Monitoring of Functional Residual Capacity and Dead Space in Mechanically Ventilated Adults

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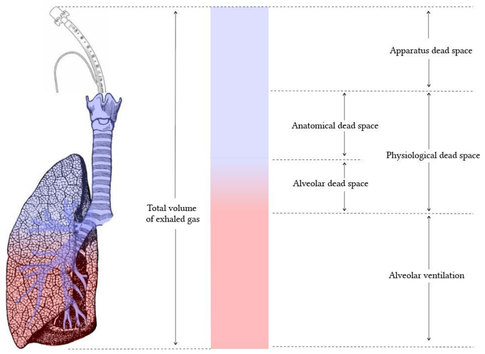
Background



- Physiological dead space (VD) is the part of the tidal volume that does not participate in gas exchange.
- Functional residual capacity (FRC) is the lung volume at the end of passive expiration.
- Measurement of VD and FRC can provide important insight into underlying pathophysiologic processes in individual patients and provide guidance for optimizing ventilatory parameters.
- While this can currently be accomplished on some ventilators, the measurements are lengthy and require a step-wise change in FiO2 and arterial blood gas measurements
- There remains a need for alternative non-invasive methods.

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Study Aim

To evaluate measurements of FRC and physiologic VD acquired from a novel, non-invasive, bedside VQm Pulmonary Health Monitor™ in comparison to current clinical reference standards.

Research Design and Methods

- The VQm PHM™estimates FRC using sequential gas delivery (SGD) technology by administrating 3-breath inspiratory boluses of CO_2 at an F_iCO_2 of 10%.
- These measurements were compared to the FRC obtained using standard nitrogen washout methods on the GE Healthcare CARESCAPE™ ventilator, FRC INview™ software module.
- To measure VD, the VQm PHM™ utilizes volumetric capnography and arterial blood gas values, the same method used by the reference measurement on the GE Healthcare ventilator.
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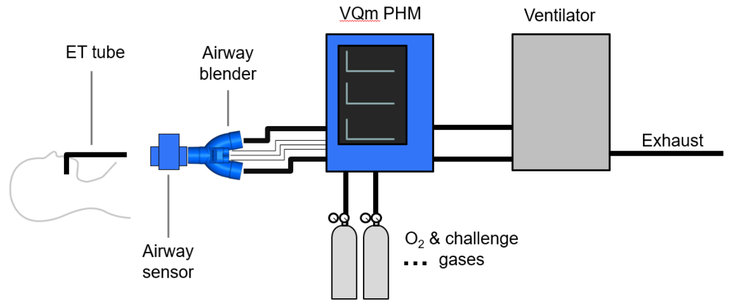

Figure 1. The systematic diagram of where the VQm PHM™ attaches to the patient's breathing circuit.

Results

- FRC data from 8 patients (30 values) demonstrated substantial differences between the two technologies (mean difference between paired values of 0.8±.37 L) (**Fig. 2A**); however, analysis of the changes associated with alterations of PEEP demonstrated excellent concordance (72%) reflecting comparable trending ability (**Fig. 2B**).
- For VD measurements, the mean difference in 7 patients (33 values) was 0.01 ±.05 L (**Fig. 3A**) demonstrating excellent agreement in the values measured by the two technologies. Bland-Altman analysis demonstrated a bias of 0.009 ±0.05 (**Fig. 3B**)

Results

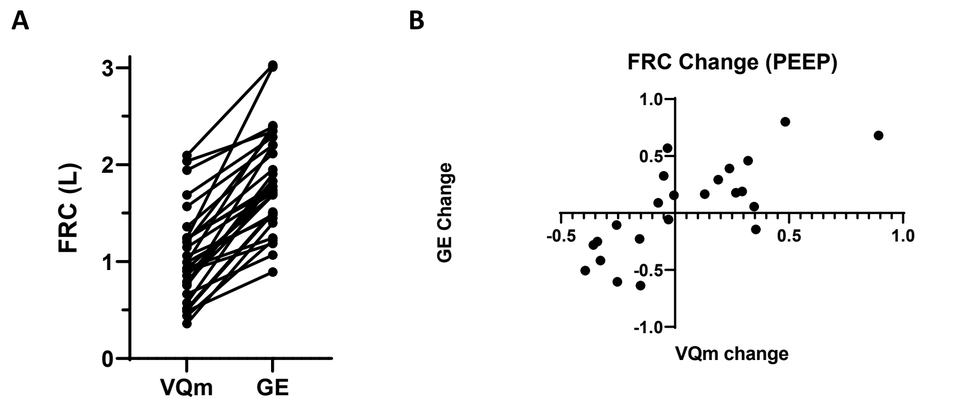

Figure 2. A. Agreement between reference VD and measurements obtained using VQm PHM™. **B.** Bland–Altman plot with lines of agreement.

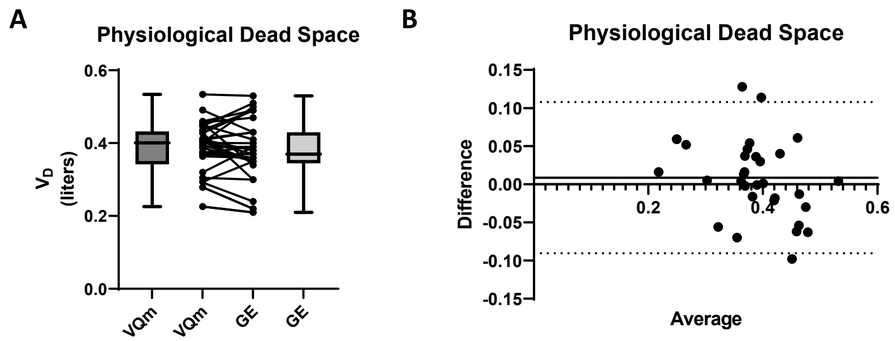

Figure 3 A. Agreement between reference FRC and measurements obtained using VQM PHM™. **B.** Direction of change between VQm PHM™ FRC measurements and reference FRC.

Conclusions

- These results represent the first data of FRC and VD pulmonary function parameters as measured by a novel, non-invasive cardiopulmonary health monitor.
- This device can provide near real-time physiological insight into the effects of changes in lung mechanics during mechanical ventilation.

Acknowledgements/Conflicts of Interest

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