Does bag-mask ventilation between induction and laryngoscopy reduce the incidence of hypoxemia during intubation of critically ill patients?

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INTRODUCTION

Background

Hypoxemia is a common complication of tracheal intubation and can lead to cardiac arrest and death.

Objectives

To compare the incidence of hypoxemia during tracheal intubation with or without bag-mask ventilation (BMV) after induction in critically ill patients.[1]

METHODS

Design

Unblinded, parallel-group randomized control trial

Setting

Seven academic intensive care units (ICU) across the USA

Eligibility Criteria

Adults aged ≥18 years undergoing rapid-sequence induction (RSI) and tracheal intubation randomized to BMV or no ventilation between induction and laryngoscopy.

Intervention

BMV was provided by treating clinicians during an interval between induction and initiation of laryngoscopy. Specifically, this was done with:

1. Oxygen flow rates of ≥15 L/min
2. PEEP valve attached to BMV set to 5–10 cmH_2O
3. OPA in situ
4. Two-handed mask seal with head-tilt and chin-lift manoeuvre
5. Ventilation at 10 breaths/min with smallest volume to generate a visible chest rise

Outcomes

Primary outcome was the median lowest oxygen saturation observed between induction and two minutes after tracheal intubation. Secondary outcome was incidence of severe hypoxemia (SpO_2 < 80%) during that same interval.

RESULTS

A total of 401 patients were enrolled, with 199 patients assigned to the BMV group and 202 patients assigned to the no-ventilation group. Further, 198 patients (99.5%) in the BMV group and five patients (2.5%) in the no-ventilation group received BMV prior to initial attempt at laryngoscopy. There was no difference in oxygen saturation at the time of induction between groups. The median

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lowest oxygen saturation was 96% in the BMV group and 93% in the no-ventilation group ($p = 0.01$). The mean difference in the lowest oxygen saturation between groups was 4.7% (95% confidence interval [CI] 2.5–6.8). There were more patients with severe hypoxemia ($SpO_2 < 80\%$) in the no-ventilation group compared with the BMV group (22.8% v. 10.9%, respectively) with a relative risk of 0.48 (CI 0.30–0.77), and a Number Needed to Treat of 9 to prevent one episode of severe hypoxemia. In addition, there were fewer patients in the BMV group who had an oxygen saturation <90% (29.5% v. 40.1%, respectively; relative risk [RR] 0.74) and <70% (4.1% v. 10.2%, respectively; RR 0.41) compared with the no-ventilation group.

APPRAISAL

Strengths

- Well-designed study that addresses a clinically relevant outcome
- Patients were randomized to treatment groups
- Very little deviation from the study protocol
- The technique of RSI from this study was consistent, and generalizable to the emergency department (ED) with 97.5% of patients receiving a neuromuscular blocking agent.

Limitations

- Excluded patients who either required ventilation post-induction (severe hypoxemia or acidosis) or were at high risk of aspiration
- Included only ICU patients that might have limited generalizability to the ED patient population
- Groups were unblinded once intervention started
- Despite randomization, the no-ventilation group had more patients with pneumonia
- Study did not assess any meaningful patient-oriented outcomes (e.g., mortality)
- There were more patients pre-oxygenated with positive pressure in the BMV group then the no-ventilation group (66% vs. 55%, respectively)
- There was ineffective preoxygenation ($SpO_2 < 92\%$) in 13.9% and 8.6% of patients in the BMV and no-ventilation groups, respectively
- Although some trials have shown a lack of benefit for apneic oxygenation in the ED,[2] only 77% of patients in the no-ventilation group received apneic oxygenation compared with 100% in the BMV group
- Clinicians had structured education on proper BMV technique prior to the study
- The trial was underpowered to detect an effect of BMV on rates of aspiration

CONTEXT

This is one of the largest studies looking at oxygenation during the apneic period following RSI in emergency airway management. However, it does not adequately address one of the key controversies of RSI, the risk of aspiration with BMV. A larger randomized trial assessing the risk of aspiration with BMV would be useful.

BOTTOM LINE

In critically ill patients undergoing tracheal intubation in the ICU, BMV between induction and laryngoscopy improves oxygen saturations and reduces the incidence of severe hypoxemia. It is unclear if this result can be generalized to the ED population undergoing tracheal intubation, given potential differences in aspiration risk. Importantly, BMV during RSI should not replace appropriate preoxygenation to prevent hypoxemia. Moreover, the study protocol required a meticulous BMV technique with a two-handed mask seal and avoidance of excessive ventilation that should be replicated. This approach should be avoided in patients at high risk of aspiration. We recommend considering BMV during RSI of the critically ill patient in the ED who is at high risk of desaturation but at low risk of aspiration.

Keywords: Emergency medicine, airway management, bag-mask ventilation, critical care

Competing interests: None declared.

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