Original Article

A survey of flexible bronchoscopy practices in India: The Indian bronchoscopy survey (2017)

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ABSTRACT

Background: There is a lack of contemporaneous data on the practices of flexible bronchoscopy in India. **Aim:** The aim of the study was to study the prevalent practices of flexible bronchoscopy across India. **Methods:** The "Indian Bronchoscopy Survey" was a 98-question, online survey structured into the following sections: general information, patient preparation and monitoring, sedation and topical anesthesia, procedural/technical aspects, and bronchoscope disinfection/staff protection. **Results:** Responses from 669 bronchoscopists (mean age: 40.2 years, 91.8% adult pulmonologists) were available for analysis. Approximately, 70,000 flexible bronchoscopy examinations had been performed over the preceding year. A majority (59%) of bronchoscopists were performing bronchoscopy without sedation. A large number (45%) of bronchoscopists had learned the procedure outside of their fellowship training. About 55% used anticholinergic premedication either as a routine or occasionally. Nebulized lignocaine was being used by 72%, while 24% utilized transtracheal administration of lignocaine. The most commonly (75%) used concentration of lignocaine was 2%. Midazolam with or without fentanyl was the preferred agent for intravenous sedation. The use of video bronchoscope was common (80.8%). The most common (94%) route for performing bronchoscopy was nasal. Conventional transbronchial needle aspiration (TBNA) was being performed by 74%, while 92% and 78% performed endobronchial and transbronchial lung biopsy, respectively. Therapeutic airway interventions (stents, electrocautery, cryotherapy, and others) were being performed by 30%, while endobronchial ultrasound guided transbronchial needle aspiration (EBUS-TBNA) and rigid bronchoscopy were performed by 27% and 19.5%, respectively. **Conclusion:** There is a wide national variation in the practices of performing flexible bronchoscopy. However, there has been a considerable improvement in bronchoscopy practices compared to previous national surveys.

KEY WORDS: Anesthesia, bronchoscopy, endobronchial ultrasound, lung biopsy, transbronchial needle aspiration

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INTRODUCTION

Although flexible bronchoscopy was introduced into pulmonology almost 50 years ago,[1] its practice and procedural aspects are yet not standardized. The paucity of technical aspects of bronchoscopy in major bronchoscopy guidelines contributes to local and international differences in practice of bronchoscopy.[2] This is highlighted by comparing the findings of a few recently published bronchoscopy surveys.[3,4] Consequently, the practice of bronchoscopy varies, depending on the physician preferences and the availability of resources. The practice is mostly dependent on the skills being passed on from the

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preceptor to the trainee, without any systematic teaching and learning methodology.

There exists a significant variation in the methods pertaining to performance of flexible bronchoscopy across India. This was highlighted 12 years ago in a bronchoscopy survey from India (including 149 respondents), akin to the bronchoscopy surveys conducted in other countries.[5-11] The "Indian Bronchoscopy Survey" was planned to study the existing practices of flexible bronchoscopy across the country and compare the prevalent practices with bronchoscopy surveys conducted in other countries. Herein, we report the results of this survey.

METHODS

The "Indian Bronchoscopy Survey" was an online survey conceptualized and designed in the Department of Pulmonary Medicine and Sleep Disorders at the All India Institute of Medical Sciences, New Delhi. The survey included 98 questions [Supplemental File 1], prepared in the English language. The responses were anonymous; no names or personal details including E-mails were required from the respondents. The survey was developed on the "Google Forms" interface. Google Forms is a free-to-use data capturing interface by "Google" that allows easy conduct of surveys.[12] The survey form was structured and divided into various sections that included general information, patient preparation and monitoring, sedation and topical anesthesia, procedural/technical aspects, and bronchoscope disinfection/staff protection. The questions were of either a descriptive response type or multiple option type. The option type questions either had a "Yes/No" response or option for multiple responses. As various procedures are not consistently performed at all the times, options for many questions were specified as "always, most of the times, sometimes, and never," wherever considered appropriate. Several questions had an option for the respondent to provide additional information if none of the options matched the operator's practice. A trial run was performed wherein the authors responded to the survey themselves and identified areas that needed refinement. The e-mail lists of the three major national bodies of pulmonologists and bronchoscopists were utilized. These included the Indian Association for Bronchology, the Indian Chest Society, and the National College of Chest Physicians of India. As many pulmonologists are members of more than one of these societies, it is likely that many participants received more than one e-mails initially. In addition, e-mails were also sent from personal e-mailing lists of the authors.

The survey protocol was finalized in mid-October 2016 and the first survey e-mail was sent on October 31, 2016. All e-mails were sent within the next 1 week and a reminder e-mail was sent a month later. It was decided to keep the survey link open for the next 3 months to gather the responses. The participation in the survey was voluntary and no financial incentive was offered to the participants for responding.

Statistical analysis

Responses were downloaded as an excel spreadsheet. Responses from only those who were performing bronchoscopy were included in the study. Descriptive statistical analysis was performed using STATA Statistical analysis package (Version 11.2), StataCorp LLC, Texas, USA. Categorical variables were presented as number (percentages) and continuous variables were presented as mean (standard deviation) or median (interquartile range [IQR]).

RESULTS

We received 701 responses, of which 669 respondents were performing flexible bronchoscopy and were included in the study. Majority (75%) of the responses were obtained within the first 3 weeks of the initiation of the survey. Approximately 66,900 bronchoscopies were performed over the preceding 1 year (median 100 procedures/physician/year; IQR, 40–200). We received responses from 155 cities; however, nearly half (313 of the 669 [46.8%]) were from ten cities: Delhi (n = 98), Mumbai (n = 37), Bengaluru (n = 37), Hyderabad (n = 34), Kolkata (n = 22), Chandigarh (n = 19), Bhopal (n = 15), Chennai (n = 14), Jaipur (n = 14), and Coimbatore (n = 13).

General information

The respondents were predominantly adult pulmonologists (91.8%), mostly male (86.7%), with a mean age of 40.2 years [Table 1]. Most were working in nongovernmental multispecialty hospitals (38.5%) or as teaching faculty in medical colleges (31.1%). About 27.8% were performing bronchoscopy in children younger than 12 years of age. Most (80.8%) were using the video bronchoscopy equipment. A large number (45.1%) had learned bronchoscopy outside their fellowship training. Bronchoscopy was being performed for 5 years or more by 57.5%. A median of two assistants (IQR, 1–5) was available during the procedure, and a bronchoscopy suite/room was the most commonly utilized area (79.8%) for performing the procedure. Endobronchial ultrasound-guided transbronchial needle aspiration (EBUS-TBNA) was being performed by 26.9%, while 19.5% and 14.2% performed rigid bronchoscopy and radial EBUS, respectively.

Patient preparation and monitoring details

The patient preparation and monitoring details are summarized in Tables 2 and 3. A written informed consent was regularly being obtained by 91.7%. A majority (97.7%) kept the patient fasting before the procedure, of which 72.7% fasted patients for 4–8 h prior. Blood pressure was recorded by 79.4% at the time of scheduling patients for bronchoscopy. An intravenous access was routinely secured by 80%, while 39.1% routinely performed electrocardiogram monitoring during flexible bronchoscopy. Almost all (99.4%) were using pulse oximetry during the procedure and 73% monitored blood pressure during the procedure. Supplemental oxygen was continuously administered during the procedure

Table 1: Baseline characteristics of the survey respondents

Item	Response
Total number or respondents (*n*)	701
Age (years), mean (SD)	40.2 (9.85)
Male gender (%)	578 (86.7)
Performing flexible bronchoscopy (*n*)*	669
Performing EBUS-TBNA (%)	173 (26.9)
Performing radial EBUS (%)	89 (14.2)
Performing rigid bronchoscopy (%)	127 (19.5)
Performing pediatric bronchoscopy* (%)	27.8
Area of specialization (%)	
Pulmonologist (adult patients)	614 (91.8)
Critical care physician (adult)	18 (2.7)
Anesthesiologist	13 (1.9)
Thoracic surgeon	9 (1.4)
Pulmonologist (pediatric)	7 (1)
General physician	6 (0.9)
Otorhinolaryngologist	1 (0.15)
Critical care physician (pediatric)	1 (0.15)
Duration since performing bronchoscopy (%)	
Less than a year	5.4
1-3 years	19.5
3-5 years	17.6
5-10 years	22.4
>10 years	35.1
Bronchoscopy examinations performed over last 1 year, median (IQR)	100 (40-200)
Place of work/designation (%)	
Private practitioner (multispecialty hospital)	38.5
Teaching faculty medical college	31.1
Post-MD or equivalent training	12.0
Private practitioner (clinic)	5.7
Postgraduate trainee	5.3
DM fellow	2.9
Others	4.5
Mode of learning bronchoscopy (%)	
Working under someone performing bronchoscopy	45.1
Training program within India	35.2
Self-learned	11.3
Training program outside India	6.8
Others	1.6
Type of flexible bronchoscope (%)	
Video bronchoscope	37.2
Fiber-optic bronchoscope	19.0
Both	43.6
Not aware of the type	0.2
Place of performing flexible bronchoscopy examinations (%)	
Bronchoscopy room	79.8
Operation theater	11.7
ICU	7.2
Endoscopy room	0.6
Others	0.7
Number of assistants during procedure, median (IQR)	2 (1-5)
Indications for flexible bronchoscopy (%)	
Diagnostic and therapeutic bronchoscopy in outpatients (airway examination, lavage, washings, TBNA, or biopsies)	644 (97.0)
ICU bronchoscopy for VAP diagnosis and suctioning of mucus	535 (80.5)
Therapeutic bronchoscopy (stents, electrocautery, cryotherapy, etc.)	200 (30.1)
Bronchoscopic intubation	416 (62.6)
Confirming double lumen endotracheal tube placement	162 (24.3)
For guidance during percutaneous tracheostomy	204 (30.7)
Others	17 (2.5)

*Children younger than 12 years. SD: Standard deviation, EBUS: Endobronchial ultrasound, ICU: Intensive Care Unit, TBNA: Transbronchial needle aspiration, VAP: Ventilator-associated pneumonia, DM: Doctor of Medicine (Superspecialization)

by 54.2%, while 43.4% gave it only when desaturation occurred. Nasal cannula was the most commonly (69.6%) utilized device for administering oxygen. About 30% did not have the facility of a separate recovery room to monitor the patient following the procedure. Majority (62.6%) of the respondents observed the patient for 1–2 h or longer following bronchoscopy. Coagulation studies were routinely performed by 26.2%, while 44.5% performed them only in patients planned for either endobronchial biopsy (EBB) or transbronchial lung biopsy (TBLB). Hemoglobin and platelet counts were obtained by 52.7% and 39.5%, respectively; 35.3% obtained renal function tests as a routine in patients planned for bronchoscopy. Only 53.6% discontinued aspirin or clopidogrel before performing flexible bronchoscopic biopsy.

As part of prebronchoscopy evaluation, 61.5% obtained spirometry, while 60.7% performed arterial blood gas measurement sometimes. Majority (83.9%) would never administer prophylactic antibiotics while a fairly large number (30.9%) were routinely or occasionally administering antibiotics following bronchoscopy. Inhaled bronchodilators administered before beginning the bronchoscopy in patients with obstructive airway diseases were being used as a routine or most of the times by 73.8%.

Sedation and topical anesthesia

The details of responses are summarized in Table 4. Bronchoscopy performed only under topical anesthesia and without any conscious sedation was the most common practice (59.4%). Anticholinergic premedication was regularly or occasionally used during bronchoscopy by 55.3%. The use of a single sedative was preferred (55.6%) and midazolam alone (or in combination) was the most commonly used drug (87.0%) for sedation. Either naloxone or flumazenil was not available with 46.7% of the respondents in their bronchoscopy area. An anesthetist was available during the procedure for only 24.6% of the respondents.

Only 33.2% used nasal vasoconstrictors before nasal bronchoscopy. Lignocaine jelly (gel) was the most common method (81.2%) for nasal lignocaine administration. Nebulized lignocaine was used for topical anesthesia either routinely or occasionally by 72.4%. The most commonly (56.1%) used concentration of lignocaine for nebulization was 2%. A large number (83.6%) used 10% lignocaine spray for pharyngeal anesthesia either routinely or occasionally. Transtracheal lignocaine administration was being performed by 23.6%. The preferred method (86.1%) of delivering lignocaine to the vocal cords and the tracheobronchial tree was the spray-as-you-go technique using 2% lignocaine (75.1%). The total lignocaine dose used was documented by only 67.9%. About 68.8% had encountered one or more bronchoscopy-related complications during the previous year.

Procedural and technical aspects

The details of responses of procedural and technical aspect section are summarized in Table 5. About 80.5%

were performing Intensive Care Unit bronchoscopy and 30% of the respondents were performing therapeutic interventions including stents, electrocautery, cryotherapy, and others [Figure 1 and Table 1]. Bronchoscopic intubation for endotracheal tube placement was being performed by 62.6%. Majority (80.8%) were left-handed bronchoscopists. The nasal route was the preferred method for bronchoscope introduction by majority (94%) of the respondents. Bronchoalveolar lavage, TBNA, EBB, and TBLB were being performed by 98.8%, 74.2%, 91.6%, and 77.6%, respectively. While performing TBNA, 93.8%, 65.4%, and 7.7% were sampling the subcarinal, right paratracheal, or other stations, respectively. Only a very small number (4.5%) performed TBNA exclusively from visible endobronchial growths, while more than a half (52.8%) performed TBNA from both endobronchial growths and paratracheobronchial locations. Almost 54% would obtain bronchial brushings, while 73.6% performed bronchial washings in visible endobronchial growths, either as a routine or most of the times. Nearly 65% routinely obtained endobronchial biopsies along with TBLB in patients with sarcoidosis. Most commonly, three to four tissue pieces were obtained when performing EBB or TBLB. Only 14% were routinely using fluoroscopy while performing TBLB. Following TBLB, 85.2% routinely obtained a chest radiograph while 17.5% performed chest ultrasound to exclude pneumothorax. Almost 92.4% obtained thoracic computed tomography scan before bronchoscopy in patients with suspected lung cancer. Postbronchoscopy sputum was routinely sent for mycobacterial investigations by 67.8% in a patient with suspected tuberculosis.

Bronchoscope disinfection and staff protection

The details of responses pertaining to this section are summarized in Table 6. For 78.3% of the respondents, there was a specifically designated area where bronchoscope disinfection was performed and 79% were performing manual scope disinfection exclusively. Almost 92% routinely cleaned the bronchoscope with enzymatic solution or any other detergent solution before and after bronchoscopy, while 93.2% regularly used a brush for cleaning the working channel of the bronchoscope. Complete bronchoscope immersion into the disinfectant solution was not being performed by 25.3%.

Bronchoscopes were being stored in the scope carrying case by 22.5% and 19.2% were keeping the bronchoscope valves attached during storage. Majority (92%) used 2% glutaraldehyde as the disinfectant and 85.8% were immersing the bronchoscope in the disinfectant solution for 20 min or longer. Almost 11% were unaware of the bronchoscope leak testing procedure and only 69.2% routinely performed it. 34.3% performed an alcohol rinse of the bronchoscope as the final step before storage. Patients were screened either routinely or most of the times for human immunodeficiency virus, hepatitis B, or hepatitis C status by 60.8%. The protective equipment used by the bronchoscopists during all procedures and high-risk procedures is depicted in Figures 2 and 3.

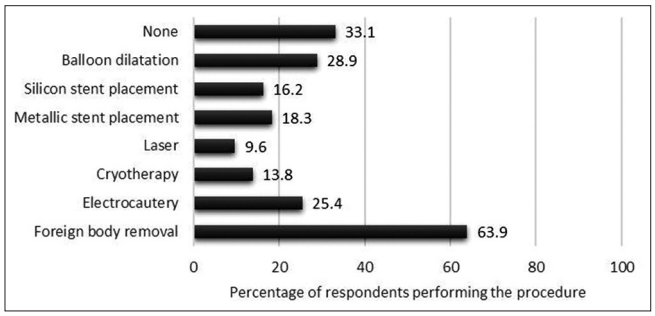

Figure 1: Details of various therapeutic bronchoscopic interventions being performed by the survey participants

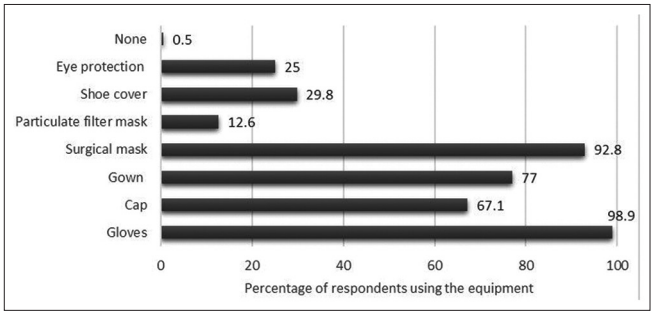

Figure 2: The protective equipment being used routinely by the survey respondents during all bronchoscopy procedures

Table 2: Patient preparation and monitoring details during flexible bronchoscopy

Question	Always (%)	Most of the times (%)	Sometimes (%)	Never (%)
Obtain written informed consent before flexible bronchoscopy procedure	610 (91.7)	37 (5.5)	11 (1.7)	7 (1.1)
Perform spirometry as part of prebronchoscopy evaluation	24 (3.6)	63 (9.5)	410 (61.5)	169 (25.4)
Perform arterial blood gas analysis as part of prebronchoscopy evaluation	19 (2.8)	34 (5.1)	405 (60.7)	209 (31.3)
Record blood pressure at the time of scheduling patients for bronchoscopy	528 (79.4)	76 (11.4)	49 (7.4)	12 (1.8)
Perform ECG monitoring during flexible bronchoscopy	261 (39.1)	87 (13.0)	227 (34.0)	92 (13.8)
Secure intravenous access in patients undergoing bronchoscopy	533 (80.0)	67 (10.1)	59 (8.9)	7 (1.0)
Administer prophylactic antibiotics (before start of procedure) to patients undergoing flexible bronchoscopy	61 (9.3)	1 (0.15)	43 (6.6)	549 (83.9)
Administer antibiotics after completing flexible bronchoscopy	115 (17.7)	0	86 (13.2)	450 (69.1)
Administer bronchodilators (nebulized/metered dose inhalers) to patients with asthma or COPD before bronchoscopy	336 (50.7)	153 (23.1)	155 (23.4)	19 (2.9)

ECG: Electrocardiogram, COPD: Chronic obstructive pulmonary disease

Table 3: Patient preparation and monitoring details during flexible bronchoscopy

Question	Responses	*n* (%)
Routinely fast patients before flexible bronchoscopy	Yes	649 (97.7)
Duration of fasting patients before bronchoscopy	4-8 h	480 (72.7)
	<4 h	79 (12)
	>8 h	101 (15.3)
Routinely monitor BP during bronchoscopy	Yes	484 (73)
Routinely monitor SpO_2 continuously during bronchoscopy	Yes	661 (99.4)
Oxygen administration during flexible bronchoscopy (When?)	Continuously during procedure	360 (54.2)
	Only when desaturation occurs	288 (43.4)
	Do not administer oxygen	2 (0.3)
	Others	14 (2.1)
Oxygen administration during flexible bronchoscopy (How?)	Nasal prongs	460 (69.6)
	Nasopharyngeal catheter/nasal cannula	121 (18.3)
	Face mask	63 (9.5)
	Others	17 (2.6)
Separate recovery room for observation	Yes	464 (70.1)
Duration of patient observation following bronchoscopy	<30 min	61 (9.2)
	30 min to 1 h	186 (28.2)
	1-2 h	304 (46.1)
	>2 h	109 (16.5)
Coagulation studies (PT, INR, and APTT) in patients planned for flexible bronchoscopy (When?)	Patients planned for either TBLB or EBB	297 (44.5)
	Always	175 (26.2)
	Only in patients planned for TBLB	92 (13.8)
	Never	44 (6.6)
	Only in patients planned for EBB	11 (1.7)
	Others	48 (7.2)
BT/CT in patients planned for flexible bronchoscopy (When?)	Patients planned for either TBLB or EBB	166 (34.2)
	Never	138 (28.4)
	Always	102 (20.1)
	Only in patients planned for TBLB	51 (10.5)
	Only in patients planned for EBB	7 (1.4)
	Others	22 (4.5)
Platelet count in patients planned for flexible bronchoscopy (When?)	Always	264 (39.5)
	Patients planned for either TBLB or EBB	229 (34.3)
	Only in patients planned for TBLB	65 (9.7)
	Never	60 (9.0)
	Only in patients planned for EBB	11 (1.7)
	Others	39 (5.8)
Hemoglobin levels in patients planned for flexible bronchoscopy (When?)	Always	350 (52.7)
	Never	133 (20.0)
	Patients planned for either TBLB or EBB	102 (15.4)
	Only in patients planned for TBLB	36 (5.4)
	Only in patients planned for EBB	3 (0.5)
	Others	40 (6.0)
Urea/creatinine levels in patients planned for flexible bronchoscopy (When?)	Always	235 (35.3)
	Only in patients with preexisting renal disease	211 (31.7)
	Never	105 (15.8)
	Patients planned for either TBLB or EBB	62 (9.3)
	Only in patients planned for TBLB	26 (3.9)
	Only in patients planned for EBB	4 (0.6)
	Others	22 (3.3)
If a patient planned for flexible bronchoscopic biopsy is receiving aspirin or Clopidogrel, what would you do?	Stop both before procedure	354 (53.6)
	Stop Clopidogrel only	148 (22.4)
	Stop aspirin only	53 (8.0)
	Continue both	52 (7.9)
	I don't know	17 (2.6)
	Others	36 (5.5)

Contd...

Table 3: Contd...

SpO_2: Oxygen saturation, BP: Blood pressure, PT: Prothrombin time, APTT: Activated partial thromboplastin time, INR: International normalized ratio, BT/CT: Bleeding time/clotting time, TBLB: Transbronchial lung biopsy, EBB: Endobronchial biopsy

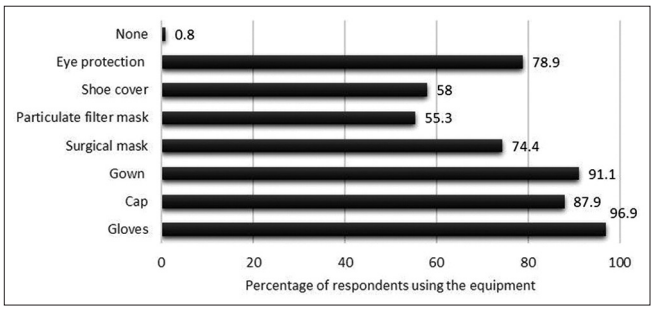

Figure 3: The protective equipment being used routinely by the survey respondents during high-risk bronchoscopy procedures

DISCUSSION

The results of the "Indian Bronchoscopy Survey" outline the bronchoscopy practices across India. The survey is large and one of the most comprehensive bronchoscopy surveys (incorporating 98 questions to assess various procedural domains) undertaken to assess the prevalent bronchoscopy practices at a national scale. The subject of bronchoscopy and interventional pulmonology has witnessed rapid developments in India over the past few years. The increasing number of publications and procedures related to bronchoscopy including therapeutic rigid bronchoscopy and EBUS-TBNA, being reported from India, has generated keen interest among pulmonologists for learning the principles and practices of bronchoscopy.[13-15] Interestingly, a PubMed search using the search string "bronchoscopy AND India" showed that 376 of 679 (55.4%) articles had been published after 2011.

The findings of the survey reveal several interesting facts. Nearly 50% of the respondents were based in 10 of the total 155 cities from where the responses were obtained. This suggests a concentration of tertiary health-care services in

Table 4: Sedation and topical anesthesia during flexible bronchoscopy

Question	Responses	*n* (%)
Perform most bronchoscopies with or without sedation	With sedation	271 (40.6)
	Without sedation	396 (59.4)
Anticholinergic premedication before flexible bronchoscopy	Always	95 (14.3)
	Most of the time	64 (9.6)
	Sometimes	209 (31.4)
	Never	297 (44.7)
Preference for single agent or combination of drugs for sedation	Single drug	370 (55.6)
	Combination	190 (28.5)
	Never use sedation	106 (15.9)
Preferred agent for sedation during bronchoscopy	Midazolam	378 (58.3)
	Midazolam + fentanyl	173 (26.7)
	Propofol	26 (4.0)
	Fentanyl	23 (3.6)
	Midazolam + pentazocine	13 (2.0)
	Dexmedetomidine	8 (1.2)
	Ketamine	1 (0.15)
	Other responses	26 (4)
Availability of naloxone or flumazenil in the bronchoscopy room	None available	293 (46.7)
	Both available	208 (33.1)
	Only naloxone available	53 (8.4)
	Only flumazenil available	29 (4.6)
	I don't know	45 (7.2)
Sedation administrator	Anesthesiologist	150 (24.6)
	Assisting doctor	171 (28.0)
	Assisting technician	74 (12.1)
	Bronchoscopy nurse	216 (35.3)
Vasoconstrictor nasal drops (xylometazoline/ oxymetazoline etc.,) before nasal bronchoscopy	Always	27 (4.1)
	Most of the time	36 (5.4)
	Sometimes	157 (23.7)
	Never	442 (66.8)
Use lignocaine for topical anesthesia	Yes	658 (99.0)
Method of administration of nasal lignocaine	Lignocaine jelly	535 (81.2)
	Lignocaine solution instillation	90 (13.7)
	Lignocaine soaked swab stick	15 (2.3)
	Combination jelly and solution	7 (1.2)
	Others	12 (1.8)
Nebulized lignocaine use for bronchoscopy	Always	221 (33.2)
	Most of the time	96 (14.4)
	Sometimes	165 (24.8)
	Never	183 (27.5)
Concentration of lignocaine solution for nebulization	1%	52 (9.2)
	2%	317 (56.1)
	4%	150 (26.6)
	I don't know	46 (8.1)
10% lignocaine spray to the pharynx	Always	187 (28.2)
	Most of the time	200 (30.1)
	Sometimes	168 (25.3)
	Never	109 (16.4)
Transtracheal lignocaine injection administration	Yes	156 (23.6)
Preferred method of delivering lignocaine to the vocal cords and the trachea	Transtracheal injection	92 (13.9)
	Spray as you go	572 (86.1)
Concentration of lignocaine solution for "spray as you go" administration	1%	129 (19.7)
	2%	492 (75.1)
	4%	13 (2.0)
	10%	15 (2.3)
	Others	6 (0.9)
Monitor and document the total dose of lignocaine	Yes	449 (67.9)
Encountered possible signs of lignocaine toxicity after bronchoscopy	Yes	109 (16.4)
	No	547 (82.4)
	Not aware of the signs of lignocaine toxicity	8 (1.2)
Encountered any complications during bronchoscopy in the last 1 year	Yes	453 (68.8)
Bronchoscopy complications (%)	Respiratory depression	34.7
	Pneumothorax	41.7
	Bleeding	74.3
	Pulmonary edema	7.2
	Acute coronary syndrome	3.2
	Vasovagal attack	15.5
	Arrhythmia	15.1
	Convulsions/seizure	2.8
	Fever	40.9
	Airway obstruction	8.7
	Mortality	6.8
	Other	3.4

the major metropolitan cities. Nearly 70% bronchoscopists were working in multispecialty hospitals or as teaching faculty in medical colleges, indicating the requirement of sufficient resources for performing bronchoscopy. Most of the bronchoscopists had received training outside of their fellowship program. This underscores the need for developing and upgrading bronchoscopy training facilities across the country with standardized teaching curricula to promote consistency in bronchoscopy training.

The current study also highlights the variation in performance of bronchoscopy procedures as compared to the available literature. Several deviations were seen compared to current evidence.[16] For instance, 17.7% were routinely administering antibiotics following bronchoscopy despite lack of evidence to support this practice. Routine monitoring of blood pressure during the procedure was not being performed by 27%. Nearly 60% of the bronchoscopists were performing flexible bronchoscopy without conscious sedation despite the fact that sedation improves the tolerance of bronchoscopy.[17] The reasons may include the lack of adequate space in the postbronchoscopy recovery room to accommodate the large number of patients, lack of adequate trained staff, and others. However, the feasibility of performing bronchoscopy without sedation using a lower concentration of lignocaine (1%) has been well described.[18] Comparing the findings of our survey with two recently published large surveys [Table 7], bronchoscopy without sedation is also the most common practice in Japan unlike Europe and the United States where most of the bronchoscopies are performed with significant amounts of sedation.[3,4,9] As part of premedication, the use of anticholinergic drugs and nebulized lignocaine for airway anesthesia was high. The current evidence does not support the use of anticholinergic premedication and nebulized lignocaine for bronchoscopy.[17,19] The evidence against the use of nebulized lignocaine stems mostly from studies that used sedation in both the arms with and without nebulized lignocaine.[17] Thus, there is a need for more data on the utility of nebulized lignocaine in bronchoscopy performed

Table 5: Procedural and technical aspects of flexible bronchoscopy

Question	Responses	*n* (%)
Preferred route of bronchoscope introduction in awake patients	Nasal	623 (94.0)
	Oral	40 (6.0)
Hold bronchoscope in which hand	Left	538 (80.8)
	Right	128 (19.2)
Perform bronchial washings or bronchoalveolar lavage	Yes	657 (98.8)
Perform conventional TBNA	Yes	488 (74.2)
Perform EBB	Yes	603 (91.6)
Perform TBLB	Yes	508 (77.6)
Obtain bronchial brushings in visible endobronchial growths	Always	197 (29.6)
	Most of the time	162 (24.4)
	Sometimes	215 (32.3)
	Never	75 (11.3)
	Not applicable	16 (2.4)
Obtain bronchial washings in visible endobronchial growths	Always	362 (54.7)
	Most of the time	125 (18.9)
	Sometimes	119 (18.0)
	Never	43 (6.5)
	Not applicable	13 (2.0)
Perform TBNA in which of the following situations	Mediastinal lymphadenopathy or peribronchial/paratracheal masses	220 (42.8)
	TBNA from endobronchial growths	23 (4.5)
	Both	271 (52.8)
Stations sampled using conventional TBNA (%)	Subcarinal	93.8
	Right paratracheal	65.4
	Other	7.7
Number of biopsy samples obtained during EBB	Fewer than three	62 (9.9)
	Three to four	396 (63.1)
	Five or more	169 (27.0)
Obtain CT scan before bronchoscopy in patients suspected with lung cancer	Always	433 (66.8)
	Most of the time	166 (25.6)
	Sometimes	47 (7.3)
	Never	2 (0.3)
Obtain EBB along with TBLB in patients with sarcoidosis undergoing bronchoscopy	Yes	395 (65.4)
Number of biopsy samples obtained during TBLB	Fewer than three	109 (19.5)
	Three to four	312 (55.8)
	Five or more	138 (24.7)
Use fluoroscopy while performing TBLB	Yes	84 (13.9)
Obtain chest X-ray following TBLB to exclude pneumothorax	Yes	494 (85.2)
Perform chest ultrasound following TBLB to exclude pneumothorax	Yes	101 (17.5)
Postbronchoscopy sputum analysis in patient with suspected TB	Yes	439 (67.8)

EBB: Endobronchial biopsy, TBLB: Transbronchial lung biopsy, CT: Computed tomography, TBNA: Transbronchial needle aspiration, TB: Tuberculosis

Table 6: Bronchoscope disinfection and staff protection

Question	Responses	*n* (%)
Clean the bronchoscope with enzymatic solution or detergent before and after bronchoscopy	Yes	605 (92.1)
	No	39 (5.9)
	I don't know	13 (2.0)
Use scope cleaning brush for cleaning all the bronchoscope channels	Yes	618 (93.2)
	No	27 (4.1)
	I don't know	18 (2.7)
Designated area for bronchoscope cleaning and disinfection	Yes	517 (78.3)
Bronchoscope suction valves used	Reusable	511 (77.4)
	Single use	95 (14.4)
	I don't know	54 (8.2)
Reuse of "single-use" bronchoscope suction valves	Yes	171 (26.7)
	No	390 (60.9)
	I don't know	79 (12.3)
Immerse the "entire" bronchoscope into the disinfectant	Yes	456 (69.1)
	No	167 (25.3)
	I don't know	24 (3.6)
	Others	13 (2.0)
Place for storing bronchoscope	Hang in storage cabinet	469 (71.0)
	In bronchoscope carrying case	149 (22.5)
	Temperature controlled cabinet	39 (5.9)
	Others	4 (0.6)
Bronchoscope valves attached during storage	Yes	126 (19.2)
	No	470 (71.5)
	I don't know	61 (9.3)
Method of performing scope disinfection	Manually	520 (79)
	Automated scope cleaner	43 (6.5)
	Both	71 (10.8)
	I don't know	21 (3.2)
	Others	3 (0.5)
Water used for rinsing bronchoscope	Distilled water	235 (35.8)
	RO water	200 (30.4)
	Tap water	149 (22.7)
	Normal saline	22 (3.4)
	I don't know	42 (6.5)
	Others	6 (1.2)
Agent for bronchoscope disinfection	Glutaraldehyde	603 (91.8)
	Other aldehyde based solution	41 (6.2)
	I don't know	13 (2.0)
Duration of bronchoscope immersion in the disinfectant solution	<20 min	76 (11.5)
	20 min or more	566 (85.8)
	I don't know	18 (2.7)
Awareness about bronchoscope "leak testing" procedure	Yes	583 (89.0)
Bronchoscope "leak testing" performance as routine	Yes	457 (69.2)
	No	175 (26.5)
	I don't know	28 (4.2)
Alcohol rinse of the bronchoscope as the final step before storage	Yes	225 (34.3)
	No	348 (53.1)
	I don't know	83 (12.6)
HIV/hepatitis B/hepatitis C screening for patients planned for bronchoscopy	Always	215 (44.6)
	Most of the time	78 (16.2)
	Sometimes	141 (29.3)
	Never	45 (9.3)
	Other responses	3 (0.6)

HIV: Human immunodeficiency virus, RO: Reverse osmosis

without sedation. Nearly one-fourth of the respondents were administering transtracheal lignocaine injection, which was far larger than we anticipated.

In the current study, only 29.6% were regularly obtaining bronchial brush specimens in visible endobronchial growths despite evidence that a combination of brush, biopsy, and needle aspiration provides the highest yields.[20] This might indicate either a lack of awareness or an attempt to keep the procedural cost low. Most bronchoscopists have

Table 7: Comparison of the Indian Bronchoscopy Survey 2017 with other major bronchoscopy surveys

	ACCP survey	Japanese survey	German survey	Indian survey 2017 (current study)
Author/publication year	Prakash *et al.*/1991	Asano *et al.*/2013	Hautmann *et al.*/2016	Madan *et al.*/2017
Number of questionnaires responded	871 individuals	511 facilities	627 facilities/ individuals	669 individuals
Pulmonary physicians	98.2%	94.5%	100%	92.8%
Number of questions	39	NA	29	98
Perform rigid bronchoscopy	8.4%	18.5%	35%	19.5%
Performing bronchoscopy >10 years	58.0%	NA	71.3%	35.1%
Average number of annual procedures/ operator	115	NA	140	100
Most common mode of learning bronchoscopy		NA	In hospital by experienced colleagues	By experienced colleagues
Perform pediatric bronchoscopy	13.2%	NA	NA	27.8%
Written informed consent before FB		96.8%	NA	91.7%
Routine prebronchoscopy spirometry	26.8%	18.3%	NA	3.6%
Routine prebronchoscopy arterial blood gas analysis	38.7%	9.3%	NA	2.8%
Routine prebronchoscopy coagulation parameters	70.3%	64.5%	NA	26.2%
Routine prebronchoscopy viral markers	NA	Hepatitis B, C: 77% HIV: 13.8%	NA	44.6% for either hepatitis B, C or HIV
Anticholinergic premedication	83.2%	67.5%	15.4%	55.3%[#]
Prebronchoscopy bronchodilators in asthma patients	NA	76.2%	NA	97.2%[#]
Use of local anesthetics	NA	NA	79.4%	99.0%
Nebulized lignocaine	NA	51.2%	NA	72.4%
Most commonly used lignocaine concentration	NA	2%	NA	2%
Intravenous sedation	73.9%[#]	36.1%	88%	40.6%
Preferred sedation regimen	Midazolam	Midazolam	Propofol and Midazolam	Midazolam with/without Fentanyl
Most common route of bronchoscope introduction	Both oral and nasal (42.6%), nasal only (33.8%)	Oral (>70%)	NA	Nasal (94.0%)
Pulse oximetry routinely	84.2%	99.0%	100%	99.4%
Oxygen administration routinely	88.9%	40.4%	95.2%	54.2%
Secure IV access routinely	76.7%	66.1%	93.9%	80%
ECG monitoring	74.6%	59.9%	76.3%	52.1%*
Noninvasive BP monitoring	NA	87.5%	84.1%	73%
Routine antibiotic prophylaxis	NA	20.5%	NA	27%[+]
Perform BAL	76.8%	NA	98.7%	98.8%
Perform EBB	NA	NA	89.3%	91.6%
Perform TBLB	68.8%	NA	71.8%	77.6%
Perform TBNA	11.8%	NA	57.8%	74.2%
Perform EBUS-TBNA	NA	28.5%	36.3%	26.9%
Perform radial EBUS	NA	19.6%	10.1%	14.2%
Laser	11.3%	22.4%	16.8%	9.6%
APC	NA	25.4%	59.3%	NA
Cryotherapy	NA	NA	28.2%	13.8%
Stents	NA	NA	34.8%	16.2%-18.3%
Foreign body removal	NA	NA	79.6%	63.9%
Electrocautery	NA	31.5%	NA	25.4%
Perform chest radiograph as routine after TBLB	79%			
Fluoroscopy availability	20.9% had dedicated bronchoscopy fluoroscopy facility, 75.3% used it routinely during TBLB	99.8% centers with availability and regular use	NA	13.9% used fluoroscopy during TBLB
Routine wearing of protective clothing during all procedures				
Gowns	NA	38.9%	NA	77.0%
Facemask	NA	94.9%	NA	92.8%
Gloves	NA	99.6%	NA	98.9%

Contd...

Table 7: Contd...

	ACCP survey	Japanese survey	German survey	Indian survey 2017 (current study)
Eye protection	NA	11.0%	NA	25%
Caps	NA	33.9%	NA	67.1%
Glutaraldehyde as primary disinfectant	NA	42.2%	NA	91.8%
Automated disinfectors for scope cleaning	NA	98.6%	NA	17.3%

*Either as a routine or most of the times, #Either as a routine or sometimes, +Either before or after completing the procedure. NA: Information not available, IV: Intravenous, ECG: Electrocardiographic, BP: Blood pressure, BAL: Bronchoalveolar lavage, EBB: Endobronchial biopsy, TBLB: Transbronchial lung biopsy, TBNA: Transbronchial needle aspiration, EBUS: Endobronchial ultrasound, APC: Argon plasma coagulation, HIV: Human immunodeficiency virus, FB: Flexible bronchoscopy, ACCP: American college of chest physicians

Table 8: Comparison of the three bronchoscopy surveys conducted in India till 2017

	1994 survey, Nanjundiah S *et al.*	1999 survey, Nanjundiah *et al.*	2017 survey, Madan *et al.* (current study)
Number of questions	42	NA	98
Number of respondents	69	90	669
Population	Members of ICS and NCCP	Members of ICS and NCCP, associations of cardiothoracic and ENT surgeons	Members of ICS, NCCP and IAB
Area of specialization	Physicians 79.7% Surgeons 17.4%	Physicians 54.5% Surgeons 22.2%	Physicians 96.5%
Training outside India	Physicians 38.2% Surgeons 33.3%	NA	6.8%
Performing bronchoscopy >10 years	21.7%	44.4%	35.1%
Video bronchoscopy	4.3%	17.8%	80.8%
Performed rigid bronchoscopy	31.9%	50.6%	19.5%
Performed pediatric bronchoscopy	36.2%	NA	27.8%
Commonest area for performing FB	Hospital operation theater 68.1%	Hospital operation theater 53.3%	Bronchoscopy room 79.8%
Used anticholinergic premedication	79.7%	64.4%	55.3%
Routinely used intravenous sedation	8.6%	14.4%	40.6%
Routine intravenous access	18.8%	37.8%	80%
Routine ECG monitoring	10.2%	25.6%	39.1%
Transtracheal lignocaine administration	49.3%	46.7%	23.6%
Routine supplemental oxygen	24.6%	28.9%	54.2%
Routine pulse oximetry	14.5%	45.6%	99.4%
Routinely used fluoroscopy during TBLB	7.3%	8.9%	13.9%
Routine chest radiograph following TBLB	20.3%	30%	85.2%
Performed TBNA routinely	17.3%	26.7%	74.2%
Performed bronchoscopic biopsy	59.9%	86.7%	77.6%-91.6%
Average number of procedures per year	197	245	100
Laser bronchoscopy	1.4%	10%	9.6%
Stents	NA	2.2%	16.2%-18.3%
EBUS	NA	NA	26.9%
Electrocautery	NA	3.3%	25.4%
Cryotherapy	NA	3.3%	13.8%
Foreign body removal	26.1%	36.7%-46.7%	63.9%

NA: Information not available, EBUS: Endobronchial ultrasound, ICS: Indian chest society, NCCP: National College of Chest Physicians, IAB: Indian Association for Bronchology, ECG: Electrocardiographic, TBLB: Transbronchial lung biopsy, TBNA: Transbronchial needle aspiration, ENT: Ear, nose, and throat, FB: Flexible bronchoscopy

the perception that a biopsy alone would be sufficient in visible endobronchial growths. About 35% were not obtaining endobronchial biopsies routinely along with TBLB in patients with suspected sarcoidosis. Recent studies have demonstrated that a combination of TBNA (EBUS or conventional), TBLB, and EBB provides the best diagnostic yield in patients with sarcoidosis.[21,22] Nearly three-fourth of the respondents were performing conventional TBNA which is an encouraging observation. Studies have demonstrated that conventional TBNA has a reasonable sensitivity,[23] and when combined with rapid on-site cytological evaluation can provide diagnostic yields similar to EBUS-TBNA.[24] The performance of chest radiograph following TBLB was very common (85.2%). British Thoracic Society guidelines recommend a chest radiograph following TBLB only if the patient is symptomatic or there is a clinical suspicion of pneumothorax. Only one-third of the respondents were performing therapeutic airway interventions such as thermoablative procedures and airway stents; fewer were performing EBUS-TBNA, rigid bronchoscopy, and radial EBUS. This indicates that there is an unmet need in training bronchoscopists in these advanced airway procedures.

The detailed questions regarding the disinfection protocol also provided important observations. Nearly one-fourth respondents were not practicing complete bronchoscope immersion into the disinfectant solution following

bronchoscopy and a similar proportion were storing the bronchoscopes in the scope carrying case which is not a recommended practice and carries infection hazards.

We also compared the findings of our survey with the two previously published bronchoscopy surveys from India [Table 8] and other international surveys [Table 7]. The findings indicated that improvements have occurred as compared to the previous national surveys. The major improvements include the increased use of video bronchoscopy, routine securing of intravenous access, reduced anticholinergic premedication use, increased performance of TBNA, near always use of pulse oximetry, and increased performance of various therapeutic airway interventions.

Finally, our study is not without limitations. Although we had many respondents, the use of electronic survey might have precluded certain respondents since they may not be using the electronic media and possibility of a selection bias. Areas that were not covered in the survey included the opinion regarding training and competency requirements, details of the assisting staff, complication rates, and practices of management of various bronchoscopy complications. An even detailed survey questionnaire than the current one might have reduced the response rate; therefore, we focused only the key areas.

CONCLUSION

The results of this bronchoscopy survey suggest that there is an urgent need for standardizing the training curriculum to provide uniform training to the pulmonologists and trainee physicians pursuing the field of bronchology.

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There are no conflicts of interest.

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