

ORIGINAL ARTICLE

Role of Bronchial Brush and Bronchial Wash Cytology in the Diagnosis of Lung Cancer: A Comparative Study

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Abstract:

Background: Lung cancer is one of the most common cancer around the world which is associated with significant mortality. Cytological techniques are used as first-line diagnostic tools in suspected lung tumors, based on which crucial management decisions are made. Bronchial brush (BB) and bronchial wash (BW) are two commonly employed techniques with variable diagnostic yield of lung cancer.

Objective: The main objective of the present study was to compare cytological pattern of Bronchial Wash and Bronchial Brush in diagnosing Lung Cancer.

Methods: This cross-sectional comparative study was conducted in the admitted patients under Department of Respiratory Medicine, National Institute of Diseases of the Chest & Hospital (NIDCH), Mohakhali, Dhaka, between January 2022 and December 2022. A total of 55 patients, clinically suspected of lung cancer and had a positive report on bronchial biopsy were included in the study. After written informed consent, a rapid diagnostic workup was made by clinical history, thorough physical examinations and necessary investigations. Bronchial biopsy was considered as a gold standard and cytology samples of bronchial brush (BB) and bronchial wash (BW) were obtained for the prediction of lung cancer. Sensitivity, specificity, accuracy, positive predictive value and negative predictive value were calculated separately for BB and BW. Collected data were compiled and appropriate analyses were done by using computer-based software, Statistical Package for Social Sciences (SPSS) version 25.0.

Results: In this study, out of 55 patients, male patients were predominant (65.5%), the male to female ratio was 1.9:1 with mean age was 54.7±12.1 years. More than two third (69.1%) patients were smoker. Among the bronchial brush specimens squamous cell carcinoma was found in 28(50.9%) cases, adenocarcinoma in 9(16.4%), small cell carcinoma in 7(12.7%), carcinoid lung cancer in 2(3.6%) and remaining 9(16.4%) cases were normal. Histological cell type in bronchial wash were 10(18.2%) squamous cell carcinoma, 4(7.3%) adenocarcinoma, 13(23.6%) small cell carcinoma, 1(1.8%) carcinoid lung cancer and 27(49.1%) normal finding. Sensitivity of bronchial brush was 82.8% in squamous cell carcinoma, 66.7% in adenocarcinoma, 55.6% in small cell carcinoma and 40.0% in carcinoid. Sensitivity of bronchial wash was 34.5% in squamous cell carcinoma, 33.3% in adenocarcinoma, 88.9% in small cell carcinoma and 20.0% in carcinoid.

Conclusion: Our results show that bronchial brush is a much superior technique in diagnosing lung cancer, as it demonstrates far better sensitivity in comparison to bronchial wash. So, this study concluded that the diagnostic yield of bronchial brush cytology is higher than that of bronchial wash cytology in the lung. Bronchial brush has better efficacy in typing squamous cell carcinoma followed by adenocarcinoma, carcinoid while bronchial wash is superior in typing small cell carcinoma.

Key words: Bronchial brush, bronchial wash, bronchial biopsy, lung.

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Introduction:

Lung cancer is one of the most common cause of death from cancer worldwide and causing 1.4 million deaths per year¹. It's the leading cause of cancer deaths in developed countries and is also rising at intimidating rates in developing countries². In Bangladesh, the circumstance of lung cancer is 16.7% of all cancers³. The most common cancer (25%) among male cancer patients with a 6.1:1 male-female ratio³. Prognosis of lung cancer is explosively related the stage of cancer at the time of diagnosis. Time survival rate ranges from 5% for IV stage and 80% for stage I cancers.⁴ So early diagnosis is essential for improving the prognosis of lung cancer. The only hope of combating the disease successfully remains in diagnosing the disease at the earliest possible stage.⁵ Procedures used to diagnose lung tumors should be accurate as far as possible and should provide an optimal characterization of tumor type. Endoscopic examination of the tracheobronchial tree is the most proven valuable method in diagnosing lung cancer. Its advent revolutionized respiratory cytology as techniques like a bronchial brush (BB), bronchial wash (BW), bronchoalveolar lavage and bronchial biopsy became more easy, accessible and more popular⁶. Cytological diagnosis of respiratory samples obtained by flexible fiberoptic bronchoscope is the most commonly used technique and is safer, economical and provides quick results. Both BW and BB used concurrently are effective in the diagnosis of lung tumor as it preserves both cells and architectural arrangement. The best result can be obtained by combining these techniques with radiological and histological findings⁷. The role of bronchial washings and brushings under bronchoscopic control for the cytological diagnosis of lung cancer has been reported by various studies. Since it is a cost-effective and dependable way of showing for early lung cancer it can be extensively applied especially in developing countries. Presently, bronchial washing and brushing studies are routinely employed for the diagnosis of pulmonary neoplasm in different parts of the globe as well as in Bangladesh⁸. This technique can be used in conjunction with radiological and histological findings to give 100% accuracy in the diagnosis of lung cancer. Most of the authors agree that bronchial washings do not add significant

information to that obtained from the brushings and that the preparations are of inferior quality⁹. The common symptoms of presentation were cough of long duration and chest pain. Very few cases presented with hemoptysis, change of voice and difficulty in swallowing. Shortness of breath was seen only in patients having an associated chronic obstructive pulmonary disease or advanced disease¹⁰.

The availability of a reliable cytological investigative tool will enable us to diagnose lung cancer at an early stage making it amenable to treatment regimens that will ultimately affect the patient's survival. Therefore, the present study is based on the cytologic evaluation of bronchial brush and bronchial wash for the diagnosis of lung cancer. It will also provide the relative incidence of various cytological types of bronchogenic carcinoma diagnosed by these procedures in our population.

Materials and methods:

This cross-sectional comparative study was conducted in the admitted patients under Department of Respiratory Medicine, National Institute of Diseases of the Chest & Hospital, Mohakhali, Dhaka, between January 2022 and December 2022. A total of 55 patients, clinically suspected for lung cancer and had a positive report on bronchial biopsy were included in the study. Radiological lesion (Chest X-ray) suggestive of centrally placed malignancy, prominence of a hilar shadow with whiskering appearance, hilar/parahilar masses, mediastinal widening, complete or partial collapse of lung, central bronchial cancer on endoscopic findings visible by fibreoptic bronchoscopy, age more than 20 years and both sexes were included in the study. All bronchial carcinoma approaching carina, all peripheral lung lesion, significantly disabled patients due to poor general condition and patient who refused to enroll in this study were excluded from the study. Consecutive convenient (purposive) sampling was done. Data were collected in a pre-designed data collection sheet designed for the study. Informed written consent was obtained from the patients or attendants after full explanation of the details of the disease process. After admission, a rapid diagnostic work up was made by clinical history, through physical examinations and necessary investigations. Demographic information like age,

sex, occupation, smoking status, etc. were obtained. All patients were investigated for Blood for CBC and ESR, X-ray chest P/A and Lateral view, Sputum for AFB, Bleeding time and Clotting time ECG and Bronchoscopy considering. Bronchial biopsy as a gold standard, cytology samples of bronchial brush (BB) and bronchial wash (BW) were obtained for prediction of lung cancer.

Cytological and histological specimens were obtained by fiberoptic bronchoscopy under local anaesthesia. In bronchial washing sterile isotonic saline introduced into the bronchi bronchoscopically and washings from different broncho-pulmonary segments are reaspirated, then smears are made from centrifuged deposits. Few slides were air dried and fixed in 100% methanol for May-Grunwald Giemsa (MGG) staining. Few slides were immediately fixed in a 95% ethanol for Papanicolaou's staining. Bronchial brushing can be done following washings. The area of suspected malignancy was brushed two or three times; smears was immediately fixed in 95% alcohol and stained by Papanicolaou's method. Then a single specimen was taken for histological examination from the same area by forceps and stained with haematoxylin and eosin after being processed. The slides were examined under the microscope first with low power objectives (10X) and then the areas in the slides having cells were focused under the high-power objectives (40X) to confirm the cytological features. Specimens that showed malignant characteristics were classified as positive, while those with appearances suggestive.

Collected data were compiled and appropriate analyses were done by using computer based software, Statistical Package for Social Sciences (SPSS) version 25.0. Qualitative variables were expressed as percentage. Quantitative variables were expressed as mean $\pm$ SD. Sensitivity, specificity, accuracy, positive predictive value and negative predictive value were calculated for BB and BW in diagnosing lung tumors. Sensitivity was the percentage of cases in which biopsy proved cancer cases were rightly diagnosed by cytology. Specificity was percentage of cases that were not malignant on biopsy which were correctly diagnosed negative on cytology. Accuracy means fraction of patients whose conditions were correctly diagnosed by cytology. Chi square test was used

for qualitative variables as shown cross tabulations. P value of less than 0.05 was considered as significant.

Results:

In this study, out of 55 patients, more than one third (34.5%) cases belonged to age >60 years. Mean age was found 54.7 $\pm$ 12.1 years with range from 25 to 72 years. Almost two third 36(65.5%) cases were male and 19(34.5%) were female. Male to female ratio was 1.9:1. More than one fourth 15(27.3%) cases were service holder and housewives respectively (Table-1). More than two third (69.1%) cases were found smoker among them 21(55.3%) were smoked >20 pack/yr and 17(44.7%) were smoked <20 pack/yr (Table-2). Histological finding in bronchial biopsy were 29(52.7%) cases of squamous cell carcinoma (SCC) followed by 12(21.8%) adenocarcinoma (AC), 9(16.4%) small cell carcinoma (SCLC) and 5(9.1%) carcinoid lung cancer (Figure-1). Among the bronchial brush specimens squamous cell carcinoma was found in 28(50.9%) cases, adenocarcinoma in 9(16.4%), small cell carcinoma in 7(12.7%), carcinoid lung cancer in 2(3.6%) and remaining 9(16.4%) cases were normal. Histological cell type in bronchial wash were 10(18.2%) squamous cell carcinoma, 4(7.3%) adenocarcinoma, 13(23.6%) small cell carcinoma, 1(1.8%) carcinoid lung cancer and 27(49.1%) normal finding (Table-3). In squamous cell carcinoma of lung tumors, bronchial brush detected 24 out of 29 cases and bronchial wash detected 10 out of 29 cases. Thus bronchial brush showed better sensitivity and accuracy regarding typing of squamous cell carcinoma. In adenocarcinoma of lung tumors, bronchial brush detected 8 out of 12 cases and bronchial wash detected 4 out of 12 cases. Thus bronchial brush showed better sensitivity regarding typing of adenocarcinoma. In small cell carcinoma of lung tumors, bronchial brush detected 5 out of 9 cases and bronchial wash detected 8 out of 9 cases. Thus bronchial wash showed better sensitivity and accuracy regarding typing of small cell carcinoma. In carcinoid of lung tumors, bronchial brush detected 2 out of 5 cases and bronchial wash detected 1 out of 5 cases. Thus bronchial wash showed better sensitivity and accuracy regarding typing of carcinoid.

Sensitivity of bronchial brush was found 82.8% in squamous cell carcinoma, 66.7% in

adenocarcinoma, 55.6% in small cell carcinoma and 40.0% in carcinoid. Sensitivity of bronchial wash was found 34.5% in squamous cell carcinoma, 33.3% in adenocarcinoma, 88.9% in small cell carcinoma and 20.0% in carcinoid (Table 4 & 5).

Table-I

Demographic characteristics of the study patients (n=55)

Variables	Frequency	Percentage
Age (years)		
≤30	2	3.6
31-40	10	18.2
41-50	8	14.5
51-60	16	29.1
>60	19	34.5
Mean±SD	54.7	±12.1
Range (min-max)	25.0	-72.0
Sex		
Male	36	65.5
Female		19
Occupational status		
Service	15	27.3
Housewife	15	27.3
Farmer	14	25.5
Businessman	10	18.2
Retired	1	1.8

Table-II

Distribution of the patients according to smoking status (n=55)

Smoking status	Frequency	Percentage
Smoker	38	69.1
Non smoker	17	30.9

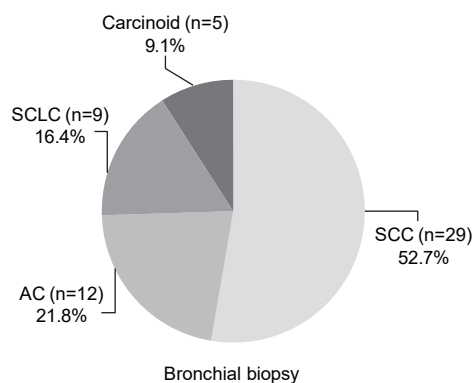


Fig.-1: Pie chart showing bronchial biopsy of the patients (n=55)

Table-III

Findings of bronchial brush and wash of the patients (n=55)

	Frequency	Percentage
Bronchial brush		
Squamous cell carcinoma	28	50.9
Adenocarcinoma	9	16.4
Small cell carcinoma	7	12.7
Carcinoid	2	3.6
Normal	9	16.4
Bronchial wash		
Squamous cell carcinoma	10	18.2
Adenocarcinoma	4	7.3
Small cell carcinoma	13	23.6
Carcinoid	1	1.8
Normal	27	49.1

Table-IV

Role of bronchial brush in subtype of lung cancer (n=55)

Bronchial brush	Validity test					P value
	Sensitivity	Specificity	Accuracy	PPV	NPV	
Squamous cell carcinoma	82.8	84.6	83.6	85.7	81.5	0.001
Adenocarcinoma	66.7	97.7	90.9	88.9	91.3	0.003
Small cell carcinoma	55.6	95.7	89.1	71.4	91.7	0.003
Carcinoid	40.0	100.0	94.5	100.0	94.3	0.007

P value reached from chi square test

Table-V

Role of bronchial wash in subtype of lung cancer (n=55)

Bronchial wash	Validity test					P value
	Sensitivity	Specificity	Accuracy	PPV	NPV	
Squamous cell carcinoma	34.5	100.0	65.5	100.0	57.8	0.001
Adenocarcinoma	33.3	100.0	85.5	100.0	84.3	0.001
Small cell carcinoma	88.9	89.1	89.1	61.5	97.6	0.001
Carcinoid	20.0	100.0	92.7	100.0	92.6	0.091

P value reached from chi square test

Discussion:

In the present study 55 patients, clinically suspected for carcinoma lung and had a positive report on bronchial biopsy are evaluated with bronchial brush and bronchial wash cytology, especially to determine the overall diagnostic yield of cytological techniques compared to histological diagnosis. Since the magnitude of carcinoma lung among various populations are still rising and the deadliest risk factor of cigarette smoking is still persisting, the control of the mortality due to carcinoma lung is possible only through early detection, advanced histological classification and specific treatment. Cytological techniques are getting more relevant especially with the bronchoscopic techniques and is a cost-effective screening method.

In this study it was observed that more than one third (34.5%) cases belonged to age >60 years. Mean age was found 54.7 ± 12.1 years with range from 25 to 72 years. In a study done in Bangladesh by Sultana et al.¹¹ obtained that the mean age of 59.65 ± 12.95 years with range from 34 to 90 years. Zainudeen et al.¹² reported that mean age of patients with lung cancer is 62.65 years ranging from 39 to 86 years. Jayakrishnan and Kamala¹³ observed that the age of the patients ranged from 35-84 years with a mean age of 64.14 years. Majority of patients were in the age group 60 -79 (75.6%). Mrudula et al.¹⁴ also revealed that majority (44%) cases belonged to age 41-70 years. Their studies finding were consisted with present study.

Present study observed that almost two third 36(65.5%) cases were male and 19(34.5%) were female. Male to female ratio was 1.9:1. More than one fourth 15(27.3%) cases were service holder and housewives respectively. Choudhury et al.¹⁵ where they showed male to female ratio was 3.3:1. Zainudeen et al.¹⁶ documented that out of total 154 cases of lung cancer 96.1% were males (148 cases) and 3.9% were females (6 cases). Male to female ratio was 24.6:1. Almost similar study conducted by Mrudula et al.¹⁷ demonstrated that 65% cases were male and 35% were female. Male female ratio was 1.6:1. Sultana et al.¹⁸ also documented that 35 (94.6%) patients were male and 2 (5.4%) patients were female with a ratio of male to female of 17.5:1. The above mentioned

studies finding were almost consisted with this study.

This study observed that 38(69.1%) cases were found smoker among them 21(55.3%) were smoked >20 pack/yr and 17(44.7%) were smoked <20 pack/yr. This finding is similar to result which was observed by Jayakrishnan and Kamala¹⁹ found their study out of 82 patients, smoking was present in 55 patients (67.1%). Choudhury et al.²⁰ also obtained that 25 cases (71.4%) were smokers and 10 were non smokers with a smokers to non-smokers ratio of 2.5:1, that was support with present study.

This study observed that in bronchial biopsy 29(52.7%) cases were squamous cell carcinoma (SCC) followed by 12(21.8%) adenocarcinoma (AC), 9(16.4%) small cell carcinoma (SCLC) and 5(9.1%) carcinoid lung cancer. In a study conducted by Zainudeen et al.²¹ reported that histological cell types (Bronchial biopsy diagnosis for comparison as gold standard) were as follows- 92/176 cases (52.3%) SCC; 30/176 cases (17%) AC; 18/176 cases (10.2%) SCLC; 14/176cases (8%) poorly differentiated carcinoma and non neoplastic lesions constituted 22/176 cases (12.5%). In our country a study documented by Sultana et al.²² observed that endobronchial biopsy and histopathology revealed bronchial carcinoma in 25 (67.6%) patients and 12 (32.4%) had no malignancy detected. Squamous cell carcinoma was diagnosed in 18 (48.6%) patients, adenocarcinoma in 4 (10.8%) patients and small cell carcinoma in 3 (8.1%) patients. This result was consistent with the study of Santos-Martínez et al.²³ that the most common histological types were squamous cell carcinoma (33.2%) and adenocarcinoma (29.8%). Choudhury et al.²⁴ reported squamous cell carcinoma was the most common malignancy constituting 85.7% of cases, followed by small cell carcinoma 9.5% and adenocarcinoma in 4.7% of cases as confirmed by histological examination. Chrabanska et al.²⁵ described that in 429 (67.8%) patients, and thus in 643 (59.3%) cytological specimens histopathology was considered as the gold standard method. Among them, 243 (56.6%) patients were positive and 186 (43.4%) patients were negative for malignancy. The presented study showed the highest number of patients were with squamous cell carcinoma (SCC) (34.57%) and adenocarcinoma

(AC) (34.57%), followed by small cell carcinoma (SCLC) (9.47%).

Present study observed that findings in bronchial brush were 28(50.9%) cases of squamous cell carcinoma, 9(16.4%) of adenocarcinoma, 7(12.7%) of small cell carcinoma, 2(3.6%) of carcinoid lung cancer and 9(16.4%) cases were normal. Histological cell type in bronchial wash were 10(18.2%) cases of squamous cell carcinoma, 4(7.3%) of adenocarcinoma, 13(23.6%) of small cell carcinoma, 1(1.8%) of carcinoid lung cancer and 27(49.1%) of normal finding. In a study conducted by Sultana et al.²⁶ reported that bronchial brush cytology revealed bronchial carcinoma in 33 (89.2%) patients of which squamous cell carcinoma was in 25 (67.6%), adenocarcinoma in 4 (10.8%) and small cell carcinoma in 4 (10.8%) patients. Agarwal et al.²⁷ reported that bronchial brush cytology showed squamous cell carcinoma in 50.0%, adenocarcinoma in 10.0% and large cell carcinoma in 40.0% of cases. The above mentioned studies finding were almost similar in this study.

This study observed that in squamous cell carcinoma of lung tumors, bronchial brush detected 24 out of 29 cases and bronchial wash detected 10 out of 29 cases. Thus bronchial brush showed better sensitivity and accuracy regarding typing of squamous cell carcinoma. In adenocarcinoma of lung tumors, bronchial brush detected 8 out of 12 cases and bronchial wash detected 4 out of 12 cases. Thus bronchial brush showed better sensitivity regarding typing of adenocarcinoma. In small cell carcinoma of lung tumors, bronchial brush detected 5 out of 9 cases and bronchial wash detected 8 out of 9 cases. Thus bronchial wash showed better sensitivity and accuracy regarding typing of small cell carcinoma. In carcinoid of lung tumors, bronchial brush detected 2 out of 5 cases and bronchial wash detected 1 out of 5 cases. Thus bronchial wash showed better sensitivity and accuracy regarding typing of carcinoid. Sensitivity of bronchial brush was found 82.8% in squamous cell carcinoma, 66.7% in adenocarcinoma, 55.6% in small cell carcinoma and 40.0% in carcinoid. Sensitivity of bronchial wash was found 34.5% in squamous cell carcinoma, 33.3% in adenocarcinoma, 88.9% in small cell carcinoma and 20.0% in carcinoid. Zainudeen et al.²⁸ reported that in typing of lung tumors, BB detected 22 out

of 32 cases while, BW correctly typed only 30 out of 92 cases. 6 cases of SCC were diagnosed as dysplastic cells by BB and 22 cases were typed to this category by BW. Thus BB showed better sensitivity and accuracy regarding typing of SCC. BW detected 8 out of 30 cases of AC. 4 cases showed dysplastic cells. While BB rightly typed 10 of 22 cases of AC and dysplastic cells seen in 12 cases. Sensitivity of BB was significantly higher (77.8%) when compared with BW (51.9%). But specificity on the other hand was higher for BW (90.9%) compared to BB (80%). Positive predictive value of BW was 97.6% compared to 93.3% obtained by BB. Negative predictive value of BB was 50% and of BW was 21.3%. Regarding accuracy, BB showed better result 78.3% compared to 56.8% with BW. This finding is similar to result which was observed by Sareen and Pandey²⁹; Bodh et al.³⁰. Both researchers obtained sensitivity of BB as 77.78. In AC BB showed higher sensitivity and accuracy than BW. BW typed 10 of 18 cases of SCLC and 6 of 12 cases by BB. Thus in typing SCLC, BW seems to be slightly more sensitive than BB. BB showed maximum sensitivity and accuracy in typing SCC (61.1%), followed by SCLC (50%) and AC (45%). While BW showed highest sensitivity in typing SCLC (50%) followed by SCC (32.6%) and AC (27.7%). The diagnostic value of BB was highest in those with SCC followed by SCLC. Jayakrishnan and Kamala³¹ also observed that in cases of squamous cell carcinoma bronchial brushing revealed sensitivity -19.6%, specificity -100%, positive predictive value -100%, negative predictive value-49.4% and accuracy-54.9%. In cases of adenocarcinoma, bronchial brushing revealed sensitivity -28.6%, specificity -92.6%, PPV-44.4%, NPV-82.9%, and accuracy-81.7%. Bronchial washing revealed sensitivity 7.1%, specificity -98.5%, PPV-50%, NPV-83.7%, and accuracy-82.9%. In cases of small cell lung carcinoma, bronchial brushing, bronchial washing and when both combined revealed similar values. Sensitivity -28.6%, specificity -100%, positive predictive value -100%, negative predictive value-93.8%, and accuracy-94%.

The limitation is small sample size, there by analysing variety of cases was minimal of bronchial biopsy specimen for the validation of cytological techniques and absence of other confirmative tests

like surgical biopsy, biopsies of extrapulmonary metastatic lesions and autopsy.

Conclusion:

This results show that bronchial brush is a much superior technique in diagnosing lung cancer, as it demonstrates far better sensitivity in comparison to bronchial wash. So, this study concluded that the diagnostic yield of bronchial brush cytology is higher than that of bronchial wash cytology in lung. Bronchial brush has better efficacy in typing squamous cell carcinoma followed by adenocarcinoma, carcinoid while bronchial wash is superior in typing small cell carcinoma.

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