Muthanna Medical Journal

Volume 11 | Issue 2 Article 2

8-1-2024

Association between oxygen saturation level during and post bronchoscopy, a cross- section study in Baghdad Teaching hospital

Saja Maher Kamil
Collage of Medicine, University of Baghdad, Baghdad, Iraq, sajamaher04@gmail.com

Abdulrasool Noori Nassr ALmoosawi
Collage of Medicine, University of Baghdad, Baghdad, Iraq

Recommended Citation
Kamil, Saja Maher and ALmoosawi, Abdulrasool Noori Nassr (2024) "Association between oxygen saturation level during and post bronchoscopy, a cross- section study in Baghdad Teaching hospital," *Muthanna Medical Journal*: Vol. 11: Iss. 2, Article 2.
DOI: 10.52113/1/1/2024-2-93
Available at: https://muthmj.mu.edu.iq/journal/vol11/iss2/2

https://muthmj.mu.edu.iq

Muthanna Medical Journal
2024; **11**(2):82-93

http://dx.doi.org/10.52113/1/1/2024-2-93

Association between oxygen saturation level during and post bronchoscopy, a cross- section study in Baghdad Teaching hospital

Saja Maher Kamil [1*], Abdulrasool Noori Nassr ALmoosawi, Mohammed Waheeb Salman Al-Obaidi

Abstract

Flexible bronchoscopy (FB) diagnoses and treats airway issues by directly visualizing them. The aim of this study is to investigate whether the percutaneous oxygen saturation (Spo2) level during bronchoscopy is associated with the development of hypoxia. We conducted a cross-sectional research of 40 Baghdad Teaching Hospital/Medical City complex patients from October 1, 2023, to March 10, 2024. The University of Baghdad College of Medicine Department of Medicine approved the study protocol. Patients aged > 18 years who underwent FB with continuous percutaneous oxygen saturation monitoring were screened. Our sample has 40 patients with a mean age of 57.97 years and BMI of 24.42 kg/m2. 19 (47.5%) smoked and 22 (55%) were male. Shortness of breath (87.5%) was the most prevalent complaint, followed by cough (45%) and hemoptysis (10%). Diabetes mellitus and hypertension were the most prevalent comorbidities, each in 8 patients (20%). The chest CT scans revealed unilateral lung involvement in 32 patients (80%), bilateral lung lesions in 6 (15%), and normal imaging in 2 (5%). Inconclusion, the study results indicate considerable decrease in intra-procedure O2 saturation levels during flexible bronchoscope, regardless of other hypoxia risk variables (BAL, biopsy, operation time, lung illness, etc.). Thus, adults should get high-flow nasal interfaces to prevent hypoxia-related problems during and after the surgery.

Keywords: Bronchoscope, hypoxia, fiberoptic flexible, oxygen saturation BAL, biopsy, time of procedure

* Correspondence author: sajamaher04@gmail.com
[1] Collage of Medicine, University of Baghdad, Baghdad, Iraq.
Received 04 July 2024; revised 03 August 2024; accepted 09 September 2024, available online 01 October 2024.

Introduction

Flexible bronchoscopy (FB) represents a cornerstone in pulmonary diagnostics and therapeutics, providing a direct visualization of the airways through a flexible bronchoscope. This technique, integral to the practices of pulmonologists and thoracic surgeons, combines diagnostic precision with therapeutic utility, making it a preferred method over more invasive alternatives due to its safety, minimal sedation requirements, and versatility [1,2]. The history of bronchoscopy began with Gustav Killian, who performed the first rigid bronchoscopy in 1897, primarily to remove a bone from a patient's airway. This procedure laid the groundwork for direct bronchoscopic techniques, earning Killian the title "Father of Bronchoscopy" [3]. The field saw a significant advancement in 1966 when Shigeto Ikeda introduced the flexible fiberoptic bronchoscope. This new instrument featured a flexible tube equipped with fiber optics and a camera, revolutionizing the approach to visualizing the upper and lower airways [4,5]. The flexible bronchoscope itself is a sophisticated device consisting of a hollow vinyl tube, which houses optical fibers for lighting and a working channel for instruments. Modern versions include a charged coupled device (CCD) for converting light into digital data, enhancing image quality and facilitating real-time video feedback [6]. This technology allows detailed examination and intervention within the airways, ranging from biopsies to foreign body removal. Indications for using flexible bronchoscopy are extensive, covering both diagnostic and therapeutic domains. Diagnostically, it is employed to evaluate unexplained pulmonary symptoms, suspicious masses, and lung cancer staging. Therapeutically, it is vital for managing airway obstructions, performing tumor debulking, and extracting foreign bodies [6]. Despite its benefits, FB is not without risks. Complications can include hypoxia, infection, and bleeding, particularly in patients with underlying conditions like thrombocytopenia or recent myocardial infarction [7,8]. The design and execution of the procedure take these factors into account, with strategies such as oxygen supplementation and careful patient selection to minimize risks [9,10]. The procedure also includes measures to manage and mitigate hypoxia, a common complication during bronchoscopies. The use of high-flow oxygen therapy and non-invasive ventilation can help maintain adequate oxygenation and reduce the risk of severe complications during and after the procedure [11]. Flexible bronchoscopy is an essential tool in modern respiratory care, reflecting significant technological and procedural advancements from its inception to the present day. Its ability to provide both diagnostic insights and therapeutic interventions safely and effectively ensures its ongoing relevance and utility in medical practice [12]. Aim of the study: to investigate whether the percutaneous oxygen saturation (Spo2) level during bronchoscopy is associated with the development of hypoxia.

Method

The methodological section of the study outlines the design and execution of a cross-sectional study conducted at the Baghdad Teaching Hospital/Medical City Complex, from October 1, 2023, to March 10, 2024. The study received approval from the Department of Medicine at the College of Medicine, University of Baghdad. **Inclusion and Exclusion Criteria:** Adult patients aged 18 years or older who underwent flexible bronchoscopy (FB) with continuous percutaneous oxygen saturation monitoring were included. Eligible patients were those with negative virology screens, normal coagulation profiles (PT, PTT, INR), and complete blood counts, who were suspected of respiratory disease based on chest computed tomography and maintained a pre-bronchoscopy SpO2 above 94%, with or without oxygen supplementation. Excluded were patients with recent severe cardiovascular events, those in intensive care during FB, those with abnormal test results, and those who experienced severe hypoxemia during the procedure. **Preparation of Patients:** The procedure was carried out in the endoscopy suite on the 9th floor. Essential equipment included a bronchoscope and its accessories, a light source, a video monitor, and various procedural tools like biopsy forceps and suction apparatus. A registered nurse and bronchoscopist, knowledgeable about the patient's medical status and the specific FB procedure, were required. Patient preparation involved obtaining informed consent after discussing the procedure’s risks and benefits. Pre-procedural requirements included fasting (NPO) guidelines and premedication norms, with the use of local/topical anesthesia such as lidocaine to mitigate discomfort and procedural risks. **FB Procedure Technique:** The FB was performed with the patient in a sitting or supine position based on the assessed risk of SpO2 decline. The bronchoscope was introduced nasally or orally. A systematic examination of the airways began with the inspection of normal areas before moving to diseased sections. Descriptions of airway configurations and abnormalities were meticulously documented for potential surgical reference. **Diagnostic and Therapeutic Procedures:** Both diagnostic and therapeutic procedures were performed during FB. These included bronchoalveolar lavage (BAL), endobronchial or transbronchial biopsies, and cytological washes or brushings. Complex procedures necessitated IV general anesthesia. **Post-Procedural Care:** Patients were monitored in the recovery unit until meeting discharge criteria. A post-procedure chest X-ray or thoracic ultrasound was performed to rule out pneumothorax, with ultrasound showing higher sensitivity and accuracy compared to X-ray in detecting complications. **Statistical Analysis:** Data were analyzed using Microsoft Excel 2010 and IBM SPSS Statistics version 26. The Shapiro–Wilk test assessed data normality. O2 saturation levels before, during, and after FB were compared using one-way ANOVA, with additional tests like the Mann-Whitney U test and Pearson’s correlation to analyze associations between demographic/periprocedural factors and O2 saturation changes. Logistic regression models were used for further analysis of these parameters.

Results

Our sample included 40 patients with a mean age of 57.97 years and an average BMI of 24.42 kg/m^2. 22(55%) were male and 19(47.5%) were smoker. Shortness of breath was the most common chief complaint (87.5%) followed by cough (45%) and hemoptysis (10%). Diabetes mellitus and hypertension were the most common comorbid diseases and each one of them was recorded in 8 participants (20%). 32 (80%) patients showed unilateral lung involvement on chest CT scans in return, 6 (15%) patients had bilateral lung lesions, and 2(5%) patients had normal imaging. Demographic features are shown in the table.1, Figure 1, figure.2, and figure.3.

Table 1.

(Demographic description of the sample)

Parameter	**Patients(n=40)**
Age(years) Mean(range)	57.97(18-83)
Sex Male(n%)/female(n%)	22(55%)/18(45%)
BMI(kg/m^2) Mean(range)	24.42(19-35)
Smoking status Yes(n%)/no(n%)	19(47.5%)/21(52.5%)
Mode of presentation(n%) Shortness of breath Cough Hemoptysis	35(87.5%) 18(45%) 4(10%)
Past-medical history(n%) Negative Diabetes mellitus Hypertension Heart failure COPD SALE Others*	12(30%) 8(20%) 8(20%) 7(17.5%) 5(12.5%) 2(5%) 9(22.5%)
Lung involvement on chest CT scan(n%) Negative Unilateral involvement Bilateral involvement	2(5%) 32(80%) 6(15%)

MI; body mass index, COPD; chronic obstructive pulmonary disease, SLE; systemic lupus erythematous, others; chronic kidney disease, breast cancer, idiopathic thrombocytopenic purpura, valvular heart disease, myopathy, non-Hodgkin lymphoma, myelofibrosis, old tuberculosis, osteosarcoma.

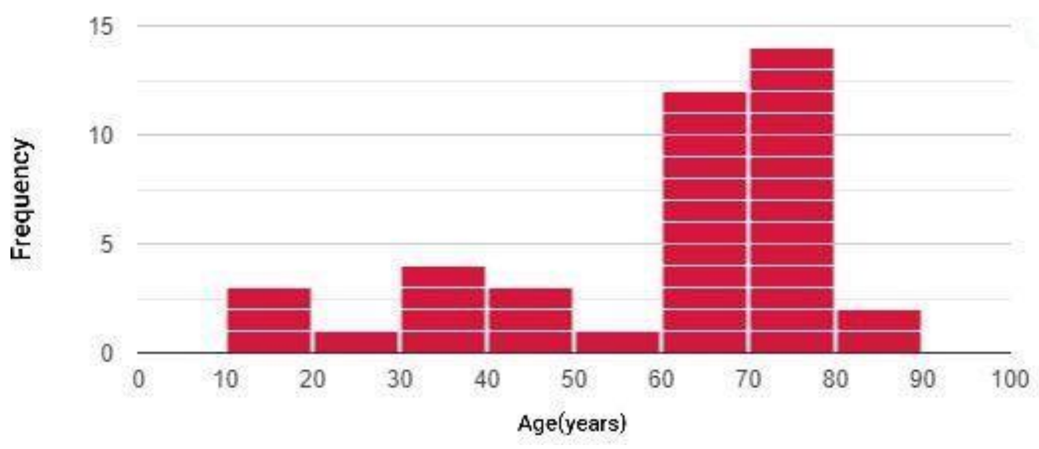
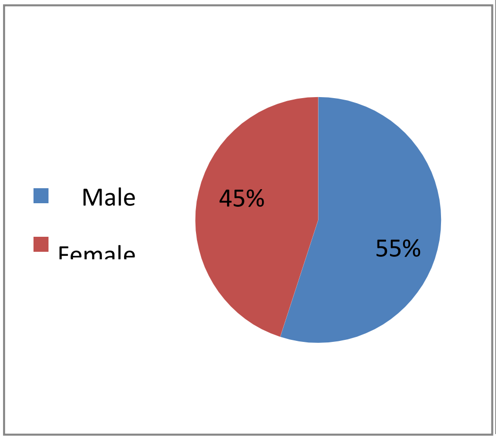


Figure 1.

(Distribution of patients according to age groups)



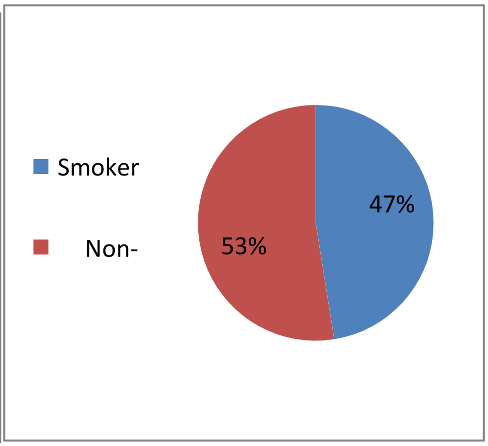


Figure 2: (male to female ratio) **Figure 3**: (smoker to non-smoker ratio)

Comparison of oxygen saturation (pre, during, post) bronchoscope:

21 (52.5%) of patients underwent bronchoalveolar lavage and 19(47.5%) had bronchoalveolar lavage with biopsy. The mean duration of procedures was 18.25 minutes. The Means of pre-procedure O2 saturation %, intra-procedure O2 saturation%, and post-procedure O2 saturation% were 96.2,94.05, and 95.72 respectively. Table 2, Figure 4, and Figure 5 illustrate a full description of periprocedural characteristics. Intra-procedure O2 saturation% values were significantly lower than pre- procedure O2 saturation % (*p-value* less than 0.00001) and post- procedure O2 saturation%(*p-value* 0.00001) (table.3).

Table 2.

(Periprocedural parameters of enrolled patients)

Parameter	Patients(n=40)	
Type of procedure BAL(n%)/BAL+Biopsy(n%)	21(52.5%)/19(47.5%)	
Pre-procedure O2 saturation(%) Mean(range)	96.2(94–100)	*p-value** <0.00001
Intra-procedure O2 saturation(%) Mean(range)	94.05(88–96)	
Post-procedure O2 saturation(%) Mean(range)	95.72(94–99)	
O2 saturation% Drop Mean(range)	2.15((-1) – 8)	*p-value*[#] 0.33
O2 saturation% rise Mean(range)	1.675((-1) – 6)	
Procedure duration(minutes) Mean(range)	18.25(15–25)	

BAL; bronchoalveolar lavage, O2 saturation% Drop equals pre-procedure O2 saturation% minus intra-procedure O2 saturation %, O2 saturation% rise equals post-procedure O2 saturation% minus intra- procedure O2 saturation%, p-value calculated using one-way ANOVA test and considered significant at less than 0.05, [#] p-value calculated using Mann-Whitney U test and considered significant at less than 0.05***.**

Table 3.

(post-hoc analysis of O2 saturation% values before, during, and after the procedure)\

Pairwise Comparisons	*p-value*
Before vs during	<0.00001
Before vs after	0.36
During vs after	0.00001

*P-value was considered significant at less than 0.05***.**

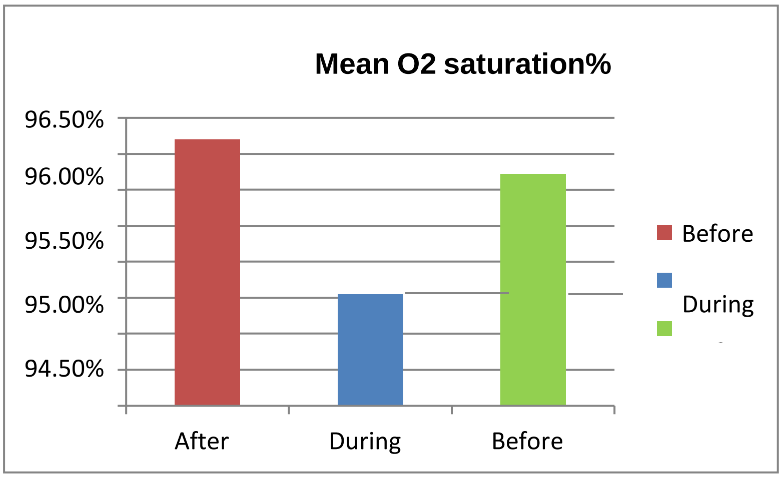


Figure 4.

(Comparison of mean O2 saturation% before, during, and after the procedure).

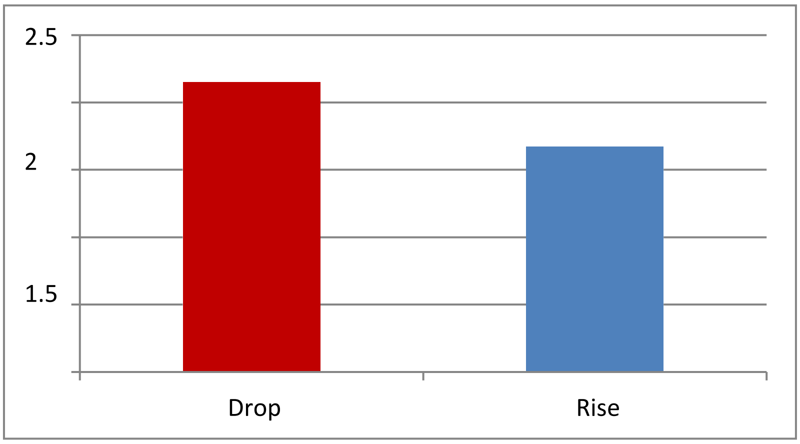


Figure 5.

(Comparison of means of O2 saturation% drop and O2 saturation% rise).

Age, sex, BMI, smoking status, past medical history, chest CT scan findings, type of procedure, and duration of procedure were not significantly correlated with O_2 saturation% drop and as shown in Table 4.

Table 4.

(Correlation of clinical characteristics with O2 saturation% drop)

Variable	**(R, *p-value*)**
Age	(-0.0364, 0.82)
Sex	(-0.0077, 0.96)
BMI	(0.1533, 0.34)
Smoking status	(-0.0216, 0.89)
Past medical history	(-0.0055, 0.97)
Chest CT scan findings	(0.1632, 0.31)
Type of procedure	(0.0038, 0.98)
Duration of procedure	(0.0602, 0.71)

p-value was considered significant at less than 0.05.

Logistic regression of factors (sex, age, BMI, smoker status, procedure type, past medical history, and chest CT scan findings) that may affect O_2 saturation% drop did not find a significant association in univariable (Table 5) and multivariable (Table 6) analysis.

Table 5.

(Univariable analysis of factors associated with O2 saturation% drop)

Variable	Odd ratio	95% confidence interval	*p-value*
Sex	0.975	0.242-3.931	0.972
Age	1.017	0.975-1.061	0.436
BMI	1.103	0.929-1.310	0.265
Smoker status	1.477	0.366-5.955	0.584
Procedure Type	1.477	0.366-5.955	0.584
Past medical history	1.200	0.257-5.612	0.817
Chest CT scan findings	1.926	0.276-13.444	0.509

p-value was considered significant at less than 0.05.

Table 6.

(Multivariable analysis of factors associated with O2 saturation% drop).

Variable	Odd ratio	95% confidence interval	*p-value*
Sex	1.143	0.124-10.562	0.907
Age	1.007	0.953-1.063	0.805
BMI	1.112	0.905-1.367	0.311
Smoker status	1.551	0.16314.731	0.702
Procedure Type	1.662	0.316-8.736	0.549
Past medical history	.868	0.146-5.151	0.876
Chest CT scan findings	2.615	0.222-30.773	0.445

p-value was considered significant at less than 0.05.

Discussion

The findings of this study highlight the complex relationship between procedural conditions and the occurrence of hypoxia during flexible bronchoscopy (FB). Notably, the study revealed a significant decrease in O2 saturation during the procedure compared to pre- and post-procedure levels, confirming the inherent risks associated with FB, particularly when additional interventions such as bronchoalveolar lavage (BAL) are incorporated [1]. Previous research has consistently demonstrated that FB can lead to significant oxygen desaturation, especially in patients with compromised pulmonary function (low FEV1) or when additional procedures like BAL are performed [12-15]. This desaturation is exacerbated with the infusion of larger volumes of saline during BAL, as highlighted by the findings that infusing 200 ml of saline leads to a greater occurrence of desaturation than 100 ml [12-15]. In our study, however, the association between BAL and hypoxia was not observed, which might be attributed to the controlled volume (100 ml or less) of saline used and the fact that only a subset of the cohort (52.5%) underwent BAL. This suggests that lower volumes of saline might mitigate some risks of hypoxia but does not eliminate it, indicating a nuanced balance between procedural necessity and patient safety. The lack of a significant correlation between hypoxia and underlying diseases or chest CT results in our study contrasts with other studies that suggest a higher risk of hypoxia in patients with severe chronic lung diseases and heart failure [16,17]. This discrepancy might be due to our study's limited scope in only confirming the presence rather than the severity of underlying conditions. It emphasizes the need for further research to explore how the severity of such diseases influences the risk of hypoxia during bronchoscopy. Age-related risks during bronchoscopy have been a subject of debate. While some studies suggest that older age does not significantly impact the risk of procedural complications [18], our findings indicate a correlation between older age and increased hypoxia risk. This contradiction may highlight the importance of individual patient assessments as opposed to relying solely on chronological age as a risk factor. Interestingly, the duration of the bronchoscopy procedure was not found to be a significant risk factor for hypoxia in our study, with a mean duration of 18.25 minutes. This finding is in line with Powers RE et al., who noted that longer procedural times were associated with hypoxemia in juvenile patients undergoing rigid bronchoscopy only when exceeding 20 minutes [19]. Similarly, Shin B et al. observed that children with longer procedure times were more susceptible to hypoxemia [20]. This suggests that the duration threshold that significantly impacts oxygen saturation may vary among different patient populations and procedural types, indicating that procedural duration alone is not a universal predictor of hypoxia risk. These findings underscore the complexity of managing oxygen saturation during FB and the importance of tailoring procedural protocols to individual patient needs and conditions. The absence of significant correlations in some expected areas suggests that individual variability in response to bronchoscopy is significant and warrants further investigation. Ultimately, this study contributes to a more nuanced understanding of the factors influencing risk during FB and supports ongoing efforts to optimize procedural safety and effectiveness in diverse patient populations [21,22]. Further studies with larger samples and more detailed assessments of disease severity and procedural specifics are necessary to refine our understanding and management of these risks.

Conclusion

The study demonstrated that intra-procedure O_2 saturation significantly dropped during flexible bronchoscopy, independent of common risk factors such as the procedure type, duration, or presence of lung disease. A high-flow nasal interface is recommended to mitigate hypoxia-related complications during and after the procedure, though COPD patients with CO_2 retention may require a lower oxygen concentration. The study also found a 20% prevalence of oxygen desaturation among patients undergoing bronchoscopy. Risk factors contributing to hypoxia included older age, smoking status, existing lung diseases, and procedural specifics.

Conflict of Interest

No conflicts of interest were declared by the authors.

Financial Disclosure

The authors declared that this study has received no financial support.

Ethics Statement

Approved by local committee.

Authors' contributions

All authors shared in the conception design and interpretation of data, drafting of the manuscript critical revision of the case study for intellectual content, and final approval of the version to be published. All authors read and approved the final manuscript.

References

1. Afriyie-Mensah JS, Kwarteng E, Tetteh J, Sereboe L, Forson A. Flexible bronchoscopy in a tertiary healthcare facility: a review of indications and outcomes. Ghana Med J. 2021;55(1):18-25.
2. Smyth CM, Stead RJ. Survey of flexible fibreoptic bronchoscopy in the United Kingdom. Eur Respir J. 2002;19(3):458–63.
3. Mohan A, Momin I, Poulose R, et al. Lack of efficacy of pre bronchoscopy inhaled salbutamol on symptoms and lung functions in patients with pre-existing airway obstruction. Lung India. 2016;33(4):362-366.
4. Bo L, Shi L, Jin F, Li C. The hemorrhage risk of patients undergoing bronchoscopic examinations or treatments. Am J Transl Res. 2021;13(8):9175-9181.
5. Panchabhai TS, Mehta AC. Historical perspectives of bronchoscopy. Connecting the dots. Ann Am Thorac Soc. 2015;12(5):631-641.
6. El-Bayoumi, Ezzat and Gerard A. Silvestri. “Bronchoscopy for the diagnosis and staging of lung cancer.” Seminars in respiratory and critical care medicine29 3 (2008): 261-70 .
7. Jeong BH, Lee SH, Kim HH, et al. Trends and an Online Survey on the Use of Rigid Bronchoscopy in Korea. J Korean Med Sci. 2023;38(3):e13.
8. Prakash UB, Stubbs SE. The bronchoscopy survey. Some reflections. Chest. 1991;100(6):1660-1667.
9. Du Rand IA, Barber PV, Goldring J, et al. British Thoracic Society guideline for advanced diagnostic and therapeutic flexible bronchoscopy in adults. Thorax. 2011;66 Suppl 3:iii1-iii21.
10. Du Rand IA, Blaikley J, Booton R, et al. British Thoracic Society guideline for diagnostic flexible bronchoscopy in adults: accredited by NICE. Thorax. 2013;68 Suppl 1:i1-i44.
11. Sorli J. Smernice za bronhoskopiju savitljivim bronhoskopom u odraslih [Guidelines for bronchoscopy with the fiberoptic bronchoscope in adults]. Plucne Bolesti. 1988;40(1-2):85-87.
12. Sooriyaghandan IV, Mohamad Jailaini MF, Nik Abeed NN, et al. Satisfaction and tolerability using virtual reality (VR) as adjunctive treatment during flexible bronchoscopy: a randomized control trial. BMC Pulm Med. 2023;23(1):10.

13. Pirozyński M, Sliwiński P, Zieliński J. Effect of different volumes of BAL fluid on arterial oxygen saturation. Eur Respir J. 1988;1(10):943-947.
14. Choi JS, Lee EH, Lee SH, et al. Risk Factors for Predicting Hypoxia in Adult Patients Undergoing Bronchoscopy under Sedation. Tuberc Respir Dis (Seoul). 2020;83(4):276-282.
15. Technical recommendations and guidelines for bronchoalveolar lavage (BAL). Report of the European Society of Pneumology Task Group. Eur Respir J. 1989;2(6):561-585.
16. Ernst A, Eberhardt R, Wahidi M, Becker HD, Herth FJ. Effect of routine clopidogrel use on bleeding complications after transbronchial biopsy in humans. Chest. 2006;129(3):734-737.
17. Mohan A, Madan K, Hadda V, et al. Guidelines for diagnostic flexible bronchoscopy in adults: Joint Indian Chest Society/National College of chest physicians (I)/Indian association for bronchology recommendations. Lung India. 2019;36(Supplement):S37-S89.
18. Bolliger CT, Mathur PN, Beamis JF, et al. ERS/ATS statement on interventional pulmonology. European Respiratory Society/American Thoracic Society. Eur Respir J. 2002;19(2):356-373.
19. Powers RE, Schwalk AJ. Overview of malignant central airway obstruction. Mediastinum. 2023;7:32.
20. Shin B, Chang B, Kim H, Jeong BH. Interventional bronchoscopy in malignant central airway obstruction by extra-pulmonary malignancy. BMC Pulm Med. 2018;18(1):46.
21. Abbas HM, Nassir KF, Al Khames Aga QA, et al. Presenting the characteristics, smoking versus diabetes, and outcome among patients hospitalized with COVID-19. J Med Virol. 2021;93(3):1556-1567.
22. Muhammed Waheeb, Hassan M Abbas, et al. The first 40 days' experience and clinical outcomes in the management of the coronavirus covid-19 crisis. A single center preliminary study. J Fac Med Baghdad. 2020; 61:4-6.