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Original Article

Diagnostic value of post bronchoscopic sputum and bronchoscopy guided cytology in diagnosing pulmonary lesions

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ABSTRACT

Background: Lung cancer is the main cause of cancer deaths in developing countries. The use of cytology in the diagnosis of cancer of the respiratory tract is one of the most useful applications of bronchoscopy. The objective of this study was to evaluate the cytomorphological features of post-bronchoscopy sputum and bronchoscopy-guided cytology samples, including bronchial wash, bronchial brush, and bronchoalveolar lavage, and to compare these with bronchoscopic biopsies.

Materials and Methods: It was a prospective cross-sectional study conducted over 2 years (1st June 2019 to 31st May 2021). All post-bronchoscopy sputum samples, bronchial wash, bronchial brushes, bronchoalveolar lavage, and bronchoscopic biopsies obtained from patients of all age groups received in the pathology laboratory of SDM College of Medical Sciences and Hospital were included in the study. In addition, bronchoscopy reports and CT scan reports were obtained.

Results: A total of 181 cytology samples were collected from 111 patients. The average age was 52.2 years, with 76 (68.47%) patients being males, and 35 (31.53%) patients being females. Infectious diseases like actinomycosis, mucormycosis, tuberculosis, and candidiasis were diagnosed. The most common malignancy diagnosed by cytology was adenocarcinoma. The diagnostic accuracy of bronchial brush was 93.75%, bronchial wash and /or bronchoalveolar lavage was 78.72%, while for post-bronchoscopy sputum, the diagnostic accuracy was 52.17%.

Conclusions: Cytology samples can be used as a reliable diagnostic tool in the diagnosis of both non-neoplastic and neoplastic pulmonary lesions.

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INTRODUCTION

Lung cancer is the main cause of cancer deaths in developing countries.[1] Early diagnosis and management are the keys to avoiding mortality in lung cancer patients.[2] Therapy for lung cancer is different for different subtypes.[3] Many of the therapeutic agents for adenocarcinoma are not used in squamous cell carcinoma (SCC).[4]

Flexible bronchoscopy is used in the diagnosis and management of patients with various lung disorders. The various cytological specimens submitted for diagnosing such pulmonary lesions include sputum, bronchoalveolar lavage

(BAL), bronchial brush smears, bronchial wash (BW), guided fine needle aspiration cytology (FNAC) smears, and pleural fluid. Obtaining samples for cytological evaluation in the diagnosis of cancer of the respiratory tract is one of the most useful applications of bronchoscopy.[5] Cytologic techniques are safer, more economical, and provide quick results.[6]

Here, we studied the diagnostic value of post-bronchoscopic sputum (PBS) and bronchoscopy-guided cytology (BW, BAL, and bronchial brush), and also correlated the results with bronchial biopsy, which is considered the gold standard. We have also studied the IHC findings in bronchoscopic biopsies wherever possible.

MATERIALS AND METHODS

This is a prospective cross-sectional study conducted in the Department of Pathology, SDM College of Medical Sciences and Hospital, Dharwad, Karnataka, India, over a period of 2 years (1st June 2019 to 31st May 2021). All PBS samples, BW, bronchial brushes, BAL, and bronchoscopic biopsies obtained from patients of all age groups received in the pathology laboratory of SDM College of Medical Sciences and Hospital were included in the study.

Bronchoscopic biopsy, BW, BAL, and bronchial brush were obtained by the pulmonologist using a flexible fiberoptic bronchoscope. PBS was collected immediately after the bronchoscope was removed with the patient in a sitting position. Informed consent was obtained before these procedures. The bronchoscopy report and CT scan report of the lung was obtained when available.

The PBS samples and aspirated fluid samples (BW and BAL) were sent unfixed to the lab immediately. If the processing was delayed, the fluids were stored at 4 degrees Celsius for 24-48 hours. It was placed in a cytospin funnel with filter paper (25x75 mm) placed between the slide and funnel, and then centrifuged at 1500 rpm for 5 minutes in a Cytospin (Thermo Scientific cytospin 4). The smears were fixed in 95% alcohol before staining with Hematoxylin & Eosin (H&E) and Papanicolaou (PAP) stain. Air-dried smears were stained with Leishman and ZN stain. Smears prepared from bronchial brush samples were also stained with Leishman, H&E, PAP, and ZN stain.

The presence of bronchial epithelial cells in the smears was required for considering BW and bronchial brush as adequate for opinion. The presence of pulmonary alveolar macrophages in BAL and PBS was considered adequate for opinion.

The biopsy sample was fixed in 10% formalin and then sent for paraffin embedding, and tissue blocks were obtained. The sections made were stained with H&E stain and then observed under the microscope. PAS staining was also done when necessary.

Malignant lesions identified in histologic sections were subjected to immunohistochemical staining using markers like TTF1, Napsin A, P63, P40, Synaptophysin, wherever required.

Statistical analysis was performed using statistical package of social sciences (SPSS) version 20. Descriptive statistics were used to conclude. Diagnostic accuracy, diagnostic yield, sensitivity, specificity, positive predictive value, and negative predictive value were calculated.

RESULTS

Bronchoscopy was performed in 111 patients, and a total of 181 cytology samples were included. The average age was 52.2 years (Range: 7 years -87 years). Seventy-six (68.47%) patients were males, and 35 (31.53%) patients were females.

Out of 111 patients, CT scan reports of 97 patients were available. A mass lesion was the most common radiological finding and was found in 35(36.08%) patients. Consolidation was the second most common finding and was found in 25 (25.77%) patients. Pleural effusion was present in 21 (21.64%) patients. Nodular lesion was found in 20(20.61%) patients. Atelectasis was found in 12(12.37%) patients. Cavitatory lesion was found in 11(11.34%) patients. Bronchiectasis and fibrosis were found in 8(8.24%) patients each. Areas of calcification were present in 5(5.15%) patients. Empyema was present in 3(3.09%) patients.

Fiberoptic bronchoscopy findings of 111 patients were studied. It was normal in 46(41.44%) patients. Endobronchial mass was present in 19(17.11%) patients. Eighteen (16.21%) patients had edematous bronchial mucosa. Mucosal bleed on touch and irregular mucosa were present in 10(9%) patients each. Luminal obstruction by viscid material, blackish mucosa, and vocal cord palsy were seen in 5(4.5%) patients each. Four (3.6%) patients had luminal purulent secretions. Two (1.8%) patients had a nodular lesion. Blood-stained mucus, mucosal ulceration, and luminal occlusion by necrotic material were seen in 1 (0.9%) patient each.

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Table 1: Cytological diagnosis of 110 BW and/or BAL samples, 28 bronchial brush samples, and 36 PBS samples

Cytological diagnosis		Number of patients (%)		
		BW and/or BAL (110 Patients)	Bronchial Brush (28 Patients)	PBS (36 Patients)
Infections	**TB**	2 (1.81%)	2 (7.14%)	-
	Actinomycosis	1 (0.90%)	-	1 (2.77%)
	Mucormycosis	1 (0.90%)	-	-
Positive/ suspicious for malignancy	Adenocarcinoma	9 (8.18%)	6 (21.4%)	2 (5.55%)
	NSCLC (NOS)	6 (5.45%)	5 (17.85%)	1 (2.77%)
	Suspicious for NSCLC (NOS)	3 (2.72%)	-	-
	NSCLC favour adenocarcinoma	1 (0.90%)	-	-
	Suspicious for SCLC	1 (0.90%)	-	-
	Suspicious for NSCLC (NOS) – Possibly squamous cell carcinoma	1 (0.90%)	-	-
	Positive for malignancy possibly SCLC	-	1 (3.57%)	-
	Negative for malignancy	85 (77.27%)	14 (50%)	32 (88.88%)

The most common malignancy was adenocarcinoma, diagnosed in 9 (8.18%) bronchial wash samples, 6 (21.4%) bronchial brush samples, and 2 (5.55%) PBS samples. The next common malignancy was NSCLC (NOS) and was diagnosed in 6 BW samples, 5 bronchial brush samples, and 1 PBS sample (fig. 1). One of the bronchial brush samples was diagnosed as positive for malignancy, possibly small-cell lung carcinoma. (fig. 2)

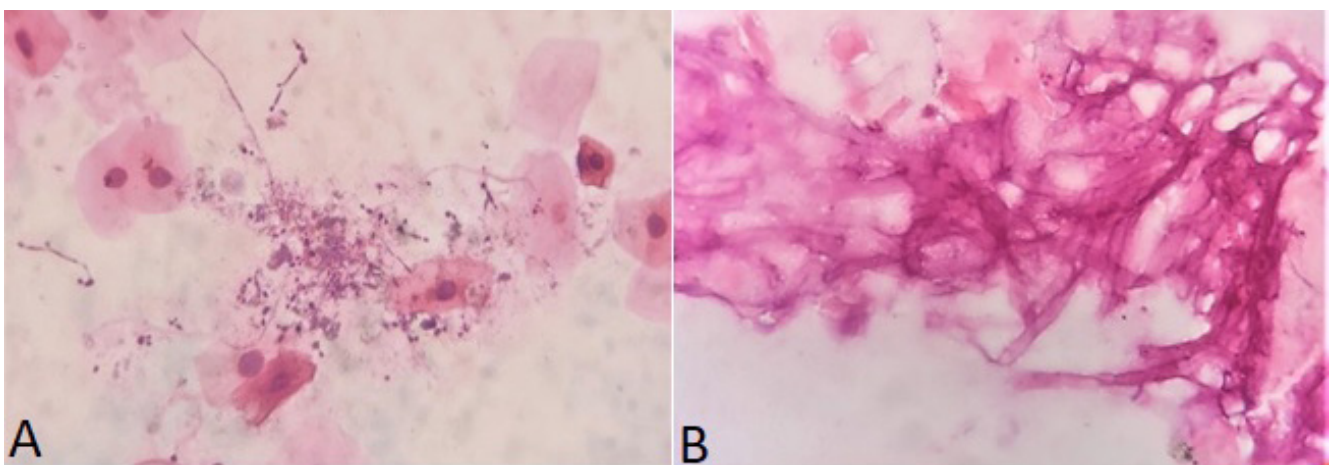

Figure 1: *Infectious organisms detected in cytology samples. A) Candida species yeast forms and hyphae in PBS (Pap stain, 40X). B) Bronchial wash smears showing Mucormycosis (H&E stain, 40X)*

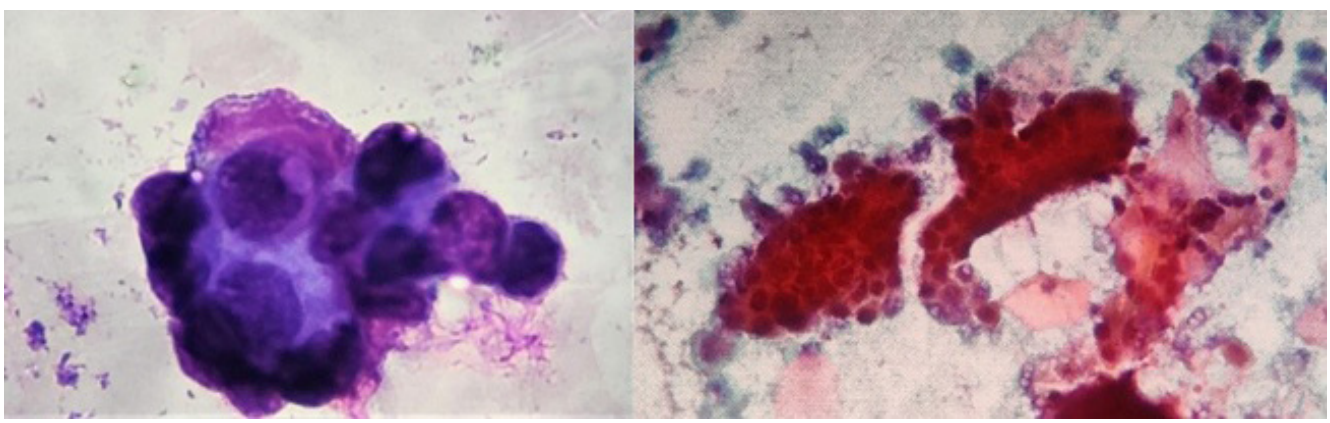

Figure 2: *Adenocarcinoma A) Post bronchoscopy sputum showing a 3-D ball of tumour cells in adenocarcinoma (Leishman stain, 40X). B) Bronchial wash smears showing pseudopapillary arrangement of tumour cells in adenocarcinoma. (Pap stain, 10X)*

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Five patients were diagnosed as suspicious for malignancy in bronchial wash samples. These samples had low cellularity of atypical cells, and marked atypia was not seen.

Bronchoscopic biopsy was done in 52 (46.84%) patients. Of these, four biopsies were inadequate. Out of these 48, IHC was done in 22 (45.83%) patients.

Table 2: Histopathological diagnosis of 48 bronchoscopic biopsy specimens

	Diagnosis	Number of patients	Percentage (%)
Infections	Tuberculosis	4	8.33%
	Mucormycosis	2	4.16%
	Actinomycosis	1	2.08%
NSCLC	NSCLC favour adenocarcinoma	13	27.08%
	Adenocarcinoma	2	4.16%
	Squamous cell carcinoma	2	4.16%
	NSCLC (NOS) possibly adenosquamous carcinoma	2	4.16%
	NSCLC favour squamous cell carcinoma	1	2.08%
	NSCLC (NOS)	1	2.08%
SCLC	Small cell carcinoma	2	4.16%
Typical carcinoid tumor with aspergillosis		1	2.08%
Anthracosis		2	4.16%
Normal bronchial mucosa		15	31.25%

NSCLC Non-small cell lung carcinoma; SCLC Small cell lung carcinoma; NOS Not otherwise specified

A total of 86 samples, including 47 samples of BW and/or BAL, 16 samples of bronchial brush, and 23 samples of PBS, were included for cytopathological and histopathological correlation (Table 3, Table 4, Table 5).

Table 3: BW and/or BAL diagnosis versus histopathological diagnosis

BW and/or BAL cytological diagnosis	Histopathological diagnosis	
	Neoplastic	Non-neoplastic
Neoplastic	13	0
Non-neoplastic	10	24
Total	23	24

Table 4: Bronchial brush diagnosis versus histopathological diagnosis

Bronchial brush cytological diagnosis	Histopathological diagnosis	
	Neoplastic	Non-neoplastic
Neoplastic	7	0
Non-neoplastic	1	8
Total	8	8

Table 5: PBS diagnosis versus histopathological diagnosis

PBS cytological diagnosis	Histopathological diagnosis	
	Neoplastic	Non-neoplastic
Neoplastic	2	0
Non-neoplastic	11	10
Total	13	10

Table 6: Sensitivity, specificity, PPV, NPV, diagnostic accuracy and diagnostic yield of BW and/or BAL, bronchial brush and PBS

	Bronchial wash and/or Bronchoalveolar lavage	Bronchial brush	Post bronchoscopy sputum
Sensitivity	56.52%	87.5%	15.38%
Specificity	100%	100%	100%
Positive predictive value	100%	100%	100%
Negative predictive value	70.58%	88.88%	47.61%
Diagnostic accuracy	78.72%	93.75%	52.17%
Diagnostic yield	27.65%	43.75%	8.69%

DISCUSSION

The most common malignancy in our study was adenocarcinoma. These cases were diagnosed on the basis of the arrangement of tumor cells in 3-dimensional balls and, in some cases, due to the presence of large cytoplasmic mucin vacuoles. Some of the patients with NSCLC could not be subcategorized due to the low cellularity of tumour cells and the absence of characteristic findings like 3-D clusters of tumor cells and cytoplasmic mucin vacuoles.

There were no false positive results in cytology smears as mimickers of malignancy (reactive atypia, bronchial epithelial hyperplasia, and reserve cell hyperplasia) were differentiated from tumor cells based on the finding of a round, regular nucleus with moderate karyomegaly and abundant cytoplasm in reactive cell.

The sensitivity of bronchial brush for the diagnosis of neoplastic lesions was high, with a low sensitivity in BW and PBS specimens. This is possibly because of the scraping of tumor cells directly from the endobronchial mass in the case of bronchial brush, thus giving a higher probability of obtaining tumor cells. In bronchial wash, exfoliated tumour cells are diluted due to the instillation of normal saline, thus yielding a lower cellularity of tumour cells. PBS smears detected the presence of exfoliated tumour cells in very few patients. This is possibly because of the low volume of sputum that was coughed out.

One of the patients with NSCLC favour squamous cell carcinoma, showed fine vacuoles in the cytoplasm of tumour

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cells, which were possibly degenerative vacuoles, and on IHC, tumor cells were positive for p63, p40, and negative for TTF1, Napsin A. Thus, the presence of fine vacuoles should not mislead the pathologist and lead to a diagnosis of adenocarcinoma.

The findings of BW cytology in our study were similar to the studies conducted by Choudhary M et al. and Rao S et al.[7,8] However, the sensitivity of Ahmad et al. was higher when compared to our study.[9] This difference is possibly because of their use of a preservative (50% ethyl alcohol) for preserving BW samples to avoid degeneration of cells, which was not used in our study and the study conducted by Choudhary M et al. and Rao S et al.[7,9]

The diagnostic accuracy of bronchial brush in our study was higher when compared to the study conducted by Acharya VK et al. and Choudhary M et al.[7,10]

The diagnostic yield of PBS was similar to the study conducted by Wongsurakiat P et al.[11] But, it was quite high in the study conducted by Lam B et al. and Funahashi A et al.[12,13] A single PBS sample was collected immediately following bronchoscopy in our study and Wongsurakiat P et al.[11] However, PBS was collected within 24 hours of bronchoscopy by Lam B et al. and was collected 3 times by Funahashi et al.[12,13] Funahashi et al. collected the 1st sputum sample immediately after bronchoscopy, 2nd sample after 4 hours and the 3rd sample after 24 hours.[12] Thus, the collection of a larger number of sputum samples increased the chances of detecting the exfoliated tumour cells following bronchoscopy. The diagnostic yield was high for PTB in PBS in a study conducted by Malekmohammad et al., where they collected sputum samples for 3 consecutive days after bronchoscopy.[14] However, none of the PBS smears in our study were positive for AFB. This difference is possibly due to the single sputum sample collection in our study.

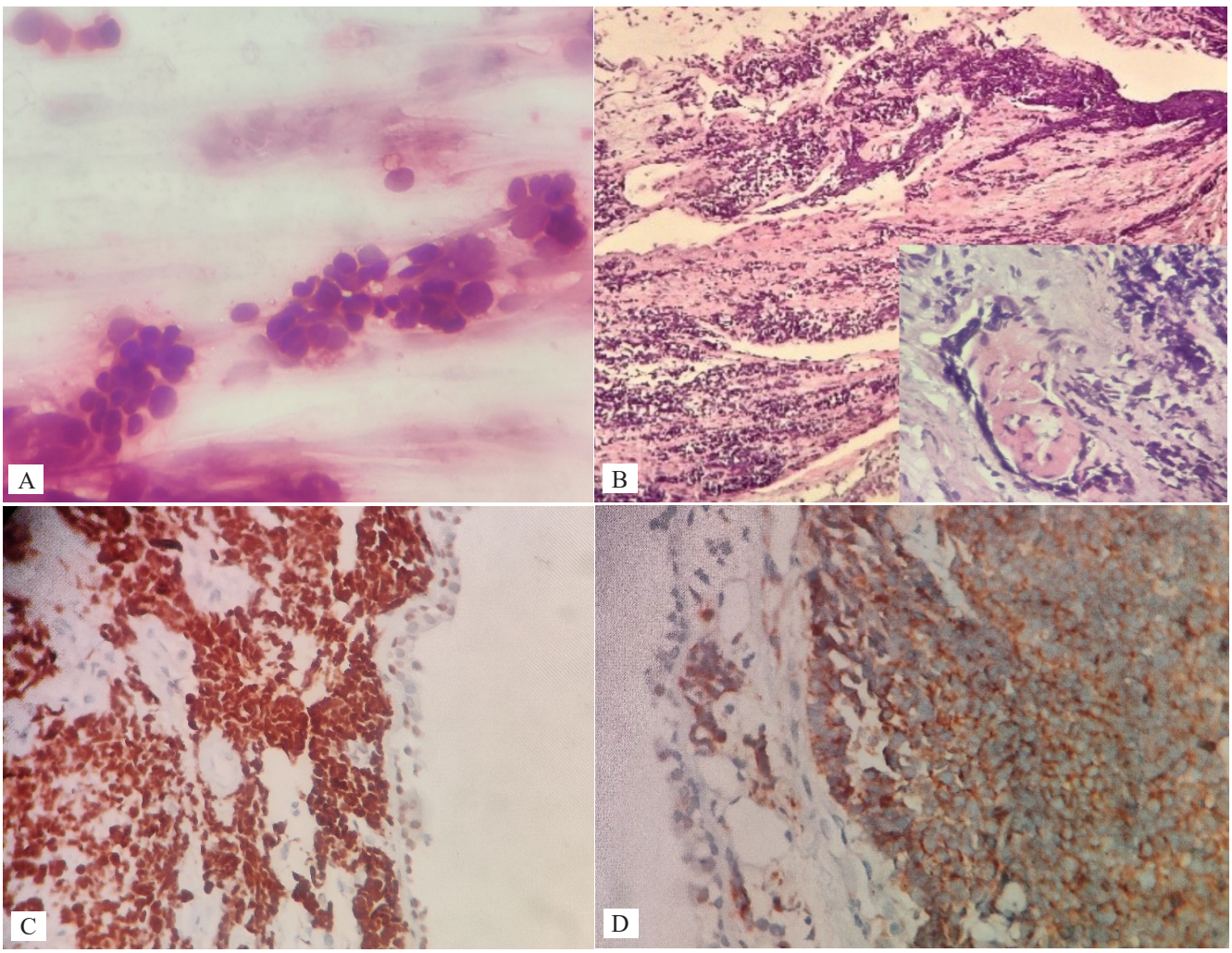

Figure 3: *Small cell lung carcinoma: A) Bronchial brush smears showing tumor cells of SCLC (H&E, 10X). B) Bronchial biopsy showing SCLC with Azzopardi phenomenon (inset) (H&E, 4X and 40X). C) Immunohistochemical marker TTF1 showing nuclear positivity in SCLC (10X). D) Immunohistochemical marker synaptophysin showing cytoplasmic positivity in SCLC. (IHC, 10X)*

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CONCLUSIONS

Cytology is a reliable diagnostic tool in the diagnosis of pulmonary lesions, varying from infectious to malignant. Among the cytological procedures, bronchial brush is superior to BW and PBS in terms of diagnostic yield and accuracy.

Conflict of interest: Nil

Acknowledgement: Nil

REFERENCES

1. Ghildiyal S, Acharya S, Thakur B, et al. Cytopathology of Pulmonary Lesions: A Tertiary Care Center Experience. J Cytol. 2018;35(4):212-6. https://doi.org/10.4103/JOC.JOC_51_18
2. Qanash S, Hakami OA, Al-Husayni, et al. Flexible Fiberoptic Bronchoscopy: Indications, Diagnostic Yield and Complications. Cureus. 12(10):e11122. https://doi.org/10.7759/cureus.11122
3. Gupta N, Sekar A, Rajwanshi A. Role of FNAC, fluid specimens, and cell blocks for cytological diagnosis of lung cancer in the present era. J Cytol. 2015;32(4):217-22. https://doi.org/10.4103/0970-9371.171219
4. Woo JS, Reddy OL, Koo M, et al. Application of Immunohistochemistry in the Diagnosis of Pulmonary and Pleural Neoplasms. Arch Pathol Lab Med. 2017;141(9):1195-213. https://doi.org/10.5858/arpa.2016-0550-RA
5. Gaur DS, Thapliyal NC, Kishore S, et al. Efficacy of broncho-alveolar lavage and bronchial brush cytology in diagnosing lung cancers. Journal of Cytology. 2007;24(2):73. https://doi.org/10.4103/0970-9371.41955
6. Sareen R, Pandey CL. Lung malignancy: Diagnostic accuracies of bronchoalveolar lavage, bronchial brushing, and fine needle aspiration cytology. Lung India. 2016;33(6):635-41. https://doi.org/10.4103/0970-2113.192882
7. Choudhury M, Singh S, Agarwal S. Efficacy of bronchial brush cytology and bronchial washings in diagnosis of non neoplastic and neoplastic bronchopulmonary lesions. Turk Patoloji Derg. 2012;28(2):142-6. https://doi.org/10.5146/tjpath.2012.01113
8. Rao S, Rao S, Lal A, et al. Bronchial wash cytology: A study on morphology and morphometry. J Cytol. 2014;31(2):63-7. https://doi.org/10.4103/0970-9371.138664
9. Ahmad M, Afzal S, Saeed W, et al. Efficacy of bronchial wash cytology and its correlation with biopsy in lung tumours. J Pak Med Assoc. 2004;54(1):13-6. URL: https://pubmed.ncbi.nlm.nih.gov/15058635/
10. Acharya VK, Unnikrishnan B, Shenoy A, et al. Utility of Various Bronchoscopic Modalities in Lung Cancer Diagnosis. Asian Pac J Cancer Prev. 2017;18(7):1931-6. https://doi.org/10.22034/apjcp.2017.18.7.1931
11. Wongsurakiat P, Wongbunnate S, Dejsomritrutai W, et al. Diagnostic value of bronchoalveolar lavage and postbronchoscopic sputum cytology in peripheral lung cancer. Respirology. 1998;3(2):131-7. https://doi.org/10.1111/j.1440-1843.1998.tb00111.x
12. Funahashi A, Browne TK, Houser WC, et al. Diagnostic value of bronchial aspirate and postbronchoscopic sputum in fiberoptic bronchoscopy. Chest. 1979;76(5):514-7. https://doi.org/10.1378/chest.76.5.514
13. Lam B, Wong MP, Ooi C, et al. Diagnostic yield of bronchoscopic sampling methods in bronchial carcinoma. Respirology. 2000;5(3):265-70. https://doi.org/10.1046/j.1440-1843.2000.00258.x
14. Malekmohammad M, Marjani M, Tabarsi P, et al. Diagnostic yield of post-bronchoscopy sputum smear in pulmonary tuberculosis. Scand J Infect Dis. 2012;44(5):369-73. https://doi.org/10.3109/00365548.2011.643820