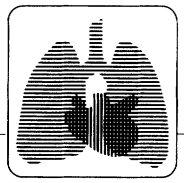

bronchoscopy

Quality Assessment Through Patient Self-report of Symptoms Prefiberoptic and Postfiberoptic Bronchoscopy*

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Study objective: **To apply the principles of quality improvement to measure the frequency and severity of symptoms that result from fiberoptic bronchoscopy (FOB), and to identify opportunities to improve FOB practice by identifying factors about patients and the process of care that predict these symptoms.**
Design: **Concurrent longitudinal cohort study.**
Patients: **Four hundred ninety-three adult patients who underwent FOB.**
Measurements and results: **Patients completed questionnaires just prior to FOB and again at 48 h postprocedure. Patients were asked to rate the severity of nose pain, throat pain, swallowing pain, and chest pain, and the frequency of coughing, hemoptysis, phlegm, shortness of breath, wheezing, difficulty swallowing, fever, and chills. Symptom severity was reported on a four-point ordinal scale. Findings: Significant worsening was found for nose pain, throat pain, swallowing pain, and hemoptysis. Shorter patients experienced more throat pain and hemoptysis, and longer procedure time predicted nose pain and hemoptysis.**
Conclusions: **Bronchoscopy causes nose pain, throat pain, swallowing pain, and hemoptysis to a larger extent than previously has been recognized. There are opportunities to improve the patient experience with bronchoscopy by using smaller bronchoscopes in shorter patients, shortening the procedure length, and reanesthetizing the nares in longer procedures.**
(CHEST 1998; 114:1446–1453)

Key words: fiberoptic bronchoscopy; patient self-report; quality improvement; symptoms

Abbreviations: aPTT = activated partial thromboplastin time; BMI = body mass index; ETT = endotracheal tube; FOB = fiberoptic bronchoscopy; PT = prothrombin time; QI = quality improvement; TBBx = transbronchial biopsy; TBNA = transbronchial needle aspiration

Fiberoptic bronchoscopy (FOB) outcomes have been reported for nearly 30 years, since the introduction of the fiberoptic bronchoscope, as diagnostic yield and adverse events. Despite the direct relevance to patients, there has been a dearth of research directed at the patient experience with FOB and little systematic effort to improve patients' experiences with the procedure.

In recent years, the patient experience with health care increasingly has been recognized as a valid and significant outcome of care. Donebedian[1] established the conceptual framework of structure, process, and outcomes in medical quality research, by which the outcomes of care can be linked to measurable aspects of care, such as the environment in which a procedure is performed and the various means by which a procedure is carried out. Iezzoni[2] and others have shown the importance of considering patient characteristics in interpreting the results of outcomes studies. We wanted to develop a sys-

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tematic approach to improving the patient experience with FOB through measuring patient characteristics and patient responses to the procedure.

In our study, we applied quality improvement (QI) principles to the experiences of care reported by patients. We reasoned that we could best design an intervention to improve the patient experience with FOB by understanding the patient and the process-of-care factors that predict symptoms. By establishing baseline values for symptom severity, we can then assess whether future interventions will succeed. The purpose of this study, then, is to understand which symptoms worsen with bronchoscopy and which factors about the patient and the process of care predict worsened symptoms.

Materials and Methods

We conducted the prospective cohort study of patients undergoing fiberoptic bronchoscopy at the Johns Hopkins Medical Institutions (Johns Hopkins Hospital and Johns Hopkins Bayview Medical Center) in Baltimore, between September 1996 and June 1997. Our study is part of an ongoing project, the Bronchoscopy Quality Improvement project, designed to identify predictors of outcomes of FOB, to reduce adverse events, and to improve diagnostic success, comfort, and satisfaction in patients undergoing FOB. All the patients eligible for the study were adults ($\geq$ 18 years old) undergoing FOB, which was performed by Pulmonary and Critical Care Medicine fellows with faculty supervision or was performed alone by full-time faculty members. Reasons for the exclusion of patients from the study included intubation and mechanical ventilation, lack of ability to speak English, other communication deficits that precluded answering questions, and death within 48 h following FOB. Our study was approved by our Joint Commission on Clinical Investigation.

Outcome Measurements

Based on a literature review, clinical observations, and the judgment of experienced bronchoscopists, we developed a 13-item questionnaire on pain and respiratory and systemic symptoms. Patients rated nose pain, throat pain, chest pain, and swallowing pain on a four-point scale (none, mild, moderate, and severe). Patients also rated the frequency of nine other symptoms (coughing, coughing up blood, coughing up yellow or green phlegm, nose bleed, shortness of breath, difficulty with swallowing, wheezing or whistling sound in the chest, shaking chills, and fever) on a four-point scale (never, once or twice, several times, and all the time).

We administered the baseline questionnaire to patients just prior to starting FOB and asked them to rate their pain and symptoms for the 24-h period prior to FOB. Patients answered the same questions 48 h later. At the follow-up, we asked them to rate symptoms in the 24-h period following the FOB. Our questionnaires were either self-administered or were administered in person or by phone by trained interviewers.

Outpatients were asked to complete the follow-up survey at home on the second day following the procedure and to return it by mail. For inpatients, a member of the study team brought the questionnaire to the patient's hospital room on the second day post-FOB. If inpatients were discharged in less than 48 h, we contacted them at home. We employed a protocol of serial phone calls and mailings to attempt to maintain a high response rate.

Predictor Variables: Patient and Process-of-Care Factors

Data on predictors of symptoms came from the patient questionnaire as well as from physician report forms designed for the Bronchoscopy Quality Improvement project. Physicians reported patient age, gender, race, comorbid conditions (renal failure, liver failure and cirrhosis, and pulmonary hypertension), immune status (normal vs abnormal), preprocedure use of supplemental oxygen, and bleeding parameters (history of excessive bleeding, aspirin use within 7 d, prothrombin time [PT; international normalized ratio], activated partial thromboplastin time [aPTT; in seconds], and platelets [in thousands/mm^3]). Patients reported their current height and weight. We used patient height as a marker of upper airway size[3] to evaluate patient susceptibility to airway symptoms (nose pain, throat pain, swallowing pain, and hemoptysis). We used body mass index (BMI; in kg/m^2) to evaluate swallowing symptoms, as we hypothesized that obesity could be a marker for prior upper airway trauma from snoring and obstructive sleep apnea.

Physicians reported the specific procedure performed (BAL, transbronchial biopsy [TBBx], endobronchial biopsy, proximal airway brushing, peripheral lung brushing, transbronchial needle aspiration [TBNA] or biopsy, or bronchial washing), length of procedure (*ie*, length of time that the bronchoscope is in the patient, measured in minutes), and admission status (inpatient vs outpatient). Physicians also reported the total dose of administered sedatives, analgesics, and premedications (midazolam, fentanyl, lidocaine, or atropine). The doses of each medication were determined in each case by the bronchoscopist and were titrated to attempt to optimize comfort and safety. The median dose (and range) for these medications was: 3 mg of midazolam (0 to 10); 100 μg of fentanyl (0 to 400); 25 mL of 2% lidocaine (0 to 120); and 0.5 mg of atropine (0 to 1).

Statistical Analysis

We examined baseline patient characteristics by the proportions of categorical or ordinal values. We used the Wilcoxon signed rank test to compare matched pre-FOB to post-FOB symptoms. Statistical significance was defined as $p < 0.05$.

For each symptom that worsened significantly post-FOB, we examined the patient and the process-of-care factors associated with the worsening of the symptom. We classified symptom changes dichotomously, so that we could test predictive models that distinguish patients with worsened symptoms from those whose symptoms did not worsen. The change in symptom score was calculated by subtracting the pre-FOB value from the post-FOB value, with a reported range of -3 to $+3$. For example, a patient with no chest pain before the procedure (1 point) and moderate pain afterward (3 points) would have a score of -2 ($1 - 3 = -2$). Then, patients were dichotomized by symptom score as worse (-1 to -3) or not worse (0 to $+3$). We tested categorical and ordinal variables in bivariate χ^2 analysis, and we tested continuous variables with Cuzick's nonparametric test for trend.

Factors with $p < 0.1$ in bivariate analysis or those that were judged by the investigators to be clinically important were examined in a multivariate logistic regression.[4] Statistical significance for multivariate analysis was reported for $p < 0.05$, with the most parsimonious models shown. All statistical analyses were performed with a computer software program (STATA 5.0; Stata Corporation; College Station, TX).[5]

RESULTS

Study Population and Characteristics

A total of 608 FOBs were performed between September 1996 and June 1997. Of patients undergoing those FOBs, 521 (86%) were eligible to complete both a pre-FOB and a post-FOB form. Reasons for ineligibility included mechanical ventilation (60), communication deficit (15), lack of ability to speak English (5), death in less than 48 h following FOB (5), and brain death (2). Of the 521 eligible patients, 492 (93%) completed the pre-FOB form, and 462 (89%) completed the post-FOB form. Overall, 451 patients (87%) completed forms both before and after the procedure. Reasons for not completing the forms by eligible patients (n = 70) included: patient refusal (27), lost to follow-up (24), and other (19). As shown in Table 1, nonresponse was more likely in patients who were nonwhite, male, and inpatients.

The characteristics of responding patients are in Table 2. Patient ages ranged from 18 to 89 years, with a mean of 50.4 years. 56% were white, and 52% were male.

Symptom Frequencies

Table 3 shows the proportion of patients who reported symptoms before and after the procedure. Pre-FOB symptom reports ranged from a low of 8% (for nose pain) to a high of 86% (for coughing). The most frequently reported symptoms (coughing, 86%; shortness of breath, 66%; wheezing, 44%; and phlegm, 39%) did not have a tendency to worsen following FOB. Shortness of breath improved significantly ($p < 0.001$), while four other symptoms worsened significantly: throat pain, swallowing pain, nose pain, and coughing blood ($p < 0.001$). Of patients who experienced the new onset of post-FOB throat pain, swallowing pain, or nose pain, 19, 20, and 14%, respectively, characterized the pain as moderate or severe. Patients with new onsets of hemoptysis (49%) reported it "several times" or "all the time."

Table 1—*Percent of Nonresponding Eligible Patients (n = 521)*

	% Nonresponse
Age, yr	
≤ 35	15.3
36–50	16.2
51–65	8.8
> 65	12.5
Race	
White	9.1*
Non-white	17.4
Gender	
Male	18.4*
Female	7.6
Inpatient	17.7*
Outpatient	8.9

*$p < 0.05$ by χ^2 for difference in proportion.

Table 2—*Characteristics of Patients with Both Prebronchoscopy and Postbronchoscopy Questionnaires (n = 451)*

Characteristic	Patients, %
Age, yr	
≤ 35	25.9
36–50	28.7
51–65	24.1
> 65	21.3
White race	55.6
Male	51.6
Abnormal immune status	39.1
On supplemental O_2	32.8
Outpatient	52.7

Predictors of Symptoms: Bivariate Analysis

Nose, Throat, and Swallowing Pain: Table 4 lists patient and process-of-care factors associated with worsened pain. Throat pain was more frequent in patients who had a normal immune status, who were not using supplemental oxygen, and who were outpatients (all had $p < 0.05$). Throat pain was also inversely related to patient height ($p < 0.05$), with 35% of the shortest patients and 15% of the tallest patients reporting worsening. Swallowing pain was related to BMI, with worsening in 33% of patients with a BMI of 31 to 35 kg/m^2, and lower rates of worsening in other BMI categories (≤ 20 kg/m^2, 15%; 21 to 25 kg/m^2, 11%; 26 to 30 kg/m^2, 21% and > 35 kg/m^2, 13%; $p < 0.05$). Nose pain was more frequent in whites ($p < 0.05$) and was more frequent with longer procedures (32% of FOBs lasting ≥ 45 min, and 12% of those lasting ≤ 15 min; $p < 0.05$).

Hemoptysis: Table 5 lists patient and process factors associated with increased hemoptysis. Whites, older patients, outpatients, and those patients with abnormal immune status were more likely to report increased hemoptysis ($p < 0.05$). Hemoptysis was inversely related to patient height (39% of patients ≤ 1.6 m vs 14% of patients ≥ 1.8 m; $p < 0.05$). Longer procedures and procedures involving TBBx, TBNA, transbronchial needle biopsy, peripheral brushing, and mucosal biopsy all were associated with worsening hemoptysis. We found that a patient history of aspirin use within 7 days of the procedure and elevated aPTT were associated with hemoptysis and were not significant. Patient histories of excess bleeding (not significant), thrombocytopenia ($p < 0.001$), and abnormal PTs (not significant) were inversely related to bleeding.

Table 3—*Patient-Reported Symptoms: Percent of Patients Reporting Each Symptom Pre- and Post-FOB, Percent Worsened and Improved,* Listed in Descending Order of Post-FOB Prevalence*

Symptom	Symptom Prevalence		Change in Symptoms	
	Pre-FOB	Post-FOB	Worse	Improved
Cough	85.5	87.3	22.6	23.5
Shortness of breath	65.8	58.6	14.0	25.6*
Wheezing	44.0	41.2	16.5	19.6
Cough phlegm	39.1	39.7	17.3	18.4
Throat pain	18.9	38.0	26.5*	11.5
Chest pain	38.7	36.5	17.5	19.7
Cough blood	18.3	34.9	26.3*	7.9
Fever	30.3	30.0	17.8	15.4
Chills	30.3	28.4	15.4	16.4
Difficulty swallowing	23.5	25.9	15.7	11.2
Swallowing pain	14.8	24.3	16.7*	7.6
Nose pain	8.2	21.2	16.4*	4.8
Nose bleed	15.8	17.0	11.5	9.9

*$p < 0.001$ by Wilcoxon signed rank test. Null hypothesis (H_0), symptom level pre-FOB = symptom level post-FOB.

Predictors of Symptoms: Multivariate Analysis

Nose, Throat, and Swallowing Pain: The results of multivariate analyses (Table 6) using logistic regression showed that worsened throat pain was more likely in shorter patients and outpatients. Compared with heights of ≤ 1.6 m, those who were > 1.8 m tall were, statistically significantly less likely to have worse throat pain. Procedure length significantly predicted nose pain. The odds of swallowing pain were three times greater in patients with a BMI of 31 to 35 kg/m^2 than in those with a BMI of ≤ 20 kg/m^2.

Hemoptysis: Patient-reported hemoptysis was more common in whites, in shorter patients, and after longer procedures (Table 6). We observed a marked dose-response relationship with time and height.

Discussion

This study reports the first comprehensive measurement of symptoms of bronchoscopy from the patient perspective. We studied a prospective cohort of patients, measured symptoms before and after the procedure, and detected changes in symptoms that were attributable to the procedure. We demonstrated the feasibility of collecting patient self-reported data to measure symptoms, and we recommend this approach to establish symptom rates in other invasive procedures.

We found that the 13 symptoms we asked about were remarkably prevalent in patients (17.0 to 87.3%) who had undergone FOB, but only a few symptoms were significantly different on follow-up. The most common patient-reported symptoms in patients undergoing FOB (coughing, shortness of breath, wheezing, and coughing phlegm) did not worsen following the procedure. This study suggests that FOB causes throat pain, nose pain, swallowing pain, and hemoptysis and that several factors predict these symptoms, especially procedure length and patient height. These symptoms were independent of the doses of analgesics and sedatives used during the procedures.

Our pain prevalence data are consistent with data reported by Mori et al,[6] in which the authors reported pharyngeal symptoms (dysphagia and difficulty swallowing) in 47% of patients within 24 h post-FOB. The high incidence of such symptoms in that study probably resulted from high endotracheal tube (ETT) use; 55% of the patients had an ETT, which the authors showed was associated with dysphagia. None of our patients had an ETT. We found a significant inverse relationship of patient height to throat pain, a finding that is consistent with shorter patients having smaller airways,[3] which may be susceptible to irritation or trauma from the bronchoscope. Mori et al[6] found that procedure length (> 15 min) was significantly related to pharyngeal symptoms. We found a nonsignificant trend in the same direction.

Our finding that outpatients were more likely to have worsened throat pain is interesting. We hypothesize that there are factors that we have not included in this study that predict this symptom. It is possible that there were systematic differences in the manner in which the procedure was performed that we did not measure. Also, outpatients may have a different threshold at which they report discomfort, or they may have taken fewer analgesics on the day following FOB. After the planned analysis, we examined (data not shown) whether the indication for the procedure

Table 4—*Factors Associated with Worsened Pain Symptoms in Patients*

	Throat, %	Swallowing, %	Nose, %
Gender			
Male	20.0*	13.9	16.7
Female	32.2	18.4	15.8
Race			
White	28.0	16.6	19.7*
Non-white	24.5	16.9	12.2
Age, yr			
≤ 35	26.8	11.1	15.9
36–50	31.4	21.2	14.9
51–65	23.1	15.5	19.4
> 65	20.2	15.9	15.7
Immune status			
Normal	31.4*	17.1	17.0
Abnormal	16.9	14.6	15.7
Height, m			
≤ 1.60	35.4†	17.2	12.5
1.61–1.70	35.6	21.0	15.3
1.71–1.80	22.9	15.1	21.5
> 1.80	14.8	13.8	13.6
Admission status			
Outpatient	33.5*	18.8	18.1
Inpatient	17.2	13.1	14.8
Oxygen use			
Room air	30.2*	17.6	15.4
Supplemental oxygen	16.4	13.1	18.6
Procedures			
BAL	25.1	16.5	16.1
TBBx	27.4	17.9	18.7
TBNA	28.0	14.5	20.7
Procedure length, min			
≤ 15	24.5	16.6	12.3†
16–30	22.6	11.2	13.1
31–45	32.9	20.7	23.8
≥ 45	29.4	23.5	32.4
Fentanyl, μg			
≤ 50	18.4†	14.6	14.3
51–100	22.2	14.0	15.2
> 100	32.2	19.3	18.6
Lidocaine 2%, mL			
≤ 20	25.0	15.9	16.7
21–40	24.6	16.0	15.8
> 40	34.9	23.8	22.7

*$p < 0.05$ by χ^2.
† $p < 0.05$ by Cuzick's nonparametric test for trend.

(to evaluate diffuse infiltrates, focal infiltrates, a solitary mass, multiple masses, and adenopathy) affected the results of the multivariate model. None of the indications was predictive of worsened throat pain, while outpatient status remained significant (odds ratio, 2.16; range, 1.25 to 3.72).

This is the first report of patient-reported nose pain following FOB. Procedure length was related to nose pain, which is consistent with our clinical impression that longer procedures expose patients to increased risk of local trauma at the site of the FOB insertion. Possibly, nose pain is increased in longer procedures because the local anesthetic is no longer

Table 5—*Factors Associated with More Frequent Hemoptysis Post-FOB**

	Patients with Worsened Hemoptysis, %
Gender	
Male	24.2
Female	27.6
Race	
White	32.1†
Non-white	19.3
Age, yr	
≤ 35	17.3‡
36–50	23.1
51–65	23.1
> 65	42.9
Immune status	
Normal	29.6†
Abnormal	19.9
Height, m	
≤ 1.60	39.0†
1.61–1.70	28.7
1.71–1.80	28.5
> 1.80	14.3
Admission status	
Outpatient	31.9†
Inpatient	19.2
Procedures	
Mucosal biopsy	48.6†
TBNA	43.8†
Brush peripheral	39.3†
TBBx	35.1†
Brush proximal	24.2
BAL	19.4†
Procedural length, min	
≤ 15	10.6‡
16–30	24.3
31–45	44.0
≥ 45	53.1
Lidocaine 2%, mL	
< 20	18.9†
31–40	31.0
> 40	32.6
History of excess bleeding	
Yes	0.0
No	26.8
Didn't ask	12.5
History of aspirin in 7 d	
Yes	36.4
No	25.6
Didn't ask	11.1
Platelets, in thousands	
≤ 50	15.0‡
51–100	14.3
> 100	30.7
PT, international normalized ratio	
≤ 1.1	26.1
1.2–1.3	29.7
> 1.3	6.7
aPTT, s	
≤ 31	27.0
32–45	26.9
> 45	40.0

*There were no patients with increased hemoptysis who had renal failure (n = 6), pulmonary hypertension (n = 8), or liver failure (n = 3).
†$p < 0.05$ by χ^2.
‡$p < 0.05$ by Cuzick's nonparametric test for trend.

Table 6—*Predictors of Worsened Symptoms from Logistic Regression (Most Parsimonious Models)*

Factor	Throat pain*	Nose pain†	Swallowing pain‡	Hemoptysis§
Height, ≤ 1.6 m				
1.61–1.70	1.01 (0.53–1.92)	—	—	0.61 (0.29–1.28)
1.71–1.80	0.57 (0.29–1.11)	—	—	0.63 (0.31–1.29)
> 1.80	0.30 (0.13–0.69)	—	—	0.24 (0.10–0.58)
Procedure time, ≤ 15 min				
16–30	—	1.08 (0.55–2.13)	—	2.58 (1.27–5.23)
31–45	—	2.24 (1.12–4.48)	—	6.01 (2.87–12.56)
> 45	—	3.42 (1.44–8.12)	—	9.62 (3.78–24.46)
Outpatient	2.20 (1.38–3.53)	—	—	—
BMI, ≤ 20 kg/m^2				
31–35	—	—	2.92 (1.26–6.77)	—
White race	—	—	—	1.90 (1.11–3.23)

*Candidate predictors in saturated models: gender, age, race, procedure length, height, lidocaine dose, fentanyl dose, route of insertion, immune status, supplemental oxygen use, and admission status.

†Candidate predictors in saturated models: gender, age, race, procedure length, height, route of insertion, and fentanyl dose.

‡Candidate predictors in saturated models: gender, age, race, BMI, procedure length, lidocaine dose, and fentanyl dose.

§Candidate predictors in saturated models: gender, age, race, height, procedure length, TBBx, needle, brushings, mucosal biopsy, lidocaine dose, route of insertion, platelet count, PT, aPTT, history of aspirin use, history of excess bleeding, immune status, and admission status.

effective (the estimated clinical duration of topical lidocaine is 30 to 60 min).[7]

This study shows a significant increase in the frequency of patient-reported hemoptysis following FOB. The literature that describes the frequency of bleeding events following FOB does not allow inferences about the patient experience, because it is from retrospective physician reports, which especially emphasize dramatic or unexpected events.[8–26] Blasco et al,[27] for example, reported a 12.4% rate of suctioning 20 or more mL of blood during FOBs with TBBx, and they conducted follow-up phone interviews with the patients. The authors reported that none of the patients had "significant hemoptysis," but the frequency and volume of hemoptysis reported by patients was not provided, and patients were not asked about hemoptysis prior to the FOB. Our study is the first to document changes in patient-reported bleeding and to measure individual procedure-level predictors of bleeding. Our multivariate analysis showed that bleeding was related to procedure length, patient height, and race, even after accounting for traditional bleeding risks (PT, aPTT, and aspirin) and the type of procedure performed. We suggest that a longer procedure time might reflect a technically difficult procedure (*eg*, difficulty with patient sedation or analgesia, or tumor blockage of the airway), a more aggressive sampling strategy, or differences in operator skill and experience. We cannot easily explain the race difference, and we suspect that it could be due to unmeasured risks, such as bleeding tendencies not measured with standard blood tests, factors related to the indication for the procedure (such as whether the patient was a lung transplant recipient, the patient's tobacco exposure, or the presence of endobronchial tumors in the patient), or a different propensity to report symptoms. The inverse relationship of bleeding to patient height again suggests a higher risk of airway trauma in smaller patients.

The findings in bivariate analysis that bleeding was less likely when patients had low platelets, elevated PT, and a history of excess bleeding can be explained by lower rates of invasive sampling methods in these patients. For example, comparing patients with ≤ 50,000 platelets to those with ≥ 100,000, respectively, the TBBx rate was 15 vs 34%, the TBNA rate was 9 vs 21%, and the mucosal biopsy rate was 6 vs 11%. Similar differences were seen in sampling rates using PT values and histories of excess bleeding. The multivariate analysis showed that these traditional risk factors were not significant predictors of bleeding after accounting for other patient and process-of-care factors.

Our study showed a nonsignificant trend toward improvement in post-FOB wheezing. Although bronchospasm has been reported previously in the literature,[13,14,16,18–20,28–31] it has only been studied by physician observation, not by patient reports. Possible explanations for our failure to show a systematic association of wheezing with FOB include the fact that the literature to date has emphasized more clinically dramatic episodes of bronchospasm that we had limited power to detect. Our bronchoscopists used atropine, which has been shown to protect against airway obstruction during FOB, as a premedication in approximately 70% of cases (rates of use were 0 to 100% in the referenced studies).[32–35] If FOB is indeed associated with wheezing, atropine

premedication could reduce or ameliorate the likelihood of postprocedure wheezing.

The improvements in shortness of breath following FOB were unexpected. Possible explanations include a real therapeutic effect of bronchoscopy (*eg*, elimination of secretions and mucous plugs), a positive effect of premedication (*eg*, atropine), a placebo effect, or chance. The patient reports of shortness of breath might have included anxiety symptoms, which diminished after the uneventful completion of the FOB.

Our study has strengths and limitations. Outcomes were from patient self-reports, which can be subject to bias and inaccuracy. However, the intent of the study, to understand the effects of bronchoscopy from the patient perspective, necessitated using data from patient reports. We developed the questionnaire for this project, and so its properties of reliability and validity have not yet been examined in other populations. We wanted to minimize the burden to patients in completing the survey and, therefore, have not examined all dimensions of certain symptoms. Future work would be needed to understand multiple facets of a particular symptom. Finally, the response was biased, with fewer responses from young, nonwhite males, especially with immunocompromise. The overall proportion missing was small in each category, though the results could be less generalizable to those particular populations.

Implications for QI in Bronchoscopy

These patient-reported data suggest that there is room for improvement in FOB-related symptoms, and that changes in practice should be made. We recommend measuring procedure time, shortening it where possible, and using bronchoscopes with smaller diameters in smaller patients, when feasible. While there are occasions when larger bronchoscopes may be needed for technical reasons, smaller bronchoscopes do not compromise the diagnostic yield when performing BAL.[36] We recommend also considering the reapplication of topical anesthetics to the nares for procedures longer than 15 to 30 min.

We believe that this patient-focused study has contributed a new perspective to the field of bronchoscopy. Further research is needed to examine factors such as operator experience and training and other details of the procedure environment that impact on pain and bleeding. The systematic longitudinal collection of patient-reported data will allow the tracking of changes in symptoms over time, in relation to changes in practice and patient selection, and will allow us to observe whether practice changes have an impact on adverse event rates, diagnostic success rates, and reports of general patient comfort and satisfaction.

Our study demonstrated that the routine collection of a relatively small set of outcome data can be accomplished successfully for FOB patients. This experience serves as a model for QI systems for a variety of invasive diagnostic procedures and suggests that data should be collected routinely over time to assess the impact of QI interventions.

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