An Easy And Reliable Method To Continuously Measure The Intracuff Pressure In Cuffed Endotracheal Tubes

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Introduction
When cuffed endotracheal tubes (cETT) are used, there is a concern that a cuff pressure (CP) ≥ 30 cmH2O may compromise the tracheal mucosal perfusion thereby predisposing to the development of airway problems. Hence, hyperinflation of the cuff should be avoided. Various devices have been used to measure the CP at the time of inflation; however, no device has found widespread acceptance for continuous monitoring of CP. We devised a simple method to continuously measure the CP using an invasive pressure monitoring setup (IPMS), which is used routinely in the operating room to monitor arterial or central venous pressures. The accuracy of the device was compared to those obtained from a commercially available and clinically used manometer (MM).

Methods
Size 4.0, 5.0 and 6.0 mm ID cETT’s were placed into one of 3 sizes of polyvinylchloride (PVC) tubes. The PVC tube was used to represent the airway. The calibration of the MM (units in cmH2O) and IPMS (units in mmHg) was validated. The cuff of the cETT was inflated using the inflating MM after inserting the cETT into the PVC pipes to mimic the clinical scenario. After inflation, CP was simultaneously checked using the MM and the IPMS. A total of 100 simultaneous (IPMS and MM) readings were obtained from each of the 3 sizes of cETT with the intracuff pressure randomly varying between 10-40 cmH2O. IPMS values in mmHg were subsequently converted to cmH2O using a standard conversion with 1 mmHg = 1.36 cmH2O.

Statistical analysis included a linear regression analysis and Bland-Altman comparison to determine the bias, precision, and 95% levels of agreement (LOA).

Results
Linear regression analysis demonstrated an R² value of 0.988, 0.9899 and 0.9879 for the comparison of the pressure from the IPMS and MM when using a 4.0, 5.0 and 6.0 mm cETT respectively.

The bias and precision were -0.02 ± 1.268 cmH2O with a 95% LOA ranging from -2.5 to 2.5 cmH2O for the 4.0 mm cETT, -0.04 ± 1.04 cmH2O with a 95% LOA ranging from -2.1 to 2.1 cmH2O for the 5.0 mm cETT, and -0.03 ± 1.2 cmH2O with a 95% LOA of -2.6 to 2.6 cmH2O for the 6.0 mm cETT.

Discussion
The agreement of the IPMS readings with standard pressure MM readings were within the acceptable levels needed for clinical care. Although the CPAP-air leak technique can be used safely to avoid hyperinflation of the cuff, it provides only an instantaneous measure of the pressure. Similarly a MM, which costs approximately $300, provides only a single CP measurement while the standard IPMS can be used to continuously monitor intracuff pressure. The cost for the IPMS is also much cheaper at approximately $7.

Inadvertent hyperinflation of the cuff or subsequent expansion of the gas inside the cuff can occur and compromise tracheal mucosal circulation. As many questions still remain about the prolonged use of cETT, our technique using an IPMS would allow for ongoing prospective trials when continuously monitoring the intracuff pressure is necessary.

References