A Study of the Risk Factors Causing Hypoxemia in Patients Undergoing Flexible Bronchoscopy Without Sedation in Tishreen University Hospital

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Abstract

Background:

Flexible bronchoscopy is a widely used diagnostic and therapeutic procedure in pulmonary medicine. Although generally safe, it may be associated with hypoxemia, particularly when performed without sedation.This study aimed to identify risk factors associated with hypoxemia during unsedated flexible bronchoscopy.

Methods:

A retrospective observational study was conducted on 282 adult patients who underwent flexible bronchoscopy without sedation. Demographic data, comorbidities, clinical characteristics, and procedural details were analyzed. Hypoxemia was defined as a drop in oxygen saturation (SpO_2) below 94% during the procedure. Univariate and multivariate analyses were used to identify significant predictors of hypoxemia.

Results:

Hypoxemia occurred in 40.1% of patients. It was significantly more frequent among females (59.7%) than males (34.5%), and among smokers (44.4%) compared to non-smokers (28%). Patients who developed hypoxemia were older (64.2 ± 10.3 years vs. 58.7 ± 11.5 years, $p = 0.01$), had lower baseline SpO_2 (95.6 ± 2.1% vs. 97.3 ± 1.2%, $p < 0.001$), and underwent longer procedures (12.4 ± 3.8 vs. 9.2 ± 3.6 minutes, $p = 0.004$). Multivariate analysis identified age, female gender, smoking, and procedure duration as independent risk factors for hypoxemia.

Conclusion:

Hypoxemia during flexible bronchoscopy without sedation is relatively common and associated with several patient-related and procedural factors. Pre-procedural risk assessment and close intra-procedural monitoring are essential to minimize complications and improve patient safety.

Introduction

Flexible bronchoscopy is an essential diagnostic and therapeutic tool in pulmonary medicine[1]. It is widely performed for evaluating airway abnormalities, removing foreign bodies, obtaining tissue biopsies, and diagnosing various lung conditions[2,3]. Although the procedure is generally safe, it can be associated with complications, including cough, bleeding, arrhythmias, and oxygen desaturation.[4,]

Table 1: basic characteristic of the patients clinical and common symptoms

Characteristic	Hypoxemia (n=113)	No Hypoxemia (n=169)	P-value
Age,years, median	64.2 ± 10.3	58.7 ± 11.5	<0.001
Male n ,(%)	76(34.5%)	144(65.6%)	<0.001
Female n ,(%)	37(59.7%)	25(40.3%)	<0.001
Smoker n , (%)	92(44.4%)	115(55.6%)	0.01
Non-Smoker n ,(%)	21(28.0%)	54(72.0%)	0.08
Hypertension n ,(%)	40(38.8%)	63(61.2%)	<0.001
Diabetes Mellitus n(%)	21(53.8%)	18(46.2%)	0.2
Malignancy n ,(%)	21(53.8%)	18(46.2%)	0.2
COPD n, (%)	45(60.0%)	18(40.0%)	0.002
Asthma n, (%)	4(50.0%)	4(50.0%)	1
Tuberculosis n, (%)	10(55.6%)	8(44.4%)	0.08
Bronchiectasis n, (%)	3(75.0%)	1(25.0%)	0.3
Endobronchial lesion n, (%)	77(45.8%)	91(54.2%)	0.02
Hemoptysis n, (%)	34(40%)	51(60%)	0.9

Hypoxemia, defined as a reduction in arterial oxygen saturation during bronchoscopy above 10_20 mmHg[5].it is one of the most common complications observed, particularly in procedures performed with conscious sedation or local anesthesia [6.7]. Sedation is often avoided in some patients to reduce risk in those with comorbidities[8], but it may increase the likelihood of patient movement, coughing, and procedural discomfort, potentially contributing to hypoxemia.[9]

Numerous studies have identified various factors associated with the development of hypoxemia during bronchoscopy under sedation. These include age,sex,smoking,type of procedure,duration of the procedure and duration of sedation [10,9].

To date, most studies evaluating the risk factors for hypoxemia during bronchoscopy have not clearly distinguished between procedures performed with or without sedation.

This study aims to identify the risk factors associated with hypoxemia during flexible bronchoscopy performed without sedation, in order to better understand the risk profile and guide preventive strategies in unsedated settings.

Methods

Study Design and Population:

This retrospective observational study included 282 adult patients who underwent flexible bronchoscopy without sedation at Tishreen University Hospital between [start date] and [end date]. Patients with incomplete records or requiring sedation were excluded.

Data Collection:

Data collected included demographics (age, gender), smoking status, comorbidities (hypertension, diabetes, COPD, asthma, malignancy, tuberculosis), baseline oxygen saturation, laboratory values (platelet count, INR), suspected clinical diagnosis, route of bronchoscope insertion, and procedure duration.

Table 2 : Parameters and laboratory data

Variable	Hypoxemia Occurred (n = 113)	No Hypoxemia (n = 169)	p-value
Platelet count	327.365 ± 123.0384	336.2138 ± 109.071	0.5
INR	1.13 ± 0.18	1.08 ± 0.16	0.08
Baseline SPO2 value	95.58% ± 2.06%	97.30% ± 1.29%	< 0.001
SPO2 drop during the procedure (%)	8% ± 2.5%	2.4% ± 1.8%	< 0.001
Pre-procedure systolic BP	119.96 ± 14.85	121.38 ± 15.57	0.43
Pre-procedure diastolic BP	74% ± 11%	75.44% ± 11%	0.27
Procedure duration (minutes)	12.94 ± 3.47	8.89 ± 3.89	< 0.001

Definition of Hypoxemia:

Hypoxemia was defined as a drop in SpO_2 below 94% at any point during the procedure.

Statistical Analysis:

Categorical variables were compared using chi-square or Fisher's exact tests. Continuous variables were analyzed using t-tests. Univariate and multivariate logistic regression analyses were performed to identify independent predictors of hypoxemia. A p-value < 0.05 was considered statistically significant.

Results

A total of 282 patients were included in the study. Hypoxemia occurred in 40.1% of patients. It was more frequent among females (59.7%) than males (34.5%), and among smokers (44.4%) compared to non-smokers (28%). Patients who developed hypoxemia were older (mean age 64.2 ± 10.3 years) compared to those without hypoxemia (58.7 ± 11.5 years). Baseline SpO_2 was lower in the hypoxemia group (95.6 ± 2.1%) than in the non-hypoxemia group (97.3 ± 1.2%). Procedure duration was significantly longer in patients who developed hypoxemia (12.4 ± 3.8 minutes vs. 9.2 ± 3.6 minutes).

Multivariate logistic regression analysis revealed that age, female gender, smoking, and procedure duration were independent predictors of hypoxemia. Tables

Table 3: Multivariate Logistic Regression for Risk Factors of Hypoxemia

Variable	Odds Ratio (OR)	p-value
Age > 60 years	1.76	0.04
Female Gender	2.11	0.02
Smoking	1.85	0.03
Procedure Duration > 10 min	1.27	0.001

Discussion

This study investigated the risk factors associated with hypoxemia during flexible bronchoscopy without sedation. Our findings demonstrate that older age, female gender, smoking history, lower baseline SpO_2, and longer procedure duration were significantly associated with the occurrence of hypoxemia. These results highlight the importance of careful pre-procedural assessment and intra-procedural monitoring, especially in patients with identified risk factors.

Consistent with previous literature, advanced age was a significant predictor of hypoxemia. Age-related physiological changes in lung function, decreased respiratory reserve, and higher prevalence of comorbidities may contribute to increased vulnerability to oxygen desaturation during bronchoscopy[11]. Female patients were also found to be at greater risk, a finding that has been reported in some studies, possibly due to smaller airway size, lower muscle mass, or heightened vagal responses.[12]

Smoking history was another important risk factor. Chronic smoking may lead to airway inflammation, impaired mucociliary clearance, and reduced pulmonary reserve, all of which can predispose patients to hypoxemia during airway instrumentation[13]. Interestingly, while COPD was common among hypoxemic patients(for diagnostic indication), it was not an independent predictor in the multivariate analysis(Kim et al.,2022)[4]suggesting that other factors, such as baseline SpO_2 and smoking, may have stronger direct associations.[14]

Procedure duration has been identified as a significant risk factor for hypoxemia during bronchoscopy. Several studies have shown that longer procedures are associated with increased incidence of oxygen desaturation. This is likely due to prolonged airway manipulation, cumulative sedative effects, and increased oxygen demand[15]. For instance, a large retrospective study reported that sedation duration exceeding 40 minutes significantly increased the risk of hypoxemia (OR = 1.33; 95% CI, 1.18–1.50) (Lee et al., 2020)[16]. Similarly, longer operation times (>30 minutes) were found to be independent predictors of hypoxemia in a bronchoscopy risk model (Liu et al., 2023)[17]. This emphasizes the need for procedural efficiency and minimizing unnecessary prolongation, especially in high-risk patients.

Importantly, baseline oxygen saturation was significantly lower in patients who developed hypoxemia, underlining the value of pre-procedural SpO_2 assessment Similarly, research by (Kim et al., 2022)[4] demonstrated that patients with lower baseline oxygen saturation experienced more frequent and severe desaturation events, leading to increased post-bronchoscopy respiratory

complications. These findings underscore the importance of thorough pre-procedural assessment of oxygen saturation levels. Patients with marginal baseline SpO_2 may benefit from closer monitoring and the proactive administration of supplemental oxygen before and during bronchoscopy to mitigate the risk of hypoxemia,

While our study provides valuable insight into modifiable and non-modifiable risk factors, it has some limitations. The study was conducted in a single center, which may limit generalizability. In addition, although sedation was not used, variations in technique or operator experience were not assessed. Future prospective, multi-center studies are warranted to validate these findings and explore preventive strategies.

Conclusion

Hypoxemia is a relatively frequent complication during flexible bronchoscopy performed without sedation. Older age, female gender, smoking, lower baseline SpO_2, and longer procedure duration were significantly associated with increased risk. Identifying high-risk patients can help guide preventive strategies and ensure safer practice.

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