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Size Matters: Endotracheal Tube Sizes and Glottic Stenosis Familiarity Among Intubating Physicians

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ABSTRACT

Objective: Given the prevalence of post-intubation acute laryngeal injury (ALgI) and its association with glottic stenosis, greater attention has been placed on the mitigation of modifiable risk factors in patients requiring intubation, notably endotracheal tube (ETT) size. No widely accepted guidelines for adult ETT sizing exist. To better understand how factors driving ETT sizing may differ across specialties, we conducted a survey of faculty Anesthesiologists, Intensivists, and Emergency Medicine (EM) physicians.

Methods: An anonymous 14-question Qualtrics survey was distributed to relevant faculty employed at a single tertiary care institution. Participants completed questions pertaining to their training, ETT sizing preferences, factors considered in decision-making, and perceived knowledge regarding risk factors of glottic stenosis.

Results: A total of 103 complete responses were included, with a response rate of 55.1%. Standard ETT size was reported by 94 (91.3%) respondents to be 7.5 mm or larger in adult males and by 92 (89.3%) respondents to be 7.0 mm or larger in adult females. All respondents preferred a significantly larger ETT size for males compared to females (all $p < 0.001$). "Need for bronchoscopy" was the most cited factor precluding both males and females from being intubated with a smaller ETT across all specialties. When queried on posterior glottic stenosis, 64 (62.1%) respondents erroneously identified cuff pressure as a risk factor.

Conclusions: Understanding ETT sizing among intubating physicians is critical to reducing intubation-related ALgI. Future laryngologist-led interventions may be directed toward the adoption of a predominately height-based model for ETT sizing and education on glottic stenosis.

Level of Evidence: 5.

1 | Introduction

Acute laryngeal injury (ALgI) has been shown to occur in approximately 57% of patients intubated with an endotracheal tube (ETT) for more than 12 h [1]. Post-intubation ALgI is associated with a plethora of debilitating complications, including glottic stenosis [1, 2]. Glottic stenosis is characterized by severe narrowing of the glottic airway with restricted vocal fold abduction and impaired breathing and often requires surgical treatment [3]. Long-term outcomes of glottic stenosis are poor as stenosis is often recurrent and current therapies have limited success in restoring laryngeal function [3–5]. As a result, greater attention has been placed on the identification of modifiable risk factors in intubated patients. Notably, increased incidence of ALgI has been associated with larger ETT sizes (≥ 7.0 mm) [1].

While there is compelling evidence that height alone is the primary determinant of tracheal morphology [6], no widely accepted

guidelines for adult ETT sizing exist and practices can vary widely among providers. "Smaller-for-height" ETTs have been shown to have little impact on ventilator pressure during anesthesia and are also associated with better laryngeal functional outcomes in critical-care settings [7, 8]. Nevertheless, patients continue to be intubated with "large-for-height" ETTs, leading to a greater risk of ALgI. However, it is unclear whether this can simply be attributed to provider knowledge gaps or if there are additional factors that may underlie the selection of a large-for-height ETT within specific clinical settings. For instance, De La Chapa et al. conducted a survey of intensivists performing intubations, finding the most common indication for the use of a larger thanstandard ETT was the anticipated need for frequent bronchoscopy [9]. However, to the best of our knowledge, no study to date has sought to compare ETT size selection across different specialties that routinely perform intubations.

To better understand how factors driving ETT size selection may differ among specialties, we conducted a survey of faculty Anesthesiologists, Intensivists, and Emergency Medicine (EM) physicians employed at our institution, querying average ETT size, reasons for tube selection, barriers to smaller ETT use, and knowledge of glottic stenosis. By understanding the common clinical practice in ETT size selection and the barriers to selecting smaller ETTs, we can implement changes in clinical practice to reduce the incidence of ALgI.

2 | Methods

2.1 | Physician Survey

An anonymous, online 14-question Qualtrics (Qualtrics, Provo, UT) survey was distributed via email from January 2024 to June 2024 to all faculty Anesthesiologists, Intensivists, and EM physicians employed at a single tertiary care institution (Figure S1). Participants completed questions pertaining to their training, ETT sizing preferences, factors considered in decision-making, and perceived knowledge regarding risk factors of posterior glottic stenosis (PGS) and subglottic stenosis (SGS)/tracheal stenosis (TS). Surveys were redistributed periodically to nonrespondents to promote survey engagement. Respondents were not offered any incentives for survey completion. Informed consent was obtained from all respondents prior to survey completion. Only surveys completed in their entirety were selected for further analysis. This study received appropriate institutional review board approval.

While nonfaculty physician providers (e.g., residents, certified registered nurse anesthetists) perform a significant number of intubations at our institution, they were not included in the present study due to their status as trainees or their practice under the supervision of faculty physician providers who ultimately determine ETT sizing. In addition, providers performing ETT intubations in predominantly pediatric populations were not invited to participate in the present survey.

2.2 | Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics version 28 (IBM Corp., Armonk, NY). Differences in continuous variables were analyzed using Kruskal–Wallis tests followed by Dunn's multiple comparisons tests with the Benjamini–Hochberg correction if the analysis included more than two groups. Pairwise comparisons were analyzed using Wilcoxon rank-sum tests. Categorical variables were compared using chi-squared tests. Correlations were computed using the nonparametric Kendall's tau correlation coefficient. All tests were two-tailed with $p < 0.05$ considered significant.

3 | Results

A total of 103 complete survey responses were included in the present analysis, with a response rate of 55.1%. Respondents consisted of 55 (53.4%) Anesthesiologists, 20 (19.4%) Intensivists, and 28 (27.2%) EM physicians. Of the 103 respondents, 35 (34.0%) reported having 1–5 years of post-training experience, 24 (23.3%) reported 6–10 years, 25 (24.3%) reported 11–20 years, and 19 (18.4%) reported 21+ years (Table S1). Furthermore, 7 (6.8%) reported performing intubations with an ETT less than once a month, 18 (17.5%) reported intubating 1–2 times per month, 14 (13.6%) reported intubating 1–2 times per week, 15 (14.6%) reported intubating multiple times per week, and 49 (47.6%) reported intubating multiple times per day.

3.1 | ETT Preferences

Standard ETT size was reported by 94 (91.3%) respondents to be 7.5 mm or larger in adult males and by 92 (89.3%) respondents to be 7.0 mm or larger in adult females (Table 1). The average preferred ETT size for males was 7.48 (±0.21), 7.63 (±0.32), and 7.55 (±0.25) mm among Anesthesiologists, Intensivists, and EM physicians, respectively. The average preferred ETT size for females was 6.96 (±0.27), 7.30 (±0.41), and 7.20 (±0.31) mm among Anesthesiologists, Intensivists, and EM physicians, respectively. There was a statistically significant difference among specialties in preferred ETT size for females ($p < 0.001$). Specifically, Anesthesiologists tended to prefer smaller ETT sizes in females compared to both Intensivists ($p = 0.001$) and EM physicians ($p = 0.003$). However, there was no significant difference among specialties in mean preferred ETT size in males ($p = 0.107$). Notably, all respondents preferred a significantly larger ETT size for males compared to females (all $p < 0.001$). Routine frequency of intubation correlated negatively with preferred ETT size for both males ($\tau = -0.177$, $p = 0.045$) and females ($\tau = -0.345$, $p < 0.001$).

Need for bronchoscopy (males: 64.1%, females: 60.2%), ventilation concerns (males: 57.3%, females: 59.2%), mucus plugging (males: 33.0%, females: 34.0%), and need for tracheobronchial toilet (males: 32.0%, females: 35.0%) were among the most cited factors precluding both males and females from being intubated with a smaller ETT (Table 2). Interestingly, "part of my standard practice" was reported by a considerable proportion of respondents as a reason for precluding both males (39.8%) and females (38.8%) from receiving a smaller ETT. Anesthesiologists reported ventilation concerns as precluding females from being intubated with a smaller ETT significantly more than both Intensivists ($p < 0.001$) and EM physicians ($p = 0.030$). Intensivists reported need for bronchoscopy as precluding both males and females from being intubated with a smaller ETT significantly more compared to

TABLE 1 | Reported ETT sizing preferences among intubating physicians. Differences in continuous variables were analyzed using Kruskal–Wallis tests followed by Dunn's multiple comparisons tests with the Benjamini–Hochberg correction.

	Anesthesiologists (*N* = 55)	Intensivists (*N* = 20)	EM physicians (*N* = 28)	Total (*N* = 103)	*p*
ETT size—male (mm)	7.48 (±0.21)	7.63 (±0.32)	7.55 (±0.25)	7.53 (±0.25)	0.107
6.0	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
6.5	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
7.0	6 (10.9%)	1 (5.0%)	2 (7.1%)	9 (8.7%)	
7.5	45 (81.8%)	14 (70.0%)	21 (75.0%)	80 (77.7%)	
8.0	4 (7.3%)	4 (20.0%)	5 (17.9%)	13 (12.6%)	
8.5	0 (0.0%)	1 (5.0%)	0 (0.0%)	1 (1.0%)	
ETT size—female (mm)	6.96 (±0.27)	7.30 (±0.41)	7.20 (±0.31)	7.09 (±0.34)	< 0.001*
6.0	1 (1.8%)	0 (0.0%)	0 (0.0%)	1 (1.0%)	
6.5	7 (12.7%)	1 (5.0%)	2 (7.1%)	10 (9.7%)	
7.	42 (76.4%)	8 (40.0%)	13 (46.4%)	63 (61.2%)	
7.5	5 (9.1%)	10 (50.0%)	13 (46.4%)	28 (27.2%)	
8.0	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
8.5	0 (0.0%)	1 (5.0%)	0 (0.0%)	1 (1.0%)	

Abbreviations: EM = emergency medicine; ETT = endotracheal tube.
*Two-tailed $p < 0.05$ was considered significant.

TABLE 2 | Reported factors precluding intubation with smaller ETTs. Categorical variables were compared using chi-squared tests.

	Anesthesiologists (*N* = 55)	Intensivists (*N* = 20)	EM physicians (*N* = 28)	Total (*N* = 103)	*p*
Factors—male					
Ventilation concerns	39 (70.9%)	6 (30.0%)	14 (50.0%)	59 (57.3%)	0.004*
Multiple/re-intubation	11 (20.0%)	3 (15.0%)	1 (3.6%)	15 (14.6%)	0.133
Length of intubation	13 (23.6%)	4 (20.0%)	0 (0.0%)	17 (16.5%)	0.021*
Tracheobronchial toilet	15 (27.3%)	9 (45.0%)	9 (32.1%)	33 (32.0%)	0.347
Bronchoscopy	32 (58.2%)	18 (90.0%)	16 (57.1%)	66 (64.1%)	0.027*
Mucus plugging	16 (29.1%)	10 (50.0%)	8 (28.6%)	34 (33.0%)	0.198
Standard practice	20 (36.4%)	5 (25.0%)	16 (57.1%)	41 (39.8%)	0.06
Other	5 (9.1%)	1 (5.0%)	2 (7.1%)	8 (7.8%)	0.834
Factors—female					
Ventilation concerns	41 (74.5%)	6 (30.0%)	14 (50.0%)	61 (59.2%)	0.001*
Multiple/re-intubation	10 (18.2%)	3 (15.0%)	3 (10.7%)	16 (15.5%)	0.672
Length of intubation	15 (27.3%)	4 (20.0%)	2 (7.1%)	21 (20.4%)	0.099
Tracheobronchial toilet	16 (29.1%)	10 (50.0%)	10 (35.7%)	36 (35.0%)	0.243
Bronchoscopy	30 (54.5%)	17 (85.0%)	15 (53.6%)	62 (60.2%)	0.041*
Mucus plugging	16 (29.1%)	10 (50.0%)	9 (32.1%)	35 (34.0%)	0.233
Standard practice	19 (34.5%)	6 (30.0%)	15 (53.6%)	40 (38.8%)	0.162
Other	5 (9.1%)	1 (5.0%)	2 (7.1%)	8 (7.8%)	0.834

Abbreviations: EM = emergency medicine; ETT = endotracheal tube.
*Two-tailed $p < 0.05$ was considered significant.

both Anesthesiologists (males: $p = 0.012$, females: $p = 0.017$) and EM physicians (males: $p = 0.023$, females: $p = 0.031$).

Providers' personal assessments of clinical factors relevant to ETT size determination were evaluated on a 5-point Likert scale (Figure 1). Mean scores were calculated by assigning values from 1 to 5 to each value of the Likert scale and then computing the average. Need for bronchoscopy received the highest mean score across all specialties [2.91 (±0.97), 3.10 (±0.64), 2.43 (±1.10) for Anesthesiologists, Intensivists, and EM physicians, respectively], followed by potential complications [2.27 (±0.89), 2.70 (±1.13), 2.11 (±1.07)] and mucus plugging [2.24 (±0.88), 2.40 (±1.05), 2.11 (±1.07)]. There were no significant differences across specialties in mean scores concerning need for multiple intubations/re-intubation, potential complications, and mucus plugging (Table S2). In comparison to EM physicians, Anesthesiologists regarded sex [2.15 (±1.03) vs. 1.46 (±1.04); $p = 0.011$], comorbidities [2.00 (±1.19) vs. 1.43 (±0.79); $p = 0.027$], expected length of intubation [2.22 (±1.13) vs. 1.04 (±0.92); $p < 0.001$], patient comfort [2.13 (±1.02) vs. 0.86 (±0.76); $p < 0.001$], and need for tracheobronchial toilet [2.20 (±1.10) vs. 1.43 (±1.10); $p = 0.006$] to be more important in determining appropriate ETT sizing. Furthermore, Intensivists regarded height [2.35 (±1.09) vs. 1.50 (±1.20); $p = 0.031$], weight/body mass index (BMI) [2.15 (±1.09) vs. 1.36 (±1.03); $p = 0.038$], expected length of intubation [2.15 (±1.23) vs. 1.04 (±0.92); $p = 0.004$], patient comfort [1.90 (±1.21) vs. 0.86 (±0.76); $p = 0.005$], and need for tracheobronchial toilet [2.40 (±1.05) vs. 1.43 (±1.10); $p = 0.012$] to be more important in determining appropriate ETT sizing in comparison to EM physicians.

3.2 | Knowledge Regarding Glottic Stenosis Risk Factors

Provider knowledge regarding risk factors for the development of PGS and SGS/TS was additionally evaluated on a 5-point Likert scale. For PGS, 22 (21.4%) respondents reported being not knowledgeable, 38 (36.9%) reported being slightly knowledgeable, and 43 (41.8%) reported being either moderately knowledgeable, very knowledgeable, or extremely knowledgeable (Table 3). Similarly, for SGS/TS, 26 (25.2%) respondents reported being not knowledgeable, 34 (33.0%) reported being slightly knowledgeable, and 42 (41.8%) reported being either moderately knowledgeable, very knowledgeable, or extremely knowledgeable (Table S3). There were no significant differences in perceived knowledge regarding both PGS and SGS/TS across specialties ($p = 0.831$). Reported knowledge of PGS risk factors correlated positively with reported knowledge of SGS/TS risk factors ($\tau = 0.824$, $p < 0.001$). Length of intubation (PGS: 68.0%, SGS/TS: 69.9%), cuff pressure (PGS: 62.1%, SGS/TS: 64.1%), ETT size (PGS: 60.2%, SGS/TS: 58.3%), multiple intubations/re-intubation (PGS: 59.2%, SGS/TS: 57.3%), and ischemia (PGS: 31.1%, SGS/TS: 27.2%) were among the most reported risk factors for the development of both PGS and SGS/TS. There were no significant differences in reported risk factors for the development of both PGS and SGS/TS across specialties.

4 | Discussion

Large ETT sizes (≥ 7.0 mm) are associated with an increased risk of developing ALgI after as little as 12 h of intubation, and most ETTs placed in the operating room or in the setting of critical illness often have an internal diameter exceeding 7.0 mm [1, 2, 10]. Thus, future initiatives promoting the use of smaller-for-height ETTs may reduce the incidence of ALgI and improve overall laryngeal health in patients requiring intubation [8]. Through the present study, we provide a comparative analysis of survey responses provided by Anesthesiologists, Intensivists, and EM physicians at our institution on average ETT size, reasons for tube selection, barriers to smaller ETT use, and knowledge of glottic stenosis. Although recent evidence has demonstrated a clear link between larger ETTs and an increased risk of ALgI

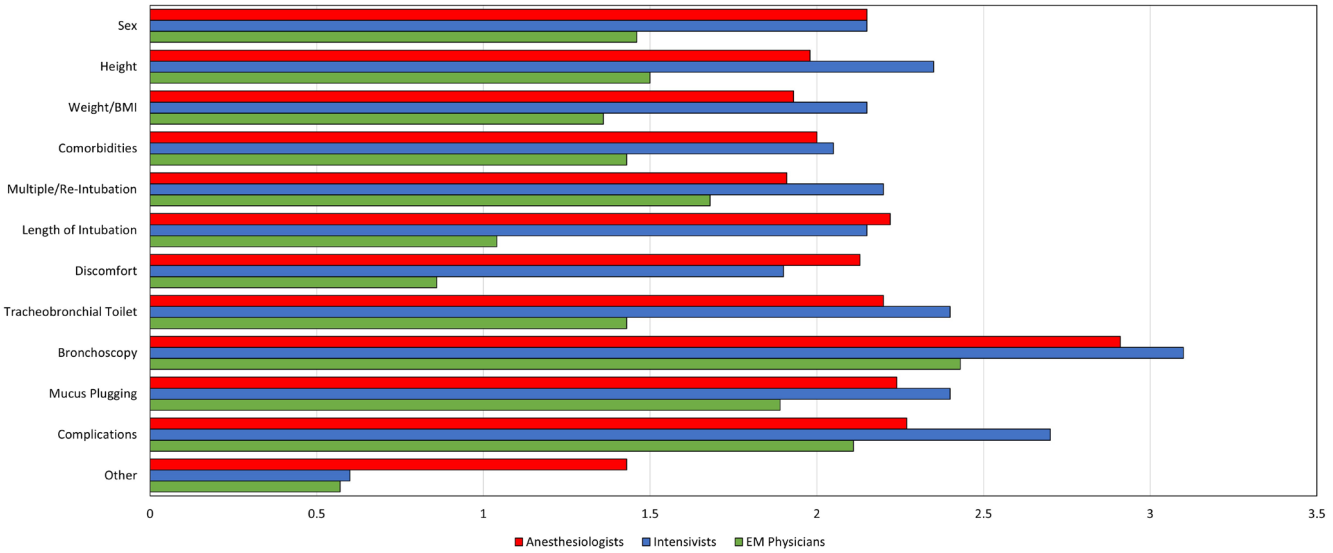

FIGURE 1 | Mean Likert scores of clinical factor relevance to ETT sizing. Providers' personal assessments of clinical factors relevant to ETT size determination were evaluated on a 5-point Likert scale. Mean scores were calculated by assigning values from 1 to 5 to each value of the Likert scale and then computing the average. Differences in mean scores were analyzed using Kruskal–Wallis tests followed by Dunn's multiple comparisons tests with the Benjamini–Hochberg correction. BMI = body mass index; EM = emergency medicine; ETT = endotracheal tube.

TABLE 3 | Reported knowledge and risk factors of posterior glottic stenosiscategorical variables were compared using chi-squared tests.

	Anesthesiologists ($N=55$)	Intensivists ($N=20$)	EM Physicians ($N=28$)	Total ($N=103$)	p*
PGS confidence					0.324
Not knowledgeable	11 (20.0%)	4 (20.0%)	7 (25.0%)	22 (21.4%)	
Slightly knowledgeable	20 (36.4%)	8 (40.0%)	10 (35.7%)	38 (36.9%)	
Moderately knowledgeable	17 (30.9%)	8 (40.0%)	11 (39.3%)	36 (35.0%)	
Very knowledgeable	7 (12.7%)	0 (0.0%)	0 (0.0%)	7 (6.8%)	
Extremely knowledgeable	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	
PGS risk factors					
Sex	6 (10.9%)	4 (20.0%)	0 (0.0%)	10 (9.7%)	0.063
Habitus/weight	7 (12.7%)	7 (35.0%)	4 (14.3%)	18 (17.5%)	0.07
Direct laryngoscopy	4 (7.3%)	0 (0.0%)	0 (0.0%)	4 (3.9%)	0.163
ETT size	34 (61.8%)	12 (60.0%)	16 (57.1%)	62 (60.2%)	0.919
Cuff pressure	36 (65.5%)	12 (60.0%)	16 (57.1%)	64 (62.1%)	0.743
Subglottic suction	7 (12.7%)	3 (15.0%)	2 (7.1%)	12 (11.7%)	0.659
Multiple/re-intubation	31 (56.4%)	14 (70.0%)	16 (57.1%)	61 (59.2%)	0.549
Length of intubation	38 (69.1%)	14 (70.0%)	18 (64.3%)	70 (68.0%)	0.885
Movement	5 (9.1%)	1 (5.0%)	1 (3.6%)	7 (6.8%)	0.601
Steroids	4 (7.3%)	1 (5.0%)	2 (7.1%)	7 (6.8%)	0.939
Diabetes mellitus	8 (14.5%)	5 (25.0%)	5 (17.9%)	18 (17.5%)	0.573
Ischemia	22 (40.0%)	4 (20.0%)	6 (21.4%)	32 (31.1%)	0.11
Hypertension	0 (0.0%)	1 (5.0%)	2 (7.1%)	3 (2.9%)	0.155
Obstructive sleep apnea	4 (7.3%)	1 (5.0%)	4 (14.3%)	9 (8.7%)	0.454
Gastroesophageal reflux	9 (16.4%)	5 (25.0%)	6 (21.4%)	20 (19.4%)	0.671
Bacteria	12 (21.8%)	4 (20.0%)	6 (21.4%)	22 (21.4%)	0.986
Smoking	12 (21.8%)	4 (20.0%)	6 (21.4%)	22 (21.4%)	0.986
Alcohol	1 (1.8%)	1 (5.0%)	3 (10.7%)	5 (4.9%)	0.671

Abbreviations: EM = emergency medicine; ETT = endotracheal tube; PGS = posterior glottic stenosis.
*Two-tailed $p < 0.05$ was considered significant.

[1, 2, 10], most literature has been published in otolaryngology journals, which may not be readily accessed by the physician specialties that routinely perform intubations. As laryngologists manage glottic stenosis but rarely perform intubations, understanding ETT size selection among intubating physicians is critical to informing collaborative efforts aimed at reducing intubation-related ALgI.

None of our respondents preferred ETT sizes < 7.0 mm for adult males, and only 11 (10.7%) preferred ETT sizes < 7.0 mm for adult females. Aside from Anesthesiologists preferring significantly smaller ETT sizes for females compared to both Intensivists and EM physicians, there was little difference in ETT size selection among specialties, with no significant differences in ETT size being found for males. However, across all specialties, providers preferred significantly larger ETT sizes for males compared to females, which may be attributed to continued reliance on outdated sex-based heuristics.

Recent studies have demonstrated that height, rather than sex, is the primary determinant of trachea morphology [6, 11]. Coordes et al. demonstrated that patient differences in tracheal diameter on the basis of sex disappeared after controlling for height [6]. Nevertheless, an estimated 20%–30% of patients undergoing endotracheal intubation may be intubated with an inappropriately large ETT (≥ 1.0 mm larger than recommended based on patient height) [11]. Most notably, female patients are disproportionately at risk for intubation-related stenosis compared to males [2, 3, 12]. While males comprise the majority of mechanically ventilated patients, up to 83% of patients who develop iatrogenic ALgI-related laryngotracheal stenosis are female [2, 3].

While ETT sizing for pediatric populations is well studied, with multiple society guidelines and nomograms correlating trachea diameter with easily measurable parameters such as weight and age [13, 14], current clinical practice regarding ETT selection in adults is widely variable and lacks definitive guidelines. Interestingly, sex and height were among the lowest ranked factors in relevance to ETT size determination, with providers viewing sex as marginally more important than height. As smaller-for-height ETTs are not associated with impaired survival or adverse ventilatory outcomes, educational initiatives may be directed towards the adoption of a predominately height-based model for adults, as is done in pediatric populations.

"Need for bronchoscopy" was the most cited factor precluding both males and females from being intubated with a smaller ETT across all specialties. Interestingly, while Intensivists reported "need for bronchoscopy" in significantly greater proportion compared to both Anesthesiologists and EM physicians—mirroring previous Intensivist preferences reported by De La Chapa et al. [9]—EM physicians, who typically do not manage patients long-term, also considered need for bronchoscopy to be most important when making ETT sizing decisions. This highlights a notable consideration of future airway management, even in emergency settings, which should be considered when designing future quality improvement initiatives.

This focus on bronchoscopy is particularly relevant in critical care settings, where it may be required for lower respiratory tract sampling, mucus plug removal, and secretion aspiration, among other diagnostic and therapeutic indications [15]. As standard intensive care unit bronchoscopes are 5.7 mm in diameter, large ETTs with an internal diameter of at least 7.5 mm may be preferred to provide adequate access for bronchoscopy and suctioning while maintaining safe airway pressures during procedures [16]. Conversely, smaller ETTs may not be able to safely accommodate standard bronchoscopes, potentially leading to increased peak airway pressures, reduced tidal volumes, hypoxia, and hypercarbia [16].

While need for bronchoscopy may necessitate use of a larger ETT, approximately 4% of mechanically ventilated ICU patients underwent bronchoscopy in the United States annually [17]. As a result, the risk for intubation-related ALgI may not be outweighed by the need for bronchoscopy due to its relative infrequency. Furthermore, use of narrower bronchoscopes can circumvent ventilatory complications associated with ETTs with an internal diameter of $\leq$7.0 mm. Of note, Kelebeyev et al. utilized a lung-simulation model to demonstrate that 5.0 mm diameter bronchoscopes could be used safely in ETTs as small as 6.0 mm, even in severe ARDS lung models [18]. Future quality improvement studies at our institution could seek to acquire smaller-diameter bronchoscopes and educate providers on the limited need for bronchoscopy in critical-care settings. In addition, a significant proportion of providers across all specialties reported "part of my standard practice" as precluding both males and females from receiving a smaller ETT, indicating a need for education regarding intubation-related ALgI at our institution.

When compared to Intensivists and EM physicians, a significantly greater proportion of Anesthesiologists at our institution cited ventilation concerns as a reason for being unable to intubate patients with a smaller ETT. Larger ETTs are generally preferred in the operating-room setting due to their ventilatory advantages and ability to maintain an adequate seal with lower cuff pressures [10]. However, not only have smaller ETTs been shown to provide sufficient ventilation during routine anesthesia, but smaller ETTs also pose numerous advantages, aside from solely minimizing tracheal damage. Use of ETTs as small as 6.0 mm has been shown to cause minimal change in ventilator pressures and air flow [7, 19]. Furthermore, when compared to small ETTs, cuffs on larger ETTs have been shown to occasionally fail to fully inflate and leave longitudinal folds, thereby posing a greater risk for air leak and aspiration of gastric contents [20, 21]. As a result, recent anesthesiology literature supports attempts to intubate with smaller ETTs unless there is a compelling reason to do otherwise [10].

Perceived knowledge regarding risk factors for PGS and SGS/TS was low across all specialties, demonstrating a critical need for education regarding glottic stenosis among intubating physicians. While length of intubation, ETT size, multiple intubations/re-intubation, and ischemia were correctly identified as risk factors for PGS and SGS/TS by the vast majority of respondents, cuff pressure was also erroneously identified by a significant proportion of respondents across all specialties as a cause of PGS. PGS refers to fibrotic changes of the posterior glottis, where the vocal cords attach to the cricoid cartilage and the arytenoids, ultimately resulting in bilateral vocal fold immobility [22]. While excessive cuff pressure ($>$30 mmHg) has been linked to TS [23, 24], as the ETT cuff is ultimately positioned below the glottis, cuff overinflation would not directly traumatize or cause ischemic damage to the posterior glottis. Thus, our findings indicate intubating physicians at our institution may not fully understand the differences between PGS and SGS/TS, and thus may not appreciate the impact of larger ETTs on the development of PGS. Ultimately, our findings suggest that future educational initiatives should place great emphasis on informing intubating physicians on PGS and its associated risk factors.

While we highlight the role of ETT size in the development of PGS, it is important to note that patient-specific comorbid factors also contribute significantly to PGS risk. Diabetes and ischemic conditions, in particular, have been associated with a higher likelihood of laryngotracheal stenosis [2, 3]. Diabetic patients may be particularly susceptible to intubation-related complications due to poor tissue repair and prolonged inflammation [2, 3]. Similarly, systemic hypoperfusion in ischemic conditions can exacerbate pressure injuries to the laryngotracheal mucosa, leading to pathologic wound healing, scar formation, and contracture. Furthermore, elevated BMI has been linked to higher rates of intubation-related complications, including PGS, potentially due to increased mechanical stress on laryngeal structures [3, 25]. These factors were included in our survey as potential risk factors for PGS and SGS/TS, and while they were not ranked as frequently as ETT size or cuff pressure, their inclusion underscores the multifactorial nature of PGS development. Future studies may further explore the interplay between patient comorbid factors and ETT selection to better stratify risk and inform clinical decision-making.

There are limitations to the present study. Our survey was distributed only to faculty physicians at a single tertiary care

institution. Thus, our findings may be prone to regional biases and may not be reflective of practices in other institutions or regions. Additionally, we did not use a standardized survey tool, as no such tool currently exists. Instead, our survey was based on previously published literature [9, 26] and our own design, which may limit the consistency and comparability of our findings. However, our approach may contribute to the future development of a standardized tool for assessing ETT sizing practices, particularly for an adult patient population. In addition, the present study did not include direct observation of clinical practice, and ETT sizing preferences were self-reported. As a result, the accuracy and reliability of the reported practices may be limited. Additionally, while our survey captured clinical settings and factors such as expected length of intubation, it did not explicitly differentiate between ETT size selection for elective surgery versus anticipated long-term intubation. This distinction is critical, as the decision-making process and risk of ALgI may differ between these scenarios–future studies should explicitly explore ETT size selection based on intubation context and duration to better understand these influences. Finally, there is potential for bias as the present authors are otolaryngologists, but our survey tool was designed with input from and ultimately approved by a multidisciplinary team.

5 | Conclusion

Our study found minimal differences in both ETT size preferences and cited barriers to use of smaller ETTs among Anesthesiologists, Intensivists, and EM physicians, despite their distinct clinical settings. However, larger ETT sizes were commonly preferred, notably in males, and such practices may contribute to increased incidence of ALgI and development of glottic stenosis. The need for bronchoscopy and ventilation concerns were among the most cited reasons for choosing larger ETT sizes across all specialties. Therefore, efforts to mitigate the risk of ALgI at our institution should focus on educating providers about the relatively low need for bronchoscopy in intubated patients and the increased risk of ALgI associated with larger ETTs, as well as implementing initiatives to acquire and promote the use of smaller-diameter bronchoscopes. Finally, our study revealed a knowledge gap concerning the risk factors for PGS, particularly regarding the distinction between PGS and SGS/TS, highlighting an opportunity for targeted educational interventions. Future multi-institutional surveys may provide additional valuable insights and help inform future quality improvement projects aimed at reducing the incidence of ALgI.

Conflicts of Interest

The authors declare no conflicts of interest.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.