PulmoVista 500 by Drager: A Snapshot of Clinical Usability in The ICU Setting

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Introduction

The PulmoVista 500 (PV 500) by Drager is a non-invasive imaging device that provides a view of lung ventilation using electrical impedance tomography (EIT). Imaging is achieved through several cross-sectional projections that display air distribution in the lungs through sensed electrical changes (1).

- Poorly ventilated areas of lung can be observed and differentiated.
- Aids in assessing effectiveness of mechanical ventilation and track real-time changes from different therapeutic maneuvers (Figure 1).
- Monitoring data is collected through a 16 electrode belt placed across the thorax through bioimpedance. Data can be presented in numerical values, graphical displays and real time cross-sectional images of the chest (1).

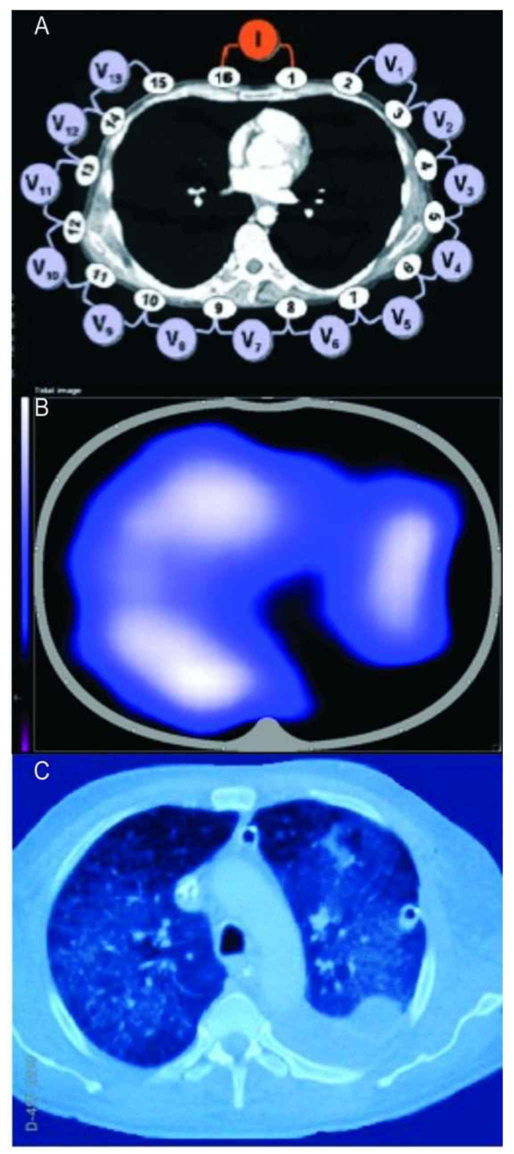


Figure 1: Comparison of CT image and EIT image of the lungs (2).

Background and Hypothesis

- Current research suggests improved detection of regional inhomogeneous lung distribution in ARDS (2,4).
- In patients with complex lung dysfunction caused by ARDS, Cystic Fibrosis and COPD, preventing VILI while maintaining effective lung ventilation is an ongoing challenge (Figure 2) (2).
- The objective of this presentation is to understand the usability of the PV 500 in the clinical setting and whether the data obtained guides changes in therapies.

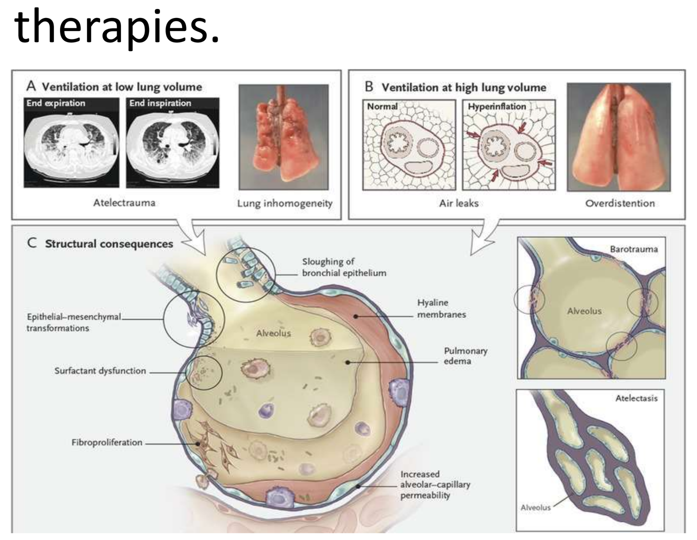


Figure 2: Ventilator induced lung injury at alveolar levels (14).

Does using the PV 500 on mechanically ventilated patients result in changes to clinical therapies including ventilation settings such as PEEP and Peak Inspiratory Pressures or changes in drug therapy?

If the data obtained through EIT monitoring with the PV 500 is effective, then changes to the above therapies are made based on the results to optimize the patient's lung ventilation. To assess this, analysis was conducted on responses to a survey.

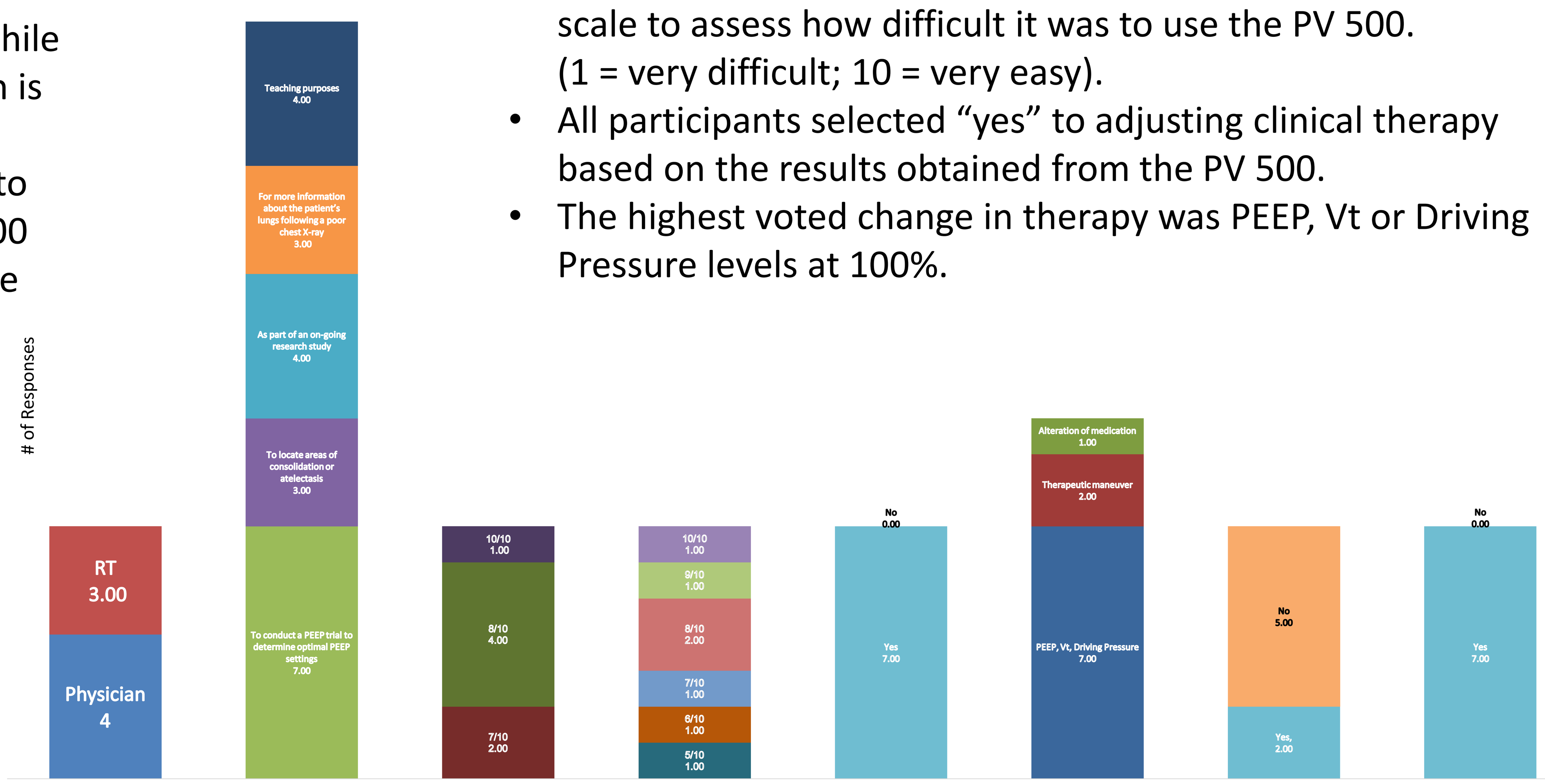
Methods

A written and online survey was conducted containing 8 questions to determine the usability of the PV 500 in the ICU environment.

- Questions were presented in a multiple choice or rating scale format.
- Completed by physicians or respiratory therapists at an academic research hospital in Toronto with experience working with the PV 500 in the hospital's ICU.
- The patients treated at this hospital include, post lung transplant, moderate to severe ARDS and COPD.

Results

- All participants selected "to conduct a PEEP trial and determine optimal PEEP" as one of the reasons why the PV 500 was used.
- 42.9% used the PV 500 to better understand changes following a poor CXR.
- All participants selected 7 or greater on a 1 to 10 rating scale to assess how difficult it was to use the PV 500. (1 = very difficult; 10 = very easy).
- All participants selected "yes" to adjusting clinical therapy based on the results obtained from the PV 500.
- The highest voted change in therapy was PEEP, Vt or Driving Pressure levels at 100%.



Graph 1: Graphical display of data (*n=7*).

Clinical Implications

Disadvantages

- Lack of research comparing EIT devices (6)
- Poor Resolution with 32 x 32 pixel images (3)
- Limited belt sizing, requiring close skin contact for adequate readings (5)

Advantages

- VALI reduction: Differentiation between over and underventilation (2,4)
- Multiple methods to trend data to ascertain correct PEEP (1)
- Real-time patient response to recruitment maneuver (5)

Clinical Applications/Protocols as per Literature (1,5)

- Differentiating between "A responder" and a "Non-responder" to a recruitment maneuver (RM)
- Identifying Derecruitment and Overdistension
- Monitoring Effect of Positioning on Ventilation
- Intubation Check
- Quantification of Pulmonary Edema

Indications

Obtain a clearer understanding of ventilation in patients with ARDS, cystic fibrosis, pneumonia, COPD, and pediatric patients (11).

Contraindications

- Patients with pacemakers, defibrillators or other electrically active implants
- Patients with damaged or impaired skin or uncontrolled body movements
- Presence of strong magnetics (1)

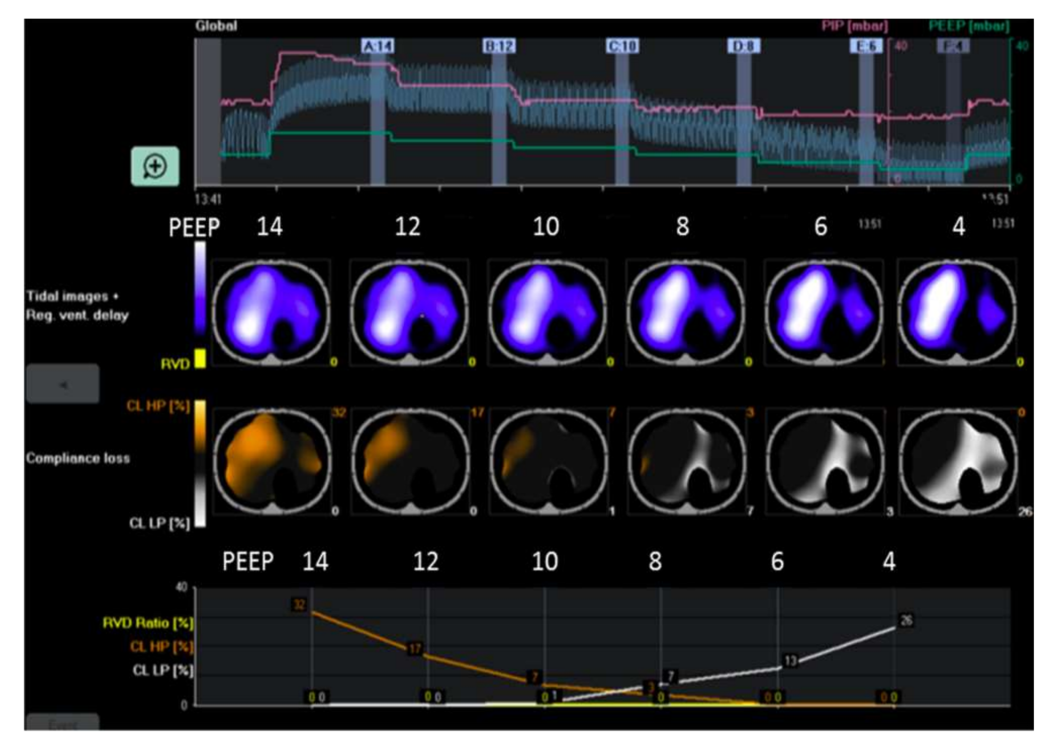


Figure 3: PEEP study, comparison of PEEP, ventilation and compliance (1).

Discussion

- The survey conducted at the Toronto hospital suggests the application of the PV 500 leads to changes in clinical therapies. These changes were only to ventilation parameters and not drug therapies.
- Although the suggested clinical applications range from quantification of pulmonary edema to identifying areas of derecruitment, the survey suggests that PEEP optimization is the most common therapeutic outcome.
- Current research indicates EIT as an effective tool to determine "personalized PEEP" in diffuse ARDS (12).
- Limitations of the survey conducted include small sample size (*n*= <10) and small number of survey responses.

Conclusion

- Real-time measurement of lung ventilation in response to mechanical ventilation, intubation and positioning.
- **Financial and Technical Considerations:** Cost ranges between \$40 000 - \$50 000, comparable to most mechanical ventilators (7). Suggests replacement of parts is potentially expensive due to complexity. A simpler electrode belt could increase efficiency in placement for clinicians (11).
- Current research indicates personalization of PEEP through EIT in COVID-19 related ARDS decreased alveolar distension (13).
- Further research through RCTs will aid in understanding the effectiveness of EIT with the PV 500 on patients with severe lung dysfunction.

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