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PRESSURE DELIVERY DURING INTRAPULMONARY PERCUSSIVE VENTILATION IN A SPONTANEOUS BREATHING INFANT MODEL

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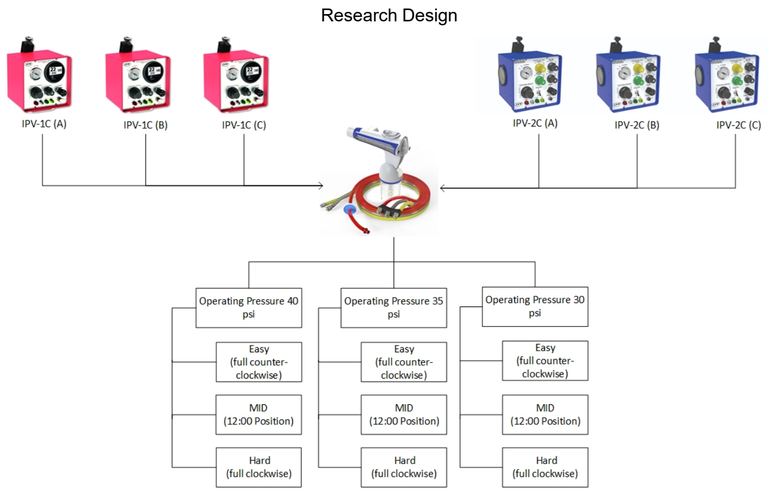
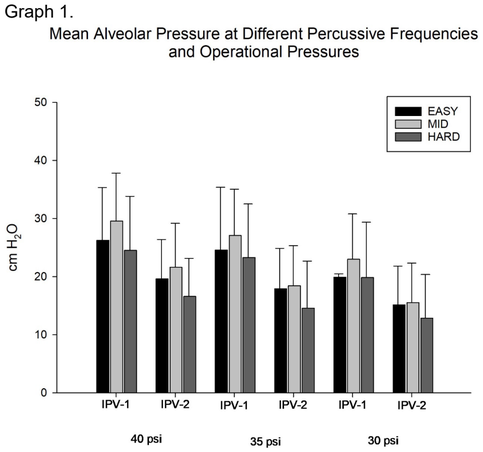
Background: Intrapulmonary percussive ventilation (IPV) facilitates airway clearance in small to mid-sized airways and promotes alveolar recruitment in diseases such as bronchiolitis, characterized by inflammation of lower airways, increased mucus production and increased airway resistance (R_{aw}).[1] However, concerns of excessive peak inspiratory pressure (PIP) delivery have been reported in instances of R_{aw}.[2, 3] The purpose of this study was to investigate pressure delivery between two IPV models in a simulated infant model intubated for bronchiolitis.

Methods: Six IPV devices, (3 IPV-1C & 3 IPV-2C, Percussionaire) were connected to a lung simulator (ASL 5000) set to simulate a 3-month-old infant intubated for severe bronchiolitis.[4] All IPV devices were tested at 30, 35, & 40 psi with frequency set at easy, mid, and hard (Figure 1). Tracheal (distal to ETT) and alveolar (distal to R_{aw}) mean airway pressure (MAP) and Peak airway pressures (Paw) were obtained over four spontaneous breaths. Overall results for IPV models based on average of each device (n=3). Descriptive statistics, T-test, and One-way ANOVA w/Holm-Sidak were used for comparison between IPV models and intra-device variability.

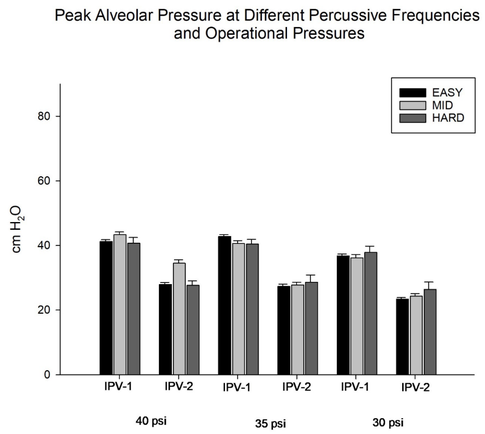
Figure 1.



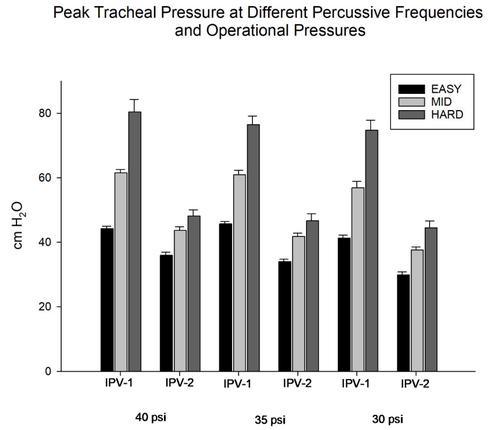
Graph 1.



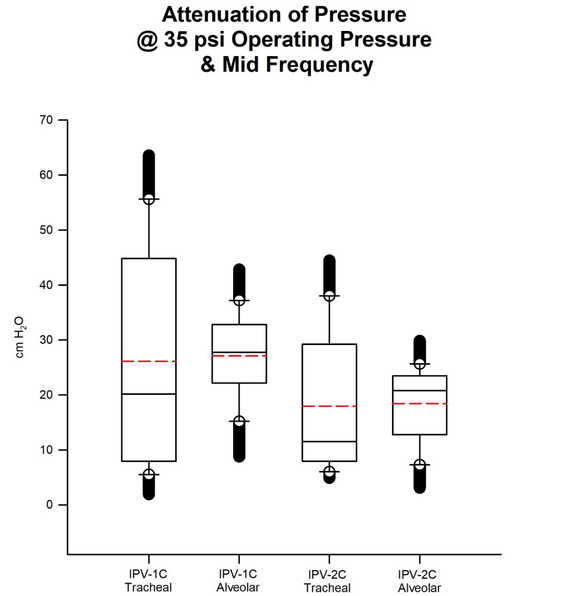
Graph 2.



Graph 3.



Results: The IPV-1C delivered significantly higher MAP (~30%) and Paw (~35%) in all tested scenarios compared to the IPV-2C ($P<0.001$) (Graph 1). Alveolar Paw was significantly less than tracheal Paw in all tested scenarios ($P<0.001$) (Graph 2,3). The highest alveolar (43.40 cm H_2O) and tracheal (80.44 cm H_2O) Paw values were observed at 40 psi "mid" and "hard" settings, respectively, with the IPV-1C. Significant intra-device variation was found in 25 of 27 comparisons with the IPV-1C, and 23 of 27 with the IPV-2C ($P<0.05$).



Graph 1. Box Plot represents Median, Mean (dashed line), 25th & 75th percentiles. Whiskers represent 5th & 95th percentiles.Circles represent values above and below 5th and 95th percentiles.

Conclusions: In this simulated infant model with high R_{aw}, significant differences in pressure delivery were observed between IPV devices and models. While attenuation of tracheal to alveolar Paw was observed, clinicians should be aware of potentially elevated MAP and Paw when using operating pressures above 30 psi and/or at lower frequencies.

1. Riffard G, Toussaint M. [Indications for intrapulmonary percussive ventilation (IPV): a review of the literature]. Rev Mal Respir 2012;29(2):178-190.
2. Karashima T, Mimura-Kimura Y, Miyakawa K, Nakamura A, Shimahara F, Kamei H, et al. Variations in the Efficiency of Albuterol Delivery and Intrapulmonary Effects With Differential Parameter Settings on Intrapulmonary Percussive Ventilation. Respir Care 2019;64(5):502-508.
3. Berlinski A. Be Aware of Intrapulmonary Percussive Ventilation. Respiratory Care 2019;64(5):612-613.
4. Andreolio C, Piva JP, Bruno F, da Rocha TS, Garcia PC. Airway Resistance and Respiratory Compliance in Children with Acute Viral Bronchiolitis Requiring Mechanical Ventilation Support. Indian J Crit Care Med 2021;25(1):88-93.