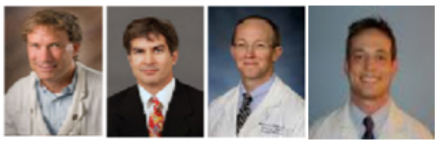
critical care perspectives in emergency medicine



Should We Use Noninvasive Ventilation for Preoxygenation for All ED Intubations?

Key Article

- *Gibbs KW, Semler MW, Driver BE, et al. Noninvasive ventilation for preoxygenation during emergency intubation. N Engl J Med. 2024; 390:2165-77.*

Background

- Approximately 1.5 million critically ill patients are intubated each year in the US.
- Hypoxemia is reported to occur in up to 20% of intubations in the ED and ICU and is associated with cardiac arrest and death.
- Preoxygenation can increased the safe apnea time and decrease the risk of hypoxemia during intubation.
- The majority of critically ill patients are preoxygenated before intubation with an oxygen mask.
    - Unfortunately, oxygen masks do not provide positive pressure and the actual amount of O2 delivered to the patient is variable when the mask does not properly fit.
- Bilevel positive airway pressure ventilation is an alternative to an oxygen mask for preoxygenation, can deliver an FiO2 of 100%, and can support ventilation.
    - Bilevel noninvasive ventilation can increase the risk of aspiration.
- At present, international guidelines state that preoxygenation with either an oxygen mask or noninvasive ventilation is acceptable.

Objective

- To determine the effect of preoxygenation with noninvasive ventilation, as compared with an oxygen mask, on the incidence of hypoxemia during intubation of critically ill adult patients.

Methods

- Pragmatic, multicenter, unblinded, randomized, parallel-group trial.
- 24 sites (7 EDs, 17 ICUs) in 15 medical centers in the US
- Patients
    - Included:
        - Adults $\geq$ 18 years
        - Undergoing tracheal intubation
        - Involved use of sedation and a laryngoscope
    - Excluded
        - Age < 18 years
        - Incarcerated
        - Pregnant
        - Already receiving positive pressure ventilation
        - Had apnea or hypopnea.
        - Had immediate need for intubation that precluded randomization.
        - If the clinician determined that one of the two preoxygenation methods was necessary

- Trial procedures
    - Randomized in 1:1 ratio to a noninvasive ventilation group or an oxygen mask group.
        - Noninvasive ventilation group
            - Operators instructed to administer noninvasive ventilation from the start of preoxygenation until the initiation of laryngoscopy.
            - FiO2 set to 100%
            - IPAP of at least 10 cm H2O
            - EPAP of at least 5 cm H2O
            - RR of at least 10 bpm
        - Oxygen mask group
            - Operators instructed to administer supplemental O2 using a NRB mask or BVM device without manual ventilation before induction from start of preoxygenation to the initiation of laryngoscopy.
            - Administered the highest flow rate available (> 15 L per min)
    - Patients in both groups underwent preoxygenation for at least 3 minutes before induction of anesthesia.
    - Protocol also allowed for administration of supplemental O2 through a standard nasal cannula or HFNC to patients in either group during preoxygenation, during induction and initiation of laryngoscopy, and from laryngoscopy until tracheal intubation (apneic oxygenation)
- Primary outcome
    - Hypoxemia during intubation
    - Defined as an SpO2 of < 85% during the interval between induction of anesthesia and 2 minutes after tracheal intubation.
- Secondary outcomes
    - Lowest oxygen saturation during the interval between induction and 2 minutes after tracheal intubation.
- Exploratory outcomes
    - Hypotension (SBP < 65 mm Hg)
    - New or increased use of pressors
    - Cardiac arrest
- Safety outcome
    - Aspiration during intubation – reported by operator
    - New infiltrate on CXR in the 24 hours after induction
    - SpO2 and FiO2 at 24 hours after induction

Results

- A total of 1301 patients were enrolled in the trial.
    - Noninvasive ventilation group: 49.6%
    - Oxygen mask group: 50.4%
- Characteristics
    - Median age was 61 years
    - 48% had hypoxemic respiratory failure
    - 73% were intubated in the ICU and 27% in the ED
    - 86% of patients were intubated by a resident or fellow
    - Operators had a median of 50 prior intubations
- Primary Outcome – hypoxemia during the interval between induction and 2 min after intubation

    - Noninvasive ventilation group: 9.1%
    - Oxygen mask group: 18.5%
    - Absolute difference -9.4%; CI, -13.2 to -5.6; p<0.001
    - Effect of noninvasive ventilation appeared to be greater among patients with a higher BMI
- Secondary outcome – lowest SpO2 during the interval between induction and 2 min after intubation
    - Noninvasive ventilation group: 99%
    - Oxygen mask group: 97%
- Exploratory outcomes
    - SpO2 < 80%
        - Noninvasive ventilation group: 6.2%
        - Oxygen mask group: 13.2%
    - SpO2 < 70%
        - Noninvasive ventilation group: 2.4%
        - Oxygen mask group: 5.7%
    - Cardiac arrest
        - Noninvasive ventilation group: 0.2%
        - Oxygen mask group: 1.1%
- Safety outcome
    - Aspiration
        - Noninvasive ventilation group: 0.9%
        - Oxygen mask group: 1.4%

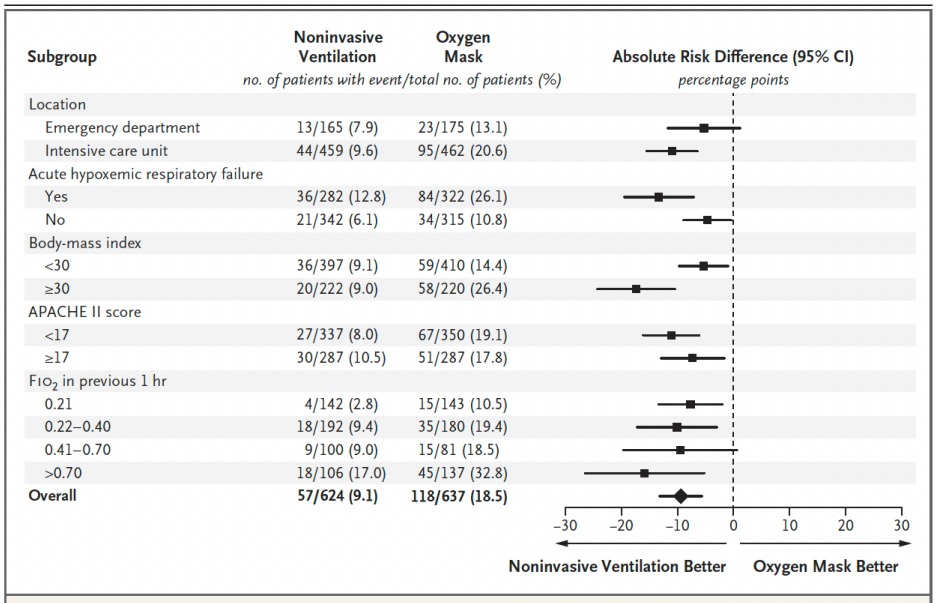


Figure 2. Subgroup Analyses of the Risk of Hypoxemia during Intubation.

Shown are the absolute risk differences and 95% confidence intervals for the primary outcome (hypoxemia during intubation, defined by an oxygen saturation of <85% during the interval between induction of anesthesia and 2 minutes after tracheal intubation) in prespecified subgroups. Absolute risk differences in the noninvasive-ventilation group as compared with the oxygen-mask group were calculated with the use of a logistic-regression model with independent variables of trial group, the proposed effect modifier, and the interaction between the trial group and the proposed effect modifier. Absolute risk differences of less than 0 indicate a lower likelihood of hypoxemia with the use of noninvasive ventilation for preoxygenation. The body-mass index is the weight in kilograms divided by the square of the height in meters. Scores on the Acute Physiology and Chronic Health Evaluation (APACHE) II range from 0 to 71, with higher scores indicating a greater severity of illness. FIO_2 denotes fraction of inspired oxygen.

Strengths Identified by Authors

- Large sample size
- Conducted in multiple EDs and ICUs
- Included broad range of conditions

Limitations Identified by Authors

- Not blinded
- Did not assess patient morbidity or mortality
- Approximately 20% of patients who underwent screening were excluded due to urgency of intubation
- Excluded patients already receiving positive pressure ventilation
- Did not evaluate the use of HFNC during intubation

Take Home Point

- The incidence of hypoxemia was lower with the use of noninvasive ventilation for preoxygenation of critically ill adult ED and ICU patients requiring intubation.