

Hypertonic Saline Nebulization: A Potential Game-Changer in Preventing Ventilator-Associated Pneumonia in Neonates?

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Ventilator-associated pneumonia (VAP) remains a persistent challenge in neonatal intensive care units (NICUs), especially in low-resource settings. Even though non-invasive modes are being used for treating an increasing number of such newborns, invasive ventilation remains a potential lifesaver for sick newborns. Unfortunately, this not only complicates neonatal care but also increases the healthcare costs. Defining VAP also remains a key difficulty; without a gold standard, it introduces subjectivity and bias, especially when considering radiological factors. [1].

This issue features a study by Gupta et al that provides early insights into the effectiveness of hypertonic saline (HS) nebulization in reducing VAP in neonates [2]. This randomized controlled trial enrolled 286 invasively ventilated neonates at a single center. The intervention group received 3% hypertonic saline nebulization for seven days or until extubation, alongside standard ventilator care. The control group received only standard care. There was a 33% decrease in the incidence of VAP (36.72 episodes per 1,000 ventilation days; $P = 0.031$). The HS group had a significantly lower mean modified Clinical Pulmonary Infection Score (mCPIS) (5.22 vs. 5.94, $P = 0.030$). Additionally, the HS group had a reduced duration of mechanical ventilation. There were minimal adverse effects, with wheezing reported in only 5.5% of neonates receiving HS nebulization. These results suggest that HS nebulization is not only effective in reducing VAP but is also safe and practical for implementation in NICUs. However, we must analyze these findings in the context of a high baseline VAP rate, potential detection biases, and investigator biases due to the unblinded nature of the intervention.

The use of HS nebulization in this study is notable for several reasons which include mechanistic advantages, reduced antibiotic dependence and cost-effectiveness. HS nebulization enhances mucociliary clearance by hydrating airway surfaces, reducing mucus viscosity, and improving its transport. These actions could directly counteract the stagnation of secretions that predispose neonates to VAP. By lowering VAP incidence, HS nebulization could

indirectly minimize the use of broad-spectrum antibiotics, contributing to the fight against antimicrobial resistance. Compared to other interventions, such as advanced ventilator technologies or pharmacologic agents, HS nebulization is inexpensive and readily available, making it a feasible option for resource-limited settings.

The study also raises questions about the optimal concentration, dosing frequency, and duration of HS nebulization in neonates. Answering these questions will be critical for developing standardized protocols. Before widely adopting this practice, we must consider the necessity of disconnecting the ventilatory circuits, which could potentially cause transient destabilization, as well as the need for specific equipment capable of providing in line nebulization and the necessary training.

In Low and middle income countries, where the burden of VAP is disproportionately high (up to and more than 37.2 episodes per 1,000 ventilation-days) [3], the diagnosis and therapy of VAP has seen modest progress over the past decade, despite advancements in medical technology within neonatology [4]. Differentiating between colonization and infection also presents a significant challenge for neonatologists when dealing with infants who exhibit persistent radiographic infiltrates. This frequently results in the overutilization of antibiotics, contributing to the development of more antibiotic resistant bacteria.

The pathophysiology of VAP is complex, necessitating a multifaceted approach for its prevention, involving many therapies or stages in the care of neonates that function synergistically. There is an emerging array of VAP preventive bundles and other non-antibiotic prophylactic agents [4]. HS nebulization can offer a practical and scalable solution. But it will only help if the unit has an ongoing infection control and surveillance program that includes collecting data, training staff on a regular basis, and basic interventions like washing hands, checking daily to see if the patient is ready to be taken off the ventilator,

oral care, positioning, housekeeping, evaluating the ventilator circuit, following asepsis protocols, and using antibiotics in a smart way [5].

Research has shown that implementing individual therapies can effectively decrease adult VAP rates. Hence, this intervention complements existing VAP prevention strategies, such as ventilator care bundles, without imposing significant additional costs or complexity.

As with any intervention, further research, preferably multicentric and pragmatic, should guide broad adoption, refine protocols, and explore long-term effects. For now, HS nebulization represents a promising addition to our arsenal against one of the most challenging complications in neonatal care. The quest for safer, more effective NICU practices continues, with a need for innovative, efficacious, cost-effective, and widely adaptable interventions along with the existing bundles of care.

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REFERENCES

1. Goldsmith JP, Karotkin E, Suresh G, Keszler M. Assisted Ventilation of the Neonate E-Book. Elsevier Health Sciences; 2016.
2. Gupta A, Vir Singh M, Yadav RK, Monica, Shrivastava A. Prevention of VAP using hypertonic saline nebulization in NICU: a randomized controlled trial. *Indian Pediatr.* 2025;62:109-15.
3. Cernada M, Brugada M, Golombek S, Vento M. Ventilator-associated pneumonia in neonatal patients: an update. *Neonatology.* 2014;105:98-107.
4. Bondarev DJ, Ryan RM, Mukherjee D. The spectrum of pneumonia among intubated neonates in the neonatal intensive care unit. *J Perinatol.* 2024;44:1235-43.
5. Rangelova V, Kevorkyan A, Raycheva R, Krasteva M. Ventilator-associated pneumonia in the neonatal intensive care unit-incidence and strategies for prevention.