

Comparison of effectiveness of two commonly used two-handed mask ventilation techniques on unconscious apnoeic obese adults

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Abstract

Background. Mask ventilation and tracheal intubation are basic techniques for airway management and mutually inclusive rescue measures to restore ventilation. The aim of this study was to compare the effectiveness of mask ventilation between two commonly used techniques of two-handed mask ventilation in obese unconscious apnoeic adults.

Methods. Eighty-one obese adults received mask ventilation after induction using C-E clamp and modified V-E clamp techniques in a randomized crossover manner. Mechanical ventilation was provided using a pressure-control mode, at a rate of 10 bpm, with an inspiratory-to-expiratory time ratio of 1:2 and a pre-set plateau airway pressure of 20 cm H₂O. The primary outcome was expired tidal volume.

Results. The BMI for the subjects was 37 (SD 4.9) kg m⁻². The failure rates for mask ventilation (tidal volume ≤ anatomical dead space) were 44% for the C-E technique and 0% for the V-E technique ($P < 0.001$). Tidal volume was significantly lower for the C-E than the V-E technique [371 (SD 345) vs 720 (244) ml, $P < 0.001$]. The peak airway pressures were 21 (SD 1.5) cm H₂O for the C-E technique and 21 (1.3) cm H₂O for the V-E technique.

Conclusions. Mask ventilation using the modified V-E technique is more effective than with the C-E technique in unconscious obese apnoeic adults. Subjects who fail ventilation with the C-E technique can be ventilated effectively with the V-E technique.

Clinical trial registration. NCT02580526.

Key words: airway obstruction; difficult airway; mask ventilation; obesity; pressure-controlled ventilation

Nearly all general anaesthesia patients require mask ventilation for a certain time period after intentional apnoea is achieved. Unintentional apnoea, secondary to cardiac arrest or trauma, often requires mask ventilation and may frequently occur outside the operating room, in the emergency room, or prehospital

field resuscitation. Failure to achieve effective mask ventilation can be rescued by successful intubation, but difficult mask ventilation and difficult intubation often occur concurrently,¹ which is catastrophic, often leading to permanent brain damage or death.² Although the guidelines on airway management for

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Editor's key points

- In a randomized crossover design, the efficacy of manual mask ventilation was compared between two methods of mask ventilation using both hands ('C-E' and 'V-E' techniques), in obese patients.
- Compared with the C-E technique, the V-E technique was associated with a lower failure rate and greater tidal volume.
- In obese patients, mask ventilation using the V-E technique is preferred.

anaesthesia and field resuscitation have been continuously improved, the Emergency Airway Algorithm focuses primarily on tracheal intubation rather than mask ventilation.³⁻⁴ In practice, providing effective mask ventilation in a timely manner continues to be a great challenge.⁵ Even though most clinicians understand that effective mask ventilation and tracheal intubation are mutually inclusive rescue methods, optimizing the skill of mask ventilation is largely under-appreciated. Clinicians often make great effort to intubate while unintentionally compromising ventilation and oxygenation.⁶ Additionally, it is particularly challenging to intubate victims during field resuscitation, where intubation commonly takes place concurrently with continuous chest compressions. In fact, the failure rate of intubation during field resuscitation is 10–22%.⁷⁻⁸ Thus, the importance of optimizing the skill of mask ventilation should be emphasized, because effective mask ventilation can indeed minimize or reverse hypoxia, particularly if timely successful intubation is impossible.

The conventional teaching of mask ventilation uses one-handed mask (C-E) ventilation. If ineffective, then a two-handed technique is recommended, because two-handed approaches provide a better mask-to-face seal⁹⁻¹⁰ and produce greater tidal volumes.¹¹⁻¹² However, there are two commonly used techniques of two-handed mask ventilation, the C-E technique (Fig. 1A) and the V-E technique (Fig. 1B). The C-E technique applies the mask by forming a 'C' shape with each thumb and index finger over each side of the mask while the third, fourth, and fifth fingers of both hands lift the mandible toward the mask in a three-fingered 'E' shape. In contrast, the V-E technique uses the thumbs and the eminence of each hand placed over each side of the mask, while the second to fifth digits pull the jaw upward, again forming an 'E' shape.¹³ These two techniques are the last rescue measures for impossible intubation before surgical intervention is used. It is unknown whether both techniques are attempted in practice, or if one is preferred over the other. Although one study has reported marginal superiority of the V-E technique over the C-E technique in novice care providers, the comparative efficacy of the two techniques has not been evaluated systemically.¹⁰ Enabling clinicians to optimize their mask ventilation skills should improve the quality of ventilation and thus oxygenation, and may improve downstream outcomes. The primary aim of this study was to determine and compare the efficiency of mask ventilation in obese adult subjects by using either the C-E technique or the modified V-E technique.

Methods

This study was approved by the Institutional Review Board of Vanderbilt University Medical Center, registered at

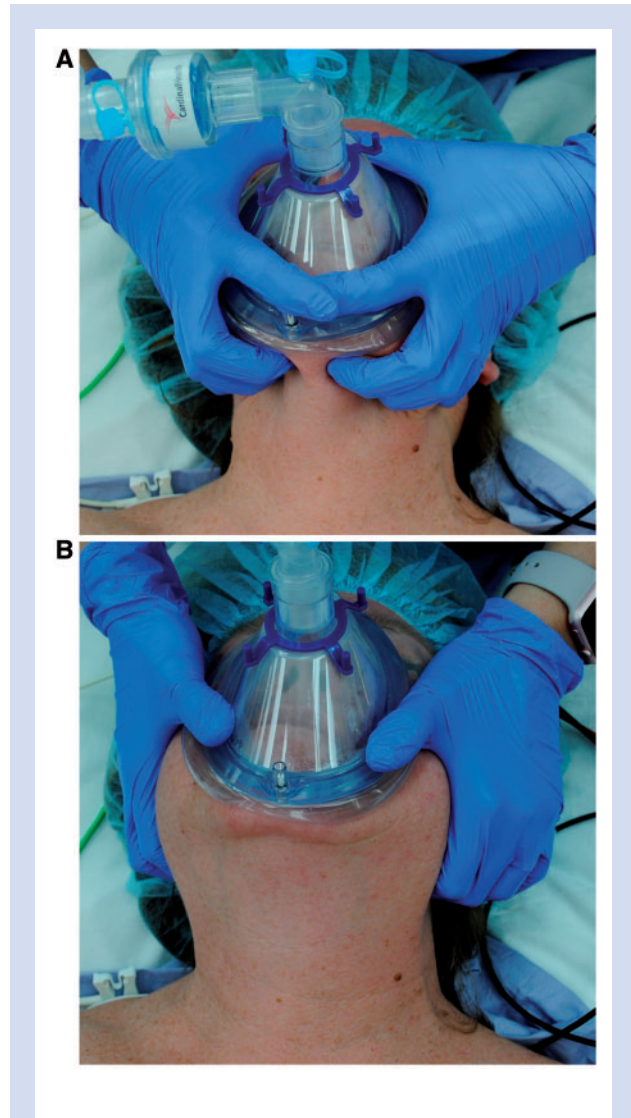


Fig 1 Two-handed bag-mask ventilation technique[s]. (A) The C-E technique. (B) The V-E technique. With the C-E technique, a jaw-thrust is performed by placing the operator's thumbs [and index fingers] on the face [mask] while simultaneously hooking the anterior mandible forward with the 3rd-5th fingers of both hands, increasing central pressure onto soft tissues into the airway. For the V-E technique, the face mask is held firmly over the face with the length of the thumbs along the sides of the mask while simultaneously performing a two-handed jaw thrust maneuver with the index and second fingers behind the angle of the mandible with mouth open. A chin lift is performed, applying anterior force to the mandible with caudal pressure on the mask.

ClinicalTrials.gov (NCT02580526), and was conducted between August 6, 2015 and February 24, 2016. A total of 103 subjects >17 yr of age, requiring general anaesthesia, with a BMI >30 kg m⁻², were recruited from the main operating rooms of Vanderbilt University Medical Center. The exclusion criteria included the following: (i) untreated ischaemic heart disease; (ii) acute and chronic respiratory disorders, including chronic obstructive pulmonary disease and asthma; (iii) ASA physical status classification ≥IV; (iv) emergency surgery; (v) induction requiring rapid sequence for intubation; (vi) pregnant women; and (vii) patients requiring an awake intubation.

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