



Comparison of three techniques of face mask ventilation in children less than two years of age—a randomized crossover study

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Received: 15 January 2019/Revised: 30 April 2019/Accepted: 30 April 2019/Published online: 16 May 2019
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To the Editor,

Anatomical variations in small children often make mask ventilation difficult. The C-E technique (Figure a) is conventionally used for face mask ventilation (FMV). The C-E technique refers to forming a “C” shape with the thumb and index finger over the side of the mask while the third, fourth, and fifth fingers elevate the mandible toward the mask in an E shape. Anesthesiologists often resort to the two-hand C-E technique (Figure b) when ventilation is difficult. The V-E clamp technique (Figure c) refers to the use of thumbs and the thenar eminence placed over each side of the mask, while the rest of the four fingers pull the jaw upward, forming an “E” shape. The V-E clamp technique was superior to both-hand C-E technique in adults.¹ We report a randomized crossover trial comparing FMV using single-hand C-E, two-hand C-E, and V-E clamp techniques in 120 American Society of Anesthesiologists physical status I and II children less than two years of age. The trial was registered (CTRI/2018/01/011318) and research ethics board approval (INT/IEC/

2017/2200278; 23 December, 2017) and written consent was obtained from the participants' parents. General anesthesia was induced with 8% sevoflurane in 50% nitrous oxide. Children received FMV using the single-hand C-E technique, two-hand C-E technique, and V-E technique in random order. Participants were ventilated for five breaths with each technique using pressure control mode at 12 cmH₂O and respiratory rate of 12. Recordings were made after 30 sec of change in FMV technique. The expired tidal volume was recorded as the primary outcome. Inability to generate 2 mL·kg⁻¹ of tidal volume for three consecutive breaths was considered as failure. Sample size was calculated using G*Power 3.1.9.2 software with analysis of variance: repeated measures, within factor F-test assuming effect size of 15% change in expired tidal volume. This assumption was based on the results of a previous study by Joffe *et al.*² Correlation was set to 0.50 for all within factor measures with 90% power of the study and 5% level of significance. A sample of 96 participants was estimated, and to account for drop outs we recruited 120 patients.

The mean (standard deviation) of age, weight, and height of study participants were 11.5 (6.6) months, 8.9 (6.7) kg, and 74 (11.2) cm, respectively. The expired tidal volume was 6.8 (2.5) mL·kg⁻¹ with single-hand C-E, 7.9 (2.4) mL·kg⁻¹ with two-hand C-E, and 8.9 (1.8) mL·kg⁻¹ with V-E technique ($P < 0.001$). Failure to ventilate with single-hand C-E, both-hand C-E, and V-E clamp technique was 5/30 (16.6%), 2/30 (6.6%) and 0/30, respectively ($P < 0.001$).

The majority of studies comparing single-hand and two-hand techniques are restricted to infant or neonatal model mannequins.^{3,4} Hart *et al.* evaluated the single-hand C-E, both-hand C-E, and V-E technique in adult mannequins and found both the two-hand techniques to be superior to

Trial registration: Clinical trial registry of India (CTRI/2018/01/011318); registered: 15 January, 2018.

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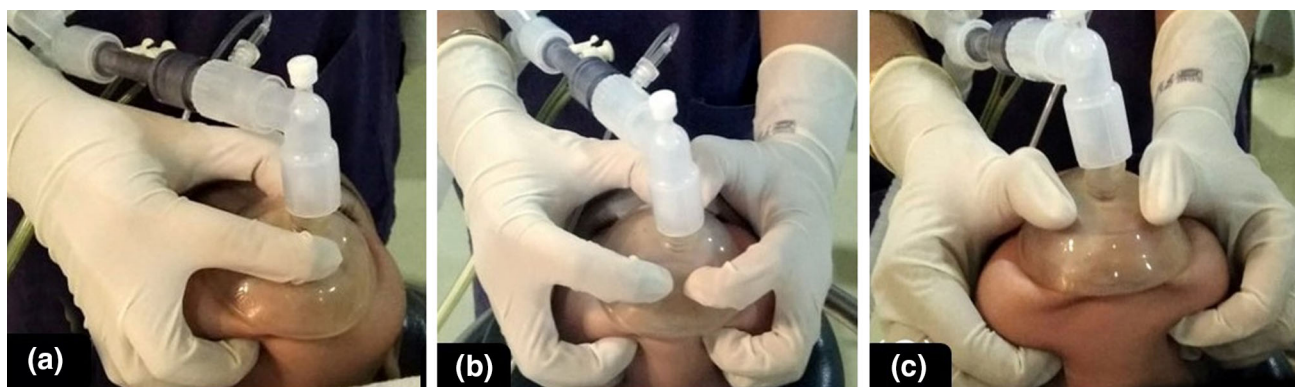


Figure The techniques of mask holding (a) single-hand C-E (b) both-hand C-E (c) V-E technique. See text for additional details

the single-hand technique.⁵ Using both hands in C-E and V-E clamp technique prevents the air leak encountered during single-hand C-E from the non-user side. The greater improvement seen with V-E clamp technique can be attributed to the jaw thrust, which prevents the closure of the mouth and compression of the submandibular tissue often encountered during the C-E technique.

In conclusion, both-hand C-E technique and V-E clamp technique improve FMV in children under two years of age. This highlights the need to incorporate both these techniques in paediatric airway management training.

Conflict of interest None declared.

Editorial responsibility This submission was handled by Dr. Gregory L. Bryson, Deputy Editor-in-Chief, *Canadian Journal of Anesthesia*.

Funding None.

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