Infant Tracheotomy

Results of a Survey Regarding Technique

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Objective: To identify practice patterns regarding tracheotomy technique among pediatric otolaryngologists.

Design: Survey of physicians.

Setting: Academic medical center.

Participants: Members of the American Society of Pediatric Otolaryngology (ASPO) residing in the United States.

Main Outcome Measures: Physician responses to survey questions, including both multiple choice and free-text responses. We used χ² tests to determine if demographic factors (pediatric otolaryngology fellowship training, the number of tracheotomies performed yearly) correlated with differences in the technique used to perform infant tracheotomies.

Results: A total of 168 of 225 surveys mailed to ASPO members (75%) were completed and returned. Most respondents (87%) report that they make a simple vertical incision in the trachea. An even greater number (94%) use stay sutures routinely. On other technical points, such as management of the thyroid gland, the subcutaneous fat, and the method of securing the tracheostomy tube, there was much greater variability: 22% of respondents reported having had a serious tracheotomy-related complication in the immediate postoperative period, and 58% of these physicians changed their technique as a result. In several areas, χ² analysis revealed statistically significant differences in technique that were dependent on both fellowship training and the number of tracheotomies performed (P ≤ .05).

Conclusions: Among ASPO members practicing in the United States, there is near-unanimity on certain technical points, with considerable divergence on others. A substantial percentage of our colleagues have experienced a tracheotomy-related complication in the early postoperative period. In many cases, these incidents led to changes in surgical technique.

INFANT TRACHEOTOMIES ARE PERCEIVED to be risky procedures compared with most routine pediatric otolaryngological surgical procedures. Rates of tracheotomy-related complications reported in the literature range from 22% to 77%.

The rate of tracheotomy-related mortality reported in various series ranges from 0% to 3.6%. Consequently, optimizing and standardizing the care of these patients, where possible, is desirable.

Other authors have used surveys to identify patterns of practice in the area of pediatric tracheotomy. Both of these efforts focused on the postoperative care of the patient. Issues such as timing of the first tracheostomy tube change, parental or caregiver education, and suctioning routine were addressed. For the most part, however, these surveys did not address the actual surgical technique used to perform tracheotomy in the pediatric population.

As with any surgical procedure, details of how to perform a pediatric tracheotomy differ somewhat from surgeon to surgeon. Technical aspects of pediatric tracheotomy as described in a selection of sources in the literature and in pediatric otolaryngology texts are summarized in Table 1. No 2 sources agree completely regarding the technical aspects of this procedure.

The survey questions employed in this study intended to address points of divergence in the pediatric tracheotomy technique. Questions were specifically focused on intraoperative technique. The scope of the study was further narrowed to infants, the subgroup of pediatric pa-
patients most likely to undergo tracheotomy as well as the patients most likely to experience complications from the procedure and those most distinct anatomically and physiologically from adults. Our purpose was to describe current practice patterns.

**METHODS**

Survey questions regarding technique in pediatric tracheotomy were developed based on a review of relevant literature. Institutional review board approval was sought and received at our institution (Penn State/Milton S. Hershey Medical Center, Hershey, Pennsylvania). A survey (Figure) was mailed to 225 members of the American Society of Pediatric Otolaryngology (ASPO) with addresses in the United States. Questions pertained to technical aspects of performing tracheotomies, specifically in patients 1 year of age or younger; experience of an early, serious, tracheotomy-related complication and the impact such an experience had on a respondent’s method of performance; and demographic data, such as the level of training respondents had undergone, the nature of their practice, and the frequency with which they performed tracheotomies for infants. An accompanying cover letter explained the goal of our study and included instructions for returning the completed survey by fax. Data from returned surveys was tabulated in spreadsheet form using Microsoft Excel (Redmond, Washington). Statistical analyses were performed using SPSS statistical software (SPSS Inc, Chicago, Illinois).

**RESULTS**

Of the 225 surveys mailed, 168 were returned, a response rate of 75%. The demographic data provided by respondents were consistent with the targeted population, namely, ASPO members residing in the United States. A large percentage of respondents (97%) reported their area of practice as “pediatric otolaryngology,” with 2% identifying themselves as general otolaryngologists and 1% as “other,” and 85% reported having completed fellowship training in pediatric otolaryngology. The frequency with which respondents reported performing tracheotomies on infants was quite variable: 34% performed 11 to 20 tracheotomies; 32%, 6 to 10; 30%, 1 to 5; and 4%, none. Results of technique questions are presented discussed in the “Comment” section.

Responses to technique questions were compared among different respondent groups using χ² tests. Groups comprised respondents with pediatric otolaryngology fellowship training vs those without, and respondents who indicated that they performed different numbers of infant tracheotomies over the previous year. Statistically significant differences in technique among groups were found for both parameters (P ≤ 0.05). Specifically, an increased volume of infant tracheotomies performed over the past year and having had fellowship training in pediatric otolaryngology were both associated with a greater likelihood of removing subcutaneous fat (Table 2 and Table 3). Also, fellowship-trained pediatric otolaryngologists were more likely than their non-fellowship-trained counterparts to routinely divide the thyroid isthmus and to use a vertical tracheal incision (Table 4 and Table 5). No other differences in technique were identified among the groups considered.

A total of 37 of 163 respondents (22%) indicated that they had experienced a serious, early postoperative complication. (Respondents were not asked to identify the type of complication.) Of these respondents, more than half (20 of 36 [56%]) reported that they had changed their technique as a result.

An area for respondents to describe the type of technical change(s) undertaken (in free-text form) was provided at the bottom of the survey. Most of the early serious complications discussed were accidental decannulations. Twenty responses were analyzed quantitatively for themes regarding a change made: a change in intraoperative technique, including starplasty or using a Bjork flap (n = 6); a change in the way the tracheostomy tube was secured, mainly adding sutures on the neck plate along with tracheotomy ties (n = 6); a change in postoperative care routine (eg, “I do not allow staff to change tracheotomy ties in the first postoperative week”); or changing the tube over a stylet (n = 5); education of caregivers (n = 2); and changed tube type from Portex to Shiley (n = 1).

**COMMENT**

In both the pediatric otolaryngology texts and peer-reviewed literature, most authors recommend a vertical skin incision. Some of the advantages of the vertical skin incision stated include the ability to extend the incision easily intraoperatively and the lack of redundant tissue above and below the tracheostoma (as with a horizontal skin incision), leading to increased ease of...

<p>| Table 1. Summary of Pediatric Tracheotomy Techniques as Described by Other Authors |</p>
<table>
<thead>
<tr>
<th>Source</th>
<th>Skin Incision</th>
<th>SC Fat Removal</th>
<th>Thyroid</th>
<th>Tracheal Incision</th>
<th>Stay Sutures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Casselbrant, et al, 1995</td>
<td>Vertical or horizontal</td>
<td>No</td>
<td>Retract or suture-ligate</td>
<td>Vertical</td>
<td>Yes</td>
</tr>
<tr>
<td>McMurray and Prescott, 1999</td>
<td>Vertical</td>
<td>Yes</td>
<td>Cautery</td>
<td>Vertical</td>
<td>Yes</td>
</tr>
<tr>
<td>Hotaling et al, 1992</td>
<td>Vertical</td>
<td>Yes</td>
<td>Retract or suture-ligate</td>
<td>Horizontal (Björk)</td>
<td>Yes</td>
</tr>
<tr>
<td>Koltai, 1998</td>
<td>X-shaped</td>
<td>Yes</td>
<td>Retract or cautery-ligate</td>
<td>Cruciate</td>
<td>No</td>
</tr>
<tr>
<td>Carron et al, 2000</td>
<td>Vertical</td>
<td>Yes</td>
<td>ND</td>
<td>Vertical</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Abbreviations: ND, not described; SC, subcutaneous.
Recannulation in the event of accidental decannulation. Casselbrant, writing in a major pediatric otolaryngology text, expressed no preference between horizontal and vertical skin incisions. Koltai described a novel technique focused on the creation of a more secure tracheostoma. A cruciate skin incision is used in the construction of a continuous mucocutaneous suture line via the interposition of skin and tracheal flaps. Koltai’s experience with starplasty indicates that the stoma will stay open even in the situation of early accidental decannulation, preventing tracheostomy-related deaths, but the rate of persisting tracheocutaneous fistula is high.

Most of our respondents (61%) reported using a horizontal incision typically, whereas a substantial minority (36%) uses a vertical skin incision. Of the remaining respondents, a few (2%), notably those who perform starplasty, make the cruciate incision required by that technique; the remainder (1%) use another method.

The survey also included a question concerning the removal of subcutaneous fat as part of the dissection. Although some authors do not explicitly mention it, many groups include this step in their description of the pediatric tracheotomy procedure. One group emphasizes the importance of this step, explaining that removal of subcutaneous fat results in an early patent stoma and allows the tracheostomy tube to rest in a central position.
sition in the trachea. In this survey, most respondents (62.2%) reported that they routinely remove subcutaneous fat (15% remove it sometimes; 15%, rarely; and 8%, never). Interestingly, this was one of several questions to yield statistically significant intergroup differences; specifically, the data show that 2 groups, those performing larger numbers of infant tracheotomies ($P \leq .05$) and those having pediatric otolaryngology fellowship training ($P \leq .05$), are more likely than their counterparts to routinely remove subcutaneous fat (Table 2 and Table 3). Although these data do not prove that defatting improves patient outcome, surgeons with more experience performing this procedure are more likely to include this step.

Management of the thyroid isthmus during infant tracheotomy was also addressed in the survey. Previous authors have offered different methods for this step. One group6 explained that the thyroid isthmus may be retracted out of the way or divided with suture ligation; another4 described routine division with cautery; and still others4 primarily retract the isthmus, dividing with suture ligation only in rare instances. One group10 made no mention of this step whatsoever. Proponents of routine division of the thyroid isthmus noted that doing so prevents the isthmus from obstructing or obscuring the tracheal incision in the event of accidental decannulation.11 In this survey, most respondents (35%) reported that they typically use cautery division. Smaller percentages of respondents supported the other techniques (22% retract out of the way; 10% clamp, divide, and then ligate; and 13% use other or variable methods). Intergroup comparison of fellowship-trained and non–fellowship-trained respondents suggested a divergence on this step between the groups, with fellowship-trained pediatric otolaryngologists more likely to routinely divide the thyroid isthmus ($P < .001$) (Table 4).

Most authors5,6,9 describe a vertical tracheal incision for pediatric tracheotomy. Exceptions are those who advocate a method of stoma creation that necessitates another design, such as a Bjork flap or starplasty.6,7,12 A vertical tracheal incision was preferred by most respondents to our survey (87%) (5% use a horizontal incision; 3%, cruciate; and 5%, other or variable incisions). This trend is even more pronounced among fellowship-trained pediatric otolaryngologists; 89% of them routinely make a vertical incision vs 72% of respondents without fellowship training who do so (Table 5).

Among the most common potentially serious early complications of pediatric tracheotomy are accidental decannulation and plugging of the tracheostomy tube. These account for 53% of the early complications in one large series1 and 61% in another.14 These results are further reinforced by the current study; specifically, the types of modifications respondents made in technique after experiencing complications seem to be directed primarily at preventing accidental decannulation. Several of the survey questions are directly relevant to these complications.

Koltai7 described the placement of stay sutures alongside a vertical tracheal incision as the most commonly practiced method of addressing the problem of accidental decannulation. Most other authors5,6,9 who discuss pediatric tracheotomy technique advocate or describe the use of stay sutures. In the event of accidental decannulation, stay sutures allow the tracheostoma to be pulled open and pulled to the skin surface to facilitate recannulation. Stay sutures can likewise make easier an urgent tracheostomy tube change in the event of recalcitrant mucus plugging in the early postoperative period.

In our survey, the use of stay sutures was prevalent among pediatric otolaryngologists, with 94% of them reporting that they always place them and only 3% reporting that they sometimes place them and another 3% never placing them.

Various techniques designed to facilitate a more secure or more rapidly maturing stoma are advocated by a number of authors.4-10,11 Again, the goal is to ease recannulation in the event of early accidental decannulation and to avoid cannulating a false passage. All of the authors describe some method of suturing the edges of the tracheal opening to the skin edges. Specific techniques described include the inferiorly based (Bjork) flap,5,12,13 starplasty,7 and others.5 Because airway obstruction related to accidental decannulation can result in death, creating a secure stoma is important. Still, only 16% of respondents report using any technique to stoma skin to trachea (starplasty, 2%; Bjork flap, 2%; and other, 12%).

In conclusion, these results describe the current practice patterns in pediatric tracheotomy but should not be interpreted to describe the proven best practices. A similar survey 20 years ago would have yielded different results, and one 20 years in the future may well too. Today, despite some disparities, certain steps in infant tracheotomy seem to predominate among pediatric otolaryngologists in the United States; features include a vertical tracheal incision, routine placement of stay sutures, and tracheotomy ties to secure the tube (36% use both tracheotomy ties and skin sutures; 59%, tracheotomy ties; 3%, skin sutures; and 2%, other methods). Technical refinements to encourage early development of a mature tracheostoma are widespread in pediatric otolaryngology texts5 and the peer-reviewed literature6,8,12,13 but despite some promising results in preventing serious complications,7,8 these techniques are infrequently used in practice. The routine removal of subcutaneous fat during tracheotomy is more common with both fellowship-trained pediatric otolaryngologists and those who perform the procedure more frequently. Finally, a considerable percentage of pediatric otolaryngologists have experienced serious complications in the immediate postoperative period of an infant tracheotomy; of those who have experienced such an event, most have changed their surgical technique.

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REFERENCES