



OROPHARYNGEAL SECRETION VOLUME IN INTUBATED PATIENTS: THE IMPORTANCE OF ORAL SUCTIONING

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Background Aspiration of secretions that accumulate above the cuff of the endotracheal tube is a risk factor for ventilator-associated pneumonia. Routine suctioning of oropharyngeal secretions may reduce this risk; the recommended frequency for suctioning is unknown.

Objectives To quantify the volume of secretions suctioned from the oropharynx of critically ill patients at 2 different intervals to assist in identifying a recommended frequency for oropharyngeal suctioning.

Methods A prospective, repeated measure, single-group design was used. Twenty-eight patients who were orally intubated and treated with mechanical ventilation were enrolled; 2 were extubated during data collection, yielding a sample of 26 patients. The patients were suctioned at baseline with a deep suction catheter, and the volume and weight of secretions were recorded. The procedure was repeated at 2-hour and 4-hour intervals.

Results Most of the patients were male (mean age, 49 years). Three suctioning passes were needed to clear secretions, with a mean time of 48.1 seconds. The mean volume of secretions at the 2-hour interval was 7.5 mL. Five patients required suctioning before the 4-hour interval. For the remaining 21 patients, the volume retrieved was 6.5 mL at the 2-hour interval and 7.5 mL at the 4-hour interval ($P = .27$). The 5 patients who required extra suctioning had significantly more secretions at the 2-hour interval (11.6 mL vs 6.5 mL; $P = .05$).

Conclusions A minimum frequency of oropharyngeal suctioning every 4 hours is recommended. However, more frequent suctioning may be needed in a subset of patients. (*American Journal of Critical Care*. 2011;20:e141-e145)

Comprehensive oral care is an important intervention to reduce the risk for ventilator-associated pneumonia in patients who are intubated with an endotracheal tube.¹ Although not well defined in terms of methods and frequency, oral care includes brushing teeth, cleansing with antiseptics, and removal (suctioning) of secretions.^{2,3} Much of the research has focused on cleansing the mouth, and little emphasis has been placed on removal of secretions. Aspiration of secretions is a mechanism that contributes to the development of ventilator-associated pneumonia. Routine oropharyngeal suctioning may reduce the likelihood of accumulation of secretions above the cuff of the endotracheal tube, where aspiration often occurs. Removal of secretions either manually or with the use of a specialized endotracheal tube that provides continuous (or intermittent) suctioning of subglottic secretions that accumulate above the cuff (SS-ETT) is a clinical strategy for preventing ventilator-associated pneumonia.⁴

Several devices are available for oropharyngeal suctioning: suctioning swabs, tonsil suctioning device (Yankauer or similar device), traditional suctioning catheter, and deep suctioning catheter (shorter version of traditional suctioning catheter; packaged in many commercial oral care kits). Most nurses suction the oropharynx with the tonsil suctioning device on an “as needed basis.”⁵ The optimal frequency of oropharyngeal suctioning has not been determined, with recommendations ranging from every 2 to 4 hours as part of oral cleansing, to “frequently.”² However, frequency should be based on assessment. Knowledge of the volume of secretions that accumulate in the oropharynx may guide the decision to perform oropharyngeal suctioning. Therefore, the purpose of this study was to quantify the volume and weight of oral secretions suctioned at 2 intervals—2 hours and 4 hours—to assist in developing a recommended frequency for oral suctioning.

Background and Significance

Normally, closure of the glottis prevents aspiration of oropharyngeal secretions. When a patient is intubated with an endotracheal tube, the glottis remains open, leaving only the inflated cuff for

protection against aspiration. Therefore, oropharyngeal suctioning may reduce the risk for aspiration and ventilator-associated pneumonia. Studies⁶⁻⁸ have shown that when oral suction was part of a comprehensive oral care program, rates of ventilator-associated pneumonia decreased. A reduction in the frequency of ventilator-associated pneumonia was also noted when patients were suctioned orally before being turned and repositioned.^{9,10} Intubation with the SS-ETT also reduces the risk of aspiration and VAP.^{4,11-13} These tubes remove secretions that have migrated from the posterior oropharynx through the vocal cords and accumulate above the inflated cuff.

Oral suctioning is important, regardless of whether the SS-ETT or a traditional endotracheal tube is used. By reducing the volume of secretions in the mouth, oral suctioning is an important early step in reducing the risk of aspiration of secretions.

Oral secretions may include saliva and gastric contents.^{14,15} Under normal conditions, approximately 1 L of saliva is produced daily in the adult at the rate of 0.5 mL/min.¹⁶ The amount of secretions that accumulates in the oropharynx while a patient is intubated is not known. Tactile stimuli from the presence of objects in the mouth, particularly smooth surfaces, may result in increased salivation.¹⁶ Humidification (or lack thereof) may also influence secretions. In one study,¹⁷ an average of 5 g of mucus (weight not volume) was retrieved as part of data collection procedures for obtaining samples of oral secretions for culture; however, up to 16 g were collected in some individuals. Knowledge of

Routine oropharyngeal suctioning may reduce accumulation of secretions above the endotracheal tube cuff.

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the volume of secretions that accumulates over time may help to determine a recommended frequency for oropharyngeal suctioning.

Methods

Design

This study used a prospective, repeated-measure, single-group design.

Human Subjects

The institutional review board at the agency approved the study with a waiver of written consent. All data were de-identified.

Sample

Patients were enrolled in the study if they were 18 years of age or older, orally intubated, and were managed with either intermittent mandatory or assist-control mode of mechanical ventilation. Patients were excluded if they were nasally intubated, on nontraditional ventilation (such as the oscillator), or on isolation precautions. A target sample size of 28 was calculated to detect a large effect between the volume retrieved at 2 hours versus 4 hours, at an α of .05 and a power of 80%.

Study Setting

Subjects were enrolled from the adult critical care units at a tertiary medical center in the Southeastern United States. These units provide care for critically ill patients with a variety of medical, surgical, and trauma diagnoses.

Instruments

Instruments included a graduated measuring device (in milliliters), a calibrated gram scale, a deep suctioning catheter, and a suction regulator. The 21-cm-deep suctioning catheter that was used for oropharyngeal suctioning was included in the oral care kit used in the critical care units (Sage Products, Cary, Illinois). The deep suctioning catheter was used for oral suctioning, versus a tonsil suctioning device or a suctioning swab, because we found that the catheter was more effective in retrieving secretions in a simulated setting before this study.

Procedures

Data were collected by 1 of 2 critical care nurses who were trained in (and observed demonstrating) standardized procedures to ensure interrater

reliability. Demographic data were obtained from the medical record. Wall suction was set between 100 and 120 mm Hg.¹⁸ With the head of the bed elevated 30°, oropharyngeal suctioning was performed with a deep suctioning catheter to clear secretions (baseline clearance). The study was done with the subject's backrest elevated to 30° because that degree of elevation is the standard at the institution.¹⁹ The catheter was advanced as tolerated to reach the posterior oropharynx; we did not measure the depth of the catheter but based our procedure on the ability to retrieve secretions. Secretion volume (in milliliters), weight (in grams), number of suctioning passes, and duration of suctioning (in seconds) needed to clear secretions were recorded. Clearing of secretions was determined by the research assistant on the basis of the absence of secretions in the suctioning catheter and the absence of visual or audible evidence of secretions in the oropharynx. The procedure was done 2 hours after baseline and again 4 hours later. If the patient required oral suctioning in the interval between scheduled suctioning, that event was recorded. Data were analyzed with descriptive statistics and paired sample *t* tests.

Results

Sample

Twenty-eight patients were enrolled in the study between April and June 2009. One patient was extubated before the 2-hour interval, and 1 was extubated before the 4-hour interval, yielding a sample of 26 patients. Most patients in the study were male (69%, *n* = 18), white (77%, *n* = 20), had a SS-ETT inserted (62%, *n* = 16), had a nasogastric or nasoenteric tube (77%, *n* = 20), and described as sedated or calm (81%, *n* = 21). The patients had a variety of diagnoses: neurological (31%, *n* = 8), medical (31%, *n* = 8), surgical-trauma (27%, *n* = 7), and burn injury (12%, *n* = 3). The mean age of the patients was 49 (SD, 15; range, 22-89) years, and they were intubated a mean of 46.3 (SD, 26.1; range, 24-96) hours.

Suctioning Passes

The mean number of suctioning passes needed to clear the oropharyngeal secretions was 3.6 (SD, 1.0); the median was 3 passes. The mean time needed to complete the oral suctioning was 48.1 (SD, 15.5) seconds.

Secretions

The volume of oral secretions retrieved ranged from 1 to 25 mL with corresponding weights ranging from 0.5 to 24.7 g (see Table). Secretions were subjectively classified as normal to thick in all patients.

Oral suctioning is an important early step in reducing the risk of aspiration of secretions.

Average secretion volume was 7.5 mL in the 2-hour interval.

Table
Characteristics of oropharyngeal suctioning

Characteristic	N	Minimum	Maximum	Mean	SD
Duration of suctioning, s					
Baseline	26	30	90	52.1	14.5
2-h interval	26	30	95	46.0	15.7
4-h interval	26	30	100	46.3	16.3
No. of suctioning passes to clear					
Baseline	26	3	8	3.8	1.3
2-h interval	26	3	6	3.4	0.8
4-h interval	26	3	6	3.5	0.9
Volume of secretions, mL					
Baseline	26	1.0	25.0	9.0	6.8
2-h interval	26	1.0	18.0	7.5	5.3
4-h interval	21	1.0	24.0	7.5	5.8
Weight of secretions, g					
Baseline	26	0.6	24.7	8.6	6.4
2-h interval	26	0.5	18.3	7.0	5.2
4-h interval	21	1.0	24.1	7.2	5.7

The mean volume of secretions for all 26 patients was 7.5 (SD, 5.3) mL in the 2-hour interval. No differences in volume related to the type of tube (traditional or SS-ETT) were found at the 2-hour interval (6.2 vs 8.3 mL; $P = .34$). For all measures, the volume of secretions corresponded to the weight of secretions, with correlations ranging from 0.96 to 0.98 ($P < .001$).

Five patients (19%) required oral suctioning between the 2-hour and 4-hour interval. Analysis of data from the 21 patients who did not need additional suctioning showed the mean volume of secretions to be 6.5 (SD, 4.9) mL at the 2-hour interval and 7.5 (SD, 5.8) mL at the 4-hour interval. The volume was not significantly different (paired sample t test, $P = .27$). The 5 patients who required suctioning during the 4-hour interval had a greater volume of secretions in the 2-hour interval than did those patients who did not require additional suctioning (11.6 vs 6.5 mL; $P = .05$). Three of these 5 patients had a diagnosis of intracranial bleeding, 1 had sustained a cervical fracture, and 1 was a general surgery patient. Because of this finding, we analyzed data for those with ($n = 8$) and without ($n = 18$) a neurological diagnosis. Patients with a neurological diagnosis had a greater volume of secretions in the 2-hour interval (10.4 vs 5.8 mL; $P = .03$).

Discussion

The AACN *Procedure Manual for Critical Care*² recommends oropharyngeal suctioning after cleansing every 2 to 4 hours, and intermittent deep suctioning as part of a comprehensive oral care program. Based on this study's findings, deep oropharyngeal suctioning should be done at least every 4 hours;

however, the frequency should be determined by the patient's status. Some patients, especially those with neurological injury or illness, may require more frequent suctioning. The mechanism behind this is unknown, but stimulation of salivation via neurological pathways may contribute to increased secretions in this subset of our sample.

One suggestion is to obtain baseline knowledge of the volume of secretions during a 2-hour interval. If the volume of secretions is high (>10 mL), oral suctioning should be done every 2 hours or more often. One-third of the patients in this sample had greater than 10 mL of secretions in the oropharynx, including the 5 patients who required additional oral suctioning.

This study demonstrated the importance of oropharyngeal suctioning, regardless of type of tube. The secretion volume was similar for both patients with a traditional endotracheal tube and patients with a SS-ETT. The volume of secretions retrieved from the SS-ETT suctioning port was not measured. Knowledge of this volume may have assisted in interpretation of findings.

Removal of secretions before they pass through the glottis is an important prevention mechanism for VAP. Nurses may assume that oral suctioning is less important if the SS-ETT is used, because its function is to remove secretions. However, difficulty with the suctioning port of the SS-ETT has been reported.²⁰ Also, if the endotracheal tube cuff pressure is not maintained, the risk for aspiration of secretions is increased.²¹

Based on study findings, deep oropharyngeal suctioning should be done at least every 4 hours.

We did not control for positioning of patients between suctioning episodes. Turning and repositioning of patients may have influenced the volume of secretions retrieved. Secretions may pool in dependent positions, facilitating removal of secretions. In contrast, patients may have drooled during position changes, resulting in fewer secretions being retrieved during the scheduled data collection.

The volume and weight of secretions were highly correlated. Therefore, for future studies, it would be appropriate to substitute weight as a proxy for volume. The gram scale is a more precise measure than is the graduated cylinder.

Implications for Practice and Research

Oral suctioning is an important component of a comprehensive oral care protocol. Closed endotracheal tube suctioning technology has changed nursing practice with oropharyngeal suctioning. When a traditional suctioning kit is used for endotracheal tube suctioning, oropharyngeal suctioning is traditionally done immediately after endotracheal tube suctioning. With closed suction commonly used for endotracheal tube suctioning, nurses must increase their awareness of the need for oropharyngeal suctioning because the 2 procedures are not done concurrently.

Findings support the need for oropharyngeal suctioning at least every 4 hours. Many patients may need to be suctioned at least every 2 hours, or more frequently, based on assessment. Future research should identify factors that influence secretion volume, such as hydration status, neurological diagnosis, chemical paralysis, and the effect of the SS-ETT on secretions. Suctioning before turning and repositioning patients also warrants additional study.

FINANCIAL DISCLOSURES

None reported.

eLetters

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REFERENCES

- Guidelines for the management of adults with hospital-acquired, ventilator-associated, and healthcare-associated pneumonia. *Am J Respir Crit Care Med.* 2005;171(4):388-416.
- Vollman KM, Sole ML. Endotracheal tube and oral care. In Wiegand D, ed. *AACN Procedure Manual for Critical Care.* Philadelphia, PA: Elsevier-Saunders; 2011:31-38.
- Tablan OC, Anderson LJ, Besser R, Bridges C, Hajjeh R; CDC; Healthcare Infection Control Practices Advisory Com-

mittee. Guidelines for preventing health-care-associated pneumonia, 2003: recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee. *MMWR Recomm Rep.* 2004;53(RR-3):1-36.

- Bouza E, Pérez MJ, Muñoz P, Rincón C, Barrio JM, Hortal J. Continuous aspiration of subglottic secretions in the prevention of ventilator-associated pneumonia in the postoperative period of major heart surgery. *Chest.* 2008;134(5):938-946.
- Sole ML, Byers JF, Ludy JE, Zhang Y, Banta CM, Brummel K. A multisite survey of suctioning techniques and airway management practices. *Am J Crit Care.* 2003;12(3):220-30; quiz 231-232.
- Hutchins K, Karras G, Erwin J, Sullivan KL. Ventilator-associated pneumonia and oral care: a successful quality improvement project. *Am J Infect Control.* 2009;37(7):590-597.
- Powers J, Brower A, Tolliver S. Impact of oral hygiene on prevention of ventilator-associated pneumonia in neuroscience patients. *J Nurs Care Qual.* 2007;22(4):316-321.
- Garcia R, Jendresky L, Colbert L, Bailey A, Zaman M, Majumder M. Reducing ventilator-associated pneumonia through advanced oral-dental care: a 48-month study. *Am J Crit Care.* 2009;18(6):523-532.
- Chao YF, Chen YY, Wang KW, Lee RP, Tsai H. Removal of oral secretion prior to position change can reduce the incidence of ventilator-associated pneumonia for adult ICU patients: a clinical controlled trial study. *J Clin Nurs.* 2009;18(1):22-28.
- Tsai HH, Lin FC, Chang SC. Intermittent suction of oral secretions before each positional change may reduce ventilator-associated pneumonia: a pilot study. *Am J Med Sci.* 2008;336(5):397-401.
- Berra L, De Marchi L, Panigada M, Yu ZX, Baccarelli A, Kolobow T. Evaluation of continuous aspiration of subglottic secretion in an in vivo study. *Crit Care Med.* 2004;32(10):2071-2078.
- Kollef MH, Skubas NJ, Sundt TM. A randomized clinical trial of continuous aspiration of subglottic secretions in cardiac surgery patients. *Chest.* 1999;116(5):1339-1346.
- Safdar N, Crnich CJ, Maki DG. The pathogenesis of ventilator-associated pneumonia: its relevance to developing effective strategies for prevention. *Respir Care.* 2005;50(6):725-739; discussion 739-741.
- Mauri T, Berra L, Kumwilaisak K, et al. Lateral-horizontal patient position and horizontal orientation of the endotracheal tube to prevent aspiration in adult surgical intensive care unit patients: a feasibility study. *Respir Care.* 2010;55(3):294-302.
- Metheny NA, Clouse RE, Chang YH, Stewart BJ, Oliver DA, Kollef MH. Tracheobronchial aspiration of gastric contents in critically ill tube-fed patients: frequency, outcomes, and risk factors. *Crit Care Med.* 2006;34(4):1007-1015.
- Guyton AC, Hall JE. *Textbook of Medical Physiology.* 11th ed. Philadelphia, PA: Saunders; 2006.
- Sole ML, Poalillo FE, Byers JF, Ludy JE. Bacterial growth in secretions and on suctioning equipment of orally intubated patients: a pilot study. *Am J Crit Care.* 2002;11(2):141-149.
- Chulay M, Seckel MA. Suctioning: endotracheal or tracheostomy tube. In: Wiegand D, ed. *AACN Procedure Manual for Critical Care.* Philadelphia, PA: Elsevier-Saunders; 2011:79-87.
- Resar R, Pronovost P, Haraden C, Simmonds T, Rainey T, Nolan T. Using a bundle approach to improve ventilator care processes and reduce ventilator-associated pneumonia. *Jt Comm J Qual Patient Saf.* 2005;31(5):243-248.
- Depew CL, McCarthy MS. Subglottic secretion drainage: a literature review. *AACN Adv Crit Care.* 2007;18(4):366-379.
- Rello J, Soñora R, Jubert P, Artigas A, Rué M, Vallés J. Pneumonia in intubated patients: role of respiratory airway care. *Am J Respir Crit Care Med.* 1996;154(1):111-115.

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