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Title: Validation of a multiple breath inert gas washout technique using a lung phantom

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Body: Background: Multiple breath inert gas washout (MBW) is a technique for assessing ventilation heterogeneity by measuring the efficiency with which an inert tracer gas is washed out of the lungs. Aims and objectives: We aimed to use a lung phantom to validate a previously published method for MBW (Horsley AR, et al. Thorax. 2008; 63(2): 135-140). Methods: We built a one-compartment lung model consisting of an enclosed clear acrylic glass tank, partly filled with water at 37^{o}C. The tank was fitted with an off-centre vertical partition that divided it into a larger and a smaller section, but did not reach the base of the tank, thus allowing the two sides to communicate. The lid of the larger section was connected to a bi-level positive airway pressure ventilator which exerted alternating high and low pressures on the water surface, thus causing the water level in the smaller section to alternately rise and fall, simulating diaphragmatic movement. FRC, tidal volume (Vt) and respiratory rate (RR) were adjusted by altering the volume of water within the phantom lung and the ventilator settings. We performed MBW on the phantom lung at a variety of values of FRC, Vt and RR. Each experiment was performed in triplicate. Measured FRC was then compared to the true FRC in each case. Results: Measured FRC was within 5% of true FRC in all but one experiment. The intraclass correlation coefficient for the triplicate measurements was 0.999, suggesting that the MBW technique is highly repeatable. Conclusion: We conclude that MBW performed using an Innocor gas analyser is highly repeatable and accurate. Simple one-compartment lung phantoms appear to be a promising method for the validation of MBW systems.