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Original Scientific Paper

IS FLEXIBLE BRONCHOSCOPY A SAFE PROCEDURE FOR CRITICAL CARE PATIENTS WITH RESPIRATORY FAILURE?

Aslıhan Gürün Kaya, Miraç Öz, Umut Dilegelen, Duygu Ecer, Serhat Erol, Fatma Çiftçi, Aydın Çiledağ and Akın Kaya

Ankara University, Faculty of Medicine, Department of Chest Diseases, Ankara, Turkey

SUMMARY – Flexible bronchoscopy (FB) plays an important role in critical care patients. But, critical care patients with respiratory failure are at an increased risk of developing complications. Considering the developments in intensive care unit care in recent years, we aimed to evaluate the use of FB in these patients. We retrospectively reviewed patients who underwent FB in critical care between 2014 and 2020. A total of 143 patients underwent FB during the study period. Arterial blood gas measurement on the FB day revealed a mean PaO_2/FiO_2 of 186.94±28.47. Eighty-one (56.6%) patients underwent an fiberoptic bronchoscopy procedure under conventional oxygen supplementation, 10 (7%) on noninvasive ventilation, 13 (9.1%) on high flow nasal cannula, and 39 (27.3%) on invasive mechanical ventilation. During and immediately after bronchoscopy, none of the patients experienced life-threatening complications. Fifty-five (38.5%) patients developed complications that could be controlled. Multivariate analysis indicated that increased Apache-II score and presence of cardiovascular disease were significantly associated with an increased complication risk. Although critical care patients with respiratory failure are more prone to complications, diagnostic and therapeutic bronchoscopy may be performed following appropriate patient selection, without leading to major complications.

Key words: *Bronchoscopy; Complication; Critical care; Respiratory failure; Respiratory support*

Introduction

Flexible bronchoscopy (FB) is a valuable technique in the approach to pulmonary disorders, and plays an important role in the management of critical care patients. It is used for both diagnostic and therapeutic purposes, such as identification of microbiological agents, determining the source of hemoptysis, removal of foreign bodies or secretions that cause atelectasis, selective intubation, or visual support during percutaneous tracheostomy[1-4].

Patients admitted to intensive care units (ICU) are prone to the development of complications related to invasive procedures linked to the severity of their diseases, treatment they are receiving, and organ dysfunction. Patients experiencing respiratory failure are at an increased risk of developing hypoxemia, which worsens during bronchoscopy, and such patients may require endotracheal intubation[1,5,6]. Also, the passage of the bronchoscope through the airway may also affect ventilation, especially in those who are being mechanically ventilated, by increasing airway resistance and thereby limiting inspiratory and expiratory flow[7]. With recent developments in respiratory support, noninvasive ventilation (NIV) or high flow nasal cannula oxygen (HFNC) can help reduce the risk of deterioration of oxygenation in these patients[8].

While there have been studies investigating the utility and safety of FB in critical patients, the majority of these researches are old. Considering the developments in ICU care and supportive therapy for respi-

Correspondence to: *Aslıhan Gürün Kaya, MD*, Department of Chest Diseases, Ankara University Faculty of Medicine, Ankara, 06100, Turkey
E-mail: agkaya@ankara.edu.tr, aslihangurun@hotmail.com

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ratory failure such as NIV, HFNC applications and improved ventilation strategies in recent years, in this study we aimed to re-evaluate the usage of FB and its complication risk in critical care patients with respiratory failure.

Patients and Methods

Study patients and data collection

We performed a retrospective review of all patients who had experienced respiratory failure and undergone flexible bronchoscopy in the pulmonary critical care unit of the Ankara University Faculty of Medicine, Department of Chest Diseases, between September 2014 and December 2020. Patients with missing comorbidity, clinical or complication outcome data were excluded from the study. Respiratory failure was defined as partial arterial oxygen pressure (PaO_2) in room air of 60 mm Hg or less.

The patient demographic features, comorbid conditions, FB indications, respiratory support type, and complications experienced related to the FB procedure (if any, including hypoxemia, bradycardia/tachycardia, hypotension/hypertension, laryngospasm/bronchospasm, minor bleeding/severe bleeding, cardiopulmonary arrest, pneumothorax) within 30 minutes after bronchoscopy were obtained from medical records. In accordance with our facility critical care standards, oxygen saturation measured by pulse oximetry below 90% during the procedure is recorded as hypoxemia; an increase or decrease in arterial blood pressure of 20 mm Hg and above compared to before the FB procedure is recorded as hypertension; and a 20% or greater increase in heart rate *per* minute compared to before FB is recorded as tachycardia, and a decrease as bradycardia. Bleeding during the procedure that does not require an additional intervention is recorded as minor bleeding, while bleeding that disrupts the hemodynamic condition and that requires additional interventional procedures is recorded as severe bleeding. The study was approved by the Human Research Ethics Committee of Ankara University (04-309-19).

Bronchoscopy procedure

In line with the standard critical care FB procedure, the main indications for FB in our critical care unit are sampling bronchial washing or bronchoalveolar lavage (BAL) and/or bronchial mucosa for cytological and microbiological examinations; inspection of the airways for the maintenance of patency; inspection of the airways to detect the source of hemoptysis; removal of a foreign body or mucous plug causing atelectasis; and assistance during airway procedures including endotracheal intubation or percutaneous tracheostomy.

Aside from the situations requiring emergency airway patency, patients are evaluated in detail prior to the procedure. All patients undergo detailed clinical evaluation and laboratory tests, with absolute contraindications for the procedure being PaO_2 <60 mm Hg after 100% oxygen administration, presence of bronchospasm and respiratory acidosis, while partial contraindications are cardiovascular system diseases (recent myocardial infarction, stable angina, arrhythmia, hypertension), presence of a cerebrovascular pathology, presence of intracranial pressure, convulsion, pneumothorax, bleeding diathesis (international normalized ratio, INR ≥1.5), thrombocytopenia (<50,000/mm^3), platelet dysfunction, severe anemia (Hb <8 g/dL), portal hypertension, and uremia.

In patients receiving mechanical ventilation, FiO_2 is increased to 100% 10 minutes before the procedure. To compensate for circuit leaks during the procedure, tidal volume is increased by 30%, with volume-controlled mode settings made in the mechanical ventilator. Positive end expiratory pressure (PEEP) values are reduced by 50% during the procedure to avoid high-pressure levels in the lungs. NIV or HFNC may be performed in hypoxemic patients whose SpO_2 values could not be brought to >90% with conventional oxygen systems.

All procedures were performed under mild to moderate sedation with midazolam or fentanyl or propofol. The FB procedure was performed using a flexible bronchoscope (Olympus Videobronchoscope BF1T200, Olympus, Tokyo, Japan)

Statistical analyses

Data were analyzed using IBM SPSS Statistics (Version 22.0, IBM Corp., Armonk, NY, USA). Continuous variables with normal distribution were presented as mean ± standard deviation and as median [25^{th}-75^{th} percentile, interquartile range (IQR)] for non-normal variables. Kolmogorov-Smirnov test was used to analyze distribution of variables, and Levene test was applied to assess the equality of variances. Unpaired Student's t-test or Mann-Whitney U test was used to compare the two groups. Categorical data were expressed as numbers and percentages, and compared with χ^2-test or Fisher exact test, as appropriate. Univari-

ate analysis was first performed to identify any potential predictor variables, and based on the univariate analysis, variables with a $p<0.25$ were included in the multivariate analysis to determine any independent predictors of bronchoscopy-related complication risk. The level of statistical significance was set at $p<0.05$ for all tests.

Results

A total of 143 patients underwent FB procedure during the study period. The mean age of the study patients was 68.7±10.5 years. Among the study patients, 88 (61.5%) were male, and 133 (93%) had at least one comorbid disease. Distribution of comorbid conditions in the study patients is presented in Table 1. The mean Acute Physiology and Chronic Health Evaluation (Apache-II) score was 14.83±4.22. Respiratory failure was present in all patients upon admission. Arterial blood gas measurement on the FB day revealed a mean PaO_2 level of 61.52±4.35 mm Hg and mean PaO_2/FiO_2 of 186.94±28.47. Pneumonia was the most common reason for study patient admission into critical care (Table 2), with aspiration pneumonia in the majority of such cases.

The main reasons for FB procedures were to collect bronchial samples for microbiological/cytological analysis, and to remove mucous plugs causing atelecta-

Table 1. Distribution of comorbid conditions in study patients

Comorbid disease	n (N=143)	%
Hypertension	99	69.2
Diabetes mellitus	37	25.9
Cardiovascular disease*	60	42
Obstructive lung disease	44	30.8
Chronic renal failure	37	25.9
Malignancy**	21	14.7
Neurological disorder#	56	39.2

*heart failure, coronary artery disease; **non-small-cell lung cancer, small-cell lung cancer, lymphoma, intrathoracic metastasis of colon cancer and breast cancer; #dementia, multiple sclerosis, Parkinson's disease, stroke and epilepsy

Table 2. Main reasons for critical care admission of study patients

	n	%
Exacerbation of obstructive lung disease	22	15.4
Pneumonia	77	53.8
Heart failure/pulmonary edema	21	14.7
Exacerbation of interstitial lung disease	11	7.7
Pulmonary embolism	2	1.4
Malignancy*	10	7

*non-small-cell lung cancer, small-cell lung cancer, lymphoma, intrathoracic metastasis of colon cancer and breast cancer

Table 3. Indications for bronchoscopy in study patients

	n (N=143)	%
Collecting lower respiratory system secretion	47	32.9
Atelectasis/removal of secretion	52	36.4
Hemoptysis	22	15.4
Foreign body removal	7	4.9
Difficult airway management	10	7
Guidance for percutaneous tracheostomy	5	3.5

Table 4. Distribution of complications in study patients during and after bronchoscopy

	n (N=143)	%
No complication	88	61.5
Transient hypoxemia	24	16.8
Hemorrhage	4	2.8
Dysrhythmia	14	9.8
Increased blood pressure	8	5.6
Stridor/bronchospasm	5	3.5

Table 5. Features of patients stratified by the presence of bronchoscopy-related complications

	Complication (n=55)	No complication (n=88)	p
Age	68.92±9.55	68.61±11.22	0.864
Gender (male)	29 (52.7%)	59 (67.0%)	0.087
Apache-II	17.70±4.27	13.03±3.04	**<0.001**
PaO_2 (mm Hg)	61.51±3.61	61.53±4.77	0.969
PaO_2/FiO_2	179.58±24.10	191.54±30.12	**0.010**
Comorbid conditions			
Hypertension	39 (70.9%)	60 (68.2%)	0.731
Diabetes mellitus	17 (30.9%)	20 (22.7%)	0.277
Obstructive lung disease	17 (30.9%)	27 (30.7%)	0.977
Chronic heart disease*	29 (52.7%)	31 (35.2%)	**0.039**
Chronic renal failure	14 (25.5%)	23 (26.1%)	0.928
Neurological disease#	19 (34.5%)	37 (42.0%)	0.371
Malignancy**	7 (12.7%)	14 (15.9%)	0.601
Bronchoscopy sample			
Bronchial lavage	35 (63.6%)	68 (77.3%)	0.077
Bronchoalveolar lavage	19 (34.5%)	16 (18.2%)	**0.027**
Bronchial biopsy	4 (7.3%)	6 (6.8%)	0.917
Respiratory support during			
conventional oxygen	29 (52.7%)	52 (59.1%)	0.455
Noninvasive ventilation	2 (3.6%)	8 (9.1%)	0.317
High flow nasal oxygen	4 (7.3%)	9 (10.2%)	0.550
Invasive mechanical ventilation	20 (36.4%)	19 (21.6%)	0.054

*heart failure, coronary artery disease, cardiac valve pathologies; **non-small-cell lung cancer, colon cancer, stomach cancer, mandibular squamous cell cancer, prostate cancer and mesothelioma; #dementia, multiple sclerosis, Parkinson's disease, stroke and epilepsy; Apache-II = Acute Physiology and Chronic Health Evaluation; PaO_2 = partial pressure of oxygen; FiO_2 = fraction of inspired oxygen

sis (Table 3). A considerable proportion of the patients (40/52; 76.9%) who underwent FB for excessive atelectasis-related secretions had neurological disorders that could lead to aspiration.

All procedures were performed under mild to moderate sedation. Bronchoscopy was performed through oral route in 104 (72.7%) patients, endotracheal tube in 26 (18.2%) patients, and tracheotomy cannula in 13 (9.1%) patients. Regarding respiratory support provided to the patients, 81 (56.6%) underwent a fiberoptic bronchoscopy (FOB) procedure under conventional oxygen supplementation, 10 (7%) on NIV, 13 (9.1%) on HFNC, and 39 (27.3%) on invasive mechanical ventilation. None of the patients experienced aggravation of hypoxemia requiring escalation of respiratory support during bronchoscopy.

Table 6. Univariate and multivariate logistic regression analyses of the risk of bronchoscopy-related complications

	Univariate analysis		Multivariate analysis	
	OR (95% CI)	p	OR (95% CI)	p
Age	1.003 (0.971-1.035)	0.863		
Gender (male)	1.824 (0.914-3.641)	0.088	1.802 (0.932-2.103)	0.062
Apache-II	1.455 (1.268-1.670)	**<0.001**	1.492 (1.280-1.740)	**<0.001**
PaO_2/FiO_2	0.984 (0.972-0.997)	**0.016**	0.985 (0.969-1.001)	0.059
Hypertension	1.137 (0.546-2.372)	0.731		
Diabetes mellitus	1.521 (0.712-3.248)	0.279		
Obstructive lung disease	1.011 (0.487-2.096)	0.977		
Cardiovascular disease*	2.051 (1.032-4.075)	**0.040**	4.270 (1.545-11.800)	**0.005**
Chronic renal failure	0.965 (0.446-2.086)	0.965		
Neurological disease#	0.727 (0.362-1.463)	0.372		
Malignancy**	0.771 (0.290-2.048)	0.602		
Conventional oxygen	0.772 (0.392-1.522)	0.748		
NIV	0.377 (0.077-1.847)	0.229	0.908 (0.802-1.434)	0.090
HFNC	0.688 (0.201-2.354)	0.552		
IMV	2.075 (0.982-4.385)	0.056	1.452 (0.521-4.052)	0.476
Bronchial washing	0.515 (0.245-1.081)	0.079	1.059 (0.306-3.669)	0.928
Bronchoalveolar lavage	2.375 (1.093-5.161)	**0.029**	2.914 (0.752-11.287)	0.122
Bronchial biopsy	1.072 (0.288-3.983)	0.917		

*heart failure, coronary artery disease, cardiac valve pathologies; **non-small-cell lung cancer, colon cancer, stomach cancer, mandibular squamous cell cancer, prostate cancer and mesothelioma; #dementia, multiple sclerosis, Parkinson's disease, stroke and epilepsy
Apache-II = Acute Physiology and Chronic Health Evaluation; PaO_2 = partial pressure of oxygen; FiO_2 = fraction of inspired oxygen; NIV = noninvasive ventilation; HFNC = high flow nasal cannula oxygen; IMV = invasive mechanical ventilation

Among all FB procedures, bronchial washing was sampled in 103 (72%), bronchoalveolar lavage in 35 (24.5%) and bronchial biopsy in 10 (7%) patients. Argon plasma coagulation (APC) was performed in a total of eight patients, four of whom developed hemorrhage during the procedure and another four who underwent bronchoscopy due to hemoptysis. Cryotherapy was performed in four patients to remove clots, plugs, and foreign bodies.

None of the patients experienced bronchoscopy-related mortality or life-threatening complications. During and immediately after bronchoscopy, 55 (38.5%) patients developed complications that could be controlled (Table 4).

On comparison of the patients with and without complications, the group of patients with complications had higher Apache-II scores and lower PaO_2/FiO_2. Concerning those with comorbid conditions, the rate of cardiovascular disease was higher in the complication group. No difference was found between the groups in terms of the respiratory support techniques applied. Clinical features of the patient groups with and without complications are shown in Table 5.

A binary logistic regression analysis was employed to determine the effect of clinical parameters on bronchoscopy-related complication risks in critical care patients, revealing an increased Apache-II score and presence of cardiovascular disease to be significantly associated with an increased complication risk (Table 6).

Discussion

This cross-sectional study revealed bronchoscopy to be a safe procedure that does not cause serious complications in critical care patients. While transient complications such as hypoxemia, hemorrhage, dysrhythmia, increased blood pressure and bronchospasm occurred in relation to bronchoscopy in the study patients, no major life-threatening complications were observed. An increased Apache score and presence of cardiovascular disease were associated with bronchoscopy-related complication risk.

In the present study, the leading reasons for bronchoscopy were collection of lower respiratory tract samples and removal of excessive secretions causing atelectasis. Similar to the findings of the present study, collecting secretions and confirming suspected lower airway infections were the most common bronchoscopy indications in a study of 40 critical care patients with respiratory failure who required bronchoscopy[9]. In a study of acute respiratory distress syndrome patients conducted by Ekren *et al*., the main FB indication was described as suspicion of infection[10]. In critical care, bronchial secretion samples are the main contributors to the diagnosis of respiratory infections, including community-acquired or ventilatory associated pneumonia. Bronchoscopy can be used to collect samples from the lower respiratory tracts of patients in whom respiratory samples cannot be obtained *via* expectoration, or in whom such samples are diagnostically inconclusive[1,2]. In a randomized study of 740 critical care invasively ventilated patients, BAL and endotracheal aspirates were found to have a similar diagnostic yield for ventilator-associated pneumonia in immunocompetent patients[11]. However, BAL offers additional diagnostic indications for respiratory failure, such as diffuse alveolar hemorrhage and eosinophilic pneumonia[12], and plays a valuable role in ruling out opportunistic infections in immunocompromised patients[13].

Flexible bronchoscopy may also be used to manage atelectasis due to the obstruction by secretions or clots, which can lead to worsening of hypoxemia. Smeijesters *et al*. showed that oxygenation and ventilation were improved by bronchoscopy for at least 24 hours in critical care cases of atelectasis[14].

The indication for bronchoscopy was hemoptysis in approximately 15% of our study patients. It is suggested that early bronchoscopy is preferred in unstable patients with hemoptysis to localize hemorrhage and to evacuate blood from the airways. In addition, in cases where bleeding originates from proximal airways, local thermoablative treatments such as electrocautery or APC may be used to achieve hemostasis *via* bronchoscopy[15,16]. In our patient group, APC was performed for the management of endobronchial hemorrhage in eight patients, and FB was performed in four of these eight patients due to the presence of hemoptysis.

It is generally accepted that critical care patients are at a high risk of procedural complications due to their severe diseases and comorbid conditions[1,17,18]. While there were no major complications leading to mortality or hemodynamic instability, or requiring escalation of respiratory support among the study patients, 55 (38.4%) developed transient complications that could be controlled. The complication rates associated with bronchoscopy in critical care patients differed from those reported in previous studies. The risk of major complications related to FB in critical care patients has been reported as 0.08% to 2%, along with a mortality risk of 0.01%-0.05%[17,18]. It is worthy of note, however, that the studies in which these rates are reported are older studies. In the study by Alvarez-Maldonado *et al*. that included 102 critical care patients, 65% of the patients are reported to have developed transient hypoxemia during bronchoscopy, while 3.5% developed other minor complications such as bleeding or dysrhythmia[19]. Prebil *et al*. examined 100 critical care patients who underwent bronchoscopy, and report a complication rate of 10% with clinically significant hypoxemia, changes in blood pressure, and bradycardia[3]. These studies of critical care patients, similar to our research, included no significant complications related to FB. We believe that differences in the rate of minor complications may be due to the diversity of clinical conditions in the study populations, and the way complications are defined within these reports.

In the present study, 7% of the patients underwent bronchoscopy on NIV, 9.1% on HFNC, and 27.3% on invasive mechanical ventilation. Patients with respiratory failure were found to be at a high risk of requiring intubation post-procedures. With the increase of noninvasive respiratory support methods in respiratory failure, the frequency of bronchoscopy procedures under NIV and HFNC support has increased in these patients[1,20-22]. Sircar *et al*. report on 27 patients with respiratory failure who underwent bronchoscopy with NIV support, without requiring intubation[22]. Baumann *et al*. conducted a study evaluating bronchoscopy application under NIV in critical care patients with respiratory failure, and report that 10% of the patients required endotracheal intubation within the first 8 hours after the procedure[9]. A randomized controlled study by Longhini *et al*. found that respiratory support with HFNC during bronchoscopy improved pulmonary exchange and diaphragm activation more than conventional oxygen support in patients with respiratory failure[23]. Likewise, clinical effectiveness of HFNC applications during FB procedures has been described in several reports[20,21,24]. A prospective randomized

study conducted in 51 patients comparing HFNC and NIV in hypoxemic patients undergoing bronchoscopy revealed a similar effectiveness of both respiratory support techniques in the prevention of hypoxemia in these patients[25].

In the present study, the patients who experienced complications had higher Apache scores, and multivariate analyses revealed an increased Apache score to be associated with FB-related complication risk. The Apache score has been widely used to predict outcome of critically ill patients[26]. To the best of our knowledge, no data have been described on the impact of the Apache score on FB complications in critical care. However, this score has been used to predict the worse outcomes of critical care patients[27,28]. We believe that increased disease severity may be associated with an increased risk of complications.

Hypoxemia is accepted as a risk factor for bronchoscopy-related complications, and especially for worsening hypoxemia and cardiac pathologies[22]. In the present study, the complication group patients showed lower PaO_2/FiO_2 than the patient group without complications. Univariate analysis revealed that a low PaO_2/FiO_2 level could predict complication risk, although this association lost its significance following multivariate analysis. In another study evaluating the need of intubation after an FB procedure in patients with acute respiratory failure, it was shown that PaO_2/FiO_2 was not associated with the need of intubation[5]. In contrast, a study assessing prediction of intubation after bronchoscopy with NIV support showed that a low PaO_2/FiO_2 before NIV initiation could predict the need of intubation[29]. Oxygen desaturation is usually correlated with dysrhythmias and changes in blood pressure, and these changes may be observed also during FB procedures with worsening hypoxemia[30,31].

Comorbid conditions also predict the risk of complications during bronchoscopy[1,30,32]. In this study, the rate of cardiovascular disease was higher in the patient group with complications. Similar to our results, a study of 164 procedures by Schnabel *et al.* revealed hemodynamic instability to be recorded in 22% of patients, and this finding was correlated with the presence of cardiovascular comorbidity upon admission to the hospital[33]. Patients with neurological diseases may be prone to complications due to the weakness of the diaphragm, and intercostal and expiratory muscles, or to concomitant pulmonary complications resulting from oropharyngeal dysfunction, leading to aspiration of secretions. Additionally, these patients may experience diminished ventilatory response to hypoxia and hypercapnia, resulting probably from the mechanoreceptors of the aorta and carotid sinus dysfunction[34,35]. In our study group, the presence of a neurological disease was not found to be associated with complication rates, which we believe may be related to the appropriate patient selection for FB and choice of the respiratory support techniques in our center.

Our study showed that the number of FB procedures in which BAL sampling was performed was higher in the patient group with complications. Hypoxemia during or immediately after taking BAL is the most common complication, and transient hypoxemia may occur during BAL sampling due to alveolar collapse and intra-alveolar oxygen consumption due to frequent suctioning and overflow of the alveoli[1,2].

Our study had some limitations, the first of which was its retrospective nature, and the fact that it was carried out at a single medical institution. Second, a decision to perform bronchoscopy was based on the consensus of the ICU team rather than following a protocol. The final limitation is that the selection of respiratory support methods was not standardized but rather based on the clinician's decision.

Bronchoscopy is a valuable diagnostic and therapeutic tool in the treatment of critical care patients with respiratory failure. It seems that within this patient population, the presence of cardiovascular diseases and increased Apache scores are associated with an increased complication risk. Although critical care patients with respiratory failure are more prone to complications due to their severe illness, diagnostic and therapeutic bronchoscopy may be performed following appropriate patient selection, without leading to major complications.

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Sažetak

JE LI FLEKSIBILNA BRONHOSKOPIJA SIGURAN POSTUPAK KOD KRITIČNIH BOLESNIKA S RESPIRACIJSKIM ZATAJENJEM?

A. G. Kaya, M. Öz, U. Dilegelen , D. Ecer , S. Erol, F. Çiftçi, A. Çiledağ i *A. Kaya*

Fleksibilna bronhoskopija (FB) igra važnu ulogu u bolesnika na kritičnoj skrbi. Međutim, ovi bolesnici na kritičnoj skrbi s respiracijskim zatajenjem imaju povećani rizik od razvoja komplikacija. S obzirom na napredak u skrbi u jedinici intenzivnog liječenja tijekom posljednjih godina cilj je bio procijeniti uporabu FB-a u ovih bolesnika. Retrospektivno smo pregledali podatke bolesnika koji su podvrgnuti FB-u u kritičnoj skrbi između 2014. i 2020. godine. Ukupno je 143 bolesnika podvrgnuto FB-u tijekom razdoblja ispitivanja. Mjerenje plinova u arterijskoj krvi na dan FB pokazalo je srednju vrijednost PaO_2/FiO_2 od 186,94±28,47. Osamdeset jedan bolesnik (56,6%) podvrgnut je postupku fiberoptičke bronhoskopije pod konvencionalnim dodacima kisika, 10 (7%) na neinvazivnoj ventilaciji, 13 (9,1%) na nosnoj kanili s velikim protokom i 39 (27,3%) na invazivnoj mehaničkoj ventilaciji. Tijekom i neposredno nakon bronhoskopije niti jedan bolesnik nije doživio komplikacije opasne za život. Osim toga, 55 (38,5%) bolesnika razvilo je komplikacije koje se mogu kontrolirati. Prema multivarijatnoj analizi, povećani rezultat Apache-II i prisutnost kardiovaskularnih bolesti bili su značajno povezani s povećanim rizikom od komplikacija. Iako su bolesnici na kritičnoj skrbi s respiracijskim zatajenjem skloniji komplikacijama, dijagnostička i terapijska bronhoskopija mogu se provesti nakon odgovarajućeg odabira bolesnika, a da to ne dovede do većih komplikacija.

Ključne riječi: *Bronhoskopija; Komplikacija; Kritična njega; Respiracijsko zatajenje; Respiracijska potpora*