Original Research Paper

Volume - 15 | Issue - 07 | July - 2025 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Respiratory Medicine

A COMPARATIVE STUDY ON DIAGNOSTIC YIELD OF POST - PROCEDURE COLLECTED SPUTUM CYTOLOGY WITH BRONCHOALVEOLAR LAVAGE AND BRUSH CYTOLOGY BY FIBRE– OPTIC BRONCHOSCOPY IN SUSPECTED CASES OF CARCINOMA LUNG.

Dr. Haripriya Menon V	Junior Resident Dept. Of Respiratory medicine, Government Medical College Kota, Rajasthan.
Dr. Babulal Bansiwal	Associate Professor Dept. Of Respiratory Medicine, Government Medical College Kota, Rajasthan
Dr. Anil Saxena	Senior Professor &Head of the Department, Dept. Of Respiratory Medicine, Government Medical College Kota, Rajasthan
Dr. Kaushal Kumar	Junior Resident Dept. Of Respiratory Medicine, Government Medical College Kota, Rajasthan.
Dr. Mukesh Kumar	Junior Resident Dept. Of Respiratory Medicine, Government Medical College Kota, Rajasthan.

ABSTRACT **Introduction:** Lung cancer is the most commonly diagnosed cancer worldwide (12.4% of the total cases).It is most frequent cancer in men . The disease ranks first among men and second among women for both incidence and mortality, with male.to.female lung cancer incidence and mortality ratios of around 2(1). **Materials and Methods:** This cross-sectional study was conducted at Government medical college hospital Kota Rajasthan, India. Samples for cytological and histological examination was collected from 100 patients in whom features were suggestive of lung malignancy. After doing bronchoscopy diagnostic yields of post-procedure sputum, Bronchoalveolar lavage (BAL) , and brush cytology were compared with histopathological biopsy findings. **Results:** Among the 95 patients with biopsy-confirmed lung cancer, squamous cell carcinoma was the most common type observed. The diagnostic procedures evaluated had generally lower sensitivity across the board. However, post-bronchoscopy sputum analysis demonstrated the highest specificity at 100.0%, meaning it was highly accurate in identifying patients without the disease.Post-bronchoscopy sputum analysis stands out for its excellent specificity and PPV, making it highly reliable for confirming lung cancer when a positive result is found.

KEYWORDS : Lung Cancer, Bronchoscopy, Post-bronchoscopy sputum, BAL, Brush cytology.

INTRODUCTION

Lung cancer is the most commonly diagnosed cancer worldwide (12.4%) of the total cases).It is most frequent cancer in men (both cases and deaths), followed by prostate and colorectal cancer for new cases and liver and colorectal cancer for deaths .With almost 2.5 million new cases and over 1.8 million deaths worldwide, lung cancer is the leading cause of cancer morbidity and mortality in 2022, responsible for close to one in eight (12.4%) cancers diagnosed globally and one in five (18.7%) cancer deaths. The disease ranks first among men and second among women for both incidence and mortality, with male-to-female lung cancer incidence and mortality ratios of around 2:1[(2).]

Bronchoscopy is an essential tool for clinicians and health care providers treating patients with lung diseases. Since its introduction to clinical practice by Shigeto Ikeda in 1966, flexible bronchoscopy has become an essential tool in diagnosis and management of patients with lung diseases[(3)]. Flexible bronchoscopy and transthoracic sampling are the most often used techniques for the diagnosis of lung cancer. In general, lesions in the central one-third of the thorax are accessed bronchoscopically, whereas lesions in the peripheral one-third are accessed transthoracically. Bronchoscopy services have witnessed tremendous growth in India over the past decade, although there seems to be a concentration of services in major metropolitan cities[(4)].

The mixture of saliva and mucus specifically coughed up from the respiratory tract, often either following an infection or an irritation of the mucosa, is precisely labeled "sputum"[(5)].The main advantage of sputum cytology is its simplicity, non-invasiveness and minimal discomfort to the patient. Hence, this study was carried out to evaluate the role of cytological examination of sputum in the diagnosis of lung malignancies and to correlate the cytological diagnosis with clinical diagnosis[(6)].

This cross-sectional, observational study was conducted at a tertiary care center in Southeastern Rajasthan over the period of 12 months with the aim to study usefulness of post bronchoscopy sputum cytology and also to correlate sputum cytology with brushing and washing cytology considering biopsy as the gold standard in the diagnosis of lung cancer[(7)].

METHODS

This cross sectional observational study was conducted in the Department of Respiratory medicine, New Medical college, Kota, Rajasthan from October 2023 to October 2024 in patients suspicious of lung malignancy .After getting the permission, the samples for cytological and histological examination was collected from the indoor/outdoor patients in whom clinical findings, radiological examination suggested lung malignancy. Bronchoscopic samples was obtained by Olympus flexible bronchoscope using the Olympus BF-TE2 scope having a 2.8 mm working channel via oral route following standard protocol. Bronchial brushings was obtained by the use of a stiff bristle disposable brush. In every case we have performed the following sequence of events: Pre-biopsy washing (bronchoalveolar lavage (BAL fluid), brushing, biopsy, post-biopsy washing (BAL), and post-procedure (post bronchoscopic sputum) sputum. In the present study, sputum samples was taken within 30 minutes of bronchoscopic procedure.

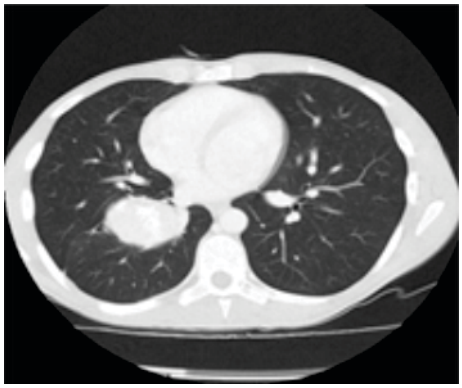

Image1: CT image of one of the study subjects showing right large heterogenous enhancing mass lesion with hyperdense foci of calcifications.

RESULTS

Among 95 patients with a biopsy-confirmed diagnosis of lung cancer,

the most frequently observed type was squamous cell carcinoma.The sensitivity was lower for all the procedures. Post-bronchoscopy sputum analysis had the best specificity of 100.0%. Positive predictive value was higher for all the four procedures with 100.0% for post-bronchoscopy sputum analysis, 97.3% for BAL, 94.9% for brush cytology. The sensitivity, specificity, positive predictive value, negative predictive value and accuracy of BAL+ brush cytology was 46.3%, 60.0%, 95.7%, 5.6% and 47.0%, respectively.

Table 1: Distribution of the Study Participants by the Type of Lung Cancer on Biopsy (N=95)

Type of lung cancer	Frequency (n)	Percentage
Adenocarcinoma	23	24.2
Small cell carcinoma	15	15.8
Squamous cell carcinoma	57	60.0
Total	95	100.0

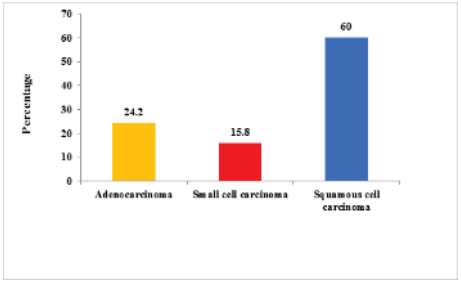

Figure 1: Distribution of the Study Participants by the Type of Lung Cancer on Biopsy (N=95)

Table 2: Diagnostic Validity of Post-bronchoscopy Sputum Analysis in the Diagnosis of Lung Cancer (N=100)

Post- bronchoscopy sputum analysis	Biopsy	
	Disease positive	Disease negative
Test positive	16	0
Test negative	79	5
Sensitivity= 16.8% Specificity= 100.0% Positive predictive value= 100.0% Negative predictive value= 6.0% Accuracy= 21.0%		

DISCUSSION

Epidemiology of Lung Cancer

The mean age of patients was 60.8 years, with 79% being male, consistent with global trends showing increased lung cancer incidence with age. SEER data places the median age at diagnosis at 71 years, attributed to cumulative mutagen exposure and age-related decline in DNA repair. Indian studies also report rising diagnosis age over decades.

Male predominance is linked to higher historical smoking rates and occupational exposures. Our findings align with studies by Singh N et al[8]. (male:female ratio 4.43:1), Bandyopadhyay A, and others showing a similar gender pattern[7].

Lung cancer is classified into SCLC and NSCLC which includes adenocarcinoma, squamous cell carcinoma, and large cell carcinoma. In our study, squamous cell carcinoma (60%) was the most common type, followed by adenocarcinoma (24.2%) and SCLC (14.2%). This aligns with findings from Dey et al[9], who reported squamous cell carcinoma as the leading subtype, and with global data from Herbst et al[10] and Dela Cruz et [11], who found adenocarcinoma to be the most prevalent globally.

Male predominance in squamous cell carcinoma is supported by studies from Jemal A et al, linking it to higher smoking rates and occupational exposures among men[12].

Diagnostic Validity of Sputum Cytology, BAL, and Brush Cytology

In our study, the sensitivity of post-bronchoscopy sputum cytology, BAL, and brush cytology was low—16.8%, 37.9%, and 38.9%, respectively. However, sputum cytology showed the highest specificity (100.0%), while BAL and brush cytology had specificities of 80.0% and 60.0%. The positive predictive values were high across all procedures, but negative predictive values and overall accuracy remained low, with diagnostic accuracies of 21.0%, 40.0%, and 40.0%, respectively.

Combining BAL and brush cytology improved sensitivity to 46.3% and accuracy to 47.0%. These findings align with previous studies showing variable sensitivity but generally high specificity for these modalities. Sputum cytology's low sensitivity may be due to peripheral tumor location, poor cell shedding, mucociliary clearance, and sample degradation. Direct sampling methods like BAL and brush cytology outperform sputum analysis in capturing tumor cells.

Although sputum cytology alone adds little diagnostic value, combining it with BAL and brushing enhances diagnostic yield and supports a multimodal approach for accurate lung cancer diagnosis.

CONCLUSION

Given the high burden of lung cancer and the need for practical, accurate diagnostic options, it became imperative to conduct a comparative analysis of post-procedural sputum cytology, BAL, and brush cytology in diagnosing lung cancer within a single patient population, which could inform more effective diagnostic protocols, potentially leading to earlier lung cancer detection, reduced reliance on invasive procedures, and optimized patient care.

REFERENCES

1. Behera D and Balamugesh T. Lung cancer in India. Indian J Chest Dis Allied Sci. 2004;46(4):269-281.
2. https://www.who.int/news/item/01-02-2024-global-cancer-burden-growing--amidst-mounting-need-for-services.
3. Thomas RJ, Yerkovich ST, Goyal V, et al. The utility of elective flexible bronchoscopy to improve quality of life and clinical outcomes for children: a systematic review. Pediatr Pulmonol. 2024; 59: 1589-1595. doi:10.1002/ppul.26940
4. Mahmoud N, Vashisht R, Sanghavi DK, et al. Bronchoscopy. [Updated 2023 Jul 24]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK448152/
5. Shen F, Sergi C. Sputum Analysis. 2023 Feb 20. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan–. PMID: 33085342.
6. Sudduth ER, Trautmann-Rodriguez M, Gill N, Bomb K, Fromen CA. Aerosol pulmonary immune engineering. Adv Drug Deliv Rev. 2023 Aug;199:114831. doi: 10.1016/j.addr.2023.114831. Epub 2023 Apr 24. PMID: 37100206; PMCID: PMC 10527166.
7. Bandyopadhyay A, Pal M, Das I, Sarkar S, Sarkar R, Taraphdar P. A study of usefulness of washes and brush cytology with respect to histopathology in diagnosis of lung malignancy by using fiberoptic bronchoscopy. Clin Cancer Investig J 2016;5:293-8.
8. Singh N, Agrawal S, Jiwnani S, Khosla D, Malik PS, Mohan A, Penumadu P, Prasad KT. Lung Cancer in India. J Thorac Oncol. 2021 Aug;16(8):1250-1266. doi: 10.1016/j.jtho. 2021.02.004. PMID: 34304854.
9. Dey A, Biswas D, Saha SK, Kundu S, Kundu S, Sengupta A. Comparison study of clinicoradiological profile of primary lung cancer cases: an Eastern India experience. Indian J Cancer. 2012 Jan-Mar;49(1):89-95. doi: 10.4103/0019-509X.98930. PMID: 22842174.
10. Herbst RS, Morgensztern D, Boshoff C. The biology and management of non-small cell lung cancer. Nature. 2018 Jan 24;553(7689):446-454. doi: 10.1038/nature25183. PMID: 29364287.
11. Dela Cruz CS, Tanoue LT, Matthay RA. Lung cancer: epidemiology, etiology, and prevention. Clin Chest Med. 2011 Dec;32(4):605-44. doi: 10.1016/j.ccm.2011.09.001. PMID: 22054876; PMCID: PMC3864624.
12. Jemal A, Schafer EJ, Sung H, Bandi P, Kratzer T, Islami F, Siegel RL. The Burden of Lung Cancer in Women Compared With Men in the US. JAMA Oncol. 2023 Dec 1;9(12):1727-1728. doi: 10.1001/jamaoncol.2023.4415. PMID: 37824139; PMCID: PMC10570912.