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Tracheotomy-Related Catastrophic Events: Results of a National Survey

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Abstract

Objectives/Hypothesis—To gather qualitative and semiquantitative information about catastrophic complications during and following tracheotomy.

Study Design—National survey distributed to American Academy of Otolaryngology–Head and Neck Surgery members via the Academy weekly email newsletter during April and May 2011.

Methods—A total of 478 respondents provided estimates of the number of four specific tracheotomy-related complications (innominate artery fistula, esophageal fistula, acute tracheotomy occlusion, and obstructing granuloma), all catastrophic events, and events resulting in death or permanent disability encountered during their careers. There were 253 respondents who provided 405 free-text descriptions of specific events.

Results—The respondents experienced approximately one catastrophic event every 10 years and one event resulting in death or permanent disability every 20 years. More than 90% occurred more than 1 week after surgery. Categories of physicians who experienced more events per year included academic physicians and laryngologists. Pediatric otolaryngologists had twice as many innominate artery fistulas per year of practice as others. Qualitative (free-text) descriptions of the most serious events demonstrated that more of these events involved loss of airway and volume bleeds, usually from innominate or carotid artery erosion. Many of the events due to airway loss involved potentially correctable deficits in family education, nursing care, home care, and other structural factors.

Conclusions—Even when we allow for selection bias, these data suggest that a substantial number of tracheotomy complications leading to death or permanent disability occur at a national level. The vast majority of events occur more than 1 week after the procedure. Many of the described events were caused by factors that should be amenable to prospective system improvement strategies.

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Keywords

Tracheotomy; patient safety; quality

INTRODUCTION

Tracheotomy is one of the most frequently performed surgical procedures in the critically ill patient and is lifesaving in patients with upper airway obstruction. Indications for tracheotomy have evolved from mainly short-term procedures secondary to infectious causes to long-term procedures for chronic disease and disability.[1]

Complications of tracheotomies are well established and have been reported to occur in 15% of patients.[2] Short-term complications include hemorrhage, infection, pneumothorax, tube obstruction, and accidental decannulation.[3,4] Late complications include development of granulation tissue, which may result in airway stenosis or obstruction, failure to decannulate, or upper-airway obstruction with respiratory failure after decannulation. Less frequent late complications include tracheomalacia, tracheoinnominate artery fistula (TIF), tracheoesophageal fistula (TEF), pneumonia, and aspiration, and each can be associated with considerable morbidity and mortality.[5] For example, although TIF is reported to occur in less than 1% of all patients undergoing tracheotomy, its mortality rate approaches 100%.[5]

Numerous studies have demonstrated an increased mortality rate due to tracheotomy complications in emergency situations,[6] severely ill patients, and children.[1,7,8] In children, the most common tracheotomy-related cause of death has been reported to be cannula obstruction, followed by cannula misplacement, and accidental decannulation.[9–12]

Although there are recent accounts of tracheotomy-related morbidity and mortality in the pediatric population,[13] a comprehensive understanding of the epidemiology of serious tracheotomy complications is lacking. The ideal means of determining the incidence of complications would be to compare the number of complications to the total number of tracheotomies in the population. However, it is essentially impossible in the US health-care system to track procedures and outcomes specifically enough to perform this study.

To gather information on the incidence and types of severe or catastrophic events, a survey methodology was used. In recent years, surveys of the membership of the American Academy of Otolaryngology–Head and Neck Surgery (AAO-HNS) have been used to estimate rates of wrong-site or wrong-sinus surgery and to learn about errors with the use of concentrated epinephrine in otolaryngology practices.[14,15] A similar methodology was employed in this quality improvement (QI) project as part of a Patient Safety and Quality Improvement (PSQI) initiative undertaken by the PSQI Committee of the AAO-HNS. The purpose of this QI project is to assess the types of complications experienced by AAO-HNS members and to identify areas for focused improvement initiatives.

MATERIALS AND METHODS

Survey Design and Deployment

Institutional review board approval was not sought for this QI project performed by the AAO-HNS PSQI Committee. A survey tool was developed and piloted before deployment; the survey had 26 questions, and there was a way to opt out if the responder did not perform tracheotomies. Respondents were asked to report the number of TIFs, TEFs, acute tracheotomy occlusions and obstructing granulomas seen during their careers. Respondents were also asked to report the number of catastrophic tracheotomy complications they had

experienced and the number of complications leading to death or permanent disability. The term catastrophic was not defined but was left to the judgement of the respondent. The survey was distributed electronically via the Academy weekly newsletter during April and May 2011 and was open for 6 weeks. All responses were anonymous. Responses to questions about long-term surveillance practices are reported in an accompanying manuscript.

Classification of Primary Area of Practice

Where respondents stated only one primary area of practice, we classified them as such (n = 395). Where respondents did not state a primary area of practice (n = 2) or stated more than one primary area of practice (n = 23) but had completed a fellowship, we classified them according to their fellowship. If respondents selected general otolaryngology and only one specialty area, we classified them in the specialty area (n = 25). If respondents selected more than two different primary areas of practice, we classified them as a general otolaryngologist (n = 29). Four respondents did not specify their primary area of practice or fellowship.

Calculation of Years of Experience

For each respondent, we calculated the number of years of experience by adding 5 years of residency to their stated number of years in practice.

Analysis of Semiquantitative Responses: Exclusions

Analysis of the number of overall catastrophic events per physician year revealed nine responses that were >3 standard deviations (SDs) from the mean (e.g., one respondent reported caring for 100 patients with catastrophic events); these were treated as outliers and excluded. Similarly, we excluded responses >3 SDs from the mean from the number of TIFs (n = 0), TEFs (n = 3), acute occlusions (n = 10), obstructing granulomas (n = 4), and events leading to death or disability (n = 17) per physician year.

Analysis of Qualitative Responses: Classification of Events

Two different free-text responses were included in the survey. One question asked for a detailed description of the most recent event a respondent had been involved in, and one asked for a list of events that resulted in death or permanent disability. Many respondents described the same event in both responses. Others described multiple distinct events. Analyzing the responses to the two different questions did not demonstrate any important differences. Therefore, all descriptions were pooled for analysis, excluding only those that represented two descriptions of the same event.

We adopted the principle of accepting the respondent's version of events. For example, if a respondent attributed a complication to poor tracheotomy care by a junior member of staff, we accepted this assessment. We aimed to avoid overinterpretation or inferring information that was not specifically provided.

Each event was reviewed and classified in regard to four components (Table I): 1) location/timing of event, 2) specific event that led to catastrophe, 3) outcome of event (death, permanent disability, or transient morbidity), and 4) associated/contributing factors.

For example, "death—mucous plugging at home in child with trach" would be classified as: 1) location/timing of event: home, 2) specific event that led to catastrophe: tracheotomy occlusion/mucous plug, 3) outcome of event: death, and 4) associated/contributing factors: pediatric patient.

If descriptions were unclear, the event was classified as not specified. For example, “patient taken to OR, expired” would be classified as: 1) location/timing of event: inpatient, 2) specific event that led to catastrophe: not specified, 3) outcome of event: death, and 4) associated/contributing factors: none stated.

After initial classification, each classification was validated by two senior authors (R.K.S., M.L.S.).

Statistical Analysis

SPSS version 12.0 (SPSS Inc., Chicago, IL) was used for all statistical analysis. We calculated the mean and SD for each type of event, overall catastrophic events, and events leading to death or severe disability. An unpaired *t* test with appropriate variance was used to test for significant differences. $P < .05$ was considered significant.

RESULTS

Demographics of Respondents

There were 478 respondents from 10,307 AAO-HNS members. These physicians represented 10,033 years of experience (mean, 21.2 years; SD, 11.1 years) (Table II).

97% of respondents (n = 464) reported caring for patients with tracheotomies 9% (n = 42) cared predominantly for pediatric tracheotomies, and 65% (n = 315) cared predominantly for adult tracheotomies. The remainder (n = 121, 25%) did not specify. Of the total 478 respondents, 263 (55.0%) cared for at least one patient with a catastrophic event related to a tracheotomy.

There were 92.3% (n = 441) of respondents who specified fellowship level training; 35% (n = 167) indicated that their practice was academic.

Semiquantitative Analysis: Number of Tracheotomy Complications per Physician Year

There were 469 respondents who reported a total of 759 overall catastrophic tracheotomy-related events in their careers (mean, 0.097 events per physician year) (Table III).

Physicians working in an academic center reported a significantly higher frequency of TIFs, TEFs, and events leading to death or disability compared to those who did not work in an academic center. Pediatric otolaryngologists reported a significantly greater number of TIFs per physician year in comparison to the rest of the respondents. Laryngologists reported a significantly greater number of TEFs, acute occlusions, overall catastrophic events, and events leading to death or disability per physician year in comparison to the rest of the respondents. Physicians within the head and neck group reported a greater number of overall catastrophic events per physician year in comparison to the rest of the respondents, with values approaching significance.

General otolaryngologists reported a significantly lower frequency of TIFs, TEFs, acute occlusions, obstructing granulomas, overall catastrophic events, and events leading to death or disability per physician year in comparison to the rest of the survey respondents. Otologists reported a significantly lower number of TIFs and TEFs per physician year in comparison the rest of the respondents.

Qualitative Analysis: Respondent Descriptions of Tracheotomy Complications

There were 253 respondents who described 405 recent catastrophic events related to tracheotomies as free-text responses (Table I). These were classified as described in the

methods section. Because these were completely free-text responses and these elements were not specifically asked for, it is likely that the true number of patients with each of these characteristics was higher.

Location/timing of event—Of those who specified the location/timing of an event, only a minority of respondents described the complication occurring during the intraoperative tracheotomy period (n = 19). The majority reported a postoperative location (n = 171), including inpatient/long-term care facility, or a description in which inpatient location could be inferred, or an event that occurred at home. Of the 101 events reported to have occurred as an inpatient, only eight were described within the first week of surgery. One such description was as follows: “As a Resident, the intern who had assisted me with tracheotomy felt he could replace a fresh trach with a cuff failure without calling me. The tube was placed anterior to the trachea. The patient did not survive.”

Specific event that led to catastrophe—The majority of events involved accidental decannulation, bleeding (TIF or carotid artery erosions and volume bleed from an unknown source), and tube occlusion/mucous plugging. Other events included TEF and airway obstruction/stenosis.

Outcome of event—Of the events where outcome was described, 177 led to death, 38 events led to permanent disability, and 16 events led to transient morbidity.

Associated/contributing factors—Associated/contributing factors were broadly grouped as 1) factors related to the patient or underlying disease, 2) factors related to tracheotomy care, and 3) factors related to the insertion of the tracheotomy tube.

PATIENT AND DISEASE FACTORS: Twenty-nine patients were reported to have a history of cancer; in these patients, bleeding events (n = 9) and loss of airway (n = 8) were the most commonly described events, followed by TEF (n = 2). Fourteen patients died, and one patient had permanent disability resulting from the complications. One description of events was as follows: “Trach downsized to Shiley 4 (postop day 4 mandibular free flap) third spaced and resulted in respiratory distress, code team bagged third space trach which resulted in airway compromise and death.”

Twenty-nine patients were specified to be children, in whom tracheotomy-tube occlusion (n = 12), decannulation leading to loss of airway (n = 10), and TIF (n = 4) were the most commonly reported events. In 17 of 29 descriptions, pediatric events were fatal, and another four resulted in permanent disability. Ten of the 28 events occurred at home. Descriptions of these events included the following:

- Child with T-tube style trach found dead with trach on floor moments before mother was to take child home. Blamed on trach tie being too loose.”
- 9 mo old with chronic trach, occluded with mucus plug and was suctioned by nursing staff that failed and pt expired.”
- Accidental decannulation at home of an infant with ventilator dependence due to pulmonary hypertension and resulting hypoxia leading to brain death.”
- Death-mucous plugging at home in child with trach and grad 4 subglottic stenosis.”

Twenty-six patients were reported to have been obese. These patients predominantly experienced decannulation with loss of a secure airway or false passage (n = 16). There were five reports of significant bleeding events and four cases of tracheotomy obstruction/ stenosis. These events tended to involve patient positioning or transfers (n = 7) by nursing

staff (n = 2) or were partially attributed to loose tracheotomy ties (n = 2). Twelve of the events resulted in death and two in permanent disability. Descriptions of these events included the following:

- Trach placed for OSA [obstructive sleep apnea] in morbidly obese patient. Did well for months but presented to the ER with an extrusion and was obstructing on sedation and was not able to be intubated."
- OSA pt, pickwickian, after elective non emergent trach partially pulled tube out, even with sutures in place. Resp therapy arrived, panicked, ambu bagged him until he had mortal subq emphysema with restrictive inability to breathe."

TRACHEOTOMY CARE ISSUES: Twenty-four events were described to have occurred during a tracheotomy change, and 15 events during patient transfer/repositioning. Fourteen events detailed poor tracheotomy care/education and others described nursing (n = 11) or junior (n = 10) care issues. Descriptions of these events included the following:

- Patient with Guillain-Barre decannulated accidentally during bed bath and unable to be intubated. Patient expired."
- A completely trach dependent patient (fully occluding airway stent above) was discharged home. His trach tube became occluded in the car on his way home. The suction equipment was in the trunk of the car. The patient could not be resuscitated and died."
- Home care long-term trach in 8 year old with subglottic stenosis mucous plug, uncle caring for child didn't know how to suction—death."
- Patient was being cared for by nurse in a 'long-term acute care hospital', trach tube was dislodged, patient coded, and died."

PERCUTANEOUS VERSUS OPEN INSERTION: Twelve events involved tracheotomies placed percutaneously.

DISCUSSION

There were 478 AAO-HNS members who responded to the survey. This is a record response for an AAO-HNS survey, which suggests that otolaryngologists have a high degree of concern regarding this topic.

Limitations

There are several important limitations to any data gathered by survey. First, there is a high likelihood of response bias, in which those who have experienced catastrophes are more likely to respond. Second, there is a possibility of recall bias, in which respondents either over- or underestimate the number of times they have encountered specific complications. Last, the data are unverifiable. Although there is high face validity to the belief that our colleagues would respond honestly and accurately, we cannot verify this.

Limitations of this particular survey include the fact that very small numbers of certain specialties responded. In addition, many of our respondents listed themselves as practicing both general otolaryngology and one or more specialties. To look at the incidence of events on a specialty-specific basis, we had to assign each respondent to one specialty or to general otolaryngology, as described in the methods section. This inevitably limits our ability to be certain about our conclusions for specific subspecialties. Finally, it is very possible for patients to die of tracheotomy-related complications and for the otolaryngologist to be

unaware, particularly if the patient has moved, is under the care of another physician (e.g., a pulmonologist), or is otherwise unavailable for follow-up. In a companion manuscript, we report that a substantial minority of survey respondents do not perform long-term ongoing surveillance care of tracheotomy patients.[16b]

Semiquantitative Responses: Incidence of Events

Each respondent was asked to quantify the number of times in their career that a patient had experienced the following: 1) four specific events: TIF, TEF, acute occlusion, and obstructing granuloma; 2) catastrophic events; and 3) events leading to death or permanent disability (Table III).

The sum of the frequency of the four specific events totaled 0.19 events per physician year; the frequency of catastrophic events was 0.097 events per physician year, and the frequency of events resulting in death or disability was 0.053 events per physician year. This finding makes sense because not every obstructing granuloma, nor even every episode of acute occlusion, would be considered catastrophic. Likewise, not every catastrophic event necessarily results in death or permanent disability.

If these incidence rates are correct for all US otolaryngologists (≈10,000), then there are approximately 1,000 catastrophic events and approximately 500 tracheotomy-related deaths in the United States annually. There is likely a response bias favoring over-response to the survey among those who have experienced catastrophes; this would result in an overestimate of event frequency. It is also likely that there are late tracheotomy-related deaths that the primary otolaryngologist is unaware of; this would result in an underestimate of event frequency. A catastrophic event frequency of one every 10 years (2–3 events per career) seems plausible. Unless these estimates are off by more than 5- or 10-fold, it is clear that every year a substantial number of patients experience major complications, death, and disability related to tracheotomy.

Subspecialty-Specific Incidence

Those respondents who were general otolaryngologists had a statistically lower frequency of all event types when compared to all other respondents (Table III). Laryngologists had a higher event rate in every category; this was statistically significant or nearly so for every event type except TIF. Pediatric otolaryngologists had a similar event rate to all others in every category except TIF. Pediatric otolaryngologists reported a TIF at twice the frequency of all other respondents ($P = .042$). It has previously been suggested that children may be more likely to experience TIFs,[16a] which is logical because a pediatric tracheotomy tube occupies a relatively greater percentage of the airway than an adult tracheotomy tube and because the pediatric trachea is softer and thinner than the adult trachea. Furthermore, pediatric patients are more likely to have an abnormally high-positioned innominate artery, which can predispose to fistula formation.[17]

Interpretation of other specialties' event rates is limited by a very low response rate. In general, otologists had lower event rates than others, which is plausible. Allergists had a very high event rate but this was based on only seven respondents, suggesting response bias.

Qualitative Responses: Event Descriptions

There were 253 respondents who provided qualitative (free-text) descriptions of 405 catastrophic events (Table I). The frequency of event types reported in the qualitative description is somewhat different from the frequency of events reported in the semiquantitative responses. This is to be expected because certain types of events are more

likely to result in catastrophic outcomes than others. Bearing in mind the limitations of free-text responses (discussed previously), a number of interesting findings emerge.

Only 19 of these 405 events occurred during the tracheotomy placement itself; only eight were described as occurring in the first week after tracheotomy. Although otolaryngologists naturally (and appropriately) place great emphasis on safe surgery and perioperative care, it seems clear that the vast majority of tracheotomy-related catastrophes occur after the immediate perioperative period and the first tracheotomy change. Most otolaryngologists would probably agree that the operative and perioperative period is an extremely dangerous period; this suggests that most of us have implemented operative and perioperative protocols that are preventing many catastrophes during this period. It would seem that the next step for our specialty would be to determine how to extend such safe practices into the later postoperative period.

Nature of Event

In the qualitative descriptions of catastrophic events, 66% (n = 267) involved loss of airway or bleeding. There were 122 events that were triggered by accidental decannulation, and 17 occurred during planned tracheotomy change. Thus 34% of all qualitative descriptions involved accidental or planned removal of tracheotomy tube with inability to reinsert. Clearly, a huge potential area for improvement is working toward systems that make accidental decannulation less likely and ensure that there is always a caregiver present who is able to reinsert the tube.

Fifty-seven events (14%) involved occlusion or plugging of the tracheotomy tube. Another clear area for improvement initiatives is reducing the likelihood of mucous plugging (e.g., by better pulmonary toilet), ensuring that occlusions are rapidly recognized, and ensuring that there is always a caregiver present who is able to suction and replace the tube if it occludes.

There were 128 events (32%) that involved major bleeding. Ninety-one were specified as being due to TIF; the remainder did not specifically report TIF, although it is likely that many of these were also due to erosion into a major artery. Unlike for tube extrusion or occlusion, which in theory can be managed if competent personnel are present, it is difficult to imagine an improvement strategy that will allow TIF to be successfully managed at home or at a long-term care facility. Efforts should be directed to understanding if there are patient factors or tube factors that predispose to TIF and whether changes in tube care could reduce the incidence of this complication.

Patient and Disease Factors

It is not surprising that patients with cancer ± radiotherapy, pediatric patients, and obese patients are heavily represented. Each of these cases presents specific challenges and risks that have previously been described.[18,19] Other associated factors reported (e.g., coagulopathy, neck trauma, burn injuries) are also intuitively plausible as risk factors for complications. Little can be done from a systems perspective to reduce complications associated with patient or disease factors. Of course, the otolaryngologist performing tracheotomy in patients with such risk factors will take unusual care to ensure that all possible risk amelioration strategies (e.g., correction of coagulopathy) are undertaken.

Tracheotomy-Care Issues

Eighty-eight respondents reported potentially correctable tracheotomy-care issues that were associated with catastrophic events. These included events during tracheotomy changes or

patient repositioning, nursing-care factors, junior physician care, poor education or poor ongoing care, and specific issues such as ties being too loose.

From a systems perspective, these areas represent an opportunity for improvement. While recognizing that humans will never achieve perfection, it should be possible to create systems improvements that will reduce the frequency of such preventable events.

Percutaneous Versus Open Tracheotomy

Only 12 events were specifically reported to occur in patients undergoing percutaneous tracheotomy. There has been a great deal of discussion in the literature regarding the relative safety of open versus percutaneous tracheotomy.[20–22] These survey data clearly do not allow us to comment on that issue, as we do not know if other events also involved percutaneous tracheotomies, and we do not know the denominator for either type of tracheotomy.

However, the vast majority of events happened after the immediate postoperative period. Once the tracheotomy tract has epithelialized, the initial technique of insertion would presumably be irrelevant to the risk of long-term complications. Therefore, these data suggest that the relative risk of a particular insertion technique is probably small relative to some of the long-term risks of indwelling tracheotomy.

CONCLUSION

Tracheotomy complications, including complications causing death or permanent disability, although uncommon in an individual otolaryngologist's practice, represent a substantial number of death or disability events nationally. We report a very approximate annual estimate of 1,000 catastrophic events and 500 causing death or permanent disability. Laryngologists experience the greatest number of complications. General otolaryngologists experience relatively fewer events compared to subspecialists. Pediatric otolaryngologists report TIFs more commonly than their peers. The vast majority of events occur after the immediate perioperative period, indicating that otolaryngologists are doing well at reducing the risk of complications in this initial high-risk period and that a focus on postoperative care may be the best means to further reduce the frequency of complications. Many of the reported events involve causes that should be amenable to prospective system improvement strategies.

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TABLE I

Qualitative Results Based on Free-Text Descriptions.

Result	No.
No. of respondents	253
No. of events described	405
Location/timing of event	
Intraoperative *	19
Postoperative: inpatient/long-term care (8 of these occurred in the first postoperative week)	101
Postoperative: inpatient location inferred	40
Postoperative: home	30
Nonspecified	215
Total	405
Specific events that led to catastrophe (no.)	
Decannulation	139
Accidental decannulation, loss of airway (88)	
Accidental decannulation, false passage (34)	
Planned tracheotomy change, loss of airway (5)	
Planned tracheotomy change, false passage (12)	
Bleeding (no.)	128
TIF/carotid artery erosion (91)	
Volume bleed, source unknown (37)	
Tube occlusion/mucous plug	57
Tracheoesophageal fistula	33
Airway obstruction/stenosis	18
Pneumothorax/subcutaneous emphysema	5
Nonspecified	6
Other †	19
Total	405
Outcome of event	
Death	177
Major disability	38
Transient morbidity	16
Nonspecified	174
Total	405
Associated/contributing factors	
Patient and disease factors	
Cancer or radiotherapy	29
Pediatric	28
Obese	26
Trauma: burns, laryngeal fracture, foreign body	6
Obstructive sleep apnea	6
Clotting defect/anticoagulation	3

Result	No.
Infection	3
Other significant illness‡	9
Total	110
Tracheotomy-care issues	
Tracheotomy change	24
Patient transfer/repositioning	15
Poor tracheotomy care/education	14
Nursing care	11
Junior care	10
Ties too loose	6
Excess cuff pressure	5
Equipment/staff did not arrive in time	3
Total	88
Tracheotomy-insertion issues	
Percutaneous tracheotomy	12
Tracheotomy placed too low	1
Total	13

See Results section for details.

Because the responses were completely free-text, and these elements shown in the table were not specifically asked for, it is likely that the true number of patients with each of these characteristics was higher.

*Intraoperative events included tracheoinnominate artery fistula, tracheoesophageal fistula, airway fire, tracheotomy change—false passage, bleeding, pneumothorax, tracheal tear, laryngomalacia.

†Tracheomalacia, necrotizing fasciitis, airway fire, tracheal tear, pneumonia, infection, foreign body, inability to cannulate stoma, downsized too early.

‡Guillain-Barre syndrome, immunocompromise, diabetes, muscular dystrophy, Down syndrome.

TIF = tracheoinnominate artery fistula.

TABLE II

Demographics of 478 Respondents.

	No. of Physicians (%)	Mean Years of Experience*
Overall respondents	478 (100)	21.0
Type of practice		
ACA	167 (35)	20.2
Group, private, or other	311(65)	21.4
Area of practice		
GEN	286 (60)	22.4
HN	56 (12)	22.9
PED	48 (10)	17.4
LAR	36 (8)	15.9
FPRS	15 (3)	16.1
RHIN	15 (3)	20.4
OTO	11 (2)	26.5
ALL	7 (1)	14.9
Did not specify	4 (<1)	N/A

Refer to Materials and Methods section for classification of primary area of practice.

*Years of experience includes residency, which adds 5 years to the years of practice.

ACA = academic center; GEN = general otolaryngology; HN = head and neck; PED = pediatric otolaryngology; LAR = laryngology; FPRS = facial plastics and reconstructive surgery; RHIN = rhinology; OTO = otology; ALL = allergy; N/A = not available.

TABLE III

Semiquantitative Analysis.

Events per Physician Year (No.)	TIFs		TEFs		Acute Occlusions		Obstructing Granulomas		Overall Catastrophic Events		Death and Disability	
	Mean (SD)	*P* Value	Mean (SD)	*P* Value	Mean (SD)	*P* Value	Mean (SD)	*P* Value	Mean (SD)	*P* Value	Mean (SD)	*P* Value
All specialties (478)	0.029 (0.073)		0.033 (0.075)		0.058 (0.11)		0.070 (0.19)		0.097 (0.16)		0.053 (0.092)	
ACA (167)	0.040 (0.088)*	.027*,†	0.048 (0.091)*	<.001†	0.068 (0.12)	.189	0.082 (0.21)*	.093*	0.12 (0.17)*	.053*	0.075 (0.12)*	.012*,†
Not ACA (311)	0.023 (0.070)		0.018 (0.048)		0.052 (0.12)		0.051 (0.14)		0.084 (0.15)		0.047 (0.097)	
GEN (286)	0.020 (0.053)‡	.006†,‡	0.022 (0.056)	<.001†,‡	0.047 (0.10)	<.014†,‡	0.048 (0.15)‡	.005†,‡	0.076 (0.14)‡	.001†,‡	0.038 (0.074)‡	0†,‡
Not GEN (192)	0.041 (0.094)		0.048 (0.095)		0.074 (0.12)		0.10 (0.24)		0.13 (0.18)		0.078 (0.11)	
HN (56)	0.028 (0.045)	.92	0.047 (0.089)	.195	0.055 (0.11)	.846	0.13 (0.31)	.142	0.14 (0.22)*	.085*,†	0.077 (0.11)	.108
Not HN (422)	0.029 (0.076)		0.031 (0.073)		0.058 (0.11)		0.063 (0.17)		0.091 (0.15)		0.050 (0.089)	
PED (48)	0.052 (0.081)*	.042*,†	0.039 (0.091)	.499	0.056 (0.086)	.928	0.079 (0.16)	.737	0.10 (0.12)	.84	0.063 (0.075)	.453
Not PED (430)	0.026 (0.072)		0.032 (0.073)		0.058 (0.11)		0.069 (0.20)		0.097(0.16)		0.052 (0.094)	
LAR (36)	0.040 (0.057)	.32	0.10 (0.13)*	.001*,†	0.14 (0.17)*	.005*	0.14 (0.27)*	.097*	0.2 (0.23)	.009*,†	0.14 (0.15)*	.001*,†
Not LAR (442)	0.028 (0.074)		0.027 (0.065)		0.051 (0.10)		0.064 (0.19)		0.089 (0.15)		0.047 (0.083)	
FPRS (15)	0.020 (0.042)	.622	0.0027 (0.010)‡	0,†,‡	0.052 (0.10)	.834	0.022 (0.048)	.331	0.088 (0.13)	.82	0.030 (0.052)	.347
Not FRPS (463)	0.029 (0.074)		0.033 (0.076)		0.058 (0.11)		0.072 (0.20)		0.097 (0.16)		0.054 (0.093)	
RHIN (15)	0.070 (0.19)	.398	0.040 (0.077)	.708	0.057 (0.087)	.968	0.045 (0.11)	.602	0.057 (0.074)	.38	0.041 (0.086)	.595
Not RHIN (463)	0.027 (0.067)		0.032 (0.075)		0.058 (0.11)		0.071 (0.20)		0.098 (0.16)		0.054 (0.092)	
OTO (11)	0‡	0†,‡	0.0033 (0.011)	<0†,‡	0.067 (0.12)	.771	0.17 (0.35)	.384	0.055 (0.82)	.41	0.029 (0.064)	.368
Not OTO (467)	0.030 (0.074)		0.033 (0.076)		0.057 (0.11)		0.068 (0.19)		0.098 (0.16)		0.054 (0.093)	
ALL (7)	0.036 (0.063)	.782§	0.024 (0.043)	.762§	0.11 (0.12)	.164§	0.12 (0.16)	.517§	0.25 (0.19)*,§	.009*,†,§	0.13 (0.17)*	.025*,†,§
Not ALL (471)	0.029 (0.073)		0.033 (0.075)		0.057 (0.11)		0.070 (0.19)		0.095 (0.16)		0.052 (0.090)	

The control group for each comparison was all respondents who were not assigned to that primary area of practice (e.g., the control group for ACA was Not ACA). Four respondents did not specify a primary area of practice or fellowship.

*Higher than control group.

†Significant (P <.05).

‡< Control group.

§Based on < 10 responses.

TIFs = tracheoinnominate artery fistulas; TEFs = tracheoesophageal fistulas; SD = standard deviation; ACA = academic center; GEN = general otolaryngology; HN = head and neck; PED = pediatric otolaryngology; LAR = laryngology; FPRS = facial plastics and reconstructive surgery; RHIN = rhinology; OTO = otology; ALL = allergy.