The Ventubation System™ for Continuous Airway Control: Results of a Pilot Usability Study

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Abstract

Emergency airway management is associated with a high rate of peri-intubation major adverse events (MAE) — including hypoxemia, hemodynamic instability, and cardiac arrest — which are independently associated with increased mortality. Two procedural variables, apnea duration during intubation and first-attempt success rate, have emerged as the most consequential, modifiable determinants of poor outcomes.[2,3] This white paper presents performance data from a pilot usability evaluation of a novel airway management system aimed at reducing apnea time and increasing first-pass success. In this manikin evaluation, a novel device combination reduced mean apnea time by 67% and time to cuff inflation by 27% compared with standard direct laryngoscopy. These findings, viewed in the context of current peri-intubation literature, support further evaluation of the system as a tool for reducing apnea duration and increasing first-attempt success in prehospital airway management.

Introduction

Emergency airway management remains among the highest-risk procedures performed in prehospital and emergency department settings. In a recent prospective multicenter cohort of 2,846 emergency intubations, peri-intubation major adverse events occurred in 32.3% of patients, and 28-day mortality among those experiencing such an event was 57.6% versus 39.2% in those without an event (adjusted hazard ratio 1.43).[1] A 2024 meta-analysis identified pre-intubation hypoxemia (pooled OR 4.43), pre-intubation hypotension (OR 4.96), and two or more intubation attempts (OR 1.88) as the dominant risk factors for peri-intubation cardiac arrest.[2,3] Among the variables driving these outcomes, two are directly modifiable by improvements in airway technology: 1) the duration of apnea during the procedure, and 2) the proportion of patients in whom the airway is secured on the first attempt. [4, 5]

The Ventubation System: A Novel Solution

The *Ventubation System*™ is a novel airway management system comprising the SupraVent™ supraglottic airway (SGA) and the IntroGard™ endotracheal (ET) introducer, which are designed to address these challenges with:

1. **Continuous Ventilation/Oxygenation.** The Ventubation System's SupraVent is inserted using the same technique as conventional supraglottic airways. Its unique, independent ventilation and intubation channels are designed to allow intubation without removal of the supraglottic device, thus eliminating the apneic exchange interval.

2. **Atraumatic Design.** The SupraVent eliminates the need for direct or video laryngoscopy with a blade, and the IntroGard introducer is specially designed to reduce intubation-associated trauma.

3. **Improved First-Attempt Success.** The system is designed to simplify intubation and increase the likelihood of successful airway placement on the first attempt, reducing procedural skill requirements and the cumulative injury and adverse event burden associated with repeated laryngoscopic attempts.

Methods

Four operators — one physician and three paramedics, all certified in airway management — performed intubations using three approaches: 1) standard direct laryngoscopy (DL) with a conventional ET tube (Standard DL), 2) Standard DL with the IntroGard introducer, and 3) the Ventubation System (SupraVent with IntroGard).

Two procedural outcomes were measured: 1) apnea time and 2) time to cuff inflation. Apnea time was defined as the elapsed time during which no ventilation was delivered, beginning with cessation of bag-mask ventilation and ending with delivery of the first ventilation through the secured airway. Time to cuff inflation was defined as the elapsed time from initiation of the airway procedure to confirmed inflation of the device cuff.

This section seems a bit sparse, and because this is a novel airway it may benefit from more detail.

Results

Across all four operators, the Ventubation System demonstrated the shortest apnea time, with a mean of approximately 12 seconds (range 9–15). Standard DL with the IntroGard introducer yielded a mean apnea time of approximately 22 seconds (range 17–28). Standard DL produced the longest apnea time, with a mean of approximately 36 seconds and substantially greater inter-operator variability (range 26–46). The Ventubation System therefore achieved an approximately 67% reduction in mean apnea time compared with Standard DL, while Standard DL with the IntroGard achieved an approximately 39% reduction *[Figure 1]*.

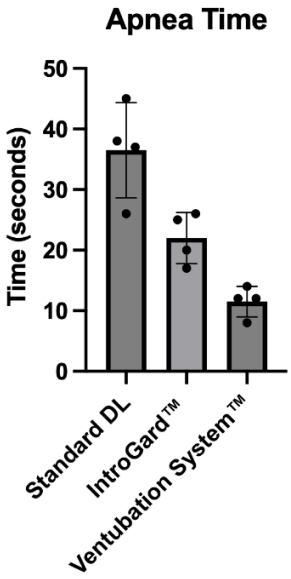

Figure 1 (above)

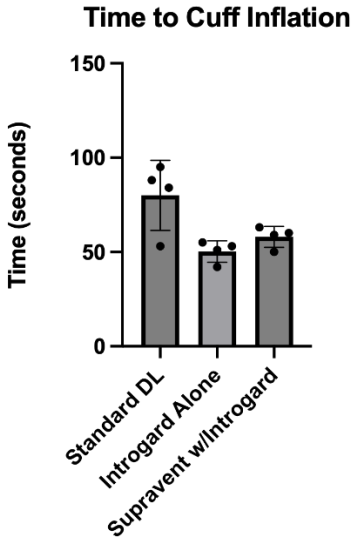

Figure 2 (above)

Mean time to cuff inflation was 78 seconds for Standard DL, 48 seconds for Standard DL with the IntroGard, and 57 seconds for the Ventubation System *[Figure 2]*. It is important to note that although the Ventubation System had a longer time to cuff inflation than Standard DL with the IntroGard, the IntroGard technique does not allow for continuous ventilation, which the patient would be receiving with the Ventubation technique. Overall, the Ventubation System achieved a 27% reduction in time to cuff inflation compared with Standard DL. And Standard DL with the IntroGard produced the shortest time to cuff inflation, reflecting the absence of supraglottic placement that precedes definitive cuff inflation in the combined methodology.

These results are limited by the small sample size (n = 4 operators per condition), the absence of randomization or blinding, and the inherent constraints of a manikin model, which does not replicate the physiologic stress, anatomic variability, or environmental challenges of clinical intubation. The findings are best interpreted as hypothesis-generating and as consistent with the procedural advantages identified in the trial described above.

Conclusion

The novel Ventubation System addresses two procedural variables — apnea duration and first-attempt success — that current peri-intubation literature has identified as the most consequential modifiable determinants of outcome. By combining the rapid insertion advantage of a supraglottic airway with the airway security of a cuffed ET tube in a single device, the Ventubation System targets the segment of airway management that no existing intervention has been designed to shorten. In this manikin study, the performance data reported here — a 67%

reduction in apnea time and a 27% reduction in time to cuff inflation provide a clear rationale for prospective clinical evaluation of the system in prehospital emergency airway management.

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References

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