

ONLINE FIRST

Practice Patterns After Tracheotomy in Infants Younger Than 2 Years

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Objectives: To report survey results of members of the American Society of Pediatric Otolaryngology (ASPO) on the practice patterns of surveillance endoscopy and management of suprastomal granuloma (SSG) in children younger than 2 years with indwelling tracheostomy tubes and to review our internal practice patterns.

Patients: All patients younger than 2 years who underwent tracheotomy between 1996 and 2006 at a tertiary children's hospital.

Interventions: (1) Retrospective medical chart summary and (2) ASPO-approved and -administered online surveys to the membership of a 14-question survey on indications for infant tracheotomy, indications for bronchoscopy after tracheotomy, and treatment preferences for SSG in this population.

Main Outcome Measures: Summary and findings of survey results and of data collected from medical chart review, including demographics, medical comorbidities, age at time of tracheotomy, indications for tracheotomy, frequency of bronchoscopy after tracheotomy, frequency of observed SSG, and interventions for SSG.

Results: Seventy-five ASPO members completed the online surveys. Practice patterns varied for frequency of bronchoscopy: only as needed, every 12 months, every 6 months, and every 3 months were reported by 38% (n=26), 25% (n=17), 24% (n=17), and 9% (n=6) of ASPO members, respectively. Most important indications for bronchoscopy were preparation for laryngotracheal reconstruction and decannulation (100% [n=65] and 92% [n=60], respectively), bleeding (76% [n=59]), and difficult tracheostomy tube changes (70% [n=57]).

Lumen obstruction of 25% to 50% and 50% to 75% by SSG would likely receive intervention (30% [n=22] and 14% [n=11], respectively) with skin hook eversion and removal being the most popular technique. We reviewed the medical records of a total of 201 infants who underwent tracheotomy at our institution (110 boys [54.7%]). Indications included ventilator dependence (32.2%), craniofacial anomaly (15.0%), cardiopulmonary insufficiency (15.0%), neuromuscular indication (15.0%), and subglottic stenosis (6.7%). Thirty patients (14.9%) were premature (mean gestational age, 27 weeks). Median age at time of tracheotomy was 4 months for premature infants and 3 months for term infants. Practice patterns regarding endoscopy and SSG management varied widely within our own institution. A total of 205 bronchoscopies were performed on 109 patients during the study period. At the time of first bronchoscopy 43 of 109 patients were noted to have an SSG (39.4%). Elective removal of SSG occurred in 20 of 43 cases (46.5%), and 9 of 20 patients were noted to have recurrent SSG at subsequent endoscopy (45%). In addition, of the 23 children who did not have intervention for their SSG, 15 of 23 had spontaneous resolution and no appreciable SSG at the time of follow-up endoscopy (65.0%).

Conclusions: There are currently various practice patterns for surveillance endoscopy and management of SSG in children younger than 2 years with indwelling tracheostomy tubes. Development of clinical practice guidelines on this topic may improve patient care and reduce unnecessary procedures.

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THERE ARE CURRENTLY NO standard clinical practice guidelines for interval endoscopic evaluation after tracheotomy in infants or children younger than 2 years who undergo tracheotomy. Otolaryngologists who perform pediatric tracheotomy procedures may conduct subsequent microlaryngoscopy and bronchoscopy (MLB) for a variety of reasons, including history of

difficult tracheostomy tube change, severe bleeding from tracheostomy site, lack of phonation, or the need to assess the evolution of congenital laryngeal, subglottic, and/or tracheal abnormalities. Infants with a history of laryngeal and/or subglottic injury from previous intubations require evaluation of scarring and subsequent stenosis for the physician to plan for potential reconstructive procedures. Regardless of whether airway reconstruction

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procedures are required, endoscopy provides critical information regarding airway status prior to attempting a safe, successful decannulation.

Indications for endoscopy in the asymptomatic patient are less clear. Some otolaryngologists may perform scheduled interval endoscopic evaluations every 3 to 6 months after tracheotomy, anticipating that the airway structures may change during the early years of development. Others advocate subsequent endoscopy only if the patient is having symptomatic complications related to the tracheotomy; these practitioners eschew routine endoscopy in the asymptomatic patient so as to avoid administering general anesthesia and incurring its related risks in a population that often has substantial medical comorbidities.

One specific problem widely encountered in children who are tracheotomy dependent is the potential for developing a suprastomal granuloma (SSG) while an indwelling tracheostomy tube is in place. Suprastomal granulomas typically form on the anterior tracheal wall just proximal to the stoma. Frictional traumas from the tracheostomy tube, chronic infection, or irritation by environmental factors and stasis of secretions have all been implicated as inciting agents in granuloma formation.¹ While early studies suggested the incidence of SSG to be about 4.6%,¹⁻³ more recent studies, in which patients were evaluated at routine intervals after tracheotomy, indicate the incidence of granuloma in these patients actually ranges from 72% to 80%.^{1,2}

Endoscopic evaluation and removal of granuloma prior to decannulation has long been the practice of pediatric otolaryngologists. Not only does this maximize the airway lumen, but also there is theoretically little risk for recurrence of obstructing granuloma because the process of decannulation removes the inciting agents. In the patient who is chronically tracheotomy dependent, development of SSG might occur, and if the SSG is large enough, it may completely occlude the tracheal lumen. Complete or nearly complete occlusion of the tracheal lumen might prevent retrograde airflow through the glottis, consequently resulting in aphonia and/or respiratory distress at the time of tube exchange or as result of accidental decannulation. Endoscopic evaluation and intervention is relatively straightforward in these situations. The question remains, however, whether asymptomatic infants with an indwelling tracheostomy tube should be routinely evaluated for SSG and, if so, what degree of granulation formation warrants intervention.

There are currently no clinical practice guidelines regarding SSG management during the period of an indwelling tracheostomy tube. Anecdotally, we have noted a wide variance in practice patterns at our own institution, which prompted us to query members of the American Society of Pediatric Otolaryngologists (ASPO) regarding their current practices through the use of an online survey tool. Herein, we summarize the ASPO survey participant responses. Our objectives were (1) to understand current surveillance endoscopy and SSG management practice patterns of otolaryngologists who perform infant tracheotomy and (2) to review our internal experience.

METHODS

SURVEY

We developed a 13-question survey regarding the practice of surveillance MLB and SSG management after infant tracheotomy. This was approved by the ASPO survey committee for administration to its members (**Figure 1**). Surveys were distributed to the entire ASPO membership electronically via e-mail, and members were invited to participate. The survey of ASPO members was performed between June 2009 and September 2009. The survey queried members about demographic data and physician practice patterns in the management of tracheotomy in children younger than 2 years. There were 75 respondents. Data were compiled by the SurveyMonkey program (SurveyMonkey, Palo Alto, California) and then analyzed.

MEDICAL CHART REVIEW

A retrospective summary was performed for all cases of infants and children younger than 2 years who underwent tracheotomy between January 1998 and August 2008. Patients were screened by procedure codes, and medical charts were reviewed. All children younger than 2 years who underwent tracheotomies were included in the study. Patients with tracheotomy performed elsewhere and not by pediatric otolaryngologists at Children's Mercy Hospital in Kansas City, Missouri, were excluded from the study. Clinical and demographic data collected include age at time of tracheotomy, sex, race, indications for tracheotomy, medical comorbidities, number of subsequent endoscopic evaluation(s), indications for each subsequent endoscopic evaluations, presence of SSG, and type of intervention for excision of SSG if performed. Data were entered into a standard database, and statistical analysis was performed.

RESULTS

SURVEY

A review of all 75 completed online surveys from ASPO members showed that 75% of respondents practiced in an urban environment (n=56). Respondents self-reported practicing in an academic university setting (48% [n=37]), children's hospital (32% [n=23]) or in private practice (21% [n=15]). Forty-six participants (61%) were older than 50 years. Fifty-two percent of those who responded performed more than 7 tracheotomies on infants annually (n=39). Over 70% of respondents routinely performed microlaryngoscopy and/or bronchoscopy at the time of tracheotomy (n=52), with no statistically significant difference in practice habits among different practice types. The most common indication for tracheotomy was prolonged ventilatory support, followed by subglottic stenosis and craniofacial anomalies.

Among survey participants, there were a wide variety of opinions with regard to outpatient follow-up. While 43% saw their tracheostomy patients at 3-month intervals (n=32), approximately a quarter of physicians (26%) prefer to see patients at 6-month intervals (n=20). A full 20% of respondents saw this patient population in the clinic only on an as-needed basis (n=15). Members of ASPO were also divided on performing routine surveil-

1. What is your age?
 - a. 30-39
 - b. 40-49
 - c. 50-59
 - d. 60-69
 - e. >70
2. What is your main practice location?
 - a. Rural
 - b. Suburban
 - c. Urban
3. What is your practice type?
 - a. Private
 - b. Academic/university
 - c. HMO
 - d. Government/VA/military
 - e. Children's hospital
4. Approximately how many tracheotomies for patients under 2 years old have you performed in the last 12 months?
 - a. None
 - b. 1-3
 - c. 4-6
 - d. 7-9
 - e. 10-12
 - f. >12
5. Do you routinely perform laryngoscopy/bronchoscopy at the time of tracheotomy?
 - a. Yes
 - b. No
6. What percentage of tracheotomies that you have performed in children under 2 years old were for following indications?

| | | | |
|----------------------------------|---------|---------|------|
| <10% | 10%-25% | 25%-50% | >50% |
| a. Prolonged ventilatory support | | | |
| b. Laryngo-/tracheomalacia | | | |
| c. Craniofacial anomaly | | | |
| d. Other | | | |
7. Approximately how long do you follow these patients in clinic after tracheotomy?
 - a. Every 3 months
 - b. Every 6 months
 - c. Every 6-12 months
 - d. As needed
 - e. Other
8. Do you routinely perform routine interval laryngoscopy/bronchoscopy after tracheotomy?
 - a. Yes
 - b. No
9. If you do perform interval/surveillance bronchoscopy, how often do you do so?
 - a. Every 3 months
 - b. Every 6 months
 - c. Every 12 months
 - d. As needed
 - e. Prior to decannulation only
10. Please rate the importance of each of the following factors when you consider/recommend bronchoscopy after tracheotomy:

| | | |
|--|--------------------|----------------|
| Not important | Somewhat important | Very important |
| a. Difficult trach change | | |
| b. Aphonia/dysphonia | | |
| c. Bleeding (other than minor) | | |
| d. Inability to wean from vent | | |
| e. Prior to decannulation | | |
| f. Prior to laryngotracheal reconstruction | | |
11. If the child is undergoing an unrelated ENT or non-ENT procedure, how likely are you to recommend concomitant surveillance bronchoscopy?
 - a. Unlikely, unless there are trach-related problems
 - b. Possibly, if there are indications
 - c. Very likely, simply for surveillance
 - d. Always
12. In your practice, what degree of lumen occlusion by suprastomal granuloma is required prior to some intervention?
 - a. Any evidence of granuloma is removed
 - b. <25%
 - c. 25%-50%
 - d. 50%-75%
 - e. >75%
 - f. Total obstruction
 - g. Granuloma removed only if symptomatic
 - h. Granuloma removed only prior to decannulation
13. What is your preferred technique for managing suprastomal granuloma requiring intervention? Check all that apply.
 - a. Skin hook, eversion, and scissor removal
 - b. Sphenoid punch
 - c. Optical forceps
 - d. Microdebrider
 - e. Electrocautery
 - f. Laser
 - g. Open tracheoplasty
 - h. Other

Figure 1. American Society of Pediatric Otolaryngology members survey on the management of tracheotomy in children younger than 2 years. ENT indicates otolaryngoscopic; HMO, health maintenance organization; VA, Veterans Affairs center.

lance endoscopy after infant tracheotomies, with 59% of respondents performing surveillance endoscopy at least annually on this patient population (n=40). Another 41% of members reported performing endoscopy only prior to decannulation or if the patient was having difficulties related to the tracheotomy (n=29). Not surprisingly, most members believed that endoscopy prior to reconstruction and decannulation was essential (100% [n=65] and 91% [n=60], respectively). Members were surveyed to rate other indications for endoscopy in order of frequency. Sixty-nine percent of those surveyed believed that difficult tracheostomy tube change was a strong indication for endoscopy (n=39), and 75% believed that any bleeding other than minor was also a strong indication (n=45). Aphonia and difficulty weaning from the ventilator were believed to be only moderately important indicators for endoscopy (59% [n=37] and 48% [n=30], respectively). Seventy-four percent of respondents reported that they observed these patients at least annually in clinic (n=55).

Responses to optimal management of SSG if found on endoscopy also varied among survey participants. Thirty-three percent would remove the granuloma only if the patient had been symptomatic (21% [n=15]) or prior to decannulation (13% [n=9]). Twenty-nine percent believed that as little as 25% to 50% lumen obstruction by the SSG was sufficient for intervention (n=22), whereas 26% believed that greater than 50% obstruction should be present to warrant excision (n=24). The favored technique for excision was skin hook eversion and scissor removal (67% [n=50]) followed by microdebridement (35% [n=26]).

MEDICAL CHART REVIEW

Between January 1998 and December 2008, 201 tracheotomies were performed on patients younger than 2 years by pediatric otolaryngologists in the Section of Otolaryngology at Children's Mercy Hospital in Kansas City, Missouri. There were 110 boys (54.7%) and 91 girls (45.3%). Thirty patients were born prematurely (14.9%) (mean gestational age, 27 weeks). The median ages at time of tracheotomy were 3 months for term infants and 4 months for premature infants. **Figure 2** illustrates differences between term and premature infants with respect to various indications for tracheotomy. The most common indication for tracheotomy overall was anticipated need for long-term mechanical ventilation (32.2%), and within this group, most patients were premature (67.0% vs 22.0%).

At our institution, a total of 205 bronchoscopies were performed on 109 patients (54.2%) during the study period. Fifty-four bronchoscopies were performed in anticipation of decannulation (26.3%). Forty-eight were performed in combination when patients were undergoing anesthesia for a separate, unrelated procedure (23.4%). Only 4.6% of endoscopies performed were for the purpose of addressing a complication of tracheotomy.

At the time of the first bronchoscopy, 43 of 109 patients had SSG (39.4%). There was no uniform method of reporting the degree of airway lumen obstruction caused by the SSG or rationale for intervention. This inflamma-

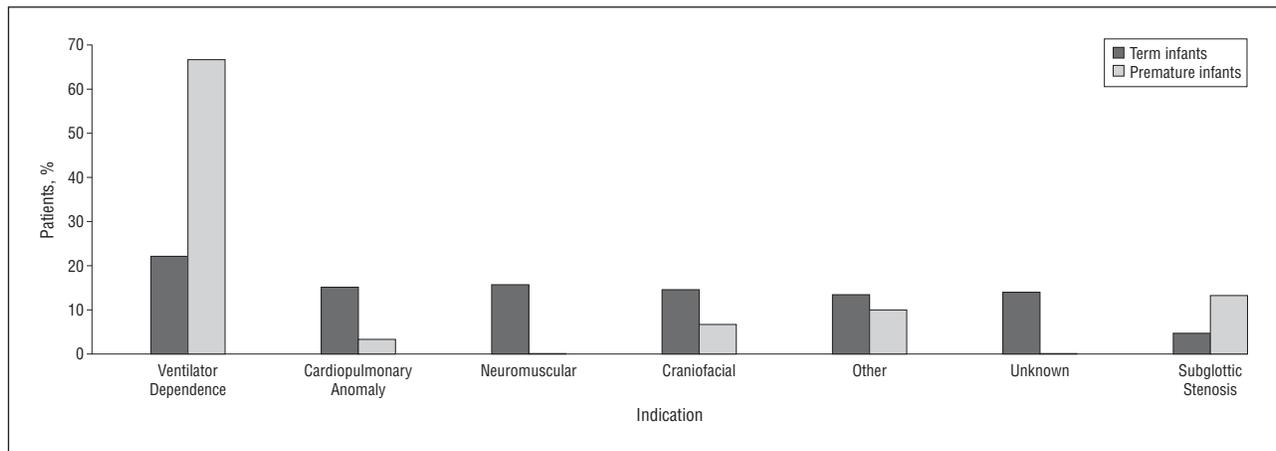


Figure 2. Tracheotomy indications in term infants vs premature infants.

tory tissue was removed in 20 of the evaluated patients (47%), and no intervention was performed in the rest. Of the 20 who had the SSG removed, 9 were noted to have recurrent SSG at subsequent endoscopy (45%). Interestingly, of the 23 patients who had no intervention performed, only 8 had appreciable SSG at the time of follow-up endoscopy, and 15 of the 23 were found to have spontaneous resolution of their SSG on subsequent endoscopy (65%).

COMMENT

Among surveyed ASPO members, the most common indication for infant tracheotomy was mechanical ventilation dependence, similar to our study population. We also examined the patients as subgroups of term vs premature infants, and indications for tracheotomy for the 2 groups are presented in Figure 2. Outpatient follow-up practices for infants with a tracheotomy varied greatly among survey participants. While 42% preferred to evaluate these patients in the clinic every 3 months ($n=32$), 20% of respondents indicated that they saw these patients in their clinic on an as-needed basis ($n=15$). Approximately half of surveyed ASPO members indicated that they performed surveillance MLB in this patient population ($n=43$), either in combination with other procedures requiring general anesthesia or as an independent routine evaluation. At our own institution, there is no protocol regarding outpatient follow-up or surveillance MLB, and practice patterns differ from surgeon to surgeon.

Management of incidental SSG found during endoscopy remains controversial among ASPO members who completed the survey. In the literature, some authors describe granulomas as a complication⁴; others view this phenomenon as an expected adverse effect of prolonged indwelling tracheotomy.¹ Among survey participants, over 33% stated that they would not remove a granuloma unless it was causing symptoms or in anticipation of decannulation ($n=15$). Even among those respondents who said they would intervene, there was no consensus on how much obstruction is enough to warrant intervention. One respondent would remove any evidence of

granuloma, while 29% believed that 25% to 50% obstruction is needed to prompt intervention ($n=22$).

The retrospective nature of our own institutional data makes it impossible to provide any additional insight into the problem. The degree of lumen occlusion by SSG and the rationale for intervention were not uniformly reported. Of those in whom granulation was removed, about half had recurrent SSG at follow-up endoscopy. It is interesting to note, however, in the nonintervention group, only a third of the patients had SSG at subsequent evaluation. This supports the findings of Rosenfeld and Stool,¹ who determined in a prospective study of 50 patients that management of granuloma by either excision or observation did not alter the probability of detecting a new or persistent granuloma at subsequent bronchoscopy.

When intervention for SSG was reported at our institution, skin hook and eversion was overwhelmingly the preferred technique. Our survey participants, however, demonstrated a greater variety of techniques. Skin hook and eversion (68%) was still the most common method used ($n=50$), but 35% of respondents were more likely to use the microdebrider ($n=26$), and 14% a laser ($n=10$) as the primary means of intervention. The skin hook and eversion technique was described by Reilly and Myer.⁵ This simple technique requires only a skin hook, straight clamp, and tenotomy scissors in addition to the endoscopic setup. Cheap and effective, the only real disadvantages are the risk of losing the tissue in the airway and bleeding, which is usually minimal. A variety of other techniques have been described over the years, to include optical forceps,⁶ sphenoid punch,⁴ microdebridement, carbon dioxide laser,⁷ and, most recently, coblation.⁸ There are no randomized data to show that any of the aforementioned techniques is superior to any other in terms of cost or safety.

As with any survey-based study, our project is not without limitations. There were only 75 respondents of over 300 ASPO members who were invited to participate. As is true of any voluntary survey, there is a certain selection bias for individuals who possess a particular interest in or strong opinion regarding the topic at hand. In addition, participants were allowed to provide multiple answers to certain questions within the survey, result-

ing in mathematical anomalies in which the total percentage of respondents exceeded 100%. Finally, a survey of this nature is limited in that the participants cannot explain the rationale behind their practices.

The predominant limitation of our internal review of practice patterns is the retrospective nature of it. Differences in physician reporting and charting accuracy introduce some degree of error in our analysis. In addition, in a tertiary referral center such as ours, many patients are either lost to follow-up or choose to follow up closer to home. Our data corroborate the findings of Rosenfeld and Stool,¹ who showed that removal of asymptomatic granulation does not change the natural course of the phenomenon. However, we are unable to make any definitive statements regarding the utility of surveillance endoscopy based on our data. In addition, without a head-to-head prospective evaluation of techniques for removal of symptomatic granulation tissue, it is impossible to perform a true cost analysis for these techniques.

While the particulars of impending health care reforms have yet to be elucidated, one thing is certain: we must develop best-practice patterns for ourselves. Several questions remain, including whether there is any real clinical benefit in routine surveillance endoscopy or in removing SSG. It has yet to be elucidated what degree of SSG, if any, is likely to result in increased risk of tracheotomy-related complications. To ascertain this, a uniform reporting method similar to the Cotton-Myer grading system for subglottic stenosis should be developed. Despite some of the inherent weaknesses of our study, we have demonstrated what we believe to be a wide variance in practice patterns among otolaryngologists with regard to infants with tracheotomies. We believe that the issue deserves further investigation and consideration as we move forward to establish evidence-based clinical practice guidelines.

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