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Clinical Profile and Positivity Rate of Fiber Optic Bronchoscopy (Fob) Procedures in Lung Cancer

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ABSTRACT

Fiber Optic Bronchoscopy (FOB) is an invasive procedure that has been traditionally used both as diagnostic and therapeutic purposes in the field of pulmonary diseases. However, it is mainly used as diagnostic method in lung cancer diagnosis, followed by appropriate sampling procedures including needle aspiration, forceps biopsy, brushing, and washing. We aim to characterize the profile of FOB results including the positivity rate (the rate in which pathology results yield either class IV or class V cells) of each FOB procedure. This is an observational descriptive study using retrospective approach using existing FOB results from our patients. The most common FOB finding was compressive stenosis (35.4%), followed by obstructive (34.8%), and infiltrative stenosis (29.8%). Positivity rate for needle aspiration was 50% for infiltrative and 57.15% for obstructive stenosis; Positivity rate for forceps biopsy was 42.1% for infiltrative and 73.33% for obstructive stenosis; Positivity rate for brushing was 6.66% for compressive, 38.24% for infiltrative, and 25.72% for obstructive stenosis; and positivity rate of washing was 5.36% for compressive, 17.54% for infiltrative, and 6.12% for obstructive stenosis. These results showed that as the main method in lung cancer diagnosis, FOB procedures have excellent results depending on the choice of sampling procedures used based on FOB findings.

KEYWORDS: Fiber Optic Bronchoscopy (FOB), Lung Cancer, Biopsy

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INTRODUCTION

Fiber Optic Bronchoscopy (FOB) is an invasive procedure which has been long used as diagnostic and therapeutic purposes in pulmonology, mainly lung cancer with intrabronchial lesions. Bronchoscopy device mainly consists of a light source, optic fibers, and a camera which enables direct visualization of both upper and lower respiratory tract. FOB plays an important role in the diagnosis of several pulmonary disorders, including hemoptysis, lung infections, parenchymal lung diseases, lung mass or nodules, and mediastinal lymphadenopathy. It also has several therapeutic purposes including in foreign body aspiration, endobronchial mass ablation/debulking, airway stenosis, and lung lavage.[1]

Although FOB is a relatively safe procedure, there are possible side effects of FOB. These includes medications used in FOB procedure-related side effects, including neuropathic seizure, local anesthesia overdose, prolonged neuromuscular paralysis, hyperthermia, and hemodynamical instability[1]; Other side effects of FOB are procedure-related, which includes pneumothorax and bleeding.[2–4]

Most of FOB procedures in our hospital are diagnostic which aims to aid the diagnosis of lung cancer, which prevalence is increasing worldwide. In Jakarta, a study of 100 hospitals showed that lung cancer is the second most prevalent malignancy after nasopharyngeal cancer. Lung cancer is more prevalent in male. Lung cancer incidence increases proportionally with age, even after smoking cessation.[5]

For diagnostic purposes, bronchoscopy procedures include several methods including needle aspiration (or trans bronchial needle aspiration/TBNA), forceps biopsy, and bronchial brushing and washing. Bronchial brushing is commonly used for endobronchial lesion sampling and more uncommonly parenchymal lesion. Bronchial washing and suctioning are commonly used for thick secretion suction for patients with mucous plug which causes hypoxemia due to lobar collapse or atelectasis.[6,7] Needle biopsy is used to obtain cellular aspirates for cytological analysis of an endobronchial lesion, while forceps biopsy is used to obtain tissue samples for histological analysis.[8]

Biopsy in FOB is a procedure with a relatively high success rate in case of obtaining lung cancer tissue for cellular analysis. A study reported a 66.3% success rate of biopsy in obtaining a diagnosis. In a visible endobronchial lesion, the success rate may reach more than 85%. In another study of 224 lung cancer patients, where specimens obtained from FOB were analyzed and compared with several methods, accuracy of FOB procedures depend highly on the infiltration and visualization of lesion inside the tracheobronchial tree. These lesions are mainly centrally-located lung cancers, which commonly manifest as endobronchial lesions.[9]

There are several categorizations of stenosis seen in FOB, including structural and dynamic or functional stenosis. Structural stenosis includes type 1 (Exophytic/intraluminal), type 2 (extrinsic), type 3 (distortion), and type 4 (strictures/scar tissue). Type 1 stenosis involves all types of intraluminal exophytic lesions of tumor (whether benign or malignant) and granulation tissue. In our setting, type 1 stenosis are divided unto infiltrative stenosis (in which infiltration of bronchial wall is seen) and obstructive stenosis or intraluminal mass with or without bronchial wall infiltration. Type 2 stenosis are due to extrinsic compression (compressive stenosis) which includes lymph node, goiter, great vessels, or other mediastinal structures enlargement, including other non-pulmonary mass. Type 3 stenosis are due to distortion, kinking, tenting, and folding of the airway structure which may occur after a surgery, i.e., lung resection, transplantation, and other mediastinal and pleural abnormalities which may cause bronchial traction. Although bronchial wall thickness may be normal, distortion may cause a segmental stenosis, causing an oval-shaped stenosis. Type 4 stenosis are due to luminal narrowing caused by scar tissue formation, which includes post intubation stenosis, burn injury, and secondary healing after surgery. Functional stenosis is airway softening which may changes with respiratory cycle, which includes type 1, which is a benign triangle-shaped stenosis due to impaired cartilage, and type 2 commonly seen in emphysema patients, which is due to inner projection of weakened (floppy) posterior membrane.[10]

In this study, we aim to characterize the profile of FOB results including the positivity rate (the rate in which pathology results yield either class IV or class V cells) of each FOB procedure.

METHOD

This study is an observational study with retrospective approach. We collect the data of all patients underwent FOB in a span of a year (2018-2019). These data were then analyzed using MS excel.

RESULT

Of all total of 281 patients underwent FOB procedure, there is 38 patients with non-tumor diagnosis (13.5%) and 243 (86.5%) patients with lung tumor diagnosis. For further analysis we only include the data from lung tumor patients (243 samples). Most of our samples were male (67.9%) and aged 40 years or more (87.2%). Based on FOB visualization, there are 70 (28.81%) patients with compressive stenosis, 59 (24.28%) patients with infiltrative stenosis, 69 (28.40%) samples with obstructive stenosis, with the rest of the samples are either normal or unclassifiable (i.e., mucosa edema only). From FOB alone, 62 samples (25.51%) were found to be malignant. Out of all FOB procedures, 162 samples underwent bronchial washing (66.67%), 114 (46.91%) underwent bronchial brushing, 11 (4.53%) underwent needle aspiration, and 83 (34.16%) underwent forceps biopsy.

Tabel 1. Distribution of FOB procedures.

FOB procedures	Frequency	Percentage (From all tumor patients = 243 patients)
Washing	162	66,67%
Brushing	114	46,91%
Needle Aspiration	11	4,53%
Biopsy Forcep	83	34,16%

From each procedure analysis we obtained that of all samples underwent bronchial washing, Pathological examination showed 144 (88.89%) Class II results, 2 (1.23%) Class III results, 9 (5.56%) Class IV results, and 7 (4.32%) Class V results, which concludes the positivity rate of bronchial washing to be 9.88%. From samples underwent bronchial brushing, 87 (76.32%) were Class II, 2 (1.75%) were Class III, 12 (10.52%) were Class IV, and 13 (11.4%) were Class V, with 21.92% positivity rate. For Forceps Biopsy, we obtained 11 (13.25%) samples with Class II, 21 (23.71%) samples with Class III, 21 (25.3%) samples with Class IV, and 28 (33.73%) samples with Class V results, with positivity rate of 59.03%. Lastly, from needle aspiration we obtained a total of 4 (36.37%) samples with Class II results, 1 (9.09%) sample each with Class III and Class IV results, and 5 (45.46%) samples with Class V results, with a positivity rate of 54.55%.

Table 2. Positivity Rate of All FOB Procedures

Procedures	Frequency	Percentage
Washing		
Class II	144	88,89%
Class III	2	1,23%
Class IV	9	5,56%
Class V	7	4,32%
Positivity Rate Washing		**9,88%**
Brushing		
Class II	87	76,32%
Class III	2	1,75%
Class IV	12	10,52%
Class V	13	11,40%
Positivity Rate Brushing		**21,92%**
Biopsi Forsep		
Class II	11	13,25%
Class III	23	27,71%
Class IV	21	25,30%
Class V	28	33,73%
Positivity Rate Forceps Biopsy		**59,03%**
Needle Aspiration		
Class II	4	36,37%
Class III	1	9,09%
Class IV	1	9,09%
Class V	5	45,46%
Positivity Rate Needle Aspiration		**54,55%**

Then we analyze the positivity rate of each FOB procedure based on FOB results. For bronchial washing, in compressive stenosis we obtained 53 Class II results (94.64%), 1 Class IV result (1.79%). and 2 Class V results (3.57%) which concludes the positivity rate of 5.36%. In Infiltrative stenosis, We obtained 46 Class II results (80.7%), 1 Class III result (1.75%), 7 Class IV results (12.28%), and 3 Class V results (5.26%) with a positivity rate of 17.54%. In obstructive stenosis, we obtained 45 Class II results (91.84%), 1 Class III and Class IV result each (2.04%), and 2 Class V results (4.08%), with a positivity rate of 6.12%.

Table 3. Positivity Rate for Bronchial Washing, based on FOB Results

Washing Results	FOB results						Total
	Compressive stenosis		Infiltrative stenosis		Obstructive stenosis		
	f	%	f	%	f	%	
Class II	53	94,64%	46	80,70%	45	91.84%	144
Class III	0	0%	1	1,75%	1	2,04%	2
Class IV	1	1,79%	7	12,28%	1	2,04%	9
Class V	2	3,57%	3	5,26%	2	4,08%	7
Total	**56**	**100%**	**57**	**100%**	**49**	**100%**	**162**
Positivity Rate	**5,36%**		**17,54%**		**6,12%**		

For bronchial brushing, in compressive stenosis we obtained 42 Class II results (93.33%), 1 Class IV result (2.22%), and 2 Class II results (4.44%) with a positivity rate of 6.66%. For Infiltrative stenosis, we obtained 21 class II results (61.76%), 7 Class IV results (20.59%), and 6 Class V results (17.65%) with positivity rate of 38.24%. And for obstructive stenosis, we obtained 24 Class II results (68.57%), 2 Class III results (5.71%), 4 Class IV results (11.43%), and 5 Class V results (14.29%), with a positivity rate of 25.72%.

Table 4. Positivity Rate for Bronchial Brushing, based on FOB Results

Brushing results	FOB results						Total
	Compressive stenosis		Infiltrative stenosis		Obstructive stenosis		
	f	%	f	%	f	%	
Class II	42	93,33%	21	61,76%	24	68,57%	87
Class III	0	0%	0	0%	2	5,71%	2

Class IV	1	2,22%	7	20,59%	4	11,43%	12
Class V	2	4,44%	6	17,65%	5	14,29%	13
Total	**45**	**100%**	**34**	**100%**	**35**	**100%**	**114**
Positivity Rate	**6,66%**		**38,24%**		**25,72%**		

Forceps biopsy is done only in infiltrative and obstructive stenosis, and not in compressive stenosis due to lack of distinctive abnormal tissue for sampling. In Infiltrative stenosis, we obtained 8 Class II results (21.05%), 14 Class III results (36.84%), 7 Class IV results (18.42%), and 9 Class V results (23.68%) with a positivity rate of 42.1%. In obstructive stenosis, we obtained 3 Class II results (6.67%), 9 Class III results (20.0%), 14 Class IV results (31.11%) and 19 Class V results (42.22%) which bring a positivity rate of 73.33%.

Table 5. Positivity Rate for Forceps biopsy, based on FOB Results

Forceps biopsy results	**FOB results**						**Total**
	Compressive stenosis		**Infiltrative stenosis**		**Compressive stenosis**		
	f	%	f	%	f	%	
Class II	0	0%	8	21.05%	3	6.67%	11
Class III	0	0%	14	36.84%	9	20%	23
Class IV	0	0%	7	18.42%	14	31.11%	21
Class V	0	0%	9	23.68%	19	42.22%	28
Total	**0**	**100%**	**38**	**100%**	**45**	**100%**	**83**
Positivity Rate	**0%**		**42,10%**		**73,33%**		

Similar with forceps biopsy, needle aspiration is done only in infiltrative and obstructive stenosis. In Infiltrative stenosis we obtained 1 Class II result (25%), 1 Class III result (25%), and 2 Class V results (50%), with a positivity rate of 50%. In obstructive stenosis, we obtained 3 Class II results (42.86%), 1 Class IV result (14.29%) and 3 Class V results (42.86%), thus brought a positivity rate of 57.15%.

Table 6. Positivity Rate for Needle aspiration, based on FOB Results

Needle aspiration results	**FOB results**						**Total**
	Compressive stenosis		**Infiltrative stenosis**		**Compressive stenosis**		
	f	%	f	%	f	%	
Class II	0	0%	1	25%	3	42.86%	4
Class III	0	0%	1	25%	0	0%	1
Class IV	0	0%	0	0%	1	14.29%	1
Class V	0	0%	2	50%	3	42.86%	5
Total	**0**	**100%**	**4**	**100%**	**7**	**100%**	**11**
Positivity Rate	**0%**		**50%**		**57,15%**		

DISCUSSION

Based on our study, Most patients underwent FOB for diagnostic purposes for the suspicion of lung mass. Most of our patients are male, which is consistent with national data which states that lung cancer are more prevalent in male, compared to female.[11,12] Most of our patients also aged 40 years or more, which is also consistent with other studies regarding the age limit of increased risk for lung cancer. [13,14] It is well known that lung cancer incidence increased with age, even with smoking cessation; however, its growth is slower in ex-smoker compared to current smoker.[5,12] An age of less than 50 year old has a substantially lower risk of lung cancer, with 65-74 year old as the most prevalent age group with risk of contracting lung cancer.[5]

A study in 231 patients underwent FOB procedure in Nepal found that the most common indication for FOB as radiological abnormality (90.2%), followed by diffuse pulmonary infiltrates (4.3%). Endobronchial growth is the most common FOB finding (47.8%).[4] In our study, the combination of endobronchial growth (obstructive stenosis) and endobronchial infiltration (infiltrative stenosis) was the most common FOB finding (54.7%) followed by external compression (compressive stenosis) (28.81%). Pathologic examinations from Nepal study found that 53.8% of the cases were malignant,4 while in our study the number is substantially lower (25.51%). This may be caused by several factors. Most of our lung cancer patients came to our hospital in late stages of cancer with relatively extensive airway involvement, in which FOB procedures (i.e. biopsy) may

yield a greater risk (i.e. massive bleeding) than its benefit. In such cases, other alternative of diagnosis methods were done to conclude the diagnosis. A cohort study also states that central airway obstruction only comprises about 13% cases of all newly-diagnosed case of lung cancer; these cases were mainly diagnosed using chest computed tomography (CT) scan. However, CT failed to identify these obstruction in 31% of cases.[15] This emphasize the importance of FOB to evaluate the airway, mainly for obstruction, in the suspicion of lung cancer patients.

Out of all FOB procedures, Forcep biopsy is the method with highest diagnostic success rate. In our study, overall positivity rate for biopsy is 59.03%. However, this rate increases significantly (73.33%) in the case of endobronchial lesion (obstructive stenosis) FOB finding. Similarly, overall positivity rate for needle aspiration is 54.55%, which slightly increases (57.15%) in the setting of endobronchial lesion (obstructive stenosis) FOB finding. These increases were not seen in infiltrative stenosis in both procedures (forceps biopsy and needle aspiration), mainly due to the similar reason above, in which a well-demarcated intrabronchial lesion is unable to be vizualized well enough to be sampled using needle aspiration and/or biopsy, due to extensive necrosis and bleeding of infiltrative tissue in the airway seen in the FOB. These numbers are quite similar to previous studies, which showed 66.3% success rate of biopsy in FOB with visible endobronchial lesion.[16] Another study in 151 patients with endobronchial lesion showed a 69.6% success rate of biopsy. However, this study also emphasized the importance of sample eligibility; It states that diagnostic success rate increases by 2.6-5.2 fold when the sample is viable and not necrotic-predominant.[9,17]

For cases in which biopsy and/or needle aspiration could not be done due to any reasons (mainly due to high risk of bleeding, hemodynamical instability, etc.), bronchial brushing and washing may be done, such as in our study. In our study, total positivity rate of bronchial washing and brushing was 9.88% and 21.92%, respectively; These rates increased substantially in the case of infiltrative stenosis FOB finding (17.54% and 38.24%, respectively), higher compared than in case of endobronchial lesion (obstructive stenosis). These findings are logical, considering that in infiltrative stenosis, infiltrative tissue in the airway were more diverse compared to those with purely endobronchial lesion without infiltration of the bronchial wall, make it easier to be obtained using bronchial washing and/or brushing. These findings were quite similar with a similar previous study in India which found a positivity rate of bronchial washing and brushing to be 7.3% and 35.4%, respectively.[18] A study also found that bronchial brushing had moderate sensitivity (0.67, 95% CI) and high specificity (0.91, 95% CI) to diagnose lung cancer, including peripheral lung lesion.[19] Furthermore, compared to forceps biopsy, bronchial brushing and washing have relatively low incidence of severe side effects, thus able to be done in most patients.

In conclusion, FOB is still a mainstay method in diagnosis of lung cancer. The choice of sampling procedures should be based on FOB findings; In the case of infiltrative or obstructive stenosis, forceps biopsy should be done whenever possible. In the case of contraindication of said technique, i.e. risk of massive bleeding, bronchial washing and/or brushing were also valuable in obtaining the diagnosis.

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