

An Audit of Complications during Various Flexible Bronchoscopic Interventions: A 4 Years Experience in a Tertiary Care Hospital

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ABSTRACT

Objective: To study the complication rate during a variety of bronchoscopic interventions.

Study Design: Observational / descriptive study.

Place and Duration of Study: This study was conducted at the Pulmonology Department, Services Institute of Medical Sciences/ Services Hospital Lahore from August 2012 to June 2016.

Material and Methods: 592 patients undergoing flexible bronchoscopic interventions for different indications in our department and severe complications associated with the bronchoscopic interventions were studied.

Results: A total of 592 patients were included. The major indication remained persistent lung infiltration in 85% patients, mediastinal lymphadenopathy in 4%, 3% had interstitial lung disease, hemoptysis in 2%, foreign body in 2%. Significant hemorrhage >50mls, occurred in 20 (3.37%) patients, mostly during endobronchial biopsies. Two out of total three pneumothorax occurred during TBB. Bronchospasm occurred in 22 (3.7%) cases, mostly during BAL. Seizures and drowsiness occurred in 02 (0.5%) patients. Hypoxemia (SpO₂ < 90%) was observed in 18 (3%) patients, mostly during BAL and EBB. 04 (0.67%) patients had supra-ventricular arrhythmias. 14 (2.4%) cases reported fever within 24 hours of procedure, out of which 07 (1.2%) had a new infiltrate/pneumonia on chest x-ray. One patient suffered myocardial infarction after 4 hours of the endobronchial biopsy.

Conclusion: Flexible bronchoscopy is a safe procedure with a low complication rate even during a variety of diagnostic and therapeutic interventions.

Key Words: Flexible bronchoscopy. Indications. Complications

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INTRODUCTION

Flexible bronchoscopy (FBS) is a widely performed procedure that is generally considered to be safe and effective. Bronchoscopy was first performed by Gustav Killian in 1897 but Shigeto Ikeda in 1964 had revolutionized the clinical sciences of bronchoscopy by developing flexible fiberoptic bronchoscope¹.

Bronchoscopy is a procedure to visualize the tracheo-bronchial tree. There are three types of bronchoscopy: rigid, flexible, and virtual. Flexible bronchoscopy is the most common type of bronchoscopy. It visualizes the trachea, proximal airways, and segmental airways out to the third generation of branching and can be used to sample and treat lesions in those airways. Flexible bronchoscopy is generally performed in a procedure room with conscious sedation².

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Indications of flexible bronchoscopy can be divided into diagnostic and therapeutic. Major diagnostic indications include: Hemoptysis, chronic cough, unexplained breathlessness or wheezing, hoarseness of voice, persistent infiltrate, hospital acquired pneumonia, pneumonia in an immunocompromised host, persistent atelectasis, parenchymal nodules or masses, mediastinal lymphadenopathy, suspected airway obstruction, suspected lung transplant rejection, suspected tracheomalacia, smoke inhalation, interstitial lung disease, chest trauma, suspected tracheo-esophageal and broncho-pleural fistula etc³.

Therapeutic indications include: bronchoscopic suction of sputum, tracheal intubation via bronchoscope, bronchoscopic hemostasis, a retrieval of foreign body, microwave thermotherapy, laser photoresection, electrocautery, argon plasma coagulation, balloon dilatation, bronchial thermoplasty and tracheobronchial stenting⁴.

Inspection of the airways is just one reason to perform a bronchoscopy; other reasons include diagnostic sampling and therapeutic interventions. Diagnostic procedures include: Brushings, Bronchoalveolar lavage (BAL), Bronchial washings, Endobronchial biopsy, Transbronchial biopsy and Transbronchial needle aspiration (either endobronchial lesion or mediastinal pathologies)⁵.

The major advantages of flexible bronchoscopy over rigid include detailed examination of tracheo-bronchial tree, ease of performance and no requirement of general anesthesia. Flexible bronchoscopy is safe in the hands of an experienced operator but certain complications do occur and rare fatalities have been recorded with major complication rate between 0.03-0.08% and mortality rate between 0.01-0.04 percent⁶.

A "Bronchoscopic complication" is defined as any adverse event directly related with the bronchoscopic procedure performed. Complications are classified as⁷:

- Complications that occur during preparation, (local anesthesia and pre-medication, if any),
- Complications that occur during bronchoscopic procedure and,
- Complications that occur within 2 hours of procedure.

Major complications encountered during bronchoscopy are: Hemorrhage (mild<50mls, moderate<200mls, severe>200mls), hypoxemia, pneumothorax, surgical emphysema, pneumomediastinum, pulmonary edema, bacteremia, fever, pneumonia laryngospasm, cough, bronchospasm, respiratory depression or arrest, dyspnea, TIA, vasovagal episodes, drowsiness, fits, airways fire, cardiac arrest, hypertension, arrhythmias, sinus tachycardia and bradycardia, which is attributed to low dose of atropine used, vagal stimulation or severe hypoxemia occurring during procedure⁸.

MATERIALS AND METHODS

This study was a hospital based observational and descriptive study. It was carried out in the department of Pulmonary, Critical Care Medicine and Thoracic Surgery, Services Hospital Lahore on 592 patients over the period of 4 years from August, 2012 to June 2016.

Inpatients and outpatients from pulmonology and medical departments of age >10 years were enrolled (as children under 10 years mostly require deep sedation or general anesthesia), irrespective of gender and occupation.

Following patients were excluded from study:

- Patients with unstable ischemic heart disease, severe hypoxemia, advanced respiratory failure, shock and toxic-metabolic encephalopathy.
- Bleeding diathesis.
- Thrombocytopenia <60,000.
- Uncooperative before or during procedure.

A detailed, explained consent was obtained including the risk of various complications like respiratory failure, massive bleeding and death etc.

Patients were kept without oral intake either overnight or at least 8 hours before procedure. Atropine 0.6mg intramuscularly was given to all patients 30mins before procedure, except in patients with obvious contraindication.

Conscious sedation using injection Midazolam 1-10mg was given to all patients as needed. 4% atomized

lignocaine was used as topical anesthesia to oral cavity and throat. 2% and 1%, 1-2mls instillations were used via bronchoscope for larynx and endo-bronchial tree respectively. The total dose of lignocaine for a 50-70kgs and above patient was kept less than 800mg. The maximum permissible dose was reduced by 20% for patients under 50kgs.

A Proforma was filled for each patient, which included patient data, history, clinical examination, relevant investigations, procedure detail, a list of complications which occurred during procedure, their management and outcome.

All outpatients without obvious procedural complication were monitored for 4 hours after the intervention and those with complications were admitted in pulmonology or ICU wards for follow up care, monitoring and a possible second intervention. Discharged patients were followed up in OPD.

All procedures were performed on Olympus Video bronchoscope system CV-260 in a dedicated bronchoscopy suite. Patients received supplementary oxygen to maintain SpO₂ more than 90% during and after the procedure. Cardiac monitoring and pulse oximetry was performed in all patients. A chest x-ray was performed in those patients who underwent trans-bronchial needle aspiration (TBNA), trans-bronchial biopsy (TBB), stricture electro cauterization or experienced chest pain and unusual shortness of breath. ECG was done in patients, who developed; hypotension during or after the procedure, central chest pain and arrhythmias etc.

RESULTS

A total of 592 patients were included in this study. Out of those, 385 (65%) were male and 207 (35%) were female patients. See table: 1. Majority of patients; 355 out of 592 (60%) were above 50 years of age. 178 out of 592 (30%) were between 25-49 years age group, and finally 59 out of 592 (10%) patients were between 10-24 years of age. See table: 1.

The major indication of bronchoscopy remained persistent lung infiltration on chest x-ray or CT chest in a symptomatic or asymptomatic patient. Approximately 85% (503 out of 592) of patients had a persistent lung infiltration including pneumonia, granulomatous infection, neoplastic process and atelectasis. 24 patients (4%) had mediastinal lymphadenopathy, 18 patients (3%) had interstitial lung disease, 12 patients (2%) had unexplained hemoptysis, 11 out of 592 (2%) had a suspected foreign body, 6 (1%) had hoarseness of voice, 4 out of 592 patients (0.67%) had suspected tracheo-esophageal fistula, 6 patients (1%) had mucus plugging, 3 (0.5%) had unexplained cough and 5 out of 592 patients (0.84%) had tracheal stenosis. See table: 2

Out of 592, 22 (3.7%) patients underwent inspection of airways, 26 (4.39%) patients had bronchial washings, 306 (52%) patients had bronchoalveolar lavage (BAL),

128 (22%) patients had endobronchial biopsies (EBB), transbronchial biopsy (TBB) was performed among 64 (11%) patients, 24 (4%) patients had transbronchial needle aspiration (TBNA), 11 (2%) patients had retrieval of foreign body, 5 (0.84%) patients had tracheal stricture electrocauterization and 6 (1%) patients underwent removal of mucus plugs with the help of negative suctioning. See table: 3

Table No. 1: Age groups of patients

Age group	10-24yrs	25-50yrs	>50yrs	Total
No. of patients	59	178	355	592
% age	10%	30%	60%	100%
Gender	Male	385	65%	
	Female	207	35%	

Table No. 2: Indications of bronchoscopy

Indications of bronchoscopy	No. of patients	% age
Persistent lung infiltration	503	85%
Mediastinal lymphadenopathy	24	4%
Interstitial lung disease	18	3%
Unexplained hemoptysis	12	2%
Suspected foreign body	11	2%
Hoarseness of voice	06	1%
Suspected tracheo-esophageal fistula	04	0.67%
Mucus plugging	06	1%
Tracheal stenosis	05	0.84%
Unexplained cough	03	0.5%
Total	592	100%

Table No. 3: Distribution of total Procedure/interventions performed among patients with percentage.

Distribution of total Procedure/interventions performed	No. of Patients	% age
Inspection of airways	22	3.7%
Bronchial washings	26	4.39%
Bronchoalveolar lavage	306	52%
Endobronchial biopsy	128	22%
Transbronchial biopsy	64	11%
Transbronchial needle aspiration	24	4%
Retrieval of foreign body	11	2%
Stricture electrocauterization	05	0.84%
Removal of mucus plugs	06	1%
Total	592	

Total 102 (17.23%) patients out of a total of 592 experienced a variety of complications. See table: 5. Significant hemorrhage; >50mls, occurred in 20 (3.37%) patients, mostly (10 patients) during endobronchial biopsies of neoplastic or inflammatory lesions. Pneumothorax remained among the rare

complications of FBS. Only 03 (0.5%) cases were noted and 02 out of 03 happened during TBB. Out of three, only one patient required tube thoracostomy, the other two patients improved on oxygen therapy. Bronchospasm was not a rare complication of FBS. Total 22 (3.7%) cases were documented out of which 12 occurred during BAL. Most patients improved spontaneously at the end of procedure but few of them required salbutamol nebulization. Only 03 (0.5%) patients had laryngospasm which required repeated boluses of sedation. All cases occurred during BAL. See table: 6

Table No. 4: No. & % age of complications recorded.

Complications	No.	% age of 102 complications	% age of 592 procedures
Hemorrhage>50mls	20	19.6%	3.37%
Pneumothorax	03	2.94%	0.5%
Bronchospasm	22	21.6%	3.7%
Laryngospasm	03	2.94%	0.5%
Seizures	02	1.96%	0.34%
Drowsiness	03	2.94%	0.5%
Hypoxemia	11	17.6%	3.0%
Arrhythmias	04	3.92%	0.67%
Fever	14	13.7%	2.4%
Pneumonia	07	6.86%	1.2%
MI/ACS	01	0.98%	0.17%
Hypotension	05	4.9%	0.84%
Total	102	100%	17.23%

Table No.5: Distribution of no. of complications by bronchoscopic procedures

Procedure performed	No. & % of complications out of total 102 cases	% out of total 592 cases
Inspection of airways	01(0.98%)	0.17%
Bronchial washings	02(1.96%)	0.34%
Bronchoalveolar lavage	47(46.1%)	7.94%
Endobronchial biopsy	20(19.6%)	3.37%
Transbronchial biopsy	11(10.8%)	1.86%
Transbronchial needle aspiration	02(1.96%)	0.34%
Retrieval of foreign body	10 (9.8%)	1.69%
Stricture electrocauterization	02(1.96%)	0.34%
Removal of mucus plugs	05(4.9%)	0.84%
Total	102(100%)	17.3%

Seizures and drowsiness, two of the serious complications of FBS, which were related to topical anesthesia, sedation and hypoxemia, occurred in 02 (0.34%) patients each during BAL. Patients with seizures required discontinuation of procedure and sedation and they subsequently improved uneventfully. Patients with drowsiness were observed for 24 hours

and discharged in a conscious state. Hypoxemia (SpO₂<90%) was observed in 18 (3%) patients mostly during BAL and EBB. All patients responded to increased supplementary oxygen during procedure. 04 (0.67%) patients had supraventricular arrhythmias which were probably related to Atropine, hypoxemia or advanced lung disease. No active management was done for these cases as arrhythmias settled spontaneously at the end of procedure.

14 (2.4%) cases reported fever within 24 hours of procedure, out of which 07 (1.2%) had a new infiltrate/pneumonia on chest x-ray requiring antibiotics. Majority of cases occurred during BAL. All patients improved within 3-10 days with or without

antibiotic therapy. One patient suffered myocardial infarction after 4 hours of the endobronchial biopsy. She had severe coronary artery disease which probably worsened on discontinuing antiplatelet therapy 7 days before the procedure. Patient required admission and improved in 5 days.

Hypotension was encountered in 5 (0.84%) patients mostly during BAL which responded to intravenous fluid replacement. It was the result of sedation in the patients with slightly low hydration status. Most of the complications occurred during BAL, EBB, TBB and retrieval of foreign body. See table: 5. No patient died during or within 02 weeks of FBS due to the complications related to the procedure.

Table No. 6: Distribution of Complications during different bronchoscopic procedures with procedure performed

Distribution of Complications during different bronchoscopic procedures	Procedure performed (n=592)									Total
	Inspection of Airways n=22	Bronchial Washings n=26	BAL n=306	EBB n=128	TBB n=64	TBNA n=24	Retrieval of Foreign Body n=11	Stricture electro-cauterization n=5	Removal of mucus plugs n=6	
morrhage>50mls	-	1	2	10	4	1	2	-	-	20
Pneumothorax	-	-	1	-	2	-	-	-	-	03
Bronchospasm	1	2	12	2	1	-	1	-	3	22
Laryngospasm	-	-	3	-	-	-	-	-	-	03
Seizures	-	-	2	-	-	-	-	-	-	02
Drowsiness	-	-	2	-	-	-	1	-	-	03
Hypoxemia	-	1	7	3	2	-	2	1	2	18
Arrhythmias	-	-	2	1	1	-	-	-	-	04
Fever	-	-	7	2	1	1	2	1	-	14
Pneumonia	-	-	6	-	-	-	1	-	-	07
MI/ACS	-	-	-	1	-	-	-	-	-	01
otension	-	-	2	1	-	-	1	-	-	05
Total	01	04	47	20	11	02	10	02	05	102

DISCUSSION

This study was performed to find out the frequency of various complications during a variety of bronchoscopic interventions. In our study which was conducted on 592 patients, 102 (17.3%) patients had various complications during different bronchoscopic interventions. Among 26 (4.39%) patients, serious complications were observed including: hemorrhage >50mls (3.37%), pneumothorax (0.5%), seizures (0.3%), and ACS (0.17%). All these patients required hospital stay (1-5days) for observation, treatment and a second intervention. No patient was died and all patients were discharged subsequently. (Tab: 4, 5, 6)

Persistent lung infiltration remained the most common (85% patients) indication for different bronchoscopic interventions proceeded by mediastinal lymphadenopathy (4%) and interstitial lung disease (3%). Hemorrhage (3.37%), bronchospasm (3.7%), hypoxemia (3.0%) and fever (2.4%) remained the most commonly encountered complications.

Charles A et al⁹ performed 4273 diagnostic and therapeutic bronchoscopies. Complication rate was observed to be 1.2% including minor and major complications. Major complications included; pulmonary hemorrhage, pneumothorax and respiratory failure, comprising 0.6% of the total complications which is low if compared with our results (4.39%). Among the total 173 trans-bronchial biopsies, pneumothorax and pulmonary hemorrhage were observed to be 4.0% and 2.8% respectively where as among 64 TBB cases in our study, pneumothorax rate was 3.1% and hemorrhage 6.2%, which are comparable.

Facciolongo N, Patelli M et al¹⁰ conducted a multi-center prospective study including 20,986 bronchoscopies. The overall incidence of complications was found to be 1.08% (227 cases in total) with a mortality of 0.02%. Among the major complications (out of 227 cases) including hemorrhage, hypoxemia and pneumothorax the incidence remained 23.78%, 11.0% and 9.69% respectively which was 19.6%, 17.6% and 2.94% respectively in our study.

Out of total 23.78% (54) cases complicating with hemorrhage, 9.2% occurred during EBB and TBB each and 0.88% during BAL which were 9.8%, 3.92% and 1.96% respectively in our study. Among 11% (25) cases of hypoxemia, 1.76% occurred during EBB, 1.32% during TBB and BAL each, which was 2.94%, 1.96% and 6.86% respectively in our study. A relatively higher incidence of hypoxemia during BAL in our study was probably due to increased no of cases undergoing BAL (306 cases out of 592) and use of larger volumes of normal saline for BAL.

Out of 9.69% (12) cases of pneumothorax, 4.4% occurred during TBB and none during EBB and BAL, where as in our study 1.96% and 0.98% cases complicated with pneumothorax during TBB and BAL respectively. Geraci G, Pisello F et al¹¹ performed a meta-analysis which included the literature review of 50 scientific articles from 1974 to 2006 by the name of flexible fiberoptic complications. On 107969 bronchoscopies the incidence of complications was studied. They have concluded that overall incidence of complications for hypoxemia, hemorrhage and pneumothorax remained 0.2-21%, 0.12-7.5% and 1-6% respectively which are comparable to the results of our study which were 3%, 3.37% and 0.5% for hypoxemia, hemorrhage and pneumothorax respectively.

Kaparianos A, Argyropoulou E et al¹²⁻¹⁴ conducted a retrospective study from 2003 to 2007. A total of 4098 bronchoscopies were performed for diagnostic and therapeutic indications. Hemoptysis was the most common indication for FFB (21%), followed by fever (19%), chronic cough (18%) and an abnormal chest x-ray or CT-chest (14%). Major complications occurred in the form of pneumothorax (0.07% of all FBSS), pulmonary hemorrhage (0.17% of all FBSS) and hypoxemia (0.13% of all FBSS) which remained 0.5%, 3.37 and 3.0% respectively in our study. A relatively higher incidence of complications in our study is probably related to difference of indication and variety of interventions other than the smaller size of patients however the incidence of pneumothorax and pulmonary hemorrhage was 2.65% and 3.19% respectively out of total 113 trans-bronchial biopsies performed which was 3.12% and 6.25% respectively for total 64 TBB in our study. Hence the results are similar and comparable as long as complications related to TBB are concerned.²⁰

Faguang Jin, Deguang Mu, Dongling Chu et al conducted a retrospective review of clinical records of 23,862 patients who underwent bronchoscopic examination from 1993 to 2016 in the department of respiratory diseases in a military hospital. 152 (0.64%) cases experienced severe complications including hemorrhage, bronchospasm, pneumothorax and death.¹⁵⁻¹⁹

During EBB bronchospasm and hemorrhage occurred in 0.04% and 0.07% of cases respectively, out of total 23,862 patients, which were 0.34% and 1.69%

respectively in our study. Incidence of bronchospasm, hemorrhage and pneumothorax was 0.008%, 0.03% and 0.016 respectively during TBB which remained 0.16%, 0.67% and 0.33% respectively in our study. Again a relatively higher incidence of complications in our study is related to a smaller patient size and more invasiveness of interventions now.

CONCLUSION

Flexible bronchoscopy is a safe procedure with a low complication rate even during a variety of interventions including EBB, TBB, TBNA and BAL etc. Results of our study are comparable with the international data. A larger prospective analysis seems inevitable.

Conflict of Interest: The study has no conflict of interest to declare by any author.

REFERENCES

1. Daniel R. Ouellette. The safety of Bronchoscopy in a pulmonary follow up program. Chest 2006; 130:1185-1190.
2. Kevin CW, Praveen NM. Flexible bronchoscopy: Indications and contraindications. UpToDate 2016;21:6.
3. Fazlanadeh H, Adimi P, Kiani A, Malekmohammad M, Jabardarjani HR, Sotaninejad F, et al. Evaluation of bronchoscopy complications in a tertiary health care center. Tanaffos 2014;13(4):48-50.
4. Jin F, Mu D, Chu D, Fu E, Xie Y, Liu T. Severe complications of bronchoscopy. Respiration. 2008; 76(4):429-33.
5. Shaheen I, Praveen NM, Flexible bronchoscopy: Equipment, procedure and complications. Up To Date 2016;21:6.
6. Khan I, Haponik E, Chatterjee A, Chin R, Conforti J. Is Sedation Necessary for Successful Completion of Flexible Bronchoscopy?. Clin Pulmonary Med. 2010;17(5):244-7.
7. Morris MJ, Kwon HP, Zanders TB. Monitoring, Sedation, and Anesthesia for Flexible Fiberoptic Bronchoscopy. INTECH Open Access Publisher; 2012.
8. Suleman A, Ikramullah Q, Ahmed F, Khan MY. Indications and complications of bronchoscopy: An experience of 100 cases in a tertiary care hospital. J Postgraduate Med Institute (Peshawar-Pakistan). 2011;22(3).
9. Diaz-Fuentes G, Venkatram SK. Role of flexible-bronchoscopy in pulmonary and critical care practice. INTECH Open Access Publisher; 2012.
10. Facciolongo N, Patelli M, Gasparini S, Agli LL, Salio M, Simonassi C, et al. Incidence of complications in bronchoscopy. Multicentre prospective study of 20,986 bronchoscopies. Monaldi Archives for Chest Disease 2016;71(1).

11. Khan GQ, Hassan G. Bronchoscopy related cardiac arrhythmias. *J Assoc Phys Ind* 2002; 50: 286-87
12. Sarinc Ulasli S, Gunay E, Akar O, Halici B, Koyuncu T, Unlu M. Diagnostic utility of flexible bronchoscopy in elderly patients. *Clin Respir J* 2014;8(3):357-63.
13. Herth FJ. Don't harm your patient-safety of bronchoscopy. *Monaldi Archives for Chest Disease*. 2016;71(1).
14. Facciolongo N, Patelli M, Gasparini S, Agli LL, Salio M, Simonassi C, et al. Incidence of complications in bronchoscopy. Multicentre prospective study of 20,986 bronchoscopies. *Monaldi Archives for Chest Disease* 2016;71(1).
15. Du Rand IA, Blaikley J, Booton R, Chaudhuri N, Gupta V, Khalid S, et al. British Thoracic Society guideline for diagnostic flexible bronchoscopy in adults. *Thorax* 2013;68(Suppl 1):i1-44.
16. Baumann HJ, Klose H, Simon M, Ghadban T, Braune SA, Hennigs JK, et al. Fiber optic bronchoscopy in patients with acute hypoxemic respiratory failure requiring noninvasive ventilation-a feasibility study. *Critical Care* 2011; 15(4):R179.
17. Pisello F, Geraci G, Sciume C. Complication of flexible fiberoptic bronchoscopy. Literature review. *Annali Italiani Di Chirurgia* 2007; 78(3): 183-192.
18. Stather DR, MacEachern P, Chee A, Dumoulin E, Tremblay A. Trainee impact on procedural complications: an analysis of 967 consecutive flexible bronchoscopy procedures in an interventional pulmonology practice. *Respiration* 2013;85(5):422-8.
19. Kabadayi S, Bellamy MC. Bronchoscopy in critical care. *BJA Education* 2016:mkw040.
20. Facciolongo N, Piro R, Menzella F, Lusuardi M, Salio M, Agli LL, et al. Training and practice in bronchoscopy. A national survey in Italy. *Monaldi Archives for Chest Disease* 2013;79(3-4).

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