Title: JUST SEAL INTRACUFF PRESSURES DURING MECHANICAL VENTILATION

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Introduction. The relationship between high cuff to tracheal wall (C-T) pressure and tracheal damage is well documented. During mechanical ventilation intracuff pressure (ICP) must be high enough during inspiration to prevent significant loss of tidal volume, high enough during expiration to prevent aspiration and low enough during mechanical inspiration and/or expiration to allow capillary perfusion. If C-T pressure exceeds the upper limits of capillary perfusion pressure (approximately 54.4 cm H2O during both mechanical inspiration and expiration, ischemic damage occurs within 15 minutes. We measured just seal ICP during both mechanical inspiration and expiration to determine which cuffs had intracuff pressures low enough to allow perfusion of mucosal capillaries yet high enough to prevent aspiration. We also measured just seal intracuff and resting volumes as well as cuff diameter, thickness and free standing compliance.

Methods. Peak just seal inspiratory and expiratory ICP during ventilation of a Manley best lung with an Emerson PV-1 ventilator was measured on samples of 13 types of size 8 tracheal tubes at 37°C and 100% humidity. Peak airway pressure was controlled at 35 cm H2O. ICP was measured with an aneroid manometer. Just seal intracuff volume (SV) after intubation and un-intubated free standing resting volume (RV) after ICP was decreased from 15 to 2 cm H2O were measured with a calibrated syringe. Cuff diameter was measured at RV with a venier caliper and cuff thickness with a Mitutoyo micrometer. Free standing cuff compliance was measured at 10 ml above RV and corrected to specific cuff compliance by dividing compliance by RV.

Results. Data is summarized in the following tables.

Discussion. To prevent cuff related ischemic damage a tracheal tube cuff should not exert a C-T pressure greater than capillary perfusing pressure. Since venous capillary pressure in tracheal mucosa probably cannot rise over 54.4 cm H2O (40 mm Hg), C-T pressure should not be allowed to exceed this pressure. Since cuffs with similar physical characteristics (lanc and NCC hi-lo) sealed with different intracuff pressures during mechanical ventilation, ICP must be measured and appropriately controlled. Any cuff with diameter less than human tracheal diameter (Bivona small diameter, Franklin NCC Lo-Pro, and Rusch latex) will seal with a high ICP and is not recommended. NCC hi-lo sealed at a lower ICP than NCC intermediate and Portex possibly because its RV is larger. Shape, geometry and durometer (hardness) undoubtedly effect just seal ICP. Thin walled large diameter cuffs with high RVs were associated with fairly low just seal ICPs and are recommended. The diameter of Rusch super safety clear (21.2 mm) and Shiley (22 mm) cuffs exceeded PVC tracheal diameter (19 mm) and ICP's were low at just seal. But, since the human tracheal diameter is larger (24.3 mm for males and 20.5 mm for females) these cuffs will not usually seal with low pressures in patients and are therefore not recommended. If ICP in large diameter thin walled high RV cuffs is maintained under 50 cm H2O during mechanical expiration, ischemic damage should be minimal. The Argyle, Ohio and NCC hi-lo cuffs sealed below 50 cm H2O in our PVC tracheas and will presumably do so in larger human tracheas. Expiration ICP in large diameter thin walled high RV cuffs must be low enough to allow adequate capillary mucosal blood flow (less than 50 cm H2O) yet high enough to prevent aspiration (25 cm H2O).