



## In vitro estimation of pressure drop across tracheal tubes during high-frequency percussive ventilation.

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### ABSTRACT:

Tracheal tubes (TT) are used in clinical practice to connect an artificial ventilator to the patient's airways. It is important to know the pressure used to overcome tube impedance to avoid lung injury. Although high-frequency percussive ventilation (HFPV) has been increasingly used, the mechanical behavior of TT under HFPV has not yet been described. Thus, we aimed at characterizing in vitro the pressure drop across TT ( $\Delta P_{TT}$ ) by identifying the model that best fits the measured pressure-flow (P-V) relationships during HFPV under different working pressures ( $P_{Work}$ ), percussive frequencies and mechanical loads. Three simple models relating  $\Delta P_{TT}$  and flow (V) were tested. Model 1 is characterized by linear resistive  $R_{tube} \cdot V_T$  and inertial  $I \cdot V_T$  terms. Model 2 takes into consideration Rohrer's approach  $K1 \cdot V_T + K2 \cdot V_T$  and inertance  $I \cdot V_T$ . In model 3 the pressure drop caused by friction is represented by the non-linear Blasius component  $[K_b \cdot V \cdot 1.75_T]$  and the inertial term  $[I \cdot V_T]$ . Model 1 presented a significantly higher root mean square error of approximation than models 2 and 3, which were similar. Thus, model 1 was not as accurate as the latter, possibly due to turbulence. Model 3 presented the most robust resistance-related coefficient. Estimated inertances did not vary among the models using the same tube. In conclusion, in HFPV  $\Delta P_{TT}$  can be easily calculated by the physician using model 3.

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