

# Comparison of Pediatric Tracheostomy Stoma Cleaning Solutions

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**BACKGROUND:** In the limited literature on cleaning tracheostomy stoma sites, there is no standard guideline for the cleaning solution. The objective of this study was to determine whether signs of stoma-site infection were different among a hospitalized pediatric population when using sterile water, sterile saline solution, or 0.25% acetic acid solution for tracheostomy stoma cleaning. **METHODS:** A retrospective chart review was completed and included nursing and physician notes. The subjects were <1 y of age, in the neonatal ICU, and received a tracheostomy within the previous 30 days. Clinical signs of infection were visually observed by the providers and documented in the medical record. The subjects were divided into 3 groups, those prescribed 0.25% acetic acid, those prescribed sterile water, and those prescribed sterile saline solution for twice daily tracheostomy stoma care. We compared the rate of signs of infection of the tracheostomy stoma site across the 3 treatments by using a chi-square test. **RESULTS:** In the 102 subjects included, there were significantly more signs of infection in the subjects for whom 0.25% acetic acid was not used for daily stoma cleaning ( $P = .03$ ). There were no differences in signs of infection between those cleaned with saline solution (39%) and those cleaned with sterile water (31%) for daily stoma cleaning. Overall, there were 29% fewer signs of infection when 0.25% acetic acid was used than either sterile water or saline solution. **CONCLUSIONS:** Analysis of our findings indicated that a 0.25% acetic acid solution used for stoma cleaning may be associated with fewer signs of infection than sterile water or sterile saline solution. More research is warranted toward establishing a standard practice. *Key words:* pediatrics; tracheostomy care; stoma cleaning; infection; postoperative complications; acetic acid. [Respir Care 2020;65(8):1090–1093. © 2020 Daedalus Enterprises]

## Introduction

Tracheostomy is performed in ~2% of pediatric patients, more than half of whom are <1 y old.<sup>1</sup> In the majority of these patients, the tracheostomy is present for 1 to 2 years, and some are never decannulated.<sup>1</sup> Neonates and infants

are particularly vulnerable to stomal complications due to delicate skin and to large tracheostomy tubes relative to neck size.<sup>2</sup> Skin breakdown around pediatric stoma is a common challenge,<sup>3,4</sup> particularly in the postoperative period.<sup>2,5</sup> A trend has been observed of progressively younger children receiving a tracheostomy, pointing to more life-saving procedures for premature infants with congenital conditions.<sup>5</sup> This is a medically fragile population, often with multiple morbidities,<sup>6,7</sup> whose risks for complications should be mitigated in any way possible. Stoma infections are a leading complication after tracheostomy in pediatrics.<sup>5,7-11</sup> Optimal management of the stoma site is an important consideration for hospital staff as well as for caregivers in non-hospital settings for patients with long-term tracheostomy.

There is no consensus reported in the pediatric literature, nor in the adult literature from which a best practice may be extrapolated, on the best solution to clean a tracheostomy stoma. We found no guidelines or comparative studies of the effectiveness of various solutions. Sterile and

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non-sterile water, saline solution, hydrogen peroxide, and acetic acid have been mentioned, sometimes in specific detail with regard to concentration and timing<sup>12,13</sup> but more often briefly.<sup>14-19</sup> No one cleaning solution is recommended as standard of care. Various concentrations of acetic acid

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have been described in the wound-care literature as an effective and inexpensive agent for preventing infection, mostly in studies specific to *Pseudomonas aeruginosa*,<sup>20-22</sup> but its use with tracheostomy site cleaning has not been studied to our knowledge. A 2013 review of wound cleaning practices stated that no adequate studies had yet been conducted on acetic acid for wound management.<sup>23</sup>

Preventing stoma infections is a worthwhile endeavor, especially when considering the population in question, infants with tracheostomy, has complex medical needs. Reducing infection rates would benefit patients, families, and health systems. A 0.25% acetic acid solution provides topical antimicrobial action, but it is unknown whether this is more effective than other solutions in preventing signs of stoma infection. Acetic acid is generally recognized safe by the U.S. Food and Drug Administration,<sup>24</sup> and a 0.25% solution is not considered hazardous per the Occupational Safety and Health Administration, 29 CFR 1910.1200.<sup>25</sup> The objective of this study was to determine whether signs of stoma-site infection were different among a hospitalized pediatric population when using sterile water, sterile saline solution, or 0.25% acetic acid solution for stomal cleaning.

### Methods

This was a retrospective review of medical records of subjects <1 y of age in the neonatal ICU who had a tracheostomy procedure at either of the 2 hospital campuses of Children's Minnesota. Only the data from the first 30 days after the tracheostomy procedure were reviewed to capture the period of acute postoperative wound management.

After approval by the institutional review board, data from 2013 to 2018 were collected. Patients diagnosed with an immune-deficiency disease, those <3 kg, and those who died within 48 h of tracheostomy were excluded. Clinical signs of infection were visually observed by providers and were documented in the medical record. Signs of infection included redness, rash, odor, increased secretions, and any other unusual tissue observations, consistent with the evidence base on wound infection.<sup>26,27</sup> The subjects were divided into 3 groups: those prescribed 0.25% acetic acid, those prescribed sterile water, and those prescribed sterile saline solution for daily tracheostomy stoma care. Stoma

### QUICK LOOK

#### Current knowledge

Many pediatric patients have tracheostomies for extended periods of time and require daily cleaning. Infections and inflammation are common complications. Cleaning solutions described in the literature include sterile water, sterile saline solution, hydrogen peroxide, and acetic acid solution.

#### What this paper contributes to our knowledge

Cleaning solutions for tracheostomy sites were compared retrospectively in a population of hospitalized subjects <1 y old. When the pediatric tracheostomy stoma-site cleaning solution was 0.25% acetic acid, there was a reduction in signs of stoma-site infections.

care was carried out twice daily (morning and evening), per hospital practice. There were no significant variations in stoma care practices during the study period.

### Statistical Analysis

We compared the rate of signs of infection of tracheostomy stoma sites across the 3 treatments using the chi-square test. The significance level was set at  $P < .05$ . All analyses were computed using SPSS version 23.0 (IBM, Armonk, New York).

### Results

A total of 102 subjects were included in the analysis. A 0.25% acetic acid solution was ordered for 24 subjects, sterile water for 29, and saline solution for 49. The sample included 58 male subjects. All but one subject had tracheostomy tubes manufactured by Bivona (Smiths Medical, Plymouth, Minnesota); one subject's tube was manufactured by Shiley (Medtronic, Fridley, Minnesota). There was a significant difference in signs of infection across the 3 treatments ( $P = .03$ ). There was no difference between saline solution and sterile water ( $P = .63$ ), but a significant difference between acetic acid and saline solution ( $P = .007$ ) and between acetic acid and water ( $P = .043$ ) (Table 1). No adverse effects (eg, increased stoma redness, granuloma growth, skin breakdown, bleeding) related to the use of 0.25% acetic acid were noted in the physician and nursing medical record notes reviewed for this analysis.

### Discussion

Our findings of significantly fewer signs of infection among subjects for whom acetic acid was used to clean the

Table 1. Rate of Signs of Infection By Treatment

Treatment	<i>n</i>	Rate (%)	95% CI
0.25% Acetic acid	24	8	-0.04 to 0.20
Sterile water	29	31	0.13-0.49
Saline solution	49	39	0.25-0.53
Total	102	29	0.20-0.38

tracheostomy stoma site supports the use of acetic acid compared with saline solution or water. These findings have the potential to inform practice changes as well as future research. We are unaware of any previous studies that evaluated stoma cleaning solution effectiveness. Our patient population of children <1 y old is a particularly vulnerable population whose challenges related to skin integrity differ from older pediatric and adult populations (eg, smaller and softer trachea in infants, mucosa more prone to edema, and different comorbidities than in adults, often linked to preterm birth and low birth weight).<sup>2,5</sup>

Precision and reduction of infection risk are particularly high stakes in tracheostomy care for infants because this is a population with higher morbidity and mortality than the general population, and most tracheostomy-related adverse events should be preventable.<sup>1</sup> Giving attention to best practices for tracheostomy stoma cleaning solutions in this population may improve the risk profile for infection in this population, and thus more research would be valuable with infants. In addition, more research should be conducted in broader pediatric settings with regard to optimal care of the tracheostomy site. One recent report of a pediatric tracheostomy care protocol implementation for prevention of wound complications reported that complications decreased after standardization of steps, including stoma site cleaning, but this study did not specify the solution used for cleaning.<sup>28</sup>

The limited literature on acetic acid for wound care describes its use at various concentrations.<sup>20-22</sup> We used a 0.25% solution because it has been our historical practice. Future study should compare infection rates at various concentrations. Agrawal et al<sup>21</sup> evaluated the minimum inhibitory concentrations of acetic acid for various microbes and reported mean minimum inhibitory concentrations, which ranged from 0.0625 to 0.25, for various bacterial strains, and a mean minimum inhibitory concentration of 0.5 for various fungal strains.

We conducted a post hoc cost assessment to determine how the costs of cleaning solution compared in our care setting. At our hospital, 1 L of 0.25% acetic acid solution costs \$4.83, 1 L of sterile saline solution costs \$1.50, and a 1-L bottle of sterile water costs \$1.43. However, for infection prevention purposes, current practice requires disposal of bottles of water and saline solution after they have been opened for 72 h, whereas 0.25% acetic acid

solution can be used until the bottle is empty. Each cleaning uses ~200 mL of acetic acid. Thus, despite the higher initial cost of acetic acid solution, it is less costly because of its extended shelf life.

Our study was limited by its retrospective nature. It was a single-center study conducted in hospitalized subjects. It was a convenience sample without randomization, and we did not conduct cultures to identify the presence of infection. However, the clinical signs of infection that we used are similar to those reported in the broader wound-care literature.<sup>26,27</sup> An appropriately powered multi-center study is necessary to confirm our findings.

## Conclusions

Analysis of our findings suggests that 0.25% acetic acid solution is an effective solution for daily cleaning of the tracheostomy stoma in hospitalized pediatric patients. Tracheostomy stoma cleaning, particularly in pediatric patients, is an understudied area, and more research should be undertaken to compare the effectiveness of cleaning solutions.

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