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

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
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.
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 dose used was documented by only 67.9%. A large number (30.9%) 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
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...
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 in the major metropolitan cities. Nearly 70% bronchoscopists were working in multispeciality 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.

**Table 4: Sedation and topical anesthesia during flexible bronchoscopy**

| Question | Responses | n (%) |
|----------|-----------|-------|
| Perform most bronchoscopies with or without sedation | With sedation | 271 (40.6) |
| Anticholinergic | Always | 95 (14.3) |
| Premedication before flexible bronchoscopy | Most of the time | 64 (9.6) |
| Preference for single agent or combination of drugs for sedation | Combination | 190 (28.5) |
| Preferred agent for sedation during bronchoscopy | Midazolam | 378 (58.3) |
| Sedation administrator | Anesthesiologist | 150 (24.6) |
| Vasoconstrictor nasal drops (xylometazoline/oxymetazoline etc.) | Most of the time | 36 (5.4) |
| Concentration of lignocaine solution for nebulization | 1% | 52 (9.2) |
| Nebulized lignocaine use for bronchoscopy | Most of the time | 96 (14.4) |
| Transtracheal lignocaine injection administration | Prefered method of delivering lignocaine to the vocal cords and the trachea | 92 (13.9) |
| 10% lignocaine spray to the pharynx | Most of the time | 187 (28.2) |
| Transtracheal lignocaine injection | Transtracheal injection | 92 (13.9) |
| Concentration of lignocaine solution for “spray as you go” administration | 1% | 129 (19.7) |
| 1 year | Respiratory depression | 34.7 |
| 10% | Convulsions/seizure | 2.8 |
| Other responses | Others | 6 (0.9) |

**Table 4: Contd...**

| Question | Responses | n (%) |
|----------|-----------|-------|
| Encountered any complications during bronchoscopy in the last 1 year | Yes | 453 (68.8) |
| Bronchoscopy complications | Respiratory depression | 34.7 |
| Bleeding | 74.3 |
| 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 |

Contd...
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 5: Procedural and technical aspects of flexible bronchoscopy

| Question | Responses | n (%) |
|----------|-----------|-------|
| Preferred route of bronchoscopy 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) |
| | No | 7 (1.2) |
| Perform conventional TBNA | Yes | 488 (74.2) |
| | No | 104 (15.2) |
| 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) |
| 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) |
| | No | 171 (26.7) |

#### 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) |
| Use scope cleaning brush for cleaning all the bronchoscope channels | Yes | 618 (93.2) |
| | No | 27 (4.1) |
| 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) |
| Immerse the “entire” bronchoscope into the disinfectant | Yes | 456 (69.1) |
| | No | 167 (25.3) |
| 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) |
| 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) |
| | 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 | 349 (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) |

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

**HIV:** Human immunodeficiency virus, RO: Reverse osmosis

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*Madan, et al.: Indian bronchoscopy survey (2017)*
Table 7: Comparison of the Indian Bronchoscopy Survey 2017 with other major bronchoscopy surveys

| Author/publication year | ACCP survey 1991 | Japanese survey 2013 | German survey 2016 | Indian survey 2017 (current study) |
|-------------------------|------------------|----------------------|--------------------|-----------------------------------|
| 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 | 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: 77%, C: 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% | 77.0% |
| | Facemask | NA | 94.9% | 92.8% |
| | Gloves | NA | 99.6% | 98.9% |

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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

### 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           | 91.9%                             |
| 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, EBUS: 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%                 | Physicians 54.5%                | Physicians 96.5%                         |
|                            | Surgeons 17.4%                   | Surgeons 22.2%                  |                                         |
|                            | Physicians 38.2%                 | NA                              |                                          |
|                            | Surgeons 33.3%                   |                                 |                                          |
| Training outside India      |                                   |                                 | 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 fluorescopy 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 bronchosopic 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
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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Conflicts of interest

There are no conflicts of interest.

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