



A Retrospective Cross-Sectional Study on Prevalence of Major Complications of Bronchoscopy in a University Hospital

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Abstract

Background: Bronchoscopy is usually a safe procedure and major complications are extremely rare; however, it may also become complicated and lead to admission to the Intensive Care Unit. This study will assess the incidence of all causes of ICU admission and mortality rate among patients admitted to the ICU subsequent to bronchoscopy.

Methods: In this cross-sectional retrospective study, all of the patients admitted to the intensive care unit of Masih Daneshvari Hospital from January 10, 2010 to January 10, 2015, subsequent to bronchoscopy related complications were assessed. Data such as demographic characteristics, type of bronchoscopy, and complications were collected in checklists and analyzed by descriptive statistics.

Results: A total of 76 patients were enrolled in this study, including 34 males (44.7%) and 42 females (55.3%). The mean age was 48.5 ± 21.2 years. Most prevalent causes of ICU admission included resistant hypoxemia (32.8%), hemoptysis (18.4%), respiratory distress (7.9%), tracheal perforation (7.9%), and loss of consciousness (7.9%). A total of 85.7% of cases of hemoptysis and all cases of pneumothorax, loss of consciousness, pleural effusion, and cardiac arrest occurred in patients with lung malignancy. A total of 0.77% of patients, after a bronchoscopy procedure, needed ICU care during the years of the study. The mortality rate was 0.28%.

Conclusions: The most prevalent and major causes of ICU admission were observed in high-risk patients. It's supposed that the selection of expert operators for such patients and performing the procedure in a well-equipped Centre may significantly decrease the rate of complications, ICU admission, and mortality.

Keywords: Bronchoscopy, Complications, ICU

1. Background

Endoscopic techniques for respiratory system are main invasive tools to evaluate and treat pulmonary disorders (1). These procedures are used to directly visualize the tracheobronchial tree (2). There are 3 types of bronchoscopy: rigid, flexible, and virtual, which are used for variant diagnostic or therapeutic indications and their use is steadily growing (3-5).

Bronchoscopy is a safe procedure according to the extensive use and very low rate of complications, if necessary precautions are taken (1, 6, 7). The rate of severe complications and mortality is extremely low in many studies (8-10).

The most common complications include transient hypotension after sedation, bronchospasm, hypoxemia,

and epistaxis because of trauma in nasal approach, nausea, vomiting, bleeding, pneumothorax, cardiac arrhythmias, infection, vasovagal syncope, laryngospasm, seizure, bacteremia, methemoglobinemia, laryngeal edema, and laryngeal injury. Bleeding and pneumothorax are most likely in the context of brushing, endobronchial biopsy, transbronchial biopsy, or needle aspiration (11).

Major complications are particularly uncommon. Procedure related mortality is extremely rare and mostly associated with organic heart disease or severe airway obstruction (12). The likelihood of complications is minimized by appropriate patient selection, careful evaluation of the risk-benefit ratio in high risk patients, and adherence to patient safety protocols (11).

This study considers the incidence of all causes of ICU

admission and mortality rate exclusively in patients admitted to the Intensive Care Unit by the reason of major bronchoscopy related complications. Therefore the results may be different from other studies to some extent. In addition, the effects of attributed factors on these variables will be assessed.

2. Methods

This is a cross sectional retrospective study accomplished in the Masih Daneshvari hospital in Tehran, Iran, from January 10 2010 to January 10 2015. All patients in the Intensive Care Unit who were admitted by the reason of major complications subsequent to bronchoscopy were included during the time of study. Data regarding each patient were extracted from the patient's medical records and collected in special checklists. The data collected included: sex, age, underlying disease, type of bronchoscope, causes of ICU admission, APACHE II score, ICU days, ventilator days, and mortality. Patients who were admitted to the ICU after bronchoscopy by other reasons irrelevant to the procedure, were excluded. Medical records with incomplete data were eliminated from the study.

2.1. Statistical Methods

Data were presented as descriptive statistics and analyzed by the t-test, Chi-squared test, and their nonparametric equations. Statistical analysis was performed using SPSS version 22. Continuous data were expressed as mean \pm standard deviation and categorical data were summarized as number (%). A level of $P < 0.05$ was considered statistically significant.

3. Results

A total of 76 patients were admitted to the intensive care unit because of major complications after a bronchoscopy, including 34 males (44.7%), 42 females (55.3%) and M:F ratio of 0.8. Patients were from 1 to 85 years old and the mean age was 48.5 ± 21.2 years. A total of 17 patients (22.3%) received a rigid bronchoscopy and 59 patients (77.6%) underwent flexible bronchoscopy.

The most frequent underlying diseases were respectively lung malignancy (38.2%), pneumonia (11.8%), metastatic carcinomas to the lungs (7.9%), and TB (6.6%). Other cases included lung malignancy and TB (3.9%), chronic bronchitis (3.9%), PAP syndrome (3.9%), asthma (2.6%), subglottic stenosis (2.6%), tracheomalacia (2.6%), bronchiectasis (2.6%), dyspnea with pleural effusion (2.6%), dyspnea with RA (2.6%), tracheoesophageal fistula (2.6%), subglottic stenosis with tracheomalacia (1.3%), subglottic

stenosis with JRA (1.3%), subglottic stenosis with squamous cell metaplasia (1.3%), and COPD (1.3%). Data about underlying disease is summarized in "Table 1":

Table 1. Numbers T the Underlying Diseases in Patients

ICU Cause	Frequency	Percent, %
Lung Malignancy	29	38.2
Pneumonia	9	11.8
Metastatic carcinoma to the lungs	6	7.9
Tuberculosis	5	6.6
Lung malignancy and Tuberculosis	3	3.9
Chronic bronchitis	3	3.9
Pulmonary Alveolar Proteinosis	3	3.9
Asthma	2	2.6
Subglottic stenosis	2	2.6
Tracheomalacia	2	2.6
Bronchiectasis	2	2.6
Dyspnea and Pleural effusion	2	2.6
Dyspnea and Rheumatoid arthritis	2	2.6
Tracheoesophageal fistula	2	2.6
Subglottic Stenosis and Tracheomalacia	1	1.3
Subglottic Stenosis and Juvenile RA	1	1.3
Subglottic Stenosis and Squamous methaplasia	1	1.3
COPD	1	1.3
Total		76

The most important causes of ICU admission included resistant hypoxemia (32.9%), hemoptysis (18.4%), loss of consciousness (10.5%), and respiratory distress (7.9%). Other causes are resumed in Table 2.

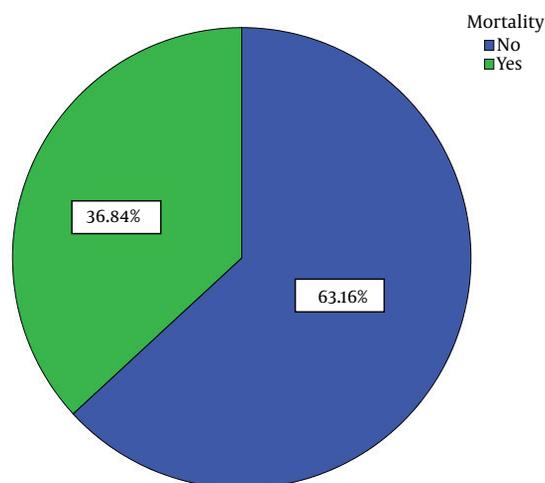
A total of 36 patients (47.4%) had an APACHE II score above 20, and 40 patients (52.6%) lower than 20. The patients stayed in the ICU 1- 21 days after admission with the mean of 5.5 days. A total of 58 patients (76.3%) needed ventilator support and the mean of ventilator days was 4 days. In total, 28 patients (36.8%) were expired in the Intensive Care Unit and 48 patients (63.2%) were discharged from the hospital (Figure 1). All of the expired patients had received vasopressor drugs in the ICU.

The mean age was 43.3 ± 19.7 years among expired patients and 51.5 ± 21.7 years for others. The results show that the mean age was significantly lower in patients who died during the study ($P = 0.05$). A total of 14 patients were expired in male group and 14 in females, which showed no relation between sex and prognosis ($P = 0.63$).

There was a significant relation between sex and the cause of ICU admission ($P = 0.005$). The most prevalent

Table 2. Causes of ICU Admission in Patients

ICU cause	Frequency	Percent, %
Resistant hypoxemia	25	32.9
Hemoptysis	14	18.4
Loss of consciousness	8	10.5
Respiratory distress	6	7.9
Tracheal perforation	6	7.9
Pneumothorax	2	2.6
Tachypnea	2	2.6
Hemoptysis and Pleural effusion	2	2.6
Hypercapnia	2	2.6
Aspiration pneumonia	2	2.6
Myocardial infarction	2	2.6
Cardiac arrest	2	2.6
Hypoxemia and Bradycardia	2	2.6
PAT arrhythmia	1	1.3
Total	76	100

**Figure 1.** Pie Chart of Mortality Rate Among the Patients

causes in men were hemoptysis (23.5%), resistant hypoxemia (23.5%), and loss of consciousness (14.7%). In women, the main causes included resistant hypoxemia (40.4%), hemoptysis (14.2%), and tracheal perforation (14.2%) (Figure 2).

There was a completely significant relation between patient's underlying diseases and the ICU causes ($P < 0.001$). A total of 12 of 14 cases of hemoptysis (85.7%) and also all cases of pneumothorax, loss of consciousness, pleural effusion, and cardiac arrest occurred in patients with

lung malignancy. All cases of tracheal perforation were observed in patients with subglottic stenosis and tracheo-esophageal fistula.

The major causes of ICU admission among patients with lung malignancy included hemoptysis (37.5%), resistant hypoxemia (18.7%), and loss of consciousness (15.6%). The main cause of ICU admission in patients with pneumonia was respiratory distress (44.4%). Among patients with TB, the main ICU cause was resistant hypoxemia (75%). The most prevalent diseases in expired patients included lung malignancy (39.2%) and metastatic carcinomas to the lungs (14.2%). Lung malignancy and metastatic carcinomas were also more frequent underlying diseases in men (58.8% and 17.6% respectively). The results didn't show any significant relationship between type of bronchoscopy and ICU cause ($P = 0.83$) or mortality ($P = 0.32$).

The mean of ICU days was 7.7 ± 6.7 in expired patients and 4.1 ± 3.0 in treated patients, which did not show significant relation ($P = 0.12$), while there was a significant relationship between ventilator days and prognosis ($P < 0.001$). The mean ventilator days were 1.7 ± 2.3 in treated patients and 7.5 ± 6.6 among patients who were died (Figure 3).

Overall, 40 patients had the APACHE II score above 20 including 27 deaths and 36 patients with APACHE II score below 20 including just 1 death. Therefore, the mortality rate was significantly more in patients with APACHE II score higher than 20 ($P < 0.001$, OR: 4.28 (CI: 95%, 2.8 - 22.4)).

In total, 9861 bronchoscopy procedures were performed in Masih Daneshvari hospital between the years of 2010 - 2015 and 2078 cases were associated with diagnostic or therapeutic interventions. The proportion of major complications with ICU admission to all bronchoscopy procedures was 0.77% and the total mortality rate was 0.28% in this study.

4. Discussion and Conclusions

As explained before, bronchoscopy is a safe procedure with a low rate of complications and mortality rate. Thus, few surveys have been performed to evaluate complications of bronchoscopy.

Pereira and colleagues assessed major and minor complications in a group of patients in 1978. Major complications (including respiratory arrest, pneumonia, pneumothorax, and airway obstruction) occurred in 6.5% cases. Minor complications (including vasovagal reactions, fever, cardiac arrhythmias, bleeding, obstruction of airways, nausea and vomiting, pneumothorax, psychotic reaction, and aphonia) also occurred in 1.7% of procedures; the mortality rate was 0.1% (11).

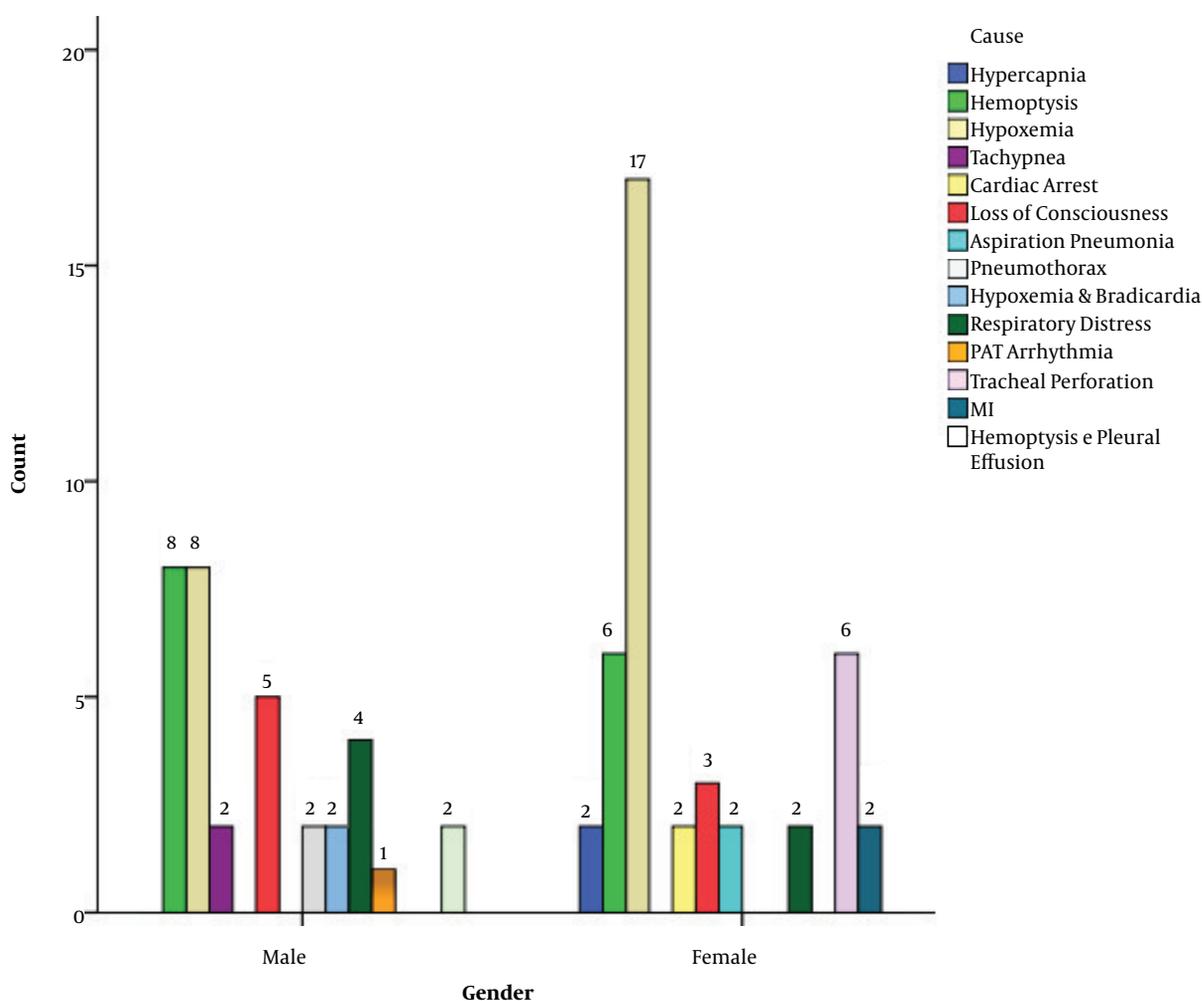


Figure 2. Causes of ICU Admission by Sex Among the Patients

Pue and Racht reviewed the indications and complications associated with flexible fiberoptic bronchoscopy (FFB) in a university teaching hospital from 1988 - 93. The mortality rate was 0% and the frequency of major and minor complications was 0.5% and 0.8%, respectively (12).

De Blic, Marchac, and Scheinmann assessed complications of flexible bronchoscopy prospectively during 1,328 diagnostic procedures in children. The total rate of complications was 6.9%. Minor and major complications were seen in 5.2% and 1.7% of procedures, respectively (13).

In 2006, Rodrigues Martinez, and Sossa evaluated the incidence of complications of bronchoscopy and associated factors in pediatrics. Among 66 bronchoscopy procedures, 33.3% developed any kind of complications and 15.2% had the most important complications such as apnea, laryngospasm, or need for ICU admission. The most

common complications included hypoxemia with O_2 saturation lower than baseline values (27.3%) and need for transferring to ICU (13.6%). None of the patients died as a consequence of the procedure (14).

Abdulaziz H. Alzeer et al. studied the complications of fiberoptic bronchoscopy in a university hospital between years 2004 - 2006 in Saudi Arabia. In this study, the complications included hypoxemia (2%), minor bleeding (1.4%), pneumothorax (0.6%), bronchospasm (0.4%), massive bleeding (0.3%), bradycardia (0.3%); the total complication rate was 5% (7).

Unlike all other studies, this study considered bronchoscopy complications exclusively in patients admitted to the intensive care unit due to major complications of the procedure. Thus, the results may be somewhat dissimilar to many other studies.

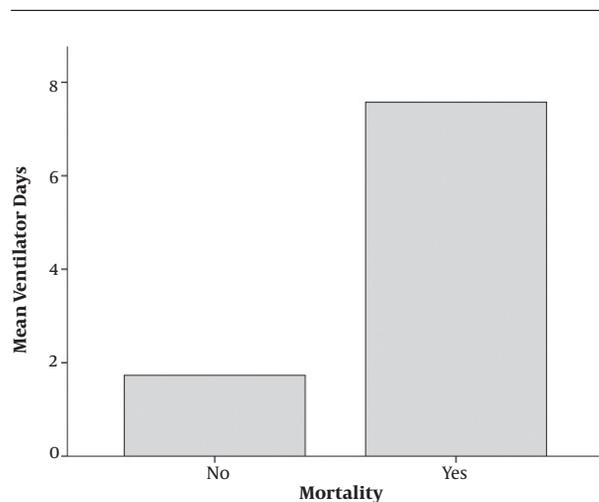


Figure 3. Mean Ventilator Days by Mortality in Patients

As told before, most prevalent causes of ICU admission due to bronchoscopy complications included resistant hypoxemia (32.8%), hemoptysis (18.4%), distress (7.9%), tracheal perforation (7.9%), and loss of consciousness (7.9%). Hypoxemia and hemoptysis were also the most common complications in other studies (7, 10, 14). The prevalence of major complications with ICU admission was 0.77% in total, which was similar to other studies (10, 11, 13).

The risk of mortality during or after bronchoscopy rates from 0.08% to 1.08% (15). In this study the total mortality rate was 0.28% similar to other researches and the standard averages (8, 12).

Among all patients, the most underlying diseases included lung malignancy, pneumonia, metastatic carcinomas to the lungs, and TB, respectively. These results show that the existence of such diseases increases the risk of major complications and ICU admission in patients undergoing bronchoscopy. Therefore, in such high-risk patients, receiving a bronchoscopy procedure in a well-equipped centre with Intensive Care Unit, CPR room, and expert operators may significantly decline the rate of life threatening complications and mortality.

All of the patients who were expired during the survey had been treated with vasopressor drugs. It shows that all of these patients had been expired in the setting of septic shock. Therefore, the results show the necessity of proper antibiotic therapy in all patients admitted to the ICU because of bronchoscopy related complications. Monitoring of vital signs helps early diagnosis of sepsis or septic shock and reduces the mortality rate significantly as well.

The average age between expired patients was significantly lower than others in this study. As told be-

fore, the most prevalent underlying disease among the expired patients were pulmonary masses with lung origin or metastatic. Also, the mean age among the patients with malignancies was generally lower in comparison with others. These results can justify the lower age among the patients who were expired.

The prevalence of pulmonary malignancies or metastatic carcinomas was significantly more in men rather than women. In such situations, the bronchoscopy procedure is performed for diagnostic purposes and sampling. Therefore, most complications would be expected to be in relation with taking a biopsy. The most frequent major complications among the men group were hemoptysis and hypoxemia as expected.

On the other hand, the most prevalent underlying diseases in women included TB, chronic bronchitis, and COPD. In such cases, the bronchoscopy procedure would be performed with the purpose of bronchoalveolar lavage. In this study, the most frequent complication in women was resistant hypoxemia, which confirmed the expected results.

The average of ventilator days was significantly more among expired patients. These results define a direct relationship between the mortality rate and ventilator days. The mortality rate would increase in cases with long time dependency to the ventilators.

A total of 27 of the 28 patients who died during the study had an APACHE II score above 20 and just 1 patient with the APACHE II score lower than 20 was expired. It demonstrates that the APACHE II score more than 20 is a predictive factor for poor prognosis in patients in the Intensive Care Unit and is accompanied with increased mortality rate.

Accordingly, most of the complications of the bronchoscopy procedure, which need ICU admission or may lead to mortality of the patients, such as hemoptysis or tracheal perforation, depend on the operator's proficiency and are preventable. In our study, most of these complications occurred in high-risk patients with lung masses. It seems that considering experienced and expert operators for this group of patients can decrease the rate of major complications, ICU admission, and mortality substantially.

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