THE EFFICACY AND SAFETY OF AUTOMATED CLOSED-LOOP VENTILATOR VERSUS CONVENTIONAL OPEN-LOOP VENTILATOR A SINGLE-CENTRE, PROSPECTIVE INTERVENTIONAL RANDOMIZED CONTROLLED TRIAL IN MECHANICALLY VENTILATED PATIENTS IN THE EMERGENCY DEPARTMENT (AVAC STUDY)

№ 003

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INTRODUCTION

Closed-loop ventilators (CLVs) are advanced mechanical ventilation modes that automatically adjust settings based on real-time patient feedback. Unlike conventional **open-loop ventilators (OLVs)**, which require continuous clinician adjustments, CLVs optimize ventilator parameters dynamically. This automation has the potential to alleviate the clinical cognitive load in overcrowded emergency departments (EDs), where resource constraints and high patient volumes challenge optimal ventilatory management.

METHODOLOGY

This single-center, prospective, interventional randomized controlled trial compared CLVs to OLVs in mechanically ventilated ED patients. Patients were randomized into CLV or OLV groups and ventilated for four hours. The primary outcome was the duration within optimal ventilatory parameters (tidal volume, end-tidal CO_2, oxygen saturation, plateau pressure). Secondary outcomes included manual adjustment frequency, arterial blood gas (ABG) parameters, vital signs, and clinical outcomes such as ED and ICU length of stay and mortality.

RESULTS

Thirty-eight patients were enrolled, with 19 in each group. CLVs successfully maintained all four ventilatory parameters within optimal ranges, demonstrating efficacy comparable to OLVs. Notably, CLV provided better CO_2 regulation, maintaining optimal end-tidal CO_2 levels significantly longer than OLV (p = 0.025). Additionally, CLV required fewer manual adjustments (median 1.0 vs. 3.0, p = 0.057). No significant differences were observed in mortality rates, ED and ICU length of stay, or hospital duration, confirming the safety of CLVs with no added complications.
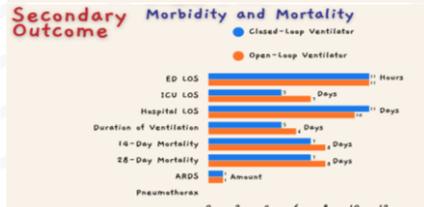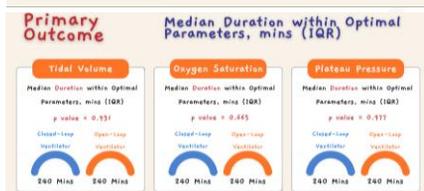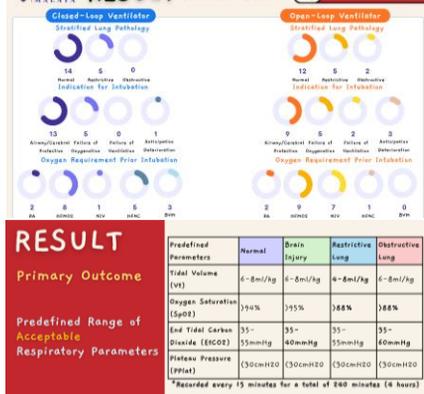
DISCUSSION

CLV matched OLV efficacy by maintaining all key ventilatory parameters within optimal ranges while enhancing CO_2 control. The reduction in manual adjustments suggests a shift toward automation without compromising safety. Additionally, CLVs demonstrated improved hemodynamic stability, reducing the variability in mean arterial pressure over time. The ability to sustain optimal ventilation without increasing complications reinforces their reliability in high-acuity settings. These findings highlight CLVs as a viable alternative to conventional ventilators in the ED, potentially improving workflow efficiency and clinician focus on other aspect of critical patient needs.

CONCLUSION

CLVs offer a promising and potential alternative to OLVs, achieving comparable efficacy and safety. The clinician's role transitions from "presetting" to "targeting" ventilator parameters. This study serves as a foundation for integrating artificial intelligence into ED ventilatory management, paving the way for future innovations in critical care automation.

REFERENCES

1. Botta, M., et al. "Effectiveness, safety and efficacy of INTELLiVENT–adaptive support ventilation, a closed–loop ventilation mode for use in ICU patients–a systematic review." Expert Review of Respiratory Medicine 15.11 (2021): 1403-1413.
2. Lellouche, François, et al. "Evaluation of fully automated ventilation: a randomized controlled study in post-cardiac surgery patients." Intensive care medicine 39.3 (2013): 463-471.

KEYWORDS

Closed Loop Ventilator, Open Loop Ventilator, Artificial Intelligence, Adaptive Support Ventilation, Ventilator Automation