

Accuracy of Delta Esophageal Pressure Measurements in Adult and Pediatric Balloon Catheters

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Argomento: Insufficienza respiratoria acuta e ventilazione meccanica

Introduction: An esophageal balloon catheter can be used to estimate effort or work of breathing by measuring the difference between pleural pressure during inspiration and exhalation. This change in pressure (delta esophageal pressure or dPes) is thought to be less subject to error from mechanical properties of the balloon such as the balloon inflation volume. We sought to explore the accuracy of dPes when using pediatric and adult sized esophageal balloons over a range of esophageal balloon inflation volumes and surrounding pressures and determine whether an algorithm for optimal inflation could ensure accuracy.

Methods: Constant pleural pressure was simulated by submerging esophageal catheters (6Fr pediatric and 8Fr adult) housed in a model esophagus to depths of 5, 10, and 15 cm of water within a sealed chamber. dPes was simulated by attaching a syringe to the top of the chamber and creating changes in chamber pressure. The esophageal balloon inflation volume was adjusted for each catheter and the difference between dPes and delta chamber pressure was reported as total error. An algorithm was developed using dPes and inflation volume to estimate the optimal filling volume that would result in minimal error.

Results: The range of inflation volume where the total error is minimal $< 2\text{cmH}_2\text{O}$, is larger for the adult catheter (0.4-1.0ml) than it is for the pediatric catheter (0.3-0.4ml). Using an algorithm to detect an optimal filling volume resulted in a mean total error that ranged from -1.5 to -0.7 cm H_2O . The optimal filling-volume values for the pediatric catheters were 0.3 mL, and 0.4-0.6 mL for the adult catheters.

Conclusions: Esophageal balloon inflation volume may affect the accuracy of dPes, particularly with smaller pediatric catheters where the working range of the balloon is much smaller. Using an in-vivo calibration may help ensure accuracy.

Delta Esophageal Pressure and Total Error as a Function of Esophageal Balloon Inflation Volume and Chamber Pressure (6Fr and 8Fr SmartCath)

