

Survey of flexible bronchoscopy practice in adults in Saudi Arabia

Ahmed A. Aljohaney, MD, FRCPC, Amr S. Albanna, MD, MSc, Mohammed A. Alhajji, MD, MRCP, Abdullah F. Mobeireek, MD, FRCPC, Enas M. Batubara, MD, SFAR, Mohammed B. Zalt, MD, AABIP, Majed A. Alghamdi, MD, SFAR.

ABSTRACT

الأهداف: تقييم مدى الالتزام الحالي للممارسات القياسية لإجراء تنظير القصبات الهوائية في المملكة العربية السعودية

الطريقة: أجري إستبيان دراسة مستعرضة خلال الفترة ديسمبر 2016 و مارس 2017م في المملكة العربية السعودية. تمت دعوة أطباء الصدرية وجراحين الصدر وأطباء العناية الحرجة في المملكة العربية السعودية للإجابة على أسئلة الإستبيان المرسل عن طريق البريد الإلكتروني للحصول على معلومات حول كيفية قيامهم بأداء تنظير القصبات الهوائية لدى البالغين. تمت مقارنة البيانات التي تم جمعها بين التخصصات الثلاثة

النتائج: إثنان وثمانون أكملوا الإستبيان (18%) من 456 ممارساً مدعواً. ثمانية وخمسون (72%) من أصل 82 مستطعلاً كانوا أطباء أمراض الصدر تلقى 40 (53%) من 76 (93%) مستجيباً ممن لديهم تدريب لإجراء مناظير القصبة الهوائية تلقوا تدريبهم في الخارج. كما تلقى 27 (33%) مستطعلاً تدريباً في استخدام منظار القصبة الهوائية المزود بالأشعة فوق صوتية، وتقنية الكي بالكهرباء، والعلاج بالأشعة الموضعية عن طريق المنظار، ووضع الدعامة وإجراءات الليزر. يفضل 58 مستطعلاً (70%) بأن تكون مدة الصوم قبل المنظار 4 ساعات على الأقل. يستخدم دواء الليدوكين للتخدير الموضعي غالباً بطريقة حقنه كسائل رذاذي أو بطريقة التبخير. استخدام المستطلعون كلاً من الميدازولام 62% والفينتانيل 50% والبروبوفول 12%. تسعون في المئة من أطباء الصدرية يطلبون عمل أشعة سينية للصدر بعد أخذ خزعة من الرئة بواسطة المنظار. لوحظ أن إجراءات السلامة لمن يعمل المناظير كإرتداء الكمامات وحماية العيون وأيضاً فيما يتعلق بسلامة المرضى كتوفر الأدوية المبتلة للتخدير لم تكن تنطبق بشكل عام.

الخاتمة: لا يتم إجراء تنظير القصبات الهوائية بطريقة قياسية في المملكة العربية السعودية. مطلوب إيجاد قواعد إرشادية وطنية لتوحيد دواعي عمل تنظير القصبات الهوائية وكل ما يخص ممارسة هذا الإجراء.

Objectives: To assess current adherence to international guidelines for practitioners of bronchoscopy in the Kingdom of Saudi Arabia.

Methods: A cross-sectional survey was conducted in Saudi Arabia between December 2016 and March 2017. Pulmonologists, thoracic surgeons, and intensivists were invited to answer an emailed self-administered

questionnaire survey seeking information on how they performed flexible bronchoscopy in adults. The data collected were compared between the 3 specialties.

Results: Eighty-two (18%) of 456 invited practitioners completed the survey. Fifty-eight (72%) of the 82 respondents were pulmonologists. Forty (53%) of 76 respondents (93%) who had received bronchoscopy training received it abroad. Twenty-seven respondents (33%) had also received training in endobronchial ultrasound, electrocautery, brachytherapy, stent insertion, and laser procedures. Fifty-eight respondents (70%) preferred patients to undergo fasting for at least 4 hours before the procedure. Lidocaine was used for topical anesthesia, mainly by aerosol spray or nebulization. Midazolam was used by 62%, fentanyl by 50%, and propofol by 12% of respondents. Ninety percent of pulmonologists reported requesting a chest radiograph after transbronchial lung biopsy. Safety procedures for bronchoscopists, for example, wearing masks and eye protection, and for patients, for example, availability of anesthetic reversal agents, were not universally applied.

Conclusion: Bronchoscopy is not standardized in Saudi Arabia. National guidelines for the indications and practice of bronchoscopy are required.

*Saudi Med J 2019; Vol. 40 (3): 238-245
doi: 10.15537/smj.2019.3.23964*

From the Department of Internal Medicine (Aljohaney), King Abdulaziz University, King Abdullah International Medical Research Center (Albanna), King Saud bin Abdulaziz University for Health Sciences, Jeddah, the Department of Medicine (Alhajji, Mobeireek), King Faisal Specialist Hospital & Research Center, the Department of Medicine (Batubara), Prince Sultan Military Medical City, the Department of Pulmonary and Critical care (Zalt), King Fahd Medical City, and the Department of Medicine (Alghamdi), King Abdulaziz Medical City, Riyadh, Kingdom of Saudi Arabia.

Received 14th August 2018. Accepted 28th January 2019.

*Address correspondence and reprint request to: Dr. Ahmed A. Aljohaney, Department of Internal Medicine, Faculty of Medicine, King Abdulaziz University, Jeddah, Kingdom of Saudi Arabia. E-mail: draljohani@yahoo.com
ORCID ID: orcid.org/0000-0002-2905-2344*

Since its introduction in 1968, flexible bronchoscopy (FB) has evolved to become an essential tool in pulmonary medicine.¹ Several international surveys on the practice of flexible bronchoscopy have been published.²⁻¹¹ These surveys used different methodologies but consistently highlighted variations in practice between countries and over time. A practice guideline was published by the British Thoracic Society in 2013 and guidelines for bronchoscopy training were published subsequently by the American College of Chest Physicians, along with more specific guidelines on preparation of patients, use of anesthetic and sedative agents, and adjunctive therapies.¹²⁻¹⁴ Apart from one single-center study, there have been no reports on the practice of bronchoscopy in Saudi Arabia.¹⁵ The availability of a national training and practice standard for bronchoscopy procedures is essential to limit variability and improve the quality and consistency of health care. We aimed to assess current adherence to international standard training and practice guidelines for bronchoscopy procedures in Saudi Arabia, in comparison with other countries.

Methods. A cross-sectional survey was conducted in Saudi Arabia in December 2016. The study protocol was approved by our institutional biomedical research ethics committee and was performed in adherence to the tenets of the Helsinki Declaration of 1975, as revised in 2000. A standardized self-administered questionnaire and informed consent form for participation were emailed to pulmonologists, thoracic surgeons, and intensivists treating adult patients in different regions of the country. The contact details of the prospective study participants were identified from the Saudi Thoracic Society database. A second request to complete the survey was emailed 4 weeks after the initial attempt, to enhance the response rate. Survey results were collected over 12 weeks.

Our survey format was adapted from surveys that had been used previously to address this issue.^{4,5} The survey domains included demographics, procedural statistics, patient preparation and tests, sedation and anesthesia, patient monitoring, infection control measures, and bronchoscopy training and competency. The international standard for practice and training

competence against which we assessed adherence was based on guidelines of the British Thoracic Society and the American College of Chest Physicians.¹²⁻¹⁴

Statistical analysis. Respondent characteristics are presented as proportions for dichotomous variables, and means for continuous variables. Comparisons between practitioners in the different specialties were performed using the chi-square test. All analyses were performed using StataCorp. 2011 software (Stata Statistical Software: Release 12. College Station, TX: StataCorp LP). Statistical significance was determined by the 95% confidence interval and *p*-values less than 0.05.

Results. Demographic characteristics. Eighty-two (18%) of the 456 practitioners invited to participate responded to the survey. Table 1 shows respondent demographic characteristics. The participants were from all regions of the country; 72 (88%) were male and the majority (n=58, 72%) were pulmonary specialists.

Training and experience. Forty (51%) of the respondents had trained abroad; approximately half had more than 10 years' experience in performing bronchoscopies. Among the advanced procedures,

Table 1 - General participant characteristics.

Characteristics	n	(%)
<i>Age categories</i>		
Less than 40 years	17	(20.7)
40 - 49 years	29	(35.4)
50 years or more	36	(43.9)
<i>Gender</i>		
Male	72	(87.8)
Female	10	(12.2)
<i>Institute</i>		
General governmental	41	(50.6)
Restricted governmental	31	(38.3)
Private	5	(6.2)
More than an institute	4	(4.9)
<i>Region</i>		
Central	43	(53.8)
Eastern	6	(7.5)
Southern	3	(3.8)
Western	28	(35)
<i>Specialty</i>		
Pulmonary	58	(71.6)
Critical care	7	(8.6)
Thoracic surgery	12	(14.8)
Other	4	(4.9)
<i>Position</i>		
Consultant	59	(72.8)
Specialist	14	(17.3)
Fellow	8	(9.9)

Disclosure. Authors have no conflict of interests, and the work was not supported or funded by any drug company.

endobronchial ultrasound was the procedure for which training had been most commonly received, and transbronchial needle aspiration (TBNA) was seldom performed (Table 2).

Table 3 compares the bronchoscopy training and experience of bronchoscopists in the different specialties. As expected, more thoracic surgeons were trained to perform rigid bronchoscopy ($p<0.001$) and laser procedures than were the bronchoscopists in other specialties ($p=0.001$). Intensivists performed significantly more bronchoscopies ($p=0.012$) than the other bronchoscopists. However, significantly more pulmonologists had performed at least 10 bronchial biopsies in the preceding year ($p=0.031$). Overall, relatively few participants reported performing therapeutic bronchoscopic interventions.

Bronchoscopy policy and practice. Table 4 highlights the policy and practice pertaining to bronchoscopic procedures. Pulmonologists preferred to perform the procedure in a bronchoscopy suite, and nasal insertion was the route preferred by pulmonologists and thoracic surgeons. Pulmonologists ordered significantly more chest radiographs after transbronchial lung biopsy (TBLB) than clinicians in the other specialties ($p=0.001$).

Preparation for bronchoscopy. The responses of the intensivists suggested that they ordered more tests before bronchoscopy than other specialties, but the difference was not statistically significant. All respondents reported that they secured venous access before the procedure. All pulmonologists and 90% of the thoracic surgeons reported that they explained the procedure to their patients. More thoracic surgeons than pulmonologists and intensivists explained the procedure to patients using illustrations ($p=0.02$; Table 4).

Infection control measures. All intensivists indicated that they always wear gloves, a gown, and a mask. All pulmonologists indicated that they always wear gloves. Significantly more intensivists than pulmonologists and thoracic surgeons reported wearing eye protection. Participants from all specialties reported implementing specific protective measures for high-risk patients (Table 5).

Patient monitoring during bronchoscopy. Pulse oximetry was almost always used for monitoring during bronchoscopy across all specialties. Eighty-six percent of intensivists always used electrocardiographic (ECG) monitoring. All intensivists always used blood pressure monitoring during bronchoscopy (Table 5).

Sedation and anesthesia. The respondents' preferences for sedation and anesthesia are shown in

Table 2 - Survey responses regarding training and experience of participants.

Characteristics	n	(%)
<i>Training site</i>		
Local	26	(33.3)
International	40	(51.3)
Both	10	(12.8)
None	2	(2.6)
<i>Trained procedures</i>		
Electrocautery	16	(19.5)
Rigid bronchoscopy	15	(18.3)
Brachytherapy	11	(13.4)
Laser procedures	12	(14.6)
EBUS	21	(25.6)
Stent Insertion	16	(19.5)
<i>Experience duration</i>		
Less than 5 years	17	(22.4)
5 – 10 years	17	(22.4)
More than 10 years	42	(55.2)
<i>Number of bronchoscopies in the past year</i>		
Zero	2	(2.8)
1 – 9	10	(13.9)
10 – 29	27	(37.5)
30 – 50	17	(23.6)
More than 50	16	(22.2)
<i>Number of bronchial biopsies in the past year</i>		
Zero	12	(16.7)
1 – 9	32	(44.4)
10 – 29	21	(29.2)
30 – 50	4	(5.6)
More than 50	3	(4.2)
<i>Number of TBNA in the past year</i>		
Zero	36	(51.4)
1 – 9	20	(28.6)
10 – 29	11	(15.7)
30 – 50	2	(2.9)
More than 50	1	(1.4)

EBUS - endobronchial ultrasound, TBNA - transbronchial needle aspiration

Table 6. Most respondents preferred to use an aerosol formulation of lidocaine for oropharyngeal anesthesia. Nebulized lidocaine was used by significantly more intensivists (86%) than clinicians in the other specialties ($p=0.055$). More than half the pulmonologists and intensivists and approximately one third of the thoracic surgeons used “spray as you go” lidocaine for tracheobronchial anesthesia.

For sedation, most respondents used intravenous midazolam followed by intravenous fentanyl. Importantly, anesthetic reversal agents were available to all thoracic surgeons during the procedure but not to 14% of intensivists and 6% of pulmonologists.

Table 3 - Bronchoscopic procedures trained and experienced by different specialties.

Variable	Pulmonologist	Thoracic surgeon	Intensivist	P-value
<i>Trained procedures (%)</i>				
Electrocautery	17.2	41.7	14.3	0.15
Rigid bronchoscopy	8.6	83.3	0	<0.001
Brachytherapy	17.2	8.3	0	0.38
Laser procedures	10.3	50	0	0.001
EBUS	32.8	8.3	14.3	0.16
Stent insertion	17.2	33.3	28.6	0.40
<i>Number of bronchoscopies in the past year (%)</i>				
Less than 10	7.6	36.4	42.9%	0.012
10 – 29	43.4	36.4	0	
30 or more	49.1	27.3	57.1%	
<i>Number of bronchial biopsies in the past year (%)</i>				
Zero	9.4	36.4	28.6	0.031
1-9	41.5	54.6	57.1	
10 or more	49.1	9.1	14.3	
<i>Number of TBNA in the past year</i>				
Zero	48.1	63.6	57.1	0.89
1-9	30.8	18.2	28.6	
10 or more	21.2	18.2	14.3	
<i>Interventional procedures performed in the past year (%)</i>				
Electrocautery	8.0	42.9	14.3	0.033
Cryotherapy	2.0	0	0	0.867
Brachytherapy	0	0	0	-
Laser procedures	0	28.6	0	<0.001
EBUS	34.0	0	28.6	0.182
Ballooning	12.0	28.6	14.3	0.498
Stent insertion	8	28.6	0	0.144
EBUS - endobronchial ultrasound, TBNA - transbronchial needle aspiration				

Discussion. We attempted to analyze the practice and training of responders before, during and after bronchoscopy. Our respondents were from all parts of Saudi Arabia and from specialties such as pulmonology, intensive care and thoracic surgery. Almost all respondents in our survey had received formal training in bronchoscopy, and at least half of them had received their training abroad. However, surveys in other countries, including Egypt, Singapore, Australia, and New Zealand, have indicated that most bronchoscopists receive their training locally.^{4,5,10,11} This variation is likely explained by the extensive postgraduate scholarship programs offered to Saudi doctors, and the high percentage of non-Saudi national doctors practicing in Saudi Arabia who had been trained in their home countries. Only 22% of the bronchoscopists in our study had performed more than 50 bronchoscopies in the previous year; this is less than the figure reported

Table 4 - Survey responses regarding policy and preparation for bronchoscopic procedures by different specialties.

Variable	Pulmonologist	Thoracic surgeon	Intensivist	P-value
<i>Explain procedure to patients (%)</i>				
Never	0	10	0	
Verbally	74.5	30.0	71.4	0.02
Verbally with illustration	25.5	60.0	28.6	
<i>Fasting duration (%)</i>				
Less than 4 hrs.	5.9	30.0	14.3	
4 - 8 hrs.	72.6	60.0	71.4	0.22
More than 8 hrs.	21.6	10.0	14.3	
<i>Investigations (%)</i>				
CXR	79.3	81.8	100	0.41
CBC	66.0	54.6	85.7	0.39
Coagulation profile	79.3	63.6	100	0.18
Spirometry	9.4	18.2	14.3	0.68
ECG	24.5	9.1	42.9	0.26
ABG	15.1	18.2	42.9	0.20
Basic screen (urea, creatinine, and electrolytes)	13.2	18.2	28.6	0.55
CT chest	77.4	63.6	71.4	0.62
Post-TBLB CXR	90.4	45.5	57.1	0.001
<i>Preferred place of bronchoscopy (%)</i>				
Bronchoscopy suite	94.8	40.0	14.3	
ICU	0	10.0	71.4	<0.001
OR	5.2	50.0	14.3	
<i>Preferred entrance route entrance of the bronchoscope (%)</i>				
Nasal	62.1	54.6	0	
Oral	29.3	9.1	0	
Through ET tube	1.7	27.3	71.4	<0.001
No preference	6.9	9.1	28.6	
Mean number of assistants	2.3	1.8	2.1	0.167
<i>Venous access (%)</i>				
Never	0	0	0	
Sometimes	4	0	0	0.73
Always	96	100	100	
ABG - arterial blood gas, CBC - complete blood count; CT - computed tomography, CXR - chest X-ray, ECG - electrocardiography, ET tube - endotracheal tube, ICU - intensive care unit, OR - operating room, Post-TBLB CXR - Post-transbronchial lung biopsy chest X-ray				

in the UK survey, in which the majority of respiratory physicians performed more than 100 bronchoscopies per year with a median bronchoscopy rate of 175 procedures per physician per year.⁶ The number of bronchoscopies performed annually may serve as a surrogate marker for

Table 5 - Survey responses regarding self-protection and patient monitoring during bronchoscopy.

Variable	Pulmonologist	Thoracic surgeon	Intensivist	P-value
Wear gloves (%)				
Never	0	0	0	
Sometimes	0	10	0	0.053
Always	100	90	100	
Wear gown (%)				
Never	0	10	0	
Sometimes	9.8	40	0	0.006
Always	90.2	50	100	
Wear eye protection (%)				
Never	13.7	40	0	
Sometimes	62.8	40	42.9	0.07
Always	23.5	20	57.1	
Wear mask (%)				
Never	2.0	10	0	
Sometimes	5.9	50	0	0.001
Always	92.2	40	100	
Special measures for high risk patients (%)				
Never	0	0	0	
Sometimes	9.8	0	0	0.41
Always	90.2	100	100	
Pulse oximeter				
Never	0	0	0	
Sometimes	2	0	0	0.859
Always	98	100	100	
ECG				
Never	8	0	0	
Sometimes	32	25	14.3	0.61
Always	60	75	85.7	
Blood pressure				
Never	4	12.5	0	
Sometimes	18	25	0	0.456
Always	78	62.5	100	

ECG - electrocardiography

establishing and maintaining competency, but evidence to support this suggestion is lacking. Nevertheless, the guidelines published by the various relevant societies recommend a minimum number of bronchoscopies to achieve competency, although there is no consensus on a mandatory requirement.^{16,17} Replacing volume-based certification with acquisition of knowledge and skills-based competencies has recently been recommended.¹³ Competence could also be assessed by the diagnostic yield of bronchoscopic biopsies and monitoring of complication rates taking into account the total number of procedures performed. In contrast to the study in India where 74% of bronchoscopists performed conventional TBNA in the preceding year,

Table 6 - Survey responses regarding medications used during bronchoscopy.

Variable	Pulmonologist	Thoracic surgeon	Intensivist	P-value
Atropine				
Never	68	62.5	71.4	
Sometimes	22	25	28.6	0.918
Always	10	12.5	0	
Lidocaine				
Soaked cotton pledge	28	12.5	28.6	0.644
Nebulized	38	37.5	85.7	0.055
Dropper instillation	24	25	28.6	0.966
Trans-cricoid	4	12.5	14.3	0.415
Aerosol spray	66	50	85.7	0.345
Spray as you go	56	37.5	57.1	0.611
Other anesthetics				
Cocaine	0	0	0	-
Benzocaine	4	0	28.6	0.03
Tetracaine	0	0	0	-
Sedatives/Opioids				
IV Midazolam	96	62.5	100	0.003
IM pethidine	12	12.5	14.3	0.98
IV Lorazepam	0	12.5	0	0.027
IV Propofol	4	12.5	14.9	0.415
IV Fentanyl	62	50	85.7	0.341
IM Hydroxyzine	0	0	0	-
IV Morphine	4	12.5	0	0.47
IV Dexmedetomidine	0	0	28.57	<0.001
Antagonist medications				
Not available	6	0	14.3	
Available	94	100	85.7	0.515

more than half the respondents in our survey had not performed a TBNA in the previous year.¹¹ Low rates of TBNA have also been reported in surveys performed in North America and UK.^{2,6} This finding may reflect a lack of adequate training in TBNA during pulmonary fellowships or concern about potential complications. Furthermore, the advent of endobronchial ultrasound may have rendered conventional TBNA a less favorable option. However, one study suggested that conventional TBNA can still be routinely performed even at centers where endobronchial ultrasound (EBUS) is available.¹⁸ More participants in our survey had received training in EBUS than those in the Singapore survey (26% versus 7%).⁵ However, training in therapeutic bronchoscopy procedures seems to be less common in our survey population than in Singapore (18% versus 32% for rigid bronchoscopy, 13% versus 25% for brachytherapy, 15% versus 29% for laser procedures, and 19.5% versus 21% for stent insertion).⁵ Among pulmonologists in

our survey, although 10% reported being trained in laser procedures and stent insertion, none performed laser procedures and only 8% performed stent insertion. This is similar to the findings of older surveys in the USA and UK; 4.5% of the respondents in the USA and 4.7% in UK had performed laser procedures or stent insertion.^{2,6} The low performance rates of therapeutic procedures may be explained by the lack of training and competency among pulmonologists, unavailability of equipment, case scarcities, and the fact that thoracic surgeons historically manage these cases. At least 50% of the bronchoscopists in our study routinely ordered a complete blood count, coagulation profile, and chest imaging (radiography and/or computed tomography) before bronchoscopy. Other investigations, such as basic laboratory tests (electrolytes and renal function), arterial blood gases, spirometry, and ECG, were less frequently requested before the procedure. The frequency of pre-procedure investigations is not consistent in the published studies; routine requests for a complete blood count and coagulation profile were reported to be common in Egypt and Italy, but less so in North America, UK, and India.^{2,4,6,7,11} Almost all bronchoscopists in our study, except for a minority (10%) of thoracic surgeons, counseled their patients at least verbally before the procedure, and most across all specialties recommended more than 4 hours of fasting before bronchoscopy. This fasting duration is similar to what has been reported by members of the Canadian Thoracic Society and the surveys in UK and India.^{3,6,11} Intravenous access was established prior to bronchoscopy by almost all respondents in our study but by only 71.5% of respondents in the Italian survey. Some Italian bronchoscopists prefer the intramuscular route for administration of sedatives and 60% reported sedating patients only occasionally.⁷ In accordance with the recent recommendations of the American College of Chest Physicians and the British Thoracic Society, the majority of our respondents did not use anticholinergic agents.^{12,14} However, 10% of pulmonologists and 12.5% of thoracic surgeons reported routine use of atropine. Randomized control studies have shown that the use of 1% lidocaine in “spray as you go” technique is effective and safe with significantly less total dose of lidocaine administered when compared to 2% lidocaine.^{19,20} In our survey, use of topical anesthetics deviated from the evidence to some extent. Although aerosol and “spray as you go” methods were frequently used, the use of nebulized lidocaine was surprisingly high, especially by intensivists (85.7%), despite the lack of evidence to

support this practice.¹⁴ Some respondents, especially thoracic surgeons and intensivists, used transcrucoid injections. This route of administration is discouraged because it requires special training and is invasive. Our findings in this regard are very similar to those of the Canadian survey, in which nebulized formulations were used by 65% of respondents and transcrucoid injections by 40%.³ In our study, benzocaine was used as a topical anesthetic by 28.6% of intensivists and 4% of pulmonologists despite the recommendation against its use because of its narrow therapeutic window and potential to cause methemoglobinemia.¹⁴

In keeping with the international guidelines, midazolam and fentanyl were the intravenous agents most commonly used for sedation.^{12,14} Combination of a benzodiazepine and an opiate is recommended because of these agents have synergistic effects in terms of the patient's tolerance of the procedure and the additional antitussive properties of opioids.¹⁴ Propofol is being used increasingly for sedation during short interventions worldwide. However, only 4% of pulmonologists, 13% of thoracic surgeons, and 15% of intensivists in our survey reported using propofol for sedation. In Switzerland, 77% of pulmonologists, and 70% in Germany, reported using propofol either as a single agent or in combination.^{8,21} In Canada, only 8% of bronchoscopists used propofol for bronchoscopy.³ These differences reflect country-specific differences in practice, training, and availability of propofol. Despite the basic requirement for sedation reversal agents to ensure safety, 6% of pulmonologists and 14% of intensivists reported that these medications were not readily available during procedures. Compliance with this important standard varies between countries; only 42% of bronchoscopists in the Egyptian survey reported availability of sedation reversal agents, but all physicians in the UK survey reported availability.^{4,6} Most bronchoscopists in our study monitored oxygen saturation, ECG, and blood pressure during a bronchoscopy procedure. They also universally reported wearing gloves and a gown for self-protection. However, masks appear to be worn less often, particularly by surgeons, and eye protection is infrequent. The incidence of pneumothorax following TBLB without fluoroscopy is 5%.²² Therefore, the British guidelines recommend ordering a chest radiograph post-TBLB if a patient is symptomatic or there is a high clinical suspicion of pneumothorax.¹² Nevertheless, the majority of bronchoscopists in this study would routinely order a chest radiograph post-TBLB to rule out pneumothorax.

Study limitations. First, it was designed as an email survey to assess the perceptions and attitudes of respondents. Such surveys are self-reported, relying on the respondent's memory and the responses are not verifiable by case records. Second, the response options for several questions, for example, "always" or "sometimes," do not provide an objective assessment. Third, some of the respondents might not have provided complete information; however, this is an inherent limitation of self-administered surveys. The fourth limitation was the low response rate of 18%, but this is expected in email surveys. Moreover, it is possible that not all of the 456 individuals who were invited to participate are still practicing in Saudi Arabia, and that not all of those who are practicing here are performing bronchoscopies. Nevertheless, we had respondents from all regions in the country.

In conclusion, this survey provides information that emphasizes the importance of establishing local standards for bronchoscopy practice and training. Advanced bronchoscopic procedures are becoming the standard of care for many diagnostic and therapeutic indications. The low level of training and experience in performing such procedures among our bronchoscopists highlights the importance of considering this field for planning our future international training sessions. In addition, our bronchoscopists are performing relatively low numbers of bronchoscopies in comparison with other countries, which raises questions about our standards for the indications to perform this procedure. Safety procedures for self-protection of bronchoscopists, such as wearing masks and eye protection, and for protecting patients, such as the availability of anesthetic antagonists, were not universally applied in practice in our population. Furthermore, the significant variation in practice and techniques performed before, during, and after bronchoscopy in our survey indicates a lack of a uniform standard of practice, which is important to ensure and maintain quality of care at a national level. Considering our study limitations, especially the low response rate, further prospective multicenter studies with larger sample sizes are required to address bronchoscopy practice and training requirements in Saudi Arabia. Establishment of national standard guidelines for the indications and practice of bronchoscopy is recommended.

Acknowledgment. We thank the Saudi Thoracic Society administration and secretaries for their help in disseminating the survey. We also thank Editage for the English language editing.

References

- Ikeda S, Yanai N, Ishikawa S. Flexible bronchofiberscope. *Keio J Med* 1968; 17: 1-16.
- Prakash U, Offord KP, Stubbs SE. Bronchoscopy in North America: the ACCP survey. *Chest* 1991; 100: 1668-1675.
- Pierce CW, Gjevre JA, Taylor-Gjevre RM. A survey of current bronchoscopy practices in Canada: a dearth of evidence or evidence-based practice? *Chest* 2011; 140: 833-834.
- Madkour A, Al Halfawy A, Sharkawy S, Zakzouk Z. Survey of adult flexible bronchoscopy practice in Cairo. *J Bronchol* 2008; 15: 27-32.
- Pyng L, Loo CM, Jagadesan R, Colt HG. Survey of bronchoscopy practice in Singapore. *J Bronchol* 2008; 15: 215-220.
- Smyth CM, Stead RJ. Survey of flexible fiberoptic bronchoscopy in the United Kingdom. *Eur Respir J* 2002; 19: 458-463.
- 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; 79: 128-133.
- Hautmann H, Hetzel J, Eberhardt R, Stanzel F, Wagner M, Schneider A, et al. Cross-sectional survey on bronchoscopy in Germany--the current status of clinical practice. *Pneumologie* 2016; 70: 110-116.
- Asano F, Aoe M, Ohsaki Y, Okada Y, Sasada S, Sato S, et al. Bronchoscopic practice in Japan: a survey by the Japan Society for Respiratory Endoscopy in 2010. *Respirology* 2013; 18: 284-290.
- Barnett AM, Jones R, Simpson G. A survey of bronchoscopy practice in Australia and New Zealand. *J Bronchology Interv Pulmonol* 2016; 23: 22-28.
- 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; 35: 98-107.
- Du Rand IA, Blaikley J, Booton R, Chaudhuri N, Gupta V, Khalid S, et al. British Thoracic Society guideline for diagnostic flexible bronchoscopy in adults: accredited by NICE. *Thorax* 2013; 68: i1-i44.
- 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: 321-332.
- Wahidi MM, Jain P, Jantz M, Lee P, Mackensen GB, Barbour SY, et al. American College of Chest Physicians consensus statement on the use of topical anesthesia, analgesia, and sedation during flexible bronchoscopy in adult patients. *Chest* 2011; 140: 1342-1350.
- Alamoudi OS, Attar SM, Ghabrah TM, Kassimi MA. Bronchoscopy, indications, safety and complications. *Saudi Med J* 2000; 21: 1043-1047.
- Bolliger CT, Mathur PN, Beamis JE, Becker HD, Cavaliere S, Colt H, et al. ERS/ATS statement on interventional pulmonology. European Respiratory Society/American Thoracic Society. *Eur Respir J* 2002; 19: 356-373.
- Fielding D, Phillips M, Robinson P, Irving L, Garske L, Hopkins P, et al. Advanced interventional pulmonology procedures: training guidelines from the Thoracic Society of Australia and New Zealand. *Respirology* 2012; 17: 1176-1189.
- Madan NK, Madan K, Jain D, Walia R, Mohan A, Hadda V, et al. Utility of conventional transbronchial needle aspiration with rapid on-site evaluation (c-TBNA-ROSE) at a tertiary care center with endobronchial ultrasound (EBUS) facility. *J Cytol* 2016; 33: 22-26.

19. Kaur H, Dhooria S, Aggarwal AN, Gupta D, Behera D, Agarwal R. A randomized trial of 1% vs 2% lignocaine by the spray as you go technique for topical anesthesia during flexible bronchoscopy. *Chest* 2015; 148: 739-745.
20. Madan K, Biswal SK, Mittal S, Hadda V, Mohan A, Khilnani GC, et al. 1% versus 2% lignocaine for airway anesthesia in flexible bronchoscopy without lignocaine nebulization (LIFE): a randomized controlled trial. *J Bronchology Interv Pulmonol* 2018; 25: 103-110.
21. Heuss LT, Froehlich F, Beglinger C. Changing patterns of sedation and monitoring practice during endoscopy: results of a nationwide survey in Switzerland. *Endoscopy* 2005; 37: 161-166.
22. Rhee CK, Kang HH, Kang JY, Kim JW, Kim YH, Park SA, et al. Diagnostic yield of flexible bronchoscopy without fluoroscopic guidance in evaluating peripheral lung lesions. *J Bronchology Interv Pulmonol* 2010; 17: 317-32.