



What is the Optimal Oxygen Saturation Target in Critically Ill Vented Patients?

Key Article

Semler MW, et al. Oxygen-saturation targets for critically ill adults receiving mechanical ventilation. *N Engl J Med.* 2022. The PILOT Investigators. Published online October 24, 2022.

Background

- Approximately 2-3 million critically ill patients are intubated and ventilated each year in the US
- In-hospital mortality among critically ill patients receiving MV is approximately 35%.
- MV always involved adjusting FiO₂ to maintain arterial oxygen saturation (assessed by either SpO₂ or PaO₂)
- The optimal oxygenation target in critically ill adults remains uncertain.
 - SpO₂ targets on the high range (96-100%) provide some safety against hypoxemia but can increase hyperoxemia and the potential detrimental effects of too much O₂
 - SpO₂ targets on the low end (88-92%) decrease risk of hyperoxemia but place the patient at risk of hypoxemia and tissue hypoxia
 - SpO₂ targets in the intermediate range by avoid risks of both extremes
- RCTs on oxygenation targets in critically ill patients have produced varying results. Some studies have reported a U-shaped association between oxygenation and clinical outcomes.
- As a result, clinical practice is widely variable with respect to oxygenation in vented critically ill patients.

Objective

- Determine the effects of lower, intermediate, and higher SpO₂ targets on outcomes in critically ill patients received mechanical ventilation.

Methods

- Pragmatic, unblinded, cluster-randomized, cluster-crossover trial
- Conducted in the ED and ICU at Vanderbilt University Medical Center
 - Initial enrollment began 7/1/2018
 - Paused from 4/1/20-5/31/20 due to COVID
 - Resumed on 6/1/20 and concluded on 8/31/21
- Patients
 - Included
 - Adults aged 18 years of age or greater
 - Located in the ED or MICU
 - Enrolled at the time of first receipt of mechanical ventilation
 - Excluded
 - Incarcerated
 - Pregnant
- Randomization

- All eligible patients (ED and ICU) were assigned together as a single cluster to an SpO2 target
- Every 2 months the ED and ICU switched together between lower, intermediate, and higher SpO2 targets in a random sequence
- The final 7 days of each 2-month period were considered an analytic washout period during which the ED and ICU continued to use the assigned SpO2 target but data from new patients were not included in the primary analysis.
- Interventions
 - Low SpO2 target 90% (goal range 88%-92%)
 - Intermediate SpO2 target 94% (goal range 92%-96%)
 - High SpO2 target 98% (goal range 96%-100%)
 - Adjusting of FiO2 to target SpO2 was initiated within 15 min of initiation of MV and ended at discontinuation of MV, transfer out of the unit, or end of the 2-month study period
 - If continuous SpO2 monitoring was unavailable, O2 was adjusted to a PaO2 target of 60 mm Hg, 70 mm Hg, and 110 mm Hg in the low, intermediate, and high target groups respectively.
- Primary Outcome
 - Numbers of days alive and free of MV through day 28
- Secondary Outcomes
 - All-cause mortality at day 28

Results

- In total, 3024 patients received MV during the study period. 446 were excluded leaving a total of **2541 patients** in the primary analysis.
 - Low SpO2 group: 808 patients
 - Intermediate SpO2 group: 859 patients
 - High SpO2 group: 874 patients
- Mean FiO2 values in each group:
 - Low SpO2 group: 0.31
 - Intermediate SpO2 group: 0.37
 - High SpO2 group: 0.45
- Median PEEP was 5 cm H2O in each group
- Primary Outcome
 - Low SpO2 group: 20 days
 - Intermediate SpO2 group: 21 days
 - High SpO2 group: 21 days
 - Results did not differ in any prespecified subgroups (including sepsis and post-arrest)
- Secondary Outcome
 - Low SpO2 group: 34.8%
 - Intermediate SpO2 group: 34%
 - High SpO2 group: 33.2%
- Safety Outcomes
 - Incidence of cardiac arrest, arrhythmia, MI, ischemic stroke, and pneumothorax were similar in all 3 groups

Limitations

- Single center – limits generalizability
- Given they started intervention immediately after intubation and initiation of MV, this precluded assessment of severity of lung injury
- Clinicians not blinded to oxygen target assignments
- Did not control for other interventions such as PEEP, sedation, and approach to weaning.

Take Home Points

- Among critically ill patients in the ED and ICU receiving mechanical ventilation, the use of a low, intermediate, or high oxygenation target did not affect the number of ventilator free days.