develop ventilator-associated pneumonia, and new cleaning devices have been designed to keep the ETT clean from secretions.[1]

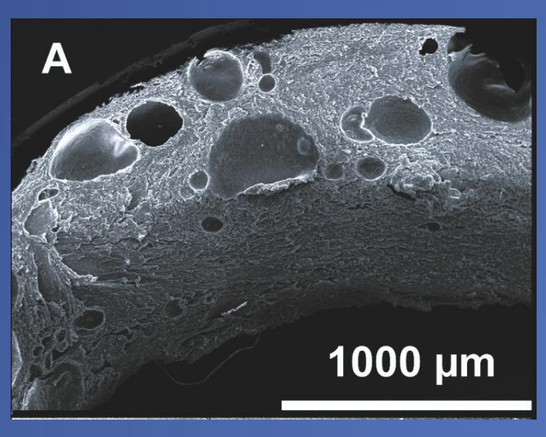

***FIG. 1** SCANNING ELECTRON MICROSCOPY OF AN ETT AT EXTUBATION (BERRA ET AL. CCM 2011)*

Methods. In an bench test, we injected a water-based gel into unused ETTs to evaluate MicroCT scan (SkyScan 1172, Bruker, Belgium) effectiveness to measure secretions. In 6 critically ill patients, a cleaning CSS (Airway Medix Closed Suction system, Biovo, Tel Aviv) was used three times a day to keep the ETT clean (Fig.2). After extubation, we measured ETT secretions volume by MicroCT scanning over a length of 20 cm from the ETT tip. We also collected ETTs from 11 patients treated with a standard CSS as controls, and evaluated ETT microbial colonization.

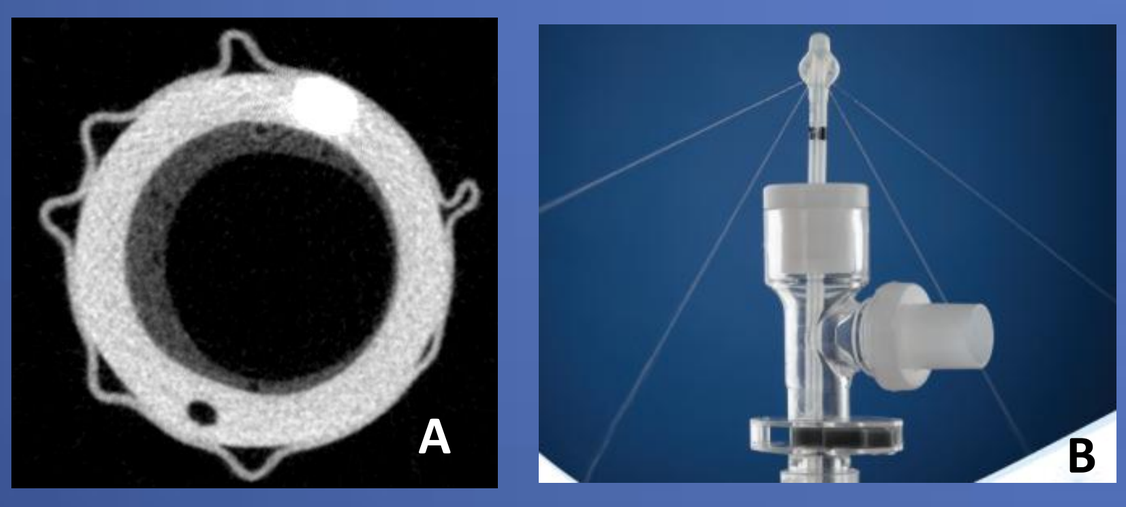

***FIG. 2** PANEL A: SECRETIONS (DARK GREY) PRESENT ON THE INNER LUMEN OF THE ETT (LIGHT GREY, NOTE THE DEFLATED CUFF) WERE MEASURED BY MICROCT SCAN, COMPARING ETTS CLEANED WITH A CLEANING CLOSED SUCTIONING SYSTEM (B) AND CONTROLS*

Results. The volume of gel measured by MicroCT strongly correlated with the volume of injected gel in bench tests ($p<0.001$, $R^2=0.99$, Fig.3).

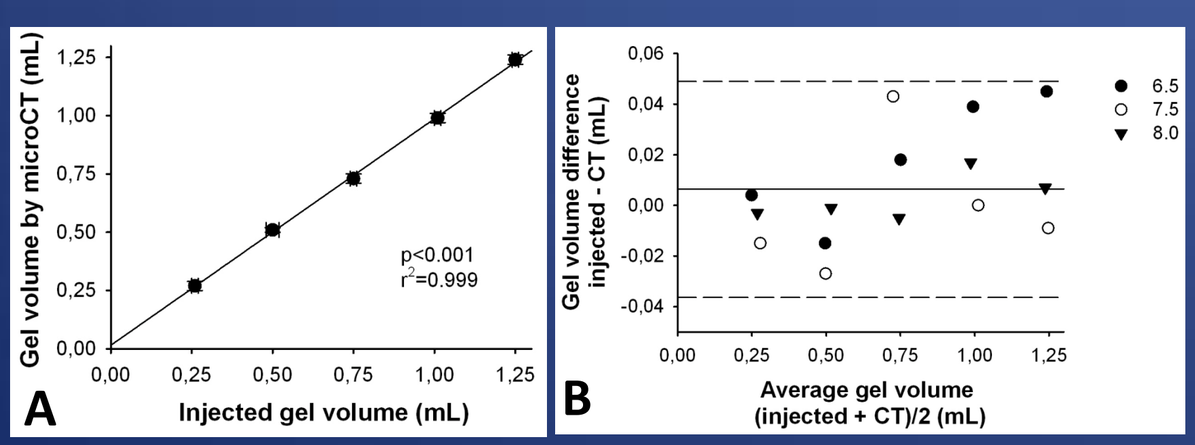

***FIG. 3** MICROCT SCAN SHOWED GOOD PRECISION IN THE QUANTIFICATION OF SECRETIONS IN BENCH TESTS*

At extubation, a lower amount of secretions was measured in the ETTs treated with the cleaning CSS as compared to controls (0.031 ±0.029 vs. 0.350 ±0.417 mm^3, $p=0.028$, Fig. 4), corresponding to a smaller occupation of the cross-sectional area (average 0.3 ±0.4 vs. 3.8 ±4.5 % respectively, $p=0.030$, Fig. 5). Microbial colonization tended to be reduced in the ETTs treated with the cleaning CSS (total bacterial charge 1.3±1.7 vs. 3.6±2.7 Log [CFU/ml], $p=0.08$).

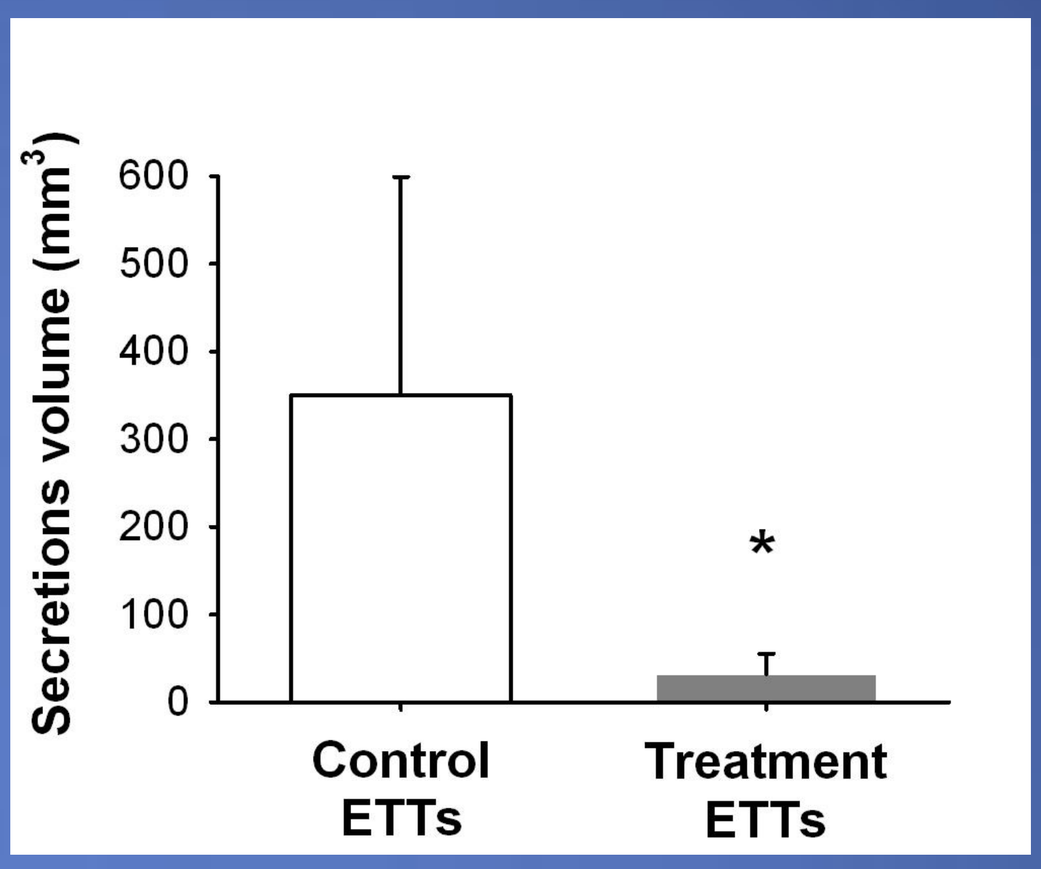

***FIG. 4** AT EXTUBATION, THE VOLUME OF RETAINED SECRETIONS WAS LOWER IN ETTS CLEANED WITH A CLEANING CLOSED SUCTIONING SYSTEM AS COMPARED TO CONTROLS*

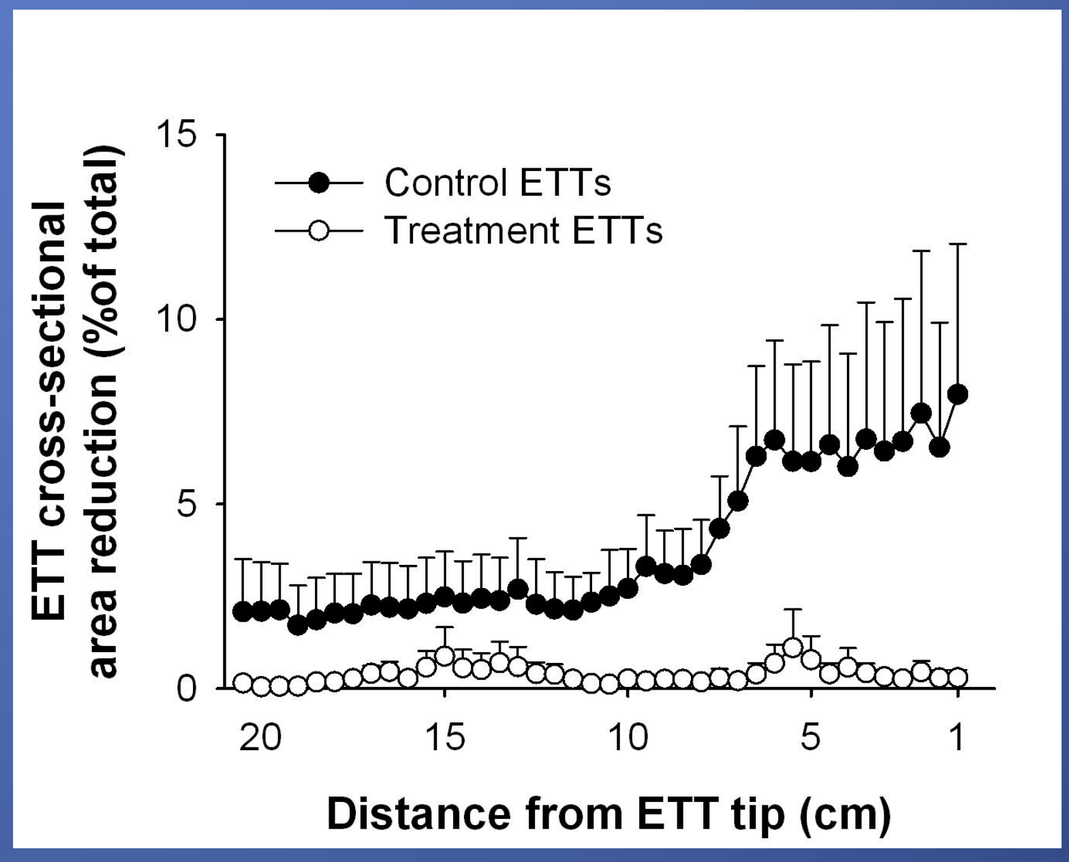

***FIG. 5** AVERAGE CROSS-SECTIONAL AREA REDUCTION ALONG THE ETT RESULTED LOWER IN CLEANED ETTS, AS COMPARED TO CONTROLS*

Conclusions. MicroCT scan showed high precision and accuracy in measuring the volume of secretions in bench tests and can thus be used to evaluate the effectiveness of actions or devices studied to reduce ETT biofilm accumulation. In a small non-randomized population of critically ill patients, the use of an ETT cleaning device appeared effective in reducing the volume of secretions present in the ETT at extubation.

(1) Berra et al. Crit Care Med, 1, 119-24, 2012