The "when and why" behind failure of a fiberoptic bronchoscopy

Eurasian Clinical and Analytical Medicine Original Research

Bronchoscopy in malignancy

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Abstract

Aim: Fiberoptic bronchoscopy (FOB) has an important role in the diagnosis of respiratory diseases. In this study, we reviewed records of the bronchoscopy from a teaching and research hospital and documented complications and reasons for failure before and during FOB (B-FOB and D-FOB, respectively).

Methods: FOB records between January 1, 2005 and January 1, 2010 were reviewed. Complications were classified as cardiac, respiratory, intolerance for FOB and other. Time of the complication was designated as B-FOB and D-FOB. Cases were grouped as patients with malignancy (M) and non-malignancy cases (NM).

Results: Total number of cases involving FOB was 1372. Sixty-six (4.8%) cases had complications in the bronchoscopy unit. 18 (27%) had cardiac complications (1 arrest, 3 arrhythmia, 9 hypertension, 5 tachycardia), 9 (14%) had respiratory complications (all hypoxia), 32 (48%) had intolerance for FOB, and 7 (11%) had other complications (2 narrowed trachea, 2 vomiting, 1 severe chest deformity, 2 syncope). 17 cases were female (8 with M), and 49 were male (15 with M). The mean age in the M group was significantly higher compared to the NM group (64.7±14.2 vs. 39.1±21.9; p<0.01). Gender distribution was not significantly different between the M and NM groups. Complications were reported in 14 (21%) cases B-FOB (5 with M), and 52 cases (79%) D-FOB (18 with M). The types of complications occurring B-FOB or D-FOB were not significantly different. However, 9 of 14 (64%) cases had cardiac complication B-FOB, and 9 of 52 (17%) cases had cardiac complications D-FOB. Cardiac complications were observed more frequently B-FOB compared to D-FOB (p<0.01). 2 of 14 (14%) cases had respiratory complications B-FOB, 7 of 52 (13%) cases had respiratory complications D-FOB. Cardiac complications were observed in 8 of 23 (35%) cases with M and 10 of 43 (23%) cases with NM, a difference that was not statistically significant. Respiratory complications occurred at a rate comparable with other complications B-FOB and D-FOB. 7 of 23 (30%) cases with M had respiratory complications while 2 of 43 (5%) cases with NM experienced respiratory complications, a rate of incidence that was significantly greater among the M group compared to the NM group (p<0.05).

Conclusion: Respiratory, cardiac, intolerance, and other complications can be observed B-FOB or D-FOB, all affecting the success of the procedure. In this study, cardiac complications were observed more frequently B-FOB and the respiratory complication rate was significantly higher among patients with M, an observation that might be partly attributable to the increased age of this group.

Keywords

bronchoscopy unit, complication, fiberoptic bronchoscopy, malignancy

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Introduction

Fiberoptic bronchoscopy (FOB) was first introduced by Ikeda in 1968.[1] Today, it is used in the diagnosis and treatment of various respiratory diseases including lung cancer. FOB has been demonstrated to be a safe procedure associated with low incidence of complications or mortality.

Complications may occur before, during, or after the procedure. Hypoxemia, syncope, bronchospasm, laryngospasm, hemorrhage, infection, pneumothorax, arrhythmia, hypertension or hypotension, and cardiac or respiratory arrest have been reported as complications.[2]

In this study, we aimed to investigate the adverse events occurring before and during FOB (B-FOB and D-FOB) in the bronchoscopy unit. We reviewed the FOB procedures and analyzed cardiac, respiratory and other causes of bronchoscopy failure. Patients diagnosed with or without malignancy were analyzed in terms of the timing of the complication, defined as B-FOB or D-FOB, and type of complication.

Materials and Methods

The records of a bronchoscopy unit at a teaching and research hospital during the period of January 1, 2005 and January 1, 2010 were retrospectively reviewed. FOB records were evaluated by two pulmonologists. Complications requiring termination of the FOB procedure were classified as cardiac, respiratory, intolerance for FOB, and other. FOB was inserted through the mouth as a bronchoscopy technique. Atropine was given as an antianxiety and antisecretory drug while midazolam was given as a sedative. Topical lidocaine spray anesthesia was used for FOB. Timing of the complication was designated as before FOB (B-FOB) and during FOB (D-FOB). Cases were grouped as patients with malignancy (M) and non-malignancy cases (NM).

Statistical analyses were performed using SPSS for Windows software version 15 (SPSS, Inc., Chicago, IL). The proportions of patients in whom bronchoscopy was performed are given as exact numbers and percentages.

The Student's t-test was used to compare the mean ages between malignant and non-malignant patients. The Chi-square test or Fisher's exact test (applied when chi-square test assumptions do not hold due to low expected cell counts), where appropriate, were used to compare these proportions in two groups. A double-sided p value < 0.05 was considered statistically significant for all results.

Results

1398 patients were scheduled for FOB in the bronchoscopy unit. 21 FOB procedures were canceled by physicians or patients for the following reasons: high risk of FOB, inappropriate laboratory results, and patients who had not fasted before FOB. 5 patients declined to sign the consent form before FOB. In total, 26 FOB cases were excluded from the study. The results of 1372 FOB procedures were reviewed. 66 (4.8%) cases had complications in the bronchoscopy unit. 17 cases were female (8 with M), 49 were male (15 with M). The mean age of the M group was significantly higher compared to the NM group (64.7±14.2 vs. 39.1±21.9; p<0.01). Gender distribution was not significantly different between the M and NM groups (p>0.05). 18 (27%) patients had cardiac complications (1 arrest, 3 arrythmia, 9 hypertension, 5 tachycardia), 9 cases (14%) had respiratory complications (9 hypoxia), 32 cases (48%) had intolerance for FOB, and 7 cases (11%) had other complications (2 narrowed trachea, 2 vomiting, 1 severe chest deformity, 2 syncope) in the bronchoscopy unit. Complications were reported in 14 cases (21%) B-FOB (5 with M) and 52 cases (79%) D-FOB (18 with M). The types of complications observed B-FOB or D-FOB were not significantly different between the M and NM groups (p>0.05).

9 of 14 cases (64%) had cardiac complications B-FOB and 9 of 52 cases (17%) had D-FOB. Cardiac complications were observed more frequently among the B-FOB group compared to the D-FOB group (p<0.01). One arrest (0.07%) was observed in the bronchoscopy unit D-FOB in a middle aged male patient without malignancy; this patient died two days after FOB.

2 of 14 cases (14%) had respiratory complications in B-FOB group and 7 of 52 cases (13%) had respiratory complications D-FOB. Cardiac complications were observed in 8 of 23 (35%) cases with M and 10 of 43 cases (23%) with NM, a difference in incidence that was not statistically significant (p>0.05).

Respiratory complications occurred at a rate comparable with other complications B-FOB and D-FOB. 7 of 23 cases (30%) with M had respiratory complications and 2 of 43 cases (5%) with NM had respiratory complications, a difference in incidence that was statistically significant (p<0.05).

Discussion

Some major complications may be associated with bronchoscopy. Procedure related complications can be classified as hypoxemia, hemorrhage, fever, pneumothorax, bronchospasm, laryngospasm and pneumonia, while sedation and anesthesia related complications include hypoxemia, respiratory depression, hypotension, syncope, arrhythmias, seizures and methemoglobinemia.

Death associated with bronchoscopy is rare. Mortality rates in FOB procedures as low as 0.01% to 0.02% have been reported. Several prospective studies reported death rates between 0.1% and 0.5%, while smaller studies have shown a 0% to 0.076% mortality rate.[2] In our study, death occurred in one patient following FOB (0.07%).

Hypoxemia may develop during the premedication before FOB, during FOB itself, or after FOB. Patients should be monitored with pulse oxymetry and supplemented with oxygen at 2 L/min during the FOB procedure and 1 to 2 hours after the FOB. This may reduce cardiac complications.[3] In our bronchoscopy unit, we use oxygen supplementation via nasal cannula at a minimum flow rate of 2 L/min as a routine procedure. Hypoxia was observed in 0.66% of FOB procedures in this study. Among the 66 complication reports, hypoxia was reported in 9 (14%) cases (B-FOB in 2 cases and D-FOB in 7 cases). 7 cases experiencing hypoxia had a diagnosis of malignancy. Episodes of hypoxemia D-FOB may occur more frequently in other hospitals than we have reported in this study if the bronchoscopist in the bronchoscopy does not terminate the bronchoscopy at the earliest signs of hypoxia.

Obstruction of the upper airways, hypoventilation, ventilation-perfusion mismatching and pneumothorax may cause hypoxemia during FOB. Alveolar hypoventilation due to anesthetics may also be observed. Obstruction of airway during bronchoscopy, instillation of drugs or fluids, or bleeding in the airway may result in ventilation-perfusion mismatching. Patients with comorbidities such as COPD, asthma, neuromuscular diseases, and IPF may have hypoxemia or respiratory failure during FOB. Inhaled bronchodilators should be given before FOB, and these patients should receive supplemental oxygen during and after bronchoscopy.[4,5]

Arrhythmias, myocardial ischemia, angina, and cardiac arrest have been reported as cardiovascular complications of bronchoscopy. During FOB, tachycardia and elevation of arterial blood pressure may be observed. This may be due to the effect of the bronchoscopy tool as it passes through the airways, or may be caused by hypoxia resulting from insufficient oxygenation. Patients with hypertension, severe lung diseases, or coronary heart diseases may have myocardial ischemia or infarction during FOB. Sedation, analgesics, and oxygen support reduces this risk.[6]

Sinus tachycardia, premature atrial and ventricular contractions, atrial fibrillation, atrial flutter, bradycardia, and supraventricular and ventricular tachycardia have been reported during bronchoscopy. Hypoxemia was associated with cardiac arrhythmias. Patients who undergo bronchoscopy may experience acute ischemic episodes, increases in blood pressure, ECG findings of cardiac stress, or tachycardia with hypoxia even if no preexisting cardiac diseases have been reported.[7]

In our study, the observed cardiac complications included 3 cases of arrythmia (0.22%), 9 cases of hypertension (0.66%), 5 cases of tachycardia (0.36%), and 1 arrest (0.07%). Cardiac complications were observed more frequently in the B-FOB group compared to the D-FOB group (64% vs. 17%, respectively; p<0.01). The incidence of cardiac complications was not significantly different among malignant patients. The distribution of cases who had cardiac complications B-FOB and D-FOB is as follows: arrhythmia (1 B-FOB, 2 D-FOB), hypertension (2 B-FOB, 4 D-FOB), tachycardia (3 B-FOB, 2 D-FOB) and arrest (1 D-FOB).

In our study, intolerance for FOB was the most frequent complication (32 cases among 66 FOB procedures). All occurred D-FOB. The distribution of cases is as follows: 7 female, 25 male, 6 with M and 26 with NM. The FOB procedure was terminated immediately in cases of intolerance. We did not collect data indicating the reasons for intolerance, but these may include anxiety, fear, insufficient inhaled or local anesthesia B-FOB or D-FOB, uncooperative patients, and avoidance of damage by the bronchoscopy tool. More education before bronchoscopy may assist patients in managing anxiety. Drugs may be used to avoid excessive anxiety and fear, and a consultation from a psychologist may be helpful. Sufficient inhaled and local anesthesia, allowing appropriate time for the drugs to take effect, may eliminate intolerance and help control reflexes. Some patients may still experience intolerance even after all precautionary measures are applied. Conscious or deep sedation using intravenous anesthetic drugs may be the appropriate choice for these patients.

In a study by Lukomsky et al, rigid bronchoscopy and FOB safety results were compared. The complication rate was 5.1% (major complication 1.1%) for all bronchoscopies. The death rate was 0.1%. The complication rate for FOB was 5.4%. The rate of complications in FOB that were related to the procedure itself was 2.9%, and the rate of anesthetic drug related complications was 2.2%. Minor complications of FOB were reported as follows: laryngospasm or bronchospasm in 1.6%, tachycardia in 1.1%, hypoxemia in 0.1%, syncope in 0.1%, and vomiting in 0.3%. Major complications were observed in 0.3% of cases with FOB. No death occurred with FOB. Only one patient had severe bronchospasm that was reported as a major complication.[8]

Kaparianos et al reported FOB results and complication rates for patients according to age (over and under 40 years). Patients with malignancy accounted for 13.1% of cases. Two deaths (0.04%) were observed during FOB. The major complication rate was 0.6%, while the minor complication rate was 0.3%. Bronchospasm and laryngospasm was reported in 0.3% as a minor complication, and respiratory failure was reported as a major complication in 0.3% of cases.[9]

Oullette et al, reviewed training bronchoscopies and observed complications in 2.06% of patients. Respiratory failure requiring intubation was reported in 0.23%, respiratory depression or hypoxia in 0.2%, bronchospasm in 0.03%, pneumomediastinum in 0.06%, syncope in 0.03%, hypotension in 0.06%, mycocardial infarct or ischemia in 0.06%, and atrial dysrhthmia in 0.14% of patients.[10]

In a study by Dreisin et al, 14.6% of cases undergoing FOB had serious underlying conditions. 11.7% of cases were critically ill and FOB was performed with respiratory support or in the ICU. The complication rate was 11%. Dyspnea was observed in 0.01%, bronchospasm or laryngospasm in 0.02%, and death in 0.005%.[11]

In a study by Alamoudi et al, 57% of patients who underwent FOB had comorbidities. Cancer was diagnosed in 44% of these patients. The complication rate was reported as 26% for all cases. Hypoxemia was observed in 14%, bronchospasm in 3%, apnea in 2%, sinus tachycardia in 5%, bradycardia in 2%, and syncope in 1%. No deaths occurred in this patient group. In this study, 18.5% of patients had COPD and 30% of them had hypoxia, while 9% had sinus tachycardia during FOB.[12]

In a study by Alzeer et al, hypoxia was reported in 2%, bronchospasm in 0.4%, bradycardia in 0.3% of patients who underwent FOB. 83.7% of FOB occured for diagnostic purposes and 19% of patients were diagnosed with cancer after FOB.[13]

Pue et al, reported major complications in 0.6% of patients, while 0.8% of patients experienced minor complications. No deaths occurred during FOB in this study group. Respiratory failure was reported in 0.2% as a major complication, while the minor complications included laryngospasm in 0.6%, bronchospasm in 0.02%, vomiting in 0.1% and syncope in 0.05% of patients.[14]

In a study by Hehn et al, the overall incidence of adverse events was 14.1%, with 16.1% of the study population being over 70 years old. Overall risk for an adverse event increased with patient age, but was uncommon and generally not severe. Oxygen desaturation was observed in 6.7%, arrhythmia in 0.96%, hypotension in 1.8% and death in 0.15% of patients. Hypotension occurred more often in older patients (1.9% in patients over 70 years old vs. 0.5% in patients under age 40). Respiratory complications other than oxygen desaturation (bronchospasm, laryngospasm, pneumothorax, hemopthysis) occurred infrequently in all age groups. Only transient hypotension and pneumothorax were associated with increasing age in this study.[15]

Knox et al, reviewed 60 bronchoscopies performed in patients over 80 years old. The incidence of cases with malignancy was 47%. Serious morbity and mortality was not observed. Only one patient had respiratory depression during bronchoscopy.[16]

In a study by Park et al, an additional patient visit was performed after FOB and overall patient satisfaction was investigated. General patient tolerability improved with the post-bronchoscopy visit, but willingness to return for another FOB was not affected.[17]

Bernasconi et al, investigated patient satisfaction with FOB. Pre-procedure anxiety was reported in 51% of patients, and 92% of patients rated their anxiety as unjustified after FOB. Dyspnea was reported in 10% of patients.[18]

In a study by Jin and Mu et al, severe complications were reported in 0.6% of patients who underwent FOB. The observed death rate was 0.013%. Comorbidities included 20% incidence of cancer, 5.5% incidence of COPD, and 1.6% incidence of coronary arterial disease. 74% of all cases underwent FOB for diagnostic purposes. Severe complication was reported in 0.4% of this study group. Cardiac arrhythmia occurred in 0.06% of cases, and laryngospasm or bronchospasm occurred in 0.17% of FOB conducted for diagnostic purposes, while cardiac arrhythmia occurred in 0.2% of cases, laryngospasm or bronchospasm in 0.6%, airway obstruction in 0.1%, and death in 0.05% of FOB conducted for therapeutic purposes.[19]

Meghjee et al, reported the affect of supine and semi-recumbent positions during FOB on oxygen saturation. Oxygen desaturation occurred more frequently among patients who were bronchoscoped in the supine position. No significant disadvantage for patients bronchoscoped in this manner was observed.[20]

In a study by Shinagawa et al, arterial oxygen desaturation was investigated during FOB. SpO2 less than 90 with duration over 10 seconds was considered oxygen desaturation. 22% of patients had an episode of oxygen desaturation during FOB. Among patients over 80

years old, 55% had oxygen desaturation while 27% under age 80 had oxygen desaturation. Patients with pulmonary fibrosis had a higher risk of desaturation (55%) compared to patients with other comorbidities or patients without comorbidities. 94% of patients in this study did not require routine oxygen.[21]

Conclusion

Respiratory complications, cardiac complications, intolerance and other complications can be observed before or during FOB in the bronchoscopy unit, affecting the success of the procedure.

In this study, cardiac complications were observed more frequently before the FOB and the respiratory complication rate was significantly higher among patients with malignancy, an observation that might be partly attributable to the significantly increased age of this group.

Declarations

Animal and Human Rights Statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments.

Informed Consent

Informed consent was obtained from all participants.

Conflict of Interest

The authors declare no conflicts of interest.

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Scientific Responsibility Statement

The authors declare that they are responsible for the scientific content of the article, including the study design, data collection, analysis and interpretation, manuscript preparation, and approval of the final version of the manuscript.

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