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Outcomes of Suspected Thoracic Malignancy Patients with Initial non-Diagnostic Bronchoscopy

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Abstract:

Introduction: Introduction: One of the most common causes of cancer-related mortality is lung cancer, and bronchoscopy is a crucial diagnostic procedure for the disease. The characteristics of the patient, chest imaging, the existence of an endobronchial lesion, and the diagnostic methods used all affect the bronchoscope's diagnostic yield.

Aim of the study: Assessment of the outcome of patients who suspected thoracic malignancy with an initial non-diagnostic bronchoscope and evaluate the predictive value of diagnostic bronchoscopy.

Subjects and Methods: This was a retrospective cohort study conducted at the chest department, Fayoum University Hospital during the period of January 2021 to January 2023 on all adult patients who suspected thoracic malignancy and underwent flexible fiberoptic bronchoscopy with transbronchial biopsies or endobronchial biopsies and the undiagnosed patients were followed up.

Results: Our study was held on 175 patients who were suspected to have thoracic malignancy. 89(50.9%) patients were diagnosed by bronchoscopy, and 86(49%) patients were not diagnosed by bronchoscopy. From the diagnostic group (96.7%) had malignancy and (3.3%) had another diagnosis, but in the non-diagnostic group (82.6%) had malignancy, (6.9%) had other diagnosis, (5.8%) resolved on follow-up and (4.7%) lost to follow.

Conclusions: The flexible bronchoscopy technique is a safe procedure with high diagnostic yield in patients suspected of thoracic malignancy and an increased chance of diagnosis in patients with hemoptysis, lung mass and endobronchial lesions. Patients who have a non-diagnostic bronchoscopy should be closely monitored. when necessary, ordering additional diagnostic tests.

Keywords: Bronchoscopy, Endobronchial biopsy, Transbronchial biopsy, thoracic malignancy.

1. Introduction

Lung cancer accounts for the majority of cancer-related fatalities globally, with a 17% 5-year survival rate following diagnosis [1]. Those who receive a diagnosis at an advanced stage typically have a very bad prognosis; in contrast, those who receive a diagnosis at an earlier stage have a 5-year survival rate of >70% [2]. Cigarette smoking habits are closely associated with both the incidence and death of lung cancer [3]. One of the variables influencing the prognosis and course of treatment for lung cancer is lung cancer staging, which is an evaluation of the extent to which the cancer has spread from its original site [4].

Through screening programs, individuals who do not yet exhibit signs of lung cancer may have their lung tumors discovered early enough to be effectively treated and have a lower death rate [5].

The flexible fiberoptic bronchoscope [FFB] is an important diagnostic tool for lung disorders. The indications and the diagnostic methods used determine the diagnostic yield of FFB [6]. For medical professionals treating patients with lung disorders, bronchoscopy is a vital tool. Ever since Shigeto Ikeda introduced flexible bronchoscopy to clinical practice in 1966, it has become a vital diagnostic and therapeutic tool for patients with lung illnesses [7].

So, the current study aimed to assess the outcome of patients who suspected thoracic malignancy with an initial non-diagnostic bronchoscope and evaluate the predictive value of diagnostic bronchoscopy.

2. Subjects and Methods

2.1. Subjects

This was a retrospective cohort study conducted at the chest department, Fayoum university hospital during the period of January 2021 to January 2023on all adult patients who suspected thoracic malignancy and underwent (FFB) with transbronchial biopsy (TBB), endobronchial biopsy (EBB). The diagnostic yield of the bronchoscope was defined as the ratio of the total number of diagnosed patients to the total number of patients undergoing the procedure. Undiagnosed Patients were followed after a bronchoscope.

All adult patients who suspected thoracic malignancy and underwent bronchoscopy with the following criteria of inclusion and exclusion.

Inclusion criteria

Those included all patients who suspected thoracic malignancy and fit for performing bronchoscope.

Exclusion criteria

All patients who underwent inspection bronchoscopy or bronchoalveolar lavage [BAL] only as these methods have low diagnostic value in lung cancer, who were not fit for performing bronchoscope as in the acute respiratory failure [unless the patient is intubated and mechanically ventilated], with uncorrected coagulation profile, and with life-threatening cardiac arrhythmias were excluded

Medical consent was taken from all participants.

2.2. Methods

The following data was collected retrospectively from medical records, radiological reports and bronchoscopy reports:

- Full medical history includes: (age, sex, smoking history, comorbidities, symptomatology) and clinical examination (general and local chest examination].
- CT-chest report.
- Bronchoscopy report include (bronchoscopy finding and way of biopsy) (**Figure 1A**).

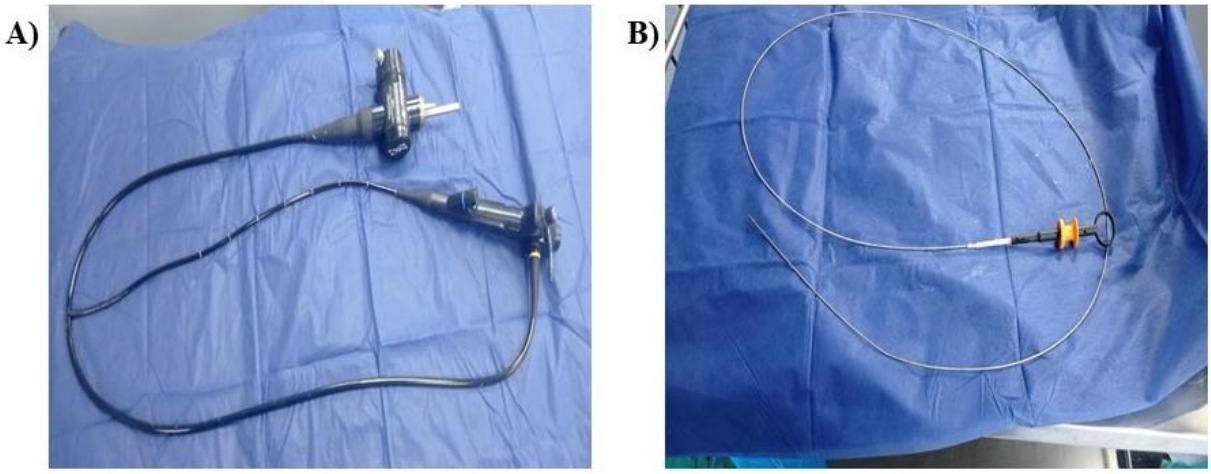

Figure 1: A) Flexible fiberoptic bronchoscopy (Olympus evis exera11), B) forceps biopsy [Endo-flex, K1618v-c] forceps.

The procedure was done depend on pervious risk evaluation under local anesthesia with conscious sedation or under general anesthesia. Endobronchial or transbronchial lung biopsies taken (**Figure 1B**).

- Histopathology report.
- Definition of diagnostic and non-diagnostic bronchoscopy: A bronchoscope was considered diagnostic when histopathology established a diagnosis with the bronchoscope. All other patients with non-established

histopathology with bronchoscopy or who need follow-up were considered non-diagnostic. All patients who had non-diagnostic bronchoscopes followed up to apply further diagnostic methods till reaching a proper diagnosis.

Patients who had non-diagnostic bronchoscopes performed other diagnostic procedures according to CT chest and bronchoscopy findings:

- Chest ultrasonography (US): A U.S-guided needle biopsy was taken using a true cut needle biopsy.
- CT chest guided biopsy using a true cut needle biopsy.
- Thoracoscopy used for non-diagnostic patients who developed pleural effusion.
- Surgery.

2.3. Statistical methods

Data were coded and entered using the statistical package for the Social Sciences (SPSS) version 28 (IBM Corp., Armonk, NY, USA). Data was summarized using mean and standard deviation for quantitative variables and frequencies (number of cases) and relative frequencies [percentages] for two categorical variables. Comparisons between groups were done using an unpaired t-test [8]. For comparing categorical data, a Chi-square test was performed. An exact test was used instead when the expected frequency was less than 5 [9]. Logistic regression was done to detect independent predictors of the diagnostic group [10]. *P*-values less than 0.05 were considered statistically significant.

3. Results

Our study was held on 175 patients who were suspected to have thoracic malignancy. Radiology, Bronchoscopy were done to all patients in bronchoscopy unit in Fayoum University hospital during period of January 2021 to January 2023. 89 (50.9%) of patients were diagnosed by bronchoscope, and 86 [49%] patients were not diagnosed by bronchoscope as shown in **Figure 2.**

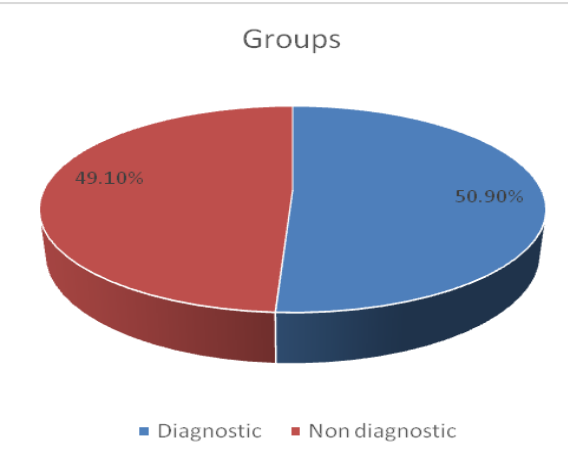

Figure 2: Diagnostic and non-diagnostic groups.

The age of the study population showed no statistically significant difference between the two groups with mean age of diagnostic group (59.57 ±13.06) while mean age of non-diagnostic group (59.47 ±12.84) as shown in **Table 1.**

Regarding demographic characters of the study population including (sex, smoking history, DM, HTN and COPD), there is significant statistical difference between diagnostic and non-diagnostic group as regarding COPD patients. There is more value in COPD patients in non-diagnostic group versus diagnostic group (23.3%) versus (11.2%) respectively as shown in **Table 1.**

Table 1: Demographic characters of the study population.

Variables		Diagnostic	Non-diagnostic	*P*-value
Age (years)		59.7 ±13.06	59.37 ±12.69	0.918
Sex	**Male**	65 (73%)	58 (67.4%)	0.418
	Female	24 (27%)	28 (32.6%)	
Smoking	**Smoker**	39 (43.8%)	32 (37.2%)	0.585
	Ex-smoker	22 (24.7%)	21 (24.4%)	
	Non-smoker	28 (31.5%)	33 (38.4%)	
DM		24 (27%)	17 (19.8%)	0.261
HTN		35 (39.3%)	33 (38.4%)	0.897
COPD		10 (11.2%)	20 (23.3%)	0.035

Regarding symptomatology of the study groups including dyspnea, cough, hemoptysis and chest pain showing statistically significant difference s regard dyspnea and chest pain, there is more value in non-diagnostic group as dyspnea represent [36%) in diagnostic group and (52.3%) in non-diagnostic group, chest pain represents (39.3%) in diagnostic group and (57%) in non-diagnostic group. While hemoptysis had more value in diagnostic group which represent (44.9%) in diagnostic group and (8.1%) in non-diagnostic group as shown in **Table 2.**

Table 2: Symptomatology of the study groups.

Variables	Diagnostic	Non-diagnostic	*P*-value
Dyspnea	32 (36%)	45 (52.3%)	0.029
Cough	26 (29.2%)	29 (33.7%)	0.521
Hemoptysis	40 (44.9%)	7 (8.1%)	< 0.001
chest pain	35 (39.3%)	49 (57%)	0.019

Regarding radiological findings [CT chest] of the study groups including lung mass, bilateral nodules, pleural effusion, un-resolving pneumonia and cavitary lesion, there is only a statistically significant difference in lung mass which represent [94.4%) in diagnostic group and [84.9%) in non-diagnostic group as shown in **Table 3.**

Table 3: Radiological findings in the study groups.

Variables	Diagnostic		non-diagnostic		*P*-value
	Count	%	Count	%	
Mass	84	94.4%	73	84.9%	0.039
Bilateral nodules	18	20.2%	17	19.8%	0.940
Pleural effusion	18	20.2%	11	12.8%	0.186
Un- resolving pneumonia	5	5.6%	7	8.1%	0.509
Cavitary lesion	0	0.0%	3	3.5%	----

Regarding bronchoscopy finding of the study groups showing statistically significant difference in endobronchial lesion and extra luminal compression. Endobronchial lesion had high diagnostic yield which represent (53.9%) of diagnostic group and (3.5%) in non-diagnostic group. While extra luminal compression represents (19.1%) of diagnostic group and (52.3%) in non-diagnostic group, infiltrating nodular mucosa represent (33.7%) in diagnostic group and (47.7%) in non-diagnostic group as shown in **Table 4.**

Table 4: Bronchoscopy finding of the study groups.

Variables	Diagnostic		Non-diagnostic		*P*-value
	Count	%	Count	%	
Endo bronchial lesion	48	53.9%	3	3.5%	< 0.001
Extra luminal compression	17	19.1%	45	52.3%	< 0.001
Infiltrating nodular mucosa	30	33.7%	41	47.7%	0.060

Comparison between diagnostic and non-diagnostic group according to way of bronchoscopy biopsy showing statistically significant difference between groups. Transbronchial biopsy represent [46.1%) of diagnostic group and [96.5%) in non-diagnostic group. While endobronchial biopsy had high diagnostic yield represent [53.9%) of diagnostic group and [3.5%) of non-diagnostic group as shown in **Table 5.**

Table 5: Comparison between diagnostic and non-diagnostic group according to bronchoscopy procedures.

Variables	Diagnostic		Non-diagnostic		*P*-value
	Count	%	Count	%	
Way of biopsy	41	46.1%	83	96.5%	< 0.001
	48	53.9%	3	3.5%	

Methods of diagnosis in group of patients not diagnosed by bronchoscope showing (57%) of patients diagnosed by US guided biopsy, (37,2%) diagnosed by CT guided biopsy, (3.5%) diagnosed by surgery and (2.3%) diagnosed by thoracoscopy as shown in **Table 6.**

Table 6: Methods of diagnosis in non-diagnostic group

Variables		Non-diagnostic	
		Count	**%**
Method of diagnosis	**US guided**	49	57.0%
	CT guided	32	37.2%
	Surgery	3	3.5%
	Thoracoscopy	2	2.3%

The following flow chart is the summary of different outcomes (**Figure 4**).

Figure 4: Flow chart show outcome of initial bronchoscopy.

Regarding histopathology report for biomicroscopically diagnosed patients, showing (24.7%) patients had adenocarcinoma, (32.6%) patients had squamous cell carcinoma, (7.9%) patients had large cell carcinoma, (21.3%) patients had small cell carcinoma, (1.1%) patients had malignant in situ, (1.1%) patients had foreign body granuloma, (2.2%) patients had mycobacterium tuberculosis, (5.6%) patients had lymphoma, (3.4%) patients had carcinoid tumor as shown in **Table 7.**

Table 7: Histopathology in the group diagnosed by bronchoscope.

Variables		Diagnostic		P value
		Count	%	
Histopathology report	**Adenocarcinoma**	22	24.7%	0.271
	Squamous cell carcinoma	29	32.6%	
	Large cell carcinoma	7	7.9%	
	Small cellcarcinoma	19	21.3%	
	Malignant *in situ*	1	1.1%	
	Foreign bodygranuloma	1	1.1%	
	Mycobacterium Tuberculosis	2	2.2%	
	Lymphoma	5	5.6%	
	Carcinoid tumor	3	3.4%	

Regarding histopathology report in the group not diagnosed by bronchoscopy showing that (32.6%) patients had adenocarcinoma, (24.4%) squamous cell carcinoma, (8.1%) large cell carcinoma, (16.3%) small cell carcinoma, (2.3%) foreign body granuloma, (2.3%) sarcoidosis, (2.3%) mycobacterium tuberculosis, (1.2%) lymphoma, (5.8%) resolved on follow up, and (4.7%) patients lost to follow up as shown in **Table 8.**

There is statistically significant difference of diagnostic value of bronchoscope with presence of lung mass in CT chest, endobronchial lesion in bronchoscopy and hemoptysis as shown in **Table 9**.

Table 8: Histopathology in the group not diagnosed by bronchoscope.

Variables		Count	%
Pathology report (non-diagnostic)	**Adenocarcinoma**	28	32.6%
	Squamous cell carcinoma	21	24.4%
	Large cell carcinoma	7	8.1%
	Small cellcarcinoma	14	16.3%
	Lost to follow	4	4.7%
	Resolved on follow up	5	5.8%
	Foreign bodygranuloma	2	2.3%
	Sarcoidosis	2	2.3%
	Mycobacterium Tuberculosis	2	2.3%
	Lymphoma	1	1.2%

Table 9: Final model.

Variables		B	S.E.	Wald	*P*-value	OR	95% C.I.	
							Lower	Upper
Diagnostic group	**Mass (CT chest)**	1.410	0.713	3.916	0.048	4.096	1.014	16.556
	Endo bronchial lesion (bronchoscopy)	3.269	0.653	25.073	<0.001	26.286	7.312	94.501
	Hemoptysis	2.030	0.530	14.689	<0.001	7.614	2.696	21.501

4. Discussion

Lung cancer remains the primary cause of cancer-related fatalities in both men and women worldwide [11]. The flexible fiberoptic bronchoscope (FFB) is an important diagnostic tool for lung conditions. The indications and diagnostic methods used determine the diagnostic yield of FFB [6].

The flexible bronchoscope has become the recommended procedure for all patients suspected of having bronchogenic carcinoma, showing a sensitivity for central airway lesions of 88% and an overall sensitivity for all modalities in the diagnosis of peripheral disease of 78%, varying from 36% to 88% according to the biopsy method used [12]. Furthermore, it allows for correct surgical planning through the evaluation of the surface, site, and extent of the tumor, vocal cord motility, and airway lumen [13].

In this study, we reported the follow-up and outcomes of patients who had a non-diagnostic bronchoscopy. In addition, we compared diagnostic and non-diagnostic bronchoscopies and evaluated the predictors for a diagnostic bronchoscopy. In our study, 175 patients suspected of having thoracic malignancy underwent FFB; 89 (50.9%) were diagnosed by bronchoscopy, while 86 (49.1%) were not diagnosed by bronchoscopy and were diagnosed by other methods (US-guided biopsy, CT-guided biopsy, surgery, and thoracoscopy). The non-diagnostic group of patients was followed up until diagnosis.

The mean age of the study population was 59.47±12.84 years. The study included 70.3% male and 29.7% female patients. Adewole et al. (2017) reviewed FFB in respiratory care: diagnostic yield and complications, agreeing with us as their study included 163 patients who underwent FFB with a mean age of 54.8±19 years but disagreeing as their study included 56.6% male and 43.4% female patients [14].

Gaddam et al. (2020) reviewed the role of bronchoscopy in patients with suspected thoracic malignancy on 311 patients suspected of thoracic malignancy. They agreed with us as the mean age group of the study population was 60±12.62 years, with males representing 79% and females 21% of the study population [15].

In this study, 89 patients (50.9%) had diagnostic bronchoscopy; 96.7% of those patients had lung cancer, and 3.3% had other diagnoses (TB and foreign body). 86 patients (49.1%) had non-diagnostic bronchoscopy; lung cancer represented 82.6% of those patients, and other diagnoses (foreign body, TB, sarcoidosis) represented 6.9%. 5.8% of the non-diagnostic group resolved on follow-up, and 4.7% were lost to follow-up.

Gaddam et al. (2020) agreed with us as in their study bronchoscopy was diagnostic in 49.3% and non-diagnostic in 50.7%, but they disagreed as lung cancer represented 63% of the diagnostic group while in the non-diagnostic group, lung cancer represented 11.3%. Other diagnoses represented 2%, 32.3% resolved on follow-up, and 54.4% were lost to follow-up [15]. Joos et al. (2006) reviewed the diagnostic yield of flexible bronchoscopy in current clinical practice, disagreeing with us as the diagnostic yield of FFB for detection of thoracic malignancy was 75.5% [16]. Adewole et al. (2017) also disagreed with us as the diagnostic yield of bronchoscopy was 62% [14].

This study matched with Venkatram et al. (2019), who conducted a study on 684 patients to detect the role of bronchoscopy in lung cancer, showing that bronchoscopy was diagnostic in 51% and non-diagnostic in 49% [17]. In our study, there was no difference in smoking history and selected comorbidities between the two groups of the study. COPD was the only significant comorbid condition in the non-diagnostic group. This matched with

Venkatram et al. (2019), who found no difference in demographic data, smoking history, or comorbid conditions between the groups [17]. Gaddam et al. (2020) also agreed with us, finding no difference in demographic data, smoking history, or comorbid conditions between the groups [15].

In this study, there was a significant difference between the diagnostic and non-diagnostic groups regarding hemoptysis, which had a high diagnostic yield, representing 44.9% of the diagnostic group, while in the non-diagnostic group it represented 8.1%. This mismatched with Joos et al. (2006), where hemoptysis represented 5.6% in the diagnostic group [16]. Gaddam et al. (2020) also disagreed with us, finding hemoptysis represented 10.4% in the diagnostic group and 1.7% in the non-diagnostic group [15]. Venkatram et al. (2019) also mismatched with us, finding hemoptysis represented 6.8% of the diagnostic group and 5.4% in the non-diagnostic group [17].

Dyspnea in our study represented 36% of the diagnostic group and 52.3% of the non-diagnostic group, which agreed with Gaddam et al. (2020), who showed 30.4% in the diagnostic group developed dyspnea, while it was 37.5% in the non-diagnostic group [15]. This mismatched with Venkatram et al. (2019), who found dyspnea represented 43.6% in the diagnostic group and 42.2% in the non-diagnostic group with no significant difference between the two groups [17].

In our study, chest pain was the most common symptom, representing 48%, followed by dyspnea (44%), cough (31%), and hemoptysis (26%). This mismatched with Sareen et al. (2016), who discussed the diagnostic accuracy of BAL and FNAC in lung malignancy; in their study, cough was the most common symptom, representing 62%, followed by dyspnea (55%), chest pain (45%), and hemoptysis (20%) [18]. This also mismatched with Venkatram et al. (2019), who found cough was the most common symptom, representing 58%, followed by dyspnea (42.9%) [17].

In our study, regarding chest imaging, lung mass was the most common radiological pattern and had a better diagnostic yield by bronchoscopy. In the diagnostic group, lung mass represented 94.4%, bilateral nodules 20.2%, and pleural effusion 20.2%, while in the non-diagnostic group, lung mass represented 84.9%, bilateral nodules 19.8%, and pleural effusion 12.8%. This mismatched with Gaddam et al. (2020), who showed the most common radiological pattern was pulmonary infiltrate (37%), followed by lung mass (20.9%), with no significant difference between the diagnostic and non-diagnostic groups regarding chest imaging [15]. Venkatram et al. (2019) also disagreed with us, finding bilateral pulmonary infiltrate was the most common radiological pattern in the diagnostic group, at 29.4%, versus 21% in the non-diagnostic group [17].

In this study, endobronchial biopsy (EBBX) correlated with better diagnostic yields, representing 53.9% of the diagnostic group and 3.5% of the non-diagnostic group, while transbronchial biopsy (TBBX) represented 46.1% of the diagnostic group and 96.5% in the non-diagnostic group. Gaddam et al. (2020) agreed with us as EBBX had better diagnostic yield, representing 40.5% of the diagnostic group and 23.4% in the non-diagnostic group, while TBBX represented 71.9% in the diagnostic group and 87.34% in the non-diagnostic group [15]. Venkatram et al. (2019) mismatched with us as EBBX was 30.3% of the diagnostic group and 21.2% in the non-diagnostic group with better diagnostic yield for EBBX, while TBBX was 79.1% of the diagnostic group and 89.5% of the non-diagnostic group [17].

In this study, histopathological diagnosis showed that 50 patients (28.6%) had squamous cell carcinoma, 50 patients (28.6%) had adenocarcinoma, and 33 patients (18.9%) had small cell carcinoma, with no statistically significant difference between bronchoscopy and other diagnostic methods regarding the type of malignancy. Sareen et al. (2016) mismatched with us, as in their study, squamous cell carcinoma represented the most common type (51%), followed by small cell carcinoma (27%) and adenocarcinoma (5.6%) [18]. Gaddam . et al. also disagreed with us regarding histopathological diagnosis, finding adenocarcinoma represented 15%, squamous cell carcinoma 7.3%, and small cell carcinoma 1.2% [15].

In our study, during the follow-up of the non-diagnostic group, 4.6% of patients were lost to follow-up, and 5.8% of patients suspected of thoracic malignancy and initial non-diagnostic bronchoscopy had their lesions resolved on follow-up. This mismatched with Gaddam . et al., who had 54% of the non-diagnostic group lost to follow-up and 32% of these patients had a resolved lesion on follow-up [15].

Also, Joos et al. (2006) reviewed the diagnostic yield of flexible bronchoscopy in current clinical practice and disagreed with us, finding the diagnostic yield of FFB for the detection of thoracic malignancy to be 75.5% [16]. Adewole et al. (2017) also disagreed with us, reporting a diagnostic yield of 62% for bronchoscopy [14]. This study matched with Venkatram et al. (2019), who conducted a study on the role of bronchoscopy in lung cancer on 684 patients, showing that bronchoscopy was diagnostic in 51% and not diagnostic in 49% [17].

In our study, there was no difference in smoking history and selected comorbidities between the two groups. COPD was the only significant comorbid condition in the non-diagnostic group. This matched with Venkatram et al. (2019), as there was no difference in demographic data, smoking history, or comorbid conditions between the groups [17]. Gaddam et al. (2020) also agreed with us, finding no

difference in demographic data, smoking history, or comorbid conditions between the groups [15].

In this study, there was a significant difference between the diagnostic and non-diagnostic groups regarding hemoptysis, which had a high diagnostic yield, representing 44.9% of the diagnostic group, while in the non-diagnostic group it represented 8.1%. This mismatched with Joos et al. (2006), where hemoptysis represented 5.6% in the diagnostic group [16]. Gaddam et al. (2020) disagreed with us, finding hemoptysis represented 10.4% in the diagnostic group and 1.7% in the non-diagnostic group [15]. Venkatram et al. (2019) also mismatched with us, finding hemoptysis represented 6.8% of the diagnostic group and 5.4% in the non-diagnostic group [17].

Dyspnea in our study represented 36% of the diagnostic group and 52.3% of the non-diagnostic group, which agreed with Gaddam et al. (2020), who showed 30.4% in the diagnostic group and 37.5% in the non-diagnostic group [15]. This mismatched with Venkatram et al. (2019), where dyspnea represented 43.6% in the diagnostic group and 42.2% in the non-diagnostic group, with no significant difference between the two groups [17].

In our study, chest pain was considered the most common symptom, representing 48%, followed by dyspnea (44%), cough (31%), and hemoptysis (26%). This mismatched with Sareen et al. (2016), who discussed the diagnostic accuracy of BAL and FNAC in lung malignancy. In their study, cough was the most common symptom, representing 62%, followed by dyspnea (55%), chest pain (45%), and hemoptysis (20%) [18]. This also mismatched with Venkatram et al. (2019), where cough was the most common symptom, representing 58%, followed by dyspnea, which represented 42.9% [17].

In our study regarding chest imaging, lung mass was the most common radiological pattern and had a better diagnostic yield by bronchoscopy. In the diagnostic group, lung mass represented 94.4%, bilateral nodules 20.2%, and pleural effusion 20.2%, while in the non-diagnostic group, lung mass represented 84.9%, bilateral nodules 19.8%, and pleural effusion 12.8%. This mismatched with Gaddam et al. (2020), who showed the most common radiological pattern was pulmonary infiltrate (37%), followed by lung mass (20.9%), with no significant difference between the diagnostic and non-diagnostic groups regarding chest imaging [15]. Venkatram et al. (2019) also disagreed with us, finding that bilateral pulmonary infiltrate was the most common radiological pattern in the diagnostic group, representing 29.4%, versus 21% in the non-diagnostic group [17].

In this study, endobronchial biopsy correlated with better diagnostic yields, representing 53.9% of the diagnostic group and 3.5% of the non-diagnostic group, while

transbronchial biopsy represented 46.1% of the diagnostic group and 96.5% of the non-diagnostic group. Gaddam et al. (2020) agreed with us, finding EBBX had a better diagnostic yield, representing 40.5% of the diagnostic group and 23.4% in the non-diagnostic group, while TBBX represented 71.9% in the diagnostic group and 87.34% in the non-diagnostic group [15]. Venkatram et al. (2019) mismatched with us, finding EBBX was 30.3% of the diagnostic group and 21.2% in the non-diagnostic group, with better diagnostic yield for EBBX. TBBX was 79.1% of the diagnostic group and 89.5% of the non-diagnostic group [17].

In this study, histopathological diagnosis showed that 50 patients (28.6%) had squamous cell carcinoma, 50 patients (28.6%) had adenocarcinoma, and 33 patients (18.9%) had small cell carcinoma, with no statistically significant difference between bronchoscopy and other diagnostic methods regarding the type of malignancy. Sareen et al. (2016) mismatched with us, finding that in their study, squamous cell carcinoma was the most common type (51%), followed by small cell carcinoma (27%) and adenocarcinoma (5.6%) [18]. Gaddam et al. (2020) also disagreed with us regarding histopathological diagnosis, finding that adenocarcinoma represented 15%, squamous cell carcinoma represented 7.3%, and small cell carcinoma represented 1.2% [15].

In our study, during the follow-up of the non-diagnostic group, 4.6% were lost to follow-up, and 5.8% of patients suspected of thoracic malignancy and with an initial non-diagnostic bronchoscopy had the lesion resolved on follow-up. This mismatched with Gaddam et al. (2020), who found that 54% of the non-diagnostic group were lost to follow-up, and 32% of these patients had a resolved lesion on follow-up [15].

There are various advantages to our study. First, there was a precise description of a diagnostic and non-diagnostic bronchoscope. Second, it is one of the few studies examining the results of non-diagnostic bronchoscopy patients and following them, providing fresh information on the outcomes of these operations. In order to find characteristics indicative of a diagnostic process, we looked at the link between clinical and radiological markers in our third analysis.

Conclusion

Flexible fiberoptic bronchoscopy is a safe procedure with a high diagnostic yield in patients suspected of thoracic malignancy. It increases the chance of diagnosis in patients with lung mass, endobronchial lesions, or those who presented with hemoptysis. The clinical implications for the pulmonologist are to follow patients with a non-diagnostic procedure and to perform further diagnostic tests when indicated. This was a single retrospective study in an inner-city community university hospital, so most

patients had unique demographic features. Bronchoscopies were performed by multiple operators, which may lead to differences in the yield of the procedures. Although multiple attempts to contact patients with an initial non-diagnostic bronchoscopy were made, some patients were lost to follow-up. The number of bronchoscopy biopsies taken was not documented in the bronchoscopy report. Methods of bronchoscopy biopsies were limited to EBBX and TBBX, with EBUS or TBNA biopsies not available. We recommend further studies on a larger number of patients using various methods of bronchoscopy biopsies. Further studies are needed to evaluate the relation between the number of bronchoscopy biopsies and the outcome of diagnostic bronchoscopy.

Ethical approval: This study was reviewed by the faculty of medicine Research Ethical committee in Fayoum university hospital numbered (M 657) in its session (104).

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Conflicts of Interest: All authors declare they have no conflicts of interest.

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