

Physicians' Concerns Regarding Bronchoscopic Procedures in Türkiye: Associations with Procedural Volume and Professional Experience: A National Survey

Derya Doğan

deryaknk1@hotmail.com

Ankara Etlik City Hospital

Ezgi Erdem Türe

Ankara Etlik City Hospital

Yağmur Gizem Timurhan

Ankara Etlik City Hospital

Merve Özdoğan Algın

Ankara Etlik City Hospital

Serap Akçalı Duru

Ankara Etlik City Hospital

Research Article

Keywords: Bronchoscopy, physician concerns, procedural volume, professional experience, survey

Posted Date: September 30th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-10796243/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Additional Declarations: No competing interests reported.

Abstract

Background: Bronchoscopy is a widely used diagnostic and therapeutic procedure in pulmonary practice; however, considerable variability exists in practice patterns across centers. This study aimed to characterize pulmonologists' concerns regarding bronchoscopic procedures in Türkiye and to evaluate their associations with monthly procedural volume and years of professional experience. The secondary aim was to describe current sedation and monitoring practices and institutional infrastructure related to bronchoscopy.

Methods: A nationwide, cross-sectional, descriptive online survey was distributed via email to 780 pulmonology residents and physicians across Türkiye on a voluntary basis. Subgroup analyses according to monthly procedural volume (≤ 10 procedures/month, $n=170$; >10 procedures/month, $n=94$) and years of professional experience (5-10 years, $n=159$; 11-20 years, $n=81$; >20 years, $n=24$) were restricted to specialists and academic physicians ($n=264$). Categorical variables were compared using the chi-square test or Fisher's exact test, as appropriate, with statistical significance defined as $p<0.05$.

Results: Of the 780 physicians invited to participate, 472 completed the survey, corresponding to a response rate of 60.5%. The mean age of the participants was 33.7 ± 7.2 years, and 62.7% were women. Although 92.4% of participants worked at institutions with a dedicated bronchoscopy unit, only 63.6% considered their unit adequately equipped. Routine sedation during diagnostic bronchoscopy was reported by 75.4% of participants, with midazolam being the most commonly used sedative agent (75.3%).

Procedural volume was significantly associated with several concerns related to patient characteristics, procedural indications, and technical and organizational factors encountered during bronchoscopy, with these concerns generally reported more frequently by physicians with lower procedural volumes. Among specialists, longer professional experience was associated with lower rates of concern, particularly regarding selected procedural indications and technical and organizational factors. In contrast, concerns about life-threatening complications, including cardiac and respiratory arrest, remained prevalent across procedural-volume and professional-experience groups. Notably, physicians with higher procedural volumes more frequently reported concerns regarding equipment damage and post-procedural respiratory arrest ($p<0.001$ and $p=0.036$, respectively).

Conclusions: Physicians' concerns regarding bronchoscopy were associated with procedural volume and professional experience, while institutional capacity also emerged as an important component of bronchoscopy practice. These findings highlight the importance of competency-based training and standardized, team-based approaches to bronchoscopy practice.

Introduction

Bronchoscopy is a widely used diagnostic and therapeutic procedure that plays a central role in the evaluation of the airways in pulmonary practice.¹ Different bronchoscopic techniques, including flexible

bronchoscopy, endobronchial ultrasound (EBUS), and rigid bronchoscopy, enable the evaluation of the tracheobronchial tree and adjacent structures, the acquisition of tissue and cytological samples, the diagnosis of benign and malignant pulmonary diseases, and the performance of various therapeutic interventions in selected patients.² In recent years, advances in bronchoscopic technologies and interventional pulmonology have improved the diagnostic accuracy of bronchoscopy and substantially expanded its clinical applications.³

The safe and effective performance of bronchoscopy depends not only on the physician's technical knowledge and procedural skills. Appropriate infrastructure, experienced supporting healthcare personnel, adequate sedation and monitoring facilities, and institutional preparedness for the management of potential complications are also essential. Survey studies conducted in different countries have demonstrated considerable heterogeneity in bronchoscopy practice, with substantial variation across countries and centers in sedation preferences, patient monitoring, infection control measures, bronchoscopy training, procedural volume, and access to advanced bronchoscopic techniques.^{4 5 6 7}

This heterogeneity in bronchoscopy practice may not be explained solely by patient-and center-related characteristics. Physicians' concerns regarding procedural safety, perceived risks of complications and transmissible infections, level of professional experience, availability of experienced supporting personnel, technical infrastructure, and institutional preparedness for complication management may also contribute to variations in practice. These factors may influence not only the decision to perform bronchoscopic procedures but also sedation strategies, preparedness for and management of complications, and the use of

Although national survey studies in Türkiye have evaluated general bronchoscopy practice patterns, including pre-procedural preparation, monitoring, premedication, and sedation practices, contemporary nationwide data comprehensively addressing physicians' clinical concerns regarding bronchoscopic procedures and their associations with procedural practices remain limited.^{8 9} This evidence gap may hinder efforts to standardize bronchoscopy practice and limit the systematic identification of the clinical, technical, and institutional challenges encountered by physicians.

The primary aim of this study was to characterize the perceived concerns regarding bronchoscopic procedures among pulmonology residents and specialists working across different institutions in Türkiye. The secondary aims were to evaluate the associations of these concerns with procedural volume and professional experience, and to describe current sedation and monitoring practices as well as institutional and technical factors relevant to procedural safety. By providing a nationwide overview of current bronchoscopy practice and the challenges encountered by physicians, this study may help inform the development of targeted training programs and clinical standards and provide evidence to support future improvements in clinical practice and health policy.

Study design

This was a nationwide, cross-sectional, descriptive online survey designed to assess clinical concerns regarding bronchoscopic procedures, sedation and monitoring practices, and physicians' perceptions of institutional factors related to procedural safety among adult pulmonology residents and specialists practicing in Türkiye. The primary and secondary objectives of the study are detailed in the introduction.

The study protocol was approved by the Clinical Research Ethics Committee of the University of Health Sciences, Etlik City Hospital (approval no. AEŞH-EK1-2023-126; May 3, 2023). The survey was conducted nationwide on a voluntary basis among physicians working at different institutions across Türkiye. The first page of the survey provided information regarding the purpose of the study, voluntary participation, and confidentiality of the collected data. Participants who proceeded to complete the survey after reviewing this information were considered to have provided informed consent. Responses were collected anonymously, and the confidentiality of participants' data was maintained throughout the study.

Participants

The study was conducted between May 1 and November 1, 2023. Eligible participants were physicians actively practicing in the field of pulmonology in Türkiye as residents, specialists, associate professors, or professors who voluntarily agreed to participate and provided online informed consent.

Participants were excluded if they did not complete the survey, did not provide informed consent, or were not actively practicing in the field of pulmonology.

The survey was distributed by email to 780 physicians practicing in adult pulmonology whose email addresses were available. Given the cross-sectional and descriptive nature of the study, no a priori sample size calculation was performed. Instead, the study aimed to reach all eligible pulmonology physicians who were accessible during the study period. Only participants who completed the entire survey were included in the statistical analyses. The survey was accessible only to invited participants, and measures were implemented to prevent multiple submissions by the same individual.

Survey development

The questionnaire was developed based on a review of previously published national and international surveys on bronchoscopy practice, as well as guidelines addressing bronchoscopy safety, sedation, and monitoring. The draft questionnaire was independently reviewed by two pulmonologists experienced in bronchoscopy and a medical statistician for content relevance, comprehensiveness, clarity of the questions, and appropriateness of the response options. To assess the clarity and feasibility of the questionnaire, a pilot test was conducted with 10 pulmonologists. Based on feedback from the pilot participants and expert review, the questionnaire was revised and finalized. The final questionnaire consisted of 21 questions organized into five main domains:

1. **Demographic and professional characteristics:** sex, age, type of institution, years of professional experience, and academic position.
2. **Bronchoscopy unit and institutional characteristics:** availability of a dedicated bronchoscopy unit, experience of nursing/technical staff, availability of dedicated administrative staff, access to thoracic surgery and interventional radiology support, and adequacy of bronchoscopy unit equipment.
3. **Procedural volume and practices:** monthly bronchoscopy volume, routine use of sedation, sedative agents used, and routine procedural monitoring practices.
4. **Perceived risks and concerns:** assessed by asking participants to select factors they considered concerning in relation to bronchoscopy:
 - Pre-procedural: patient age, comorbidities, and procedural indication.
 - Intra-procedural: risk of infection, staff experience, inadequate equipment, technical difficulties, and risk of complications.
 - Post-procedural: availability of an appropriate recovery/observation setting, equipment damage, and risk of complications.
5. **Complication management:** preferred sources of assistance in the event of complications occurring during or after the procedure.

Most questions were structured as binary yes/no items, whereas others consisted of single- or multiple-response closed-ended questions. Participants responded by selecting the option or options applicable to them.

Data Collection

The survey was administered online using the SurveyMonkey platform. The study was conducted in accordance with the Checklist for Reporting Results of Internet E-Surveys (CHERRIES). The survey was closed-access and available only to invited participants. Responses were collected anonymously, and the platform's single-response restriction was used to prevent multiple submissions by the same participant. Participants received a single invitation email, and no reminder emails were sent. The study aimed to reach all eligible pulmonology physicians who were accessible during the study period.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics version 27 (IBM Corp., Armonk, NY, USA). Categorical variables were summarized as frequencies and percentages. For questions allowing multiple responses, each response option was treated as a separate binary variable. Associations between categorical variables were assessed using Pearson's chi-square test or Fisher's exact test, as appropriate when expected cell counts were insufficient. All statistical tests were two-sided, and a p value < 0.05 was considered statistically significant.

Comparative analyses according to monthly procedural volume were restricted to specialists and academic physicians. Residents were excluded from these analyses because bronchoscopic procedures are generally performed under the supervision of a specialist or academic physician during residency training; therefore, their reported concerns may not fully reflect independent procedural experience.

Monthly procedural volume was assessed using predefined categories in the questionnaire. For comparative analyses, these categories were collapsed into ≤ 10 and > 10 procedures per month to maintain adequate cell sizes and create two clinically interpretable groups. This threshold was not intended to represent a validated cutoff for bronchoscopy competency. Given the exploratory nature of the subgroup analyses, no adjustment for multiple comparisons was applied; therefore, the resulting p values should be interpreted as hypothesis-generating rather than confirmatory.

Results

Of the 780 pulmonology physicians invited to participate, 505 (64.7%) initiated the survey. Of these, 33 (4.2% of all invited physicians) provided partial responses, while 472 (60.5%) completed the survey in full. The mean age of the participants was 33.7 ± 7.2 years, and 62.7% were women. Regarding professional position, 44.1% were residents, 44.1% were specialists, 8.1% were associate professors, and 3.8% were professors.

Most participants (92.4%) reported working at institutions with a dedicated bronchoscopy unit. Experienced nursing or technical staff were available in 81.8% of bronchoscopy units, whereas dedicated administrative staff were available in only 31.8%. Thoracic surgery and interventional radiology support at the participants' institutions were reported by 87.3% and 76.3% of respondents, respectively. However, only 63.6% considered their bronchoscopy unit adequately equipped. Routine sedation during diagnostic bronchoscopy was reported by 75.4% of participants (Table 1).

Table 1
Participant characteristics, institutional resources, and bronchoscopy practice

Category	Characteristic	n (%)
Demographic characteristics	Age, years	33.7 ± 7.2
	Female sex	296 (62.7)
Professional position	Resident	208 (44.1)
	Specialist	208 (44.1)
	Associate professor	38 (8.1)
	Professor	18 (3.8)
Institution type	State hospital	60 (12.7)
	Training and research hospital	168 (35.6)
	City hospital	68 (14.4)
	University hospital	158 (33.5)
	Private healthcare institution	18 (3.8)
Institutional resources and practice	Bronchoscopy unit available	436 (92.4)
	Experienced bronchoscopy nurse/technician	386 (81.8)
	Dedicated administrative staff	150 (31.8)
	Thoracic surgery support	412 (87.3)
	Interventional radiology support	360 (76.3)
	Adequate bronchoscopy unit equipment	300 (63.6)
	Routine sedation use	356 (75.4)

Data are presented as n (%) unless otherwise indicated. Age is presented as mean±standard deviation. Total study population: n = 472.

Among physicians who routinely used sedation, midazolam was the most frequently selected sedative agent (75.3%), followed by the combinations of midazolam-fentanyl (20.8%) and midazolam-propofol (15.7%); propofol alone was selected by only 10.1%. As participants were allowed to select more than one sedative regimen, the total number of responses exceeded the number of physicians who routinely used sedation. The most commonly reported routine procedural measures during bronchoscopy were SpO₂ monitoring (95.8%), establishment of intravenous access (92.8%), supplemental oxygen administration (91.9%), and non-invasive blood pressure monitoring (87.7%). Continuous ECG monitoring was routinely performed by 75.4% of participants (Table 2).

Table 2
Sedation regimens and routine procedural measures during bronchoscopy

Category	Characteristic	n (%)
Sedation regimens	Midazolam	268 (75.3)
	Fentanyl	42 (11.8)
	Propofol	36 (10.1)
	Midazolam+fentanyl	74 (20.8)
	Midazolam+propofol	56 (15.7)
	Midazolam+fentanyl+propofol	36 (10.1)
Routine procedural measures	Establishment of intravenous access	438 (92.8)
	Pulse oximetry monitoring	452 (95.8)
	Continuous ECG monitoring	356 (75.4)
	Supplemental oxygen administration	434 (91.9)
	Non-invasive blood pressure monitoring	414 (87.7)

Participants could select more than one option. Percentages for sedation regimens were calculated among physicians who routinely used sedation (n = 356); percentages for routine procedural measures were calculated among all participants (n = 472). Therefore, percentages within each category do not sum to 100%. ECG, electrocardiography.

A total of 264 specialists and academic physicians were included in the comparative analysis according to monthly bronchoscopy volume, with residents excluded (≤ 10 procedures/month, n = 170; >10 procedures/month, n = 94) (Table 3). Physicians performing ≤ 10 bronchoscopies per month reported significantly higher rates of concern for most pre-procedural variables, including older age (p = 0.038), younger age (p < 0.001), hemoptysis (p < 0.001), biopsy indication (p = 0.003), a history of cardiac disease (p = 0.006), and a history of chronic obstructive pulmonary disease (COPD)/asthma (p = 0.023). During the procedure, concerns regarding inexperienced supporting staff (p < 0.001), inadequate bronchoscopy unit equipment (p < 0.001), risk of transmissible infection (p = 0.011), epistaxis (p = 0.013), coughing (p = 0.018), bronchospasm (p = 0.026), and laryngospasm (p = 0.033) were also significantly more frequently reported by physicians with lower procedural volumes. In contrast, no significant between-group differences were observed in concerns regarding serious intra-procedural complications, including iatrogenic bleeding, tracheal injury, desaturation, cardiac arrest, and respiratory arrest (all p > 0.05).

In the post-procedural period, a different pattern was observed. Concerns regarding equipment damage (25.9% vs. 46.8%; p < 0.001), hypotension (23.5% vs. 38.3%; p = 0.011), and respiratory arrest (60.6% vs. 73.4%; p = 0.036) were significantly more frequently reported among physicians performing > 10

bronchoscopies per month. Conversely, concern regarding the lack of an appropriate post-procedural observation setting was more frequent in the lower-volume group (30.6% vs. 12.8%; $p = 0.001$).

Table 3
Association between monthly bronchoscopy volume and physicians' reported concerns

Concern		Total (n = 264)	≤ 10/month (n = 170)	> 10/month (n = 94)	p value
Pre-procedural	Older patient	118 (44.7)	84 (49.4)	34 (36.2)	0.038
	Younger patient	44 (16.7)	38 (22.4)	6 (6.4)	< 0.001
	Hemoptysis	176 (66.7)	129 (75.6)	47 (50)	< 0.001
	Biopsy indication	74 (28)	58 (34.1)	16 (17)	0.003
	Respiratory failure	224 (84.4)	147 (86.5)	77 (81.9)	0.323
	History of cardiac disease	182 (68.9)	127 (74.7)	55 (58.5)	0.006
	History of COPD/asthma	94 (35.6)	69 (40.6)	25 (26.6)	0.023
Intra-procedural	Risk of transmissible infection	82 (31.1)	62 (36.5)	20 (21.3)	0.011
	Inexperienced supporting staff	122 (46.2)	97 (57.1)	25 (26.6)	< 0.001
	Inadequate bronchoscopy unit equipment	100 (37.9)	84 (49.4)	16 (17)	< 0.001
	Inability to reach the vocal cords	14 (5.3)	10 (5.9)	4 (4.3)	0.776
	Inability to advance into the trachea	26 (9.8)	20 (11.8)	6 (6.4)	0.160
	Epistaxis	28 (10.6)	24 (14.1)	4 (4.3)	0.013
	Patient touching the bronchoscope	28 (10.6)	18 (10.6)	10 (10.6)	0.990
	Patient movement	56 (21.2)	36 (21.2)	20 (21.3)	0.985
	Coughing	58 (22)	45 (26.5)	13 (13.8)	0.018
	Iatrogenic bleeding	150 (56.8)	97 (57.1)	53 (56.4)	0.915
	Tracheal injury	92 (34.8)	59 (34.7)	33 (35.1)	0.948

Concern		Total (n = 264)	≤ 10/month (n = 170)	> 10/month (n = 94)	p value
	Nausea/vomiting	36 (13.6)	22 (12.9)	14 (14.9)	0.658
	Tachycardia	78 (29.5)	49 (28.8)	29 (30.9)	0.730
	Bradycardia	88 (33.3)	57 (33.5)	31 (33)	0.928
	Arrhythmia	112 (42.4)	72 (42.4)	40 (42.6)	0.975
	Hypertension	88 (33.3)	57 (33.5)	31 (33)	0.928
	Hypotension	90 (34.1)	56 (32.9)	34 (36.2)	0.596
	Bronchospasm	114 (43.2)	82 (48.2)	32 (34)	0.026
	Laryngospasm	110 (41.7)	79 (46.5)	31 (33)	0.033
	Desaturation	164 (62.1)	111 (65.3)	53 (56.4)	0.153
	Cardiac arrest	200 (75.8)	125 (73.5)	75 (79.8)	0.256
	Respiratory arrest	182 (68.9)	115 (67.6)	67 (71.3)	0.542
Post-procedura	Equipment damage	88 (33.3)	44 (25.9)	44 (46.8)	< 0.001
	Lack of an appropriate post-procedural observation setting	64 (24.2)	52 (30.6)	12 (12.8)	0.001
	Tachycardia	56 (21.2)	37 (21.8)	19 (20.2)	0.768
	Bradycardia	58 (22)	35 (20.6)	23 (24.5)	0.466
	Arrhythmia	96 (36.4)	58 (34.1)	38 (40.4)	0.308
	Hypertension	50 (18.9)	31 (18.2)	19 (20.2)	0.695
	Hypotension	76 (28.8)	40 (23.5)	36 (38.3)	0.011

Concern		Total (n = 264)	≤ 10/month (n = 170)	> 10/month (n = 94)	p value
	Bronchospasm	100 (37.9)	67 (39.4)	33 (35.1)	0.490
	Desaturation	156 (59.1)	103 (60.6)	53 (56.4)	0.506
	Pneumothorax	154 (58.3)	101 (59.4)	53 (56.4)	0.633
	Cardiac arrest	184 (69.7)	117 (68.8)	67 (71.3)	0.678
	Respiratory arrest	172 (65.2)	103 (60.6)	69 (73.4)	0.036

Data are presented as n (%). Comparative analyses included specialists and academic physicians only (n = 264); residents were excluded. Participants could select more than one concern. P values were calculated using Pearson's chi-square test or Fisher's exact test, as appropriate. Statistically significant p values (< 0.05) are shown in bold. COPD, chronic obstructive pulmonary disease.

Significant differences in the frequency of reported concerns regarding bronchoscopic procedures were observed across professional experience groups (5–10 years, n = 159; 11–20 years, n = 81; >20 years, n = 24) (Table 4). In the pre-procedural period, concerns regarding bronchoscopy in younger patients (p = 0.040), hemoptysis (p = 0.002), biopsy indication (p < 0.001), and the presence of respiratory failure (p = 0.005) progressively decreased with increasing professional experience. Concern regarding bronchoscopy in older patients also differed significantly across experience groups (p < 0.001), although no linear pattern was observed.

Table 4
Association between professional experience and physicians' reported concerns

Concern		Total (n = 264)	5–10 years (n = 159)	11–20 years (n = 81)	> 20 years (n = 24)	p value
Pre-procedural	Older patient	118 (44.7)	85 (53.5)	23 (28.4)	10 (41.7)	< 0.001
	Younger patient	44 (16.7)	34 (21.4)	8 (9.9)	2 (8.3)	0.040
	Hemoptysis	176 (66.7)	118 (74.2)	48 (59.3)	10 (41.7)	0.002
	Biopsy indication	74 (28)	58 (36.5)	14 (17.3)	2 (8.3)	< 0.001
	Respiratory failure	224 (84.4)	143 (89.9)	65 (80.2)	16 (66.7)	0.005
	History of cardiac disease	182 (68.9)	103 (64.8)	59 (72.8)	20 (83.3)	0.124
	History of COPD/asthma	94 (35.6)	58 (36.5)	28 (34.6)	8 (33.3)	0.930
Intra-procedural	Risk of transmissible infection	82 (31.1)	57 (35.8)	17 (21.0)	8 (33.3)	0.061
	Inexperienced supporting staff	122 (46.2)	89 (56)	31 (38.3)	2 (8.3)	< 0.001
	Inadequate bronchoscopy unit equipment	100 (37.9)	81 (50.9)	17 (21)	2 (8.3)	< 0.001
	Inability to reach the vocal cords	14 (5.3)	12 (7.5)	2 (2.5)	0	0.120
	Inability to advance into the trachea	26 (9.8)	24 (15.1)	2 (2.5)	0	0.002
	Epistaxis	28 (10.6)	24 (15.1)	4 (4.9)	0	0.011
	Patient touching the bronchoscope	28 (10.6)	22 (13.8)	6(7.4)	0	0.065
	Patient movement	56 (21.2)	42 (26.4)	10 (12.3)	4 (16.7)	0.035

Data are presented as n (%). Analyses included specialists and academic physicians only (n = 264). Participants could select more than one concern. P values were calculated using Pearson's chi-square test or Fisher's exact test, as appropriate. Statistically significant p values (< 0.05) are shown in bold. COPD, chronic obstructive pulmonary disease.

Concern		Total (n = 264)	5–10 years (n = 159)	11–20 years (n = 81)	> 20 years (n = 24)	p value
	Coughing	58 (22)	44 (27.7)	12 (14.8)	2 (8.3)	0.018
	Iatrogenic bleeding	150 (56.8)	100 (62.9)	34 (42)	16(66.7)	0.005
	Tracheal injury	92 (34.8)	72 (45.3)	16 (19.8)	4 (16.7)	< 0.001
	Nausea/vomiting	36 (13.6)	26 (16.4)	10 (12.3)	0	0.086
	Tachycardia	78 (29.5)	50 (31.4)	24 (29.6)	4 (16.7)	0.335
	Bradycardia	88 (33.3)	58 (36.5)	26 (32.1)	4 (16.7)	0.152
	Arrhythmia	112 (42.4)	59 (37.1)	43 (53.1)	10 (41.7)	0.060
	Hypertension	88 (33.3)	50 (31.4)	34 (42)	4 (16.7)	0.050
	Hypotension	90 (34.1)	62 (39)	24 (29.6)	4 (16.7)	0.059
	Bronchospasm	110 (41.7)	74 (46.5)	28 (34.6)	8 (33.3)	0.141
	Laryngospasm	114 (43.2)	84 (52.8)	22 (27.2)	8 (33.3)	< 0.001
	Desaturation	164 (62.1)	101 (63.5)	47 (58)	16 (66.7)	0.631
	Cardiac arrest	200 (75.8)	119 (74.8)	59 (72.8)	22 (91.7)	0.153
	Respiratory arrest	182 (68.9)	107 (67.3)	57 (70.4)	18 (75)	0.708
Post-procedural	Equipment damage	88 (33.3)	45 (28.3)	31 (38.3)	12 (50)	< 0.001
	Lack of an appropriate post-procedural observation setting	64 (24.2)	56 (35.2)	6 (7.4)	2 (8.3)	< 0.001

Data are presented as n (%). Analyses included specialists and academic physicians only (n = 264). Participants could select more than one concern. P values were calculated using Pearson's chi-square test or Fisher's exact test, as appropriate. Statistically significant p values (< 0.05) are shown in bold. COPD, chronic obstructive pulmonary disease.

Concern	Total (n = 264)	5–10 years (n = 159)	11–20 years (n = 81)	> 20 years (n = 24)	p value
Tachycardia	56 (21.2)	40 (25.2)	16 (19.8)	0	0.018
Bradycardia	58 (22)	40 (25.2)	18 (22.2)	0	0.021
Arrhythmia	96 (36.4)	59 (37.1)	29 (35.8)	8 (33.3)	0.930
Hypertension	50 (18.9)	30 (18.9)	18 (22.2)	2 (8.3)	0.312
Hypotension	76 (28.8)	48 (30.2)	26 (32.1)	2 (8.3)	0.064
Bronchospasm	100 (37.9)	74 (46.5)	22 (27.2)	4 (16.7)	0.001
Desaturation	156 (59.1)	97 (61)	47 (58)	12 (50)	0.557
Pneumothorax	154 (58.3)	100 (62.9)	46 (56.8)	8 (33.3)	0.022
Cardiac arrest	184 (69.7)	109 (68.6)	57 (70.4)	18 (75)	0.804
Respiratory arrest	172 (65.2)	103 (64.7)	55 (67.9)	14 (58.3)	0.036
Data are presented as n (%). Analyses included specialists and academic physicians only (n = 264). Participants could select more than one concern. P values were calculated using Pearson's chi-square test or Fisher's exact test, as appropriate. Statistically significant p values (< 0.05) are shown in bold. COPD, chronic obstructive pulmonary disease.					

During the procedure, several technical, organizational, and clinical concerns, including inexperienced supporting staff ($p < 0.001$), inadequate bronchoscopy unit equipment ($p < 0.001$), inability to advance into the trachea ($p = 0.002$), epistaxis ($p = 0.011$), patient movement ($p = 0.035$), coughing ($p = 0.018$), and laryngospasm ($p < 0.001$), decreased significantly with increasing professional experience. Concerns regarding iatrogenic bleeding ($p = 0.005$) and tracheal injury ($p < 0.001$) also differed significantly across professional experience groups, although these differences did not follow a linear pattern with increasing experience. In contrast, no significant differences across experience groups were observed for concerns regarding cardiac and pulmonary comorbidities ($p = 0.124$ and $p = 0.930$, respectively), inability to reach the vocal cords ($p = 0.120$), or life-threatening complications such as cardiac and respiratory arrest ($p = 0.153$ and $p = 0.708$, respectively). Concerns regarding these life-threatening complications remained frequently reported even among the most experienced physicians.

In the post-procedural period, concerns regarding the lack of an appropriate observation setting ($p < 0.001$), tachycardia ($p = 0.018$), bradycardia ($p = 0.021$), bronchospasm ($p = 0.001$), and pneumothorax ($p = 0.022$) decreased with increasing professional experience. In contrast, concern regarding equipment damage differed significantly across experience groups and was most frequently reported in the most experienced group (28.3%, 38.3%, and 50.0%, respectively; $p < 0.001$). Concern regarding respiratory arrest also differed significantly across professional experience groups but did not follow a linear pattern (64.7%, 67.9%, and 58.3%, respectively; $p = 0.036$).

Discussion

In this nationwide survey, physicians' concerns regarding bronchoscopic procedures were associated with procedural volume, professional experience, and institutional factors. Overall, concerns related to patient characteristics, procedural indications, technical difficulties, and organizational limitations tended to decrease with increasing monthly bronchoscopy volume and years of professional experience. In contrast, concerns regarding serious complications, such as desaturation, cardiac arrest, and intra-procedural respiratory arrest, showed less variation across professional experience groups and remained prevalent even among experienced physicians. In particular, the lower frequency of concerns regarding hemoptysis and biopsy indications, technical and clinical challenges such as difficulty advancing into the trachea, patient coughing and laryngospasm, as well as inexperienced supporting staff and inadequate bronchoscopy unit equipment, among more experienced physicians may reflect greater procedural familiarity and confidence acquired through clinical experience. Conversely, the persistence of concerns regarding life-threatening cardiopulmonary complications suggests that such concerns may not be fully mitigated by procedural experience alone.

Our findings suggest that the reported concerns regarding bronchoscopy may be conceptualized as two interrelated but distinct components. The first comprises technical, patient-related, and organizational concerns that tend to decrease with increasing procedural volume and professional experience, whereas the second encompasses more persistent concerns regarding major complications that, although infrequent, may have serious clinical consequences. Nevertheless, although bronchoscopy units were available at the institutions of the vast majority of participants, only 63.6% considered their units adequately equipped, and experienced supporting staff were not available at all centers. These findings suggest that bronchoscopy practice may be influenced not only by individual experience but also by institutional capacity. Therefore, efforts to improve bronchoscopy safety and standardize practice should focus not only on operators' procedural experience but also on a team-based approach incorporating adequate equipment, trained supporting staff, standardized monitoring, and protocols for complication management.

Although most participants in our study worked at tertiary care centers with dedicated bronchoscopy units, only approximately two-thirds considered their units adequately equipped. This finding suggests that the availability of a bronchoscopy unit alone may not ensure a standardized and adequately resourced procedural environment. Consistent with this observation, the WABIP survey conducted by

Quadrelli et al. among bronchoscopists from 65 countries demonstrated substantial international variation in bronchoscopy practice, institutional resources, monitoring practices, and access to formal training.⁷

The rate of routine sedation use during diagnostic bronchoscopy in our study (75.4%) was higher than that reported in a previous national survey from Türkiye but remained below the approximately 95% rates reported from Switzerland and Latin America.^{8 10 11} These differences across studies may reflect variation in healthcare system organization, access to anesthesia support, bronchoscopists' training in sedation, and institutional protocols. Our findings suggest that sedation use in Türkiye may have become more widespread compared with previous national data, although its implementation does not yet appear to be uniform across centers. However, given differences in study methodology and participant characteristics between the previous national survey and the present study, this comparison should not be interpreted as evidence of a temporal trend.

Among participants who routinely used sedation, the predominance of midazolam monotherapy suggests that sedation practice for bronchoscopy in Türkiye is largely based on a moderate sedation approach. Although benzodiazepine–opioid combinations have been reported to improve patient and bronchoscopist satisfaction, these regimens may require closer respiratory monitoring.¹² The relatively less frequent use of midazolam-fentanyl and midazolam-propofol combinations, as well as propofol monotherapy, in our study may reflect safety concerns, differences in physicians' experience with sedation, or variations in institutional protocols. The limited use of propofol may also be related to the need for appropriately trained personnel, close monitoring, and the availability of airway support when required. A recent comprehensive systematic review reported that propofol-containing sedation regimens were not associated with a clinically meaningful increase in complications, while emphasizing the importance of trained personnel and adequate institutional support for their safe administration.¹³ Therefore, the relatively low use of propofol in our study may reflect not only individual drug preferences but also the personnel and infrastructure requirements associated with its administration.

The high rates of pulse oximetry, intravenous access, supplemental oxygen administration, and blood pressure monitoring observed in our study suggest broad adherence to basic periprocedural safety practices. In contrast, continuous ECG monitoring was not routinely performed by approximately one in four participants, which may reflect a risk-based approach to electrocardiographic monitoring or differences in institutional protocols. Current guidelines consider continuous oxygen saturation and hemodynamic monitoring to be fundamental components of procedural monitoring, while recommending electrocardiographic monitoring particularly for patients at increased cardiac risk.^{14 15} Accordingly, the rate of continuous ECG monitoring observed in our study should not necessarily be interpreted as non-adherence to guideline recommendations, but rather may reflect selective use based on patient risk and variation in institutional protocols.

Physicians with lower monthly procedural volumes reported concerns related to patient characteristics, technical difficulties, and organizational factors more frequently, suggesting that regular exposure to

bronchoscopic procedures may influence not only technical skills but also periprocedural decision-making and perceptions related to the management of procedural complications. However, procedural volume alone should not be considered a direct measure of competence. Current literature on bronchoscopy training supports competency assessment based on direct observation, validated assessment tools, and simulation-based training rather than fixed procedural thresholds.^{16 17} In this context, our findings support the potential value of structured, competency-based training programs, particularly for physicians with lower procedural volumes. Nevertheless, given the cross-sectional design of our study, procedural volume cannot be considered a direct cause of the observed differences in reported concerns.

The decrease in technical and clinical concerns with increasing professional experience may reflect greater procedural familiarity and enhanced skills in complication management acquired over time. In contrast, the relatively similar frequency of concerns regarding life-threatening cardiopulmonary events, such as cardiac arrest, respiratory arrest, and desaturation, across professional experience groups suggests that the influence of experience on perceptions of these serious complications may be more limited. Although systematic evaluations of bronchoscopy safety have reported low rates of serious complications and mortality, hypoxemia and cardiopulmonary events cannot be completely eliminated.¹³ ¹⁸ Therefore, the persistence of concerns regarding major complications even among experienced physicians may reflect sustained awareness of serious but potentially unpredictable adverse events rather than a lack of procedural confidence.

Concerns regarding cardiac and pulmonary comorbidities were more frequently reported by physicians with lower procedural volumes, which may be related to a heightened perception of the risk of complications such as hypoxemia and hypoventilation in these patient groups. Nevertheless, available evidence indicates that bronchoscopy can generally be performed safely in patients with COPD when appropriate patient selection, careful sedation titration, and adequate monitoring are ensured.^{19 20 21} In contrast, concerns regarding cardiac and pulmonary comorbidities did not differ significantly according to years of professional experience, and concern regarding cardiac comorbidity was relatively more frequent in the most experienced group. These findings suggest that, unlike procedural volume, years of professional experience alone may not fully explain differences in perceived risk related to patients with comorbidities and that such perceptions may instead reflect patient-specific clinical safety awareness.

The association of inexperienced supporting staff and inadequate bronchoscopy unit equipment with more frequently reported concerns further suggests that bronchoscopy safety cannot be attributed solely to operator experience. Similarly, the recent international WABIP survey demonstrated substantial variation in bronchoscopy infrastructure, formal training, and practice standards.⁷ Taken together, these findings suggest that trained supporting staff, standardized procedural checklists, complication-management algorithms, and team-based simulation training may represent potential strategies to enhance procedural safety and team preparedness, particularly in lower-volume settings. However, as

our study did not directly evaluate whether these interventions reduce physicians' reported concerns, their potential benefits should be assessed in future studies.

The more frequent reporting of concerns regarding equipment damage and post-procedural respiratory arrest among physicians with higher procedural volumes represents an unexpected and exploratory finding of this study. This pattern may be related to greater equipment utilization and increased opportunities to encounter rare but serious adverse events with increasing procedural volume. However, because previous experience with complications or equipment damage, responsibility for equipment maintenance, procedure type, and case complexity were not assessed, this explanation remains speculative. In addition, the possibility of chance findings arising from the cross-sectional design and multiple comparisons should be considered. Therefore, these associations require confirmation in future studies incorporating procedural characteristics, previous complication experience, and institutional equipment utilization.

A similar pattern was observed in analyses according to years of professional experience. Concern regarding equipment damage differed significantly across experience groups and was most frequently reported in the most experienced group (28.3%, 38.3%, and 50.0%, respectively; $p < 0.001$). Concern regarding post-procedural respiratory arrest also differed significantly across experience groups but did not follow a linear pattern (64.7%, 67.9%, and 58.3%, respectively; $p = 0.036$). These findings suggest that the observed associations may not be specific to procedural volume alone and could potentially reflect characteristics shared by more experienced and higher-volume physicians. However, this interpretation remains limited because procedural volume and professional experience were not modeled simultaneously as independent factors in the present study.

Limitations and strengths

This study has several limitations. First, its cross-sectional design precludes causal inference, and the reliance on self-reported data may have introduced recall and social desirability bias. Second, the predominance of participants from tertiary care centers may limit the generalizability of the findings to other healthcare settings. The questionnaire was not formally psychometrically validated, and the availability of anesthesiology support within bronchoscopy units was not assessed; both should be considered when interpreting the findings. Furthermore, because the characteristics of respondents and non-respondents could not be compared, the possibility of non-response bias cannot be excluded. Responses from physicians working within the same institution were treated as statistically independent, and the potential effect of within-institution clustering was not accounted for in the analyses; consequently, the statistical significance of some associations may have been overestimated. Nevertheless, the relatively large sample size and representation of physicians across different levels of professional experience are important strengths of the study.

Conclusion

This nationwide survey demonstrated that physicians' concerns regarding bronchoscopic procedures in Türkiye were associated with procedural volume, professional experience, and institutional factors. Technical and organizational concerns were generally less frequently reported with increasing procedural volume and professional experience, whereas concerns regarding life-threatening complications persisted even among experienced physicians. Despite the widespread availability of bronchoscopy units, variability in perceived adequacy of equipment and access to experienced supporting staff suggests that safe bronchoscopy practice depends not only on individual experience but also on institutional capacity. Future multicenter, prospective studies are needed to further clarify the relationships among procedural volume, institutional capacity, and physicians' concerns regarding bronchoscopic procedures.

Declarations

Ethics approval and consent to participate

The study was approved by the Clinical Research Ethics Committee of the University of Health Sciences, Etlik City Hospital (Decision No: AEŞH-EK1-2023-126; date: 03 May 2023). The study was conducted in accordance with the Declaration of Helsinki and relevant ethical guidelines and regulations. All participants were informed about the purpose and voluntary nature of the study on the first page of the online survey, and informed consent was obtained electronically before participation. Responses were collected anonymously, and the confidentiality of personal data was maintained.

Funding

No funding was received for this study.

Clinical trial number

Not applicable.

Consent for publication

Not applicable.

Availability of Data and Materials

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

References

1. -Du Rand IA, Blaikley J, Booton R, Chaudhuri N, Gupta V, Khalid S, British Thoracic Society Bronchoscopy Guideline Group. British Thoracic Society guideline for diagnostic flexible bronchoscopy in adults: accredited by NICE. *Thorax*. 2013;68 Suppl 1:i1-i44. <https://doi.org/10.1136/thoraxjnl-2013-203618>. PMID: 23860341.

2. -Du Rand IA, Barber PV, Goldring J, Lewis RA, Mandal S, Munavvar M, British Thoracic Society Interventional Bronchoscopy Guideline Group. British Thoracic Society guideline for advanced diagnostic and therapeutic flexible bronchoscopy in adults. *Thorax*. 2011;66 Suppl 3:iii1-21. 10.1136/thoraxjnl-2011-200713. PMID: 21987439.
3. -Yarmus L, Ernst A, Herth FJ, editors. *Principles and Practice of Interventional Pulmonology*. Springer Nature Switzerland; 2025.
4. -Facciolongo N, Piro R, Menzella F, Lusuardi M, Salio M, Agli LL et al. Training and practice in bronchoscopy a national survey in Italy. *Monaldi Arch Chest Dis*. 2013 Sep-Dec;79(3–4):128 – 33. <https://doi.org/10.4081/monaldi.2013.5211>. PMID: 24761531.
5. -Madan K, Mohan A, Agarwal R, Hadda V, Khilnani GC, Guleria R. A survey of flexible bronchoscopy practices in India: The Indian bronchoscopy survey (2017). *Lung India*. 2018 Mar-Apr;35(2):98–107. https://doi.org/10.4103/lungindia.lungindia_417_17. PMID: 29487243; PMCID: PMC5846281.
6. -Aljohaney AA, Albanna AS, Alhajji MA, Mobeireek AF, Batubara EM, Zalt MB, et al. Survey of flexible bronchoscopy practice in adults in Saudi Arabia. *Saudi Med J*. 2019;40(3):238–45. <https://doi.org/10.15537/smj.2019.3.23964>. . PMID: 30834418; PMCID: PMC6468201.
7. -Quadrelli S, Buero A, Gasparini S. Assessment of Worldwide Bronchoscopy Practices and Training Methods: A WABIP Survey. *Thorac Res Pract*. 2025;26(6):359–65. <https://doi.org/10.4274/ThoracResPract.2025.2025-3-1>. . Epub 2025 Aug 11. PMID: 40788098; PMCID: PMC12572898.
8. -Tozkoparan E, Çağlayan B, Dalar L, Bilaçeroğlu S, Ilgazlı A. Bronchoscopy practice in Turkey: a questionnaire study. *Eurasian J Pulmonol*. 2014;16(2):110–7. <https://doi.org/10.5152/ejp.2014.93685>.
9. -Akyurt D, Canikli Adigüzel Ş, Güllü Arslan N, Bahadır Altun H, Ültan Özgen G, Kömürcü Ö, et al. Pre-procedure preparation, monitoring, premedication and sedation practices of bronchoscopists in Türkiye. *Tuberk Toraks*. 2024;72(4):239–46. <https://doi.org/10.5578/tt.2024041000>.
10. -Rubinstein-Aguñín P, García-Choque MA, López-Araoz A, Fernández-Bussy S, Latin American Thoracic Association. Sedation for bronchoscopy: current practices in Latin America. *J Bras Pneumol*. 2020 Jan-Feb;46(1):e20180240. <https://doi.org/10.1590/1806-3713/e20180240>. PMCID: PMC7462680.
11. -Gaisl T, Bratton DJ, Heuss LT, Kohler M, Schlatzer C, Zalunardo MP, et al. Sedation during bronchoscopy: data from a nationwide sedation and monitoring survey. *BMC Pulm Med*. 2016;16(1):113. <https://doi.org/10.1186/s12890-016-0275-4>. . PMID: 27495824; PMCID: PMC4974777.
12. -Prabhudev AM, Chogtu B, Magazine R. Comparison of midazolam with fentanyl-midazolam combination during flexible bronchoscopy: A randomized, double-blind, placebo-controlled study. *Indian J Pharmacol*. 2017 Jul-Aug;49(4):304–11. https://doi.org/10.4103/ijp.IJP_683_16. . PMID: 29326491; PMCID: PMC5754938.

13. -Matthes S, Trembl M, Hübner RH, Hetzel J, Eberhardt R, Franke KJ, et al. A Systematic Review of the Safety of Sedation during Flexible Bronchoscopy. *Respiration*. 2026;105(1):37–56. <https://doi.org/10.1159/000548435>. . Epub 2025 Sep 16. PMID: 40956775.
14. -Wang L, Wang M, Xu R, Li J, Cao Y, Ji F. Comparative analysis of guidelines and recommendations for sedation during flexible bronchoscopy: a narrative review. *Eur Respir Rev*. 2025;34(177):250045. <https://doi.org/10.1183/16000617.0045-2025>. . PMID: 40835396; PMCID: PMC12365665.
15. -Mohan A, Madan K, Hadda V, Tiwari P, Mittal S, Guleria R, et al. Guidelines for diagnostic flexible bronchoscopy in adults: Joint Indian Chest Society/National College of chest physicians (I)/Indian association for bronchology recommendations. *Lung India*. 2019;36(Supplement):S37–89. https://doi.org/10.4103/lungindia.lungindia_108_19. . PMID: 32445309; PMCID: PMC6681731.
16. -Ernst A, Wahidi MM, Read CA, Buckley JD, Addrizzo-Harris DJ, Shah PL, et al. Adult Bronchoscopy Training: Current State and Suggestions for the Future: CHEST Expert Panel Report. *Chest*. 2015;148(2):321–32. <https://doi.org/10.1378/chest.14-0678>. . PMID: 25674901; PMCID: PMC4524325.
17. -Shore D, Patel P, Ahmad D. Assessment of bronchoscopy training and competency: a narrative review. *AME Med J*. 2024;9:16. <https://doi.org/10.21037/amj-23-147>.
18. -Leiten EO, Martinsen EM, Bakke PS, Eagan TM, Grønseth R. Complications and discomfort of bronchoscopy: a systematic review. *Eur Clin Respir J*. 2016;3:33324. <https://doi.org/10.3402/ecrj.v3.33324>. . PMID: 27839531; PMCID: PMC5107637.
19. -Choi JS, Lee EH, Lee SH, Leem AY, Chung KS, Kim SY, et al. Risk Factors for Predicting Hypoxia in Adult Patients Undergoing Bronchoscopy under Sedation. *Tuberc Respir Dis (Seoul)*. 2020;83(4):276–82. <https://doi.org/10.4046/trd.2020.0002>. . Epub 2020 Jul 9. PMID: 32640767; PMCID: PMC7515671.
20. -Grendelmeier P, Tamm M, Jahn K, Pflimlin E, Stolz D. Flexible bronchoscopy with moderate sedation in COPD: a case-control study. *Int J Chron Obstruct Pulmon Dis*. 2017;12:177–87. <https://doi.org/10.2147/COPD.S119575>. . PMID: 28115841; PMCID: PMC5221558.
21. -Li C, Zhu T, Ma D, Chen Y, Bo L. Complications and safety analysis of diagnostic bronchoscopy in COPD: a systematic review and meta-analysis. *Expert Rev Respir Med*. 2022;16(5):555–65. <https://doi.org/10.1080/17476348.2022.2056023>. . Epub 2022 Apr 7. PMID: 35313123.