



Low-Tidal Volume Ventilation in the ED – Are We Doing Better and Does it Really Matter?

Key Article

Monnin KE, et al. Low tidal volume ventilation for emergency department patients: A systematic review and meta-analysis on practice patterns and clinical impact. *Crit Care Med.* 2022; published online ahead of print Feb 7, 2022.

Background

- Critically ill ventilated patients experience high morbidity and mortality.
- Low tidal volume ventilation (LTVV) reduces mortality among patients with ARDS by decreasing VALI. There is increasing literature that suggests LTVV also decreases mortality for those without ARDS.
- ED lengths of stay are now long enough to where VALI can occur. Longer lengths of stay for ventilated ED patients is associated with worse outcome and lower compliance with lung protective ventilation. The use of LTVV in the ED may be beneficial.
- Furthermore, ventilator settings early in the course of respiratory failure are especially impactful on outcome in ARDS.
- Lastly, initial ventilator settings in the ICU tend to persist over time and change very little during the first few days of respiratory failure. ED ventilator settings have been shown to impact ICU ventilator settings.
- The authors report that it has been almost a decade since publications first highlighted that LTVV was rarely used in the ED. Over the past ten years more studies have been published on the use of LTVV in the ED.
- So...have we gotten better and has it impacted outcomes?

Objective

- Perform a comprehensive systematic review to evaluate LTVV use in mechanically ventilated ED patients.

Methods

- Authors searched MEDLINE, EMBASE, Scopus, Cochrane Register of Controlled Trials, and Cochrane Database of Systematic Reviews. Also searched reference lists of publications along with abstracts from scientific meetings of ACEP, SAEM, SCCM, ESICM, ATS, and Chest.
- Studies
 - Included
 - Adults receiving invasive ventilation
 - Randomized studies
 - Nonrandomized studies
 - Cohort studies
 - Compared outcomes between patients receiving ED LTVV and non-LTVV
 - Excluded
 - Pediatric studies

- Case studies
 - Reviews
 - Correspondence
 - Editorials
- Definition of LTVV: tidal volume less than or equal to 8 ml/kg PBW
- Primary Outcome
 - In-hospital mortality
- Secondary Outcomes
 - Duration of mechanical ventilation
 - ICU LOS
 - Hospital LOS
 - Occurrence of ARDS after admission

Results

- In the final analysis, **21 studies** were included
 - 11 studies provided outcome data
 - Published between 2016-2021
 - 3 quasi-experimental, before-and-after studies
 - 2 retrospective before-and-after studies
 - 6 cohort studies
 - 8 rated as good quality
 - 3 rated as poor quality
 - 10 studies provided descriptive tidal volume data
 - All cohort studies conducted between 2009-2020
 - 3 rated as good quality
 - 7 rated as poor quality
- *Impact of ED LTVV on Ventilator Settings*
 - Implementation of ED-based ventilator protocols led to an increase in ED LTVV
 - A significant reduction in ED tidal volume (-1.5 ml/kg PBW) over a 10-yr period
 - Use of ED LTVV associated with an increase in ICU LTVV (odds ratio 4.41) and significant reduction in ICU tidal volume (-1.0 ml/kg PBW)
- *Impact of ED LTVV on Clinical Outcomes*
 - *Mortality*
 - 10 studies included (11,086 patients) – pooled mortality of 24.5% for LTVV group vs. 23.1% for non-LTVV group.
 - 1 study identified as a significant outlier. When that was removed from the analysis – pooled mortality of 26.5% for LTVV group and 31.1% for non-LTVV group.
 - *Occurrence of ARDS after admission*
 - 4.5% for ED LTVV group
 - 8.3% for non-LTVV group
- *Impact on Lengths of Stay*
 - Hospital LOS
 - 7 studies (10,163 patients)
 - ED LTVV associated with shorter hospital LOS (-1.2 days)
 - ICU LOS
 - 7 studies (10,163 patients)

- ED LTVV associated with shorter ICU LOS (-1.0 days)
- *Duration of Mechanical Ventilation*
 - Six studies (7,122 patients)
 - ED LTVV associated with an increase in ventilator-free days (1.4 days)
- *Patients with ARDS*
 - 2 studies evaluated the impact of ED LTVV on patients with ARDS while in the ED
 - Mortality
 - 33.6% in the LTVV group
 - 47.9% in the non-LTVV group
 - Associated with shorter ICU LOS and increase in ventilator-free days

Limitations

- No current randomized clinical trials compared ED LTVV with non-LTVV or usual care
- This review focused only on tidal volume. Did not take into account the other components of lung-protective strategies – limiting plateau pressures, PEEP, limiting hyperoxia, etc.
- Statistical heterogeneity was moderate to high
- Majority of studies conducted in the US and Canada and in academic medical centers
- Did not investigate long-term outcomes

Take Home Points

- ED tidal volumes have decreased over the past decade.
- ED LTVV was associated with decreased mortality, decreased frequency of ARDS development after ICU admission, decreased ICU and hospital LOS, and a decreased duration of mechanical ventilation.
- Consider LTVV as the initial ventilator setting for the majority of ventilated ED patients.
- A protocolized approach to ED ventilator settings improves compliance with ED LTVV and decreases tidal volumes by about 1.5 ml/kg PBW