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ORIGINAL ARTICLE

Comparison of Image-Guided Fine Needle Aspiration Cytology (FNAC) findings with Biopsy in Lung Lesions: Emphasis on diagnostic accuracy of FNAC on Benign-Malignant Differentiation and Carcinoma Subtyping

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ABSTRACT

Introduction: Accurate and timely diagnosis of lung cancer is essential for appropriate management. Fine-needle aspiration cytology (FNAC) is a minimally invasive diagnostic tool; however, its diagnostic performance in differentiating non-small cell lung carcinoma (NSCLC) from small cell lung carcinoma (SCLC) requires evaluation. This study aimed to assess the diagnostic accuracy of FNAC compared with biopsy in lung cancer patients for benign-malignant differentiation and carcinoma subtyping.

Method: This hospital-based cross-sectional study was conducted from September-2024 to November-2025 at B.P. Koirala Memorial Cancer Hospital, Nepal. A total of 53 patients with radiologically detected lung lesions underwent image-guided (USG: Ultrasonography or CT: Computed Tomography), followed by histopathological biopsies. FNAC findings were compared with biopsy results, which served as the reference standard. The clinico-demographic data were collected. The statistical analysis was performed using STATA, and diagnostic performance metrics: sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy for FNAC in differentiating benign and malignant lesions, as well as SCLC and NSCLC. The associations between FNAC and biopsy results were assessed using the Chi-square test.

Result: Out of 53 total cases, FNAC differentiated into 6 benign and 47 malignant cases, whereas biopsy confirmed 10 as benign and 43 as malignant cases. FNAC demonstrated sensitivity of 100%, specificity of 60%, PPV of 91%, NPV of 100%, and overall accuracy of 92% in differentiating benign and malignant cases. The association was further assessed using chi square test (χ^2: 23.4; p<0.01). Similarly, in cancer sub-typing, FNAC showed 11 SCLC and 32 NSCLC, whereas biopsy confirmed 16 cases as SCLC and 27 as NSCLC. FNAC demonstrated sensitivity of 44%, specificity of 85%, PPV of 64%, NPV of 72%, and overall accuracy of 70% in sub-typing SCLC and NSCLC. The association was further assessed using chi square test (χ^2: 8.81; p=0.003).

Conclusion: Compared to biopsy, image-guided FNAC demonstrates high diagnostic accuracy in differentiating the lung lesions into benign and malignant and can therefore be used as a first-line diagnostic tool to facilitate early detection and management of lung malignancies. However, it is less reliable in carcinoma subtyping into SCLC and NSCLC; thus, histopathological examination is recommended for definitive subtyping.

Key words: **Image-guided FNAC, Biopsy, Non-small cell Lung carcinoma, Small-cell Lung carcinoma**

INTRODUCTION

Lung masses represent a significant clinical problem and require prompt and accurate diagnosis to guide appropriate management. With the increasing incidence of Lung Cancer worldwide, early and reliable diagnostic techniques are essential for improving patient outcomes. Lung cancer remains one of the leading causes of cancer-related mortality globally, and timely pathological diagnosis plays a crucial role in determining therapeutic strategies.[1]

Various diagnostic modalities are available for evaluating lung lesions, including radiological imaging, bronchoscopy, cytological techniques, and histopathological examination. Among these, image-guided fine needle aspiration cytology (FNAC) has gained wide acceptance as a minimally invasive and cost-effective method for the evaluation of pulmonary masses. When performed under computed tomography (CT) or ultrasound guidance, FNAC allows accurate localization of deep-seated or peripheral lung lesions and facilitates adequate sampling for cytological assessment.[2]

Image-guided FNAC offers several advantages, such as rapid diagnosis, minimal patient discomfort, and a low complication rate compared with more invasive procedures. Several studies have demonstrated high sensitivity and specificity of CT-guided FNAC in distinguishing benign from malignant lung lesions.[3-4] It is particularly useful in diagnosing primary lung malignancies as well as metastatic tumors involving the lung. Despite these advantages, cytological evaluation alone may occasionally be limited in providing definitive tumor typing and architectural details, which are essential for accurate histological classification. Therefore, histopathological examination of biopsy specimens continues to be regarded as the gold standard for the diagnosis of lung lesions and for performing ancillary studies such as immunohistochemistry and molecular testing.[5]

Correlation between cytological findings obtained by image-guided FNAC and histopathological diagnosis is important to assess the diagnostic accuracy and reliability of FNAC in lung masses. Such studies help in determining the effectiveness of FNAC as a primary diagnostic tool and in identifying potential limitations in cytological interpretation. The study was designed to assess the diagnostic accuracy of image-guided FNAC in comparison with

biopsy for benign-malignant differentiation and carcinoma subtyping among patients with lung lesions.

METHODS

Study design and settings:

This cross-sectional study was conducted at the Department of Pathology, B.P. Koirala Memorial Cancer Hospital (BPKMCH), Chitwan, Nepal, from September, 2024 to November, 2025.

Study population: A total of 53 patients suspected of lung cancer and radiologically detected lung lesions were included in the study. Image-guided FNAC followed by histopathological biopsy collection from all the patients was done. Inclusion and exclusion criteria: The study included patients with suspected lung cancer who underwent both fine-needle aspiration cytology (FNAC) and biopsy for definitive diagnosis. Patients with incomplete medical records or inadequate cytology/biopsy samples were excluded.

Data collection and procedure: Clinicodemographic data, including age, sex, lesion site, and type of diagnostic procedure (computed tomography [CT]-guided or ultrasonography [USG]-guided), were collected from hospital records using a pre-defined questionnaire. FNAC was performed under CT or USG guidance depending on lesion location, while biopsy samples, obtained via core needle or surgical methods, served as the reference standard. Cytological and histopathological evaluations were conducted by experienced pathologists, and lesions were classified as benign or malignant, with malignant cases further categorized into non-small cell carcinoma (NSCLC) and small cell carcinoma (SCLC) according to World Health Organization (WHO) criteria.

Statistical analysis: Data were entered in Microsoft Excel Worksheet and checked for completeness. The statistical analysis was done using STATA. Descriptive statistics were used to summarize categorical variables as frequencies and percentages and continuous variables as mean ± standard deviation (SD). Associations between categorical variables were assessed using the Chi-square test. The diagnostic performance of FNAC in differentiating NSCLC from SCLC was evaluated using sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy, with 95% confidence intervals (CI) reported for each measure. A p-value < 0.05 was considered statistically significant.

Ethical considerations: Ethical approval was obtained from the Institutional Review Committee, BPKMCH, and data collection was done. All the procedures were conducted in accordance with institutional ethical standards, ensuring patient confidentiality and adherence to good clinical practice.

RESULTS

A total of 53 patients were included in the study. The majority of patients were aged 65–75 years (34.0%), followed by 55–65 years (22.6%) and >75 years (20.8%). The mean age was 65.36 ± 11.33 years, with ages ranging from 36 to 87 years. More than half of the patients were male (58.5%), while 41.5% were female. Regarding the site of involvement, 54.7% of lesions were located in the right lung and 45.3% in the left lung. Most procedures were performed under CT guidance (64.2%), whereas 35.8% were conducted under ultrasonography (USG) guidance. Fine-needle aspiration cytology (FNAC) results showed that 88.7% of cases were malignant and 11.3% as benign. These findings were subsequently confirmed by biopsy, which demonstrated that 81.1% of cases were malignant and 18.9% were benign, as shown in Table 1.

Table 1: Clinicodemographic characteristics of patients (n=53)

Characteristics	Number of cases	Percentage
Age		
35-45	3	5.7
45-55	9	17.0
55-65	12	22.6
65-75	18	34.0
>75	11	20.8
Mean ± SD	**65.36±11.33**	**Min(Max): 36(87)**
Sex		
Female	22	41.5
Male	31	58.5
Site		
Left lung	24	45.3
Right lung	29	54.7
Procedure		
CT guided	34	64.2
USG guided	19	35.8
FNAC		
Benign	6	11.3
Malignancy	47	88.7
Biopsy		
Benign	10	18.9
Malignancy	43	81.1

The comparison of diagnostic performance of FNAC with the results of biopsy was done. Out of 53 total cases, biopsy confirmed 43 as malignant and 10 as benign. FNAC correctly identified all 43 malignant cases, without missing any malignancy, resulting in 100% sensitivity (95% CI: 90%–100%) of FNAC. Whereas, out of 10 benign cases confirmed by biopsy, 6 were correctly identified and only 4 cases were misdiagnosed as malignancy, resulting in 60% specificity (95% CI: 27%–86%) of FNAC. The positive predictive value of FNAC was 91% (CI: 79%-97%), indicating that cases diagnosed by FNAC as malignant have high probability of being truly malignant, and only minor cases may result in false positive. Similarly, the negative predictive value of FNAC was 100% (CI: 52%-100%), indicating the cases diagnosed as benign by FNAC are highly reliable and have no chance of missing a malignancy. The overall accuracy of FNAC procedure was 92% (95% CI: 82%–98%), making it highly reliable as biopsy

result, which is further shown by the chi-square association (χ^2: 23.4; p<0.01) as shown in Table 2 and Table 3 below.

Table 2: Comparison of FNAC findings with biopsy findings for differentiating benign and malignant cases.

FNAC	Biopsy		Total	χ^2	p-value
	Benign	Malignancy			
Benign	6	0	6	23.42	<0.01
Malignancy	4	43	47		
Total	10	43	53		

Table 3: Diagnostic Performance of FNAC in diagnosing benign and malignant cases as compared to biopsy

Statistic	Value	95% CI
Sensitivity	100 %	90-100%
Specificity	60 %	27-86%
Positive Predictive Value	91%	79-97%
Negative Predictive Value	100%	52-100%
Overall accuracy	92%	82-98%

Furthermore, we compared FNAC results with biopsy in differentiating SCLC from NSCLC. Out of 43 malignant cases, biopsy confirmed 16 as SCLC and 27 as NSCLC. FNAC correctly identified 7 cases as SCLC (True positive) but incorrectly diagnosed 9 cases (false negative) as NSCLC. This results in 44% (CI: 20%-70%) sensitivity of FNAC, indicating the limited reliability of FNAC in differentiating SCLC from NSCLC. On the other hand, FNAC was correct in identifying 23 NSCLC cases out of 27 NSCLC cases, and the remaining 4 cases of NSCLC were misdiagnosed as SCLC by FNAC. This results in 85% (CI: 66%-96%) specificity of FNAC in carcinoma subtyping. The positive predictive value (64%) of FNAC indicates low probability of correct diagnosis of SCLC. The negative predictive value (72%) of FNAC indicates moderate confidence in NSCLC reports and the chances of missing some SCLC. The overall diagnostic accuracy of FNAC was 70% (CI: 54%-83%) in differentiating SCLC and NSCLC, reflecting moderate agreement with biopsy findings, and the association is further demonstrated by chi-square test (χ^2: 3.03; p=0.08) as shown in Table 4 and Table 5 below.

Table 4: Comparison of FNAC findings with biopsy in SCLC and NSCLC subtyping

FNAC	Biopsy		Total	χ^2	p-value
	SCLC	NSCLC			
SCLC	7	4	11	3.03	0.08
NSCLC	9	23	32		
Total	10	43	53		

Table 5: Diagnostic Performance of FNAC in SCLC and NSCLC subtyping

Statistic	Value	95% CI
Sensitivity	44%	20% - 70%
Specificity	85%	66% - 96%
Positive Predictive Value	64%	38% - 83%
Negative Predictive Value	72%	62% - 80%
Overall accuracy	70%	54% - 83%

DISCUSSION

Accurate and early diagnosis of lung masses is essential for appropriate patient management, particularly with the increasing availability of targeted therapies for lung cancer. Image-guided fine needle aspiration cytology (FNAC) has become an important minimally invasive diagnostic technique for evaluating pulmonary lesions. It provides rapid, safe, and cost-effective preliminary diagnosis, especially when performed under radiological guidance such as computed tomography (CT) or ultrasonography.[2]

In the present study, most lung masses were malignant, which is consistent with the epidemiological trend reported in the previous studies, where the majority of radiologically detected lung masses represent primary lung cancer or metastatic lesions.[6] Image-guided FNAC demonstrated a high level of diagnostic accuracy in differentiating benign and malignant lesions. Similar findings have been reported by several authors who observed high sensitivity and specificity of CT-guided FNAC in the diagnosis of pulmonary lesions.[7-8] CT-guided FNAC has demonstrated effective results in diagnosing malignant lesions due to its ability to obtain representative cellular material from deep-seated pulmonary masses.[9] The use of imaging guidance improves sampling accuracy and reduces the likelihood of inadequate aspirates.[10]

However, in this study, the diagnostic accuracy of image-guided FNAC was moderate in carcinoma subtyping, which is in accordance with substantial publications.[11-12] However, some of the publications have demonstrated higher diagnostic accuracy.[13-15] Since the variation in accuracy of image guided FNAC in carcinoma subtyping, histopathological examination has always been the standard procedure. Cytological evaluation allows identification of characteristic malignant features such as increased nuclear-cytoplasmic ratio, nuclear pleomorphism, and prominent nucleoli. However, precise histological subtyping of lung tumors may sometimes be difficult on cytology alone, highlighting the complementary role of tissue biopsy.[11] A small number of discordant cases were observed between FNAC and biopsy findings. Such discrepancies may occur due to inadequate sampling, tumor necrosis, or tumor heterogeneity within the lesion. Inflammatory or granulomatous lesions may also mimic malignancy on cytology examination, leading to potential diagnostic challenges.[12]

Despite the limitation, image-guided FNAC remains a valuable diagnostic tool due to its minimally invasive nature, rapid turnaround time, and relatively low complication rate. It is particularly useful as an initial diagnostic modality, helping clinicians decide further management strategies. However, histopathological examination continues to be the gold standard for definitive diagnosis and for performing ancillary studies such as immunohistochemistry and molecular testing, which are increasingly important in the management of lung cancer.[2]

The limitations of this study include the relatively small sample size and the inclusion of only cases that underwent both FNAC and biopsy. Larger studies incorporating ancillary diagnostic techniques may improve the diagnostic utility of cytological evaluation of lung lesions.

CONCLUSION

Compared to biopsy, the diagnostic accuracy of image-guided FNAC is highly reliable in differentiating benign and malignant lung lesions. It can be used in rapid preliminary diagnosis, which is crucial for early clinical decision-making in patients with suspected Lung cancer. However, it is less reliable for sub-typing carcinomas into SCLC and NSCLC, making histopathological examination essential.

REFERENCES

1. Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, Jemal A. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA: a cancer journal for clinicians. 2018 Nov;68(6):394-424.
2. Rivera MP, Mehta AC, Wahidi MM. Establishing the diagnosis of lung cancer: Diagnosis and management of lung cancer: American College of Chest Physicians evidence-based clinical practice guidelines. Chest. 2013 May 1;143(5):e142S-65S.
3. Bhaduri J. Ultrasound and Computed Tomographic Guided Fine Needle Aspiration Cytology of Intrathoracic Lesions. TAJ: Journal of Teachers Association. 2009 Jan 1.
4. Nasit JG, Patel V, Parikh B, et al. CT-guided FNAC of lung lesions: A study of 200 cases. Indian Journal of Pathology and Microbiology. 2012;55:36-42.
5. Manhire A, Charig M, Clelland C, et al. Guidelines for radiologically guided lung biopsy. Thorax. 2003;58:920-936.
6. Schreiber G, McCrory DC. Performance characteristics of different modalities for diagnosis of suspected lung cancer. Chest. 2003;123:115S–128S
7. Singh JP, Garg L, Setia V. CT-guided transthoracic needle aspiration cytology in intrathoracic lesions. Journal of Cytology. 2004;21:16-20
8. Ranabhat S, Poudel S, Pun G, Awale A. Role of image guided fine needle aspiration cytology of lung lesions in patients visiting Gandaki Medical College. Journal of Pathology of Nepal. 2022 Sep 30;12(2):1956-9.
9. Mondal SK, Nag D, Parikh B, Shah M, Davara K. Computed tomogram guided fine-needle aspiration cytology of lung mass with histological correlation: A study in Eastern India. South Asian journal of cancer. 2013 Jan;2(01):014-8.
10. Manhire A, Charig M, Clelland C, Gleeson F, Miller R, Moss H, Pointon K, Richardson C, Sawicka E. Guidelines for radiologically guided lungbiopsy. Thorax. 2003 Nov 1;58(11):920-36.
11. Layfield LJ, Pearson L, Walker BS, White SK, Schmidt RL. Diagnostic accuracy of fine-needle aspiration cytology for discrimination of squamous cell carcinoma from adenocarcinoma in non-small cell lung cancer: a systematic review and meta-analysis. Acta Cytologica. 2018 Dec 4;62(5-6):318-26.
12. Shrestha M, Karki S, Sayami G. Evaluation of intrathoracic lesions by image guided fine needle aspiration cytology. Journal of Pathology of Nepal. 2019 Mar 29;9(1):1464-8.
13. Taviad DS, Hiryur SP, Patel VP, Nikhra PC, Panchal AB. Diagnostic value of ultrasound-guided transthoracic fine needle aspiration cytology in bronchogenic carcinoma. Int J Med Sci Public Health. 2014 Aug 1;3:1007-10.
14. Dahlstrom JE, Langdale-Smith GM, James DT. Fine needle aspiration cytology of pulmonary lesions: a reliable diagnostic test. Pathology. 2001 Jan 1;33(1):13-6.
15. Bajaj D, Gupta MK, Bhargava JK, Bajaj J. Image-Guided Fine Needle Aspiration Cytology of Pulmonary Lesions at a Tertiary Care Hospital. IMCC Journal of Science. 2022 Dec;2(2):1-4.
16. Travis WD, Brambilla E, Noguchi M, Nicholson AG, Geisinger K, Yatabe Y, Ishikawa Y, Wistuba I, Flieder DB, Franklin W, Gazdar A. Diagnosis of lung cancer in small biopsies and cytology: implications of the 2011 International Association for the Study of Lung Cancer/ American Thoracic Society/European Respiratory Society classification. Archives of pathology & laboratory medicine. 2013 May 1;137(5):668-84.
17. Zhu Y, Song Y, Xu G, Fan Z, Ren W. Causes of misdiagnoses by thyroid fine-needle aspiration cytology (FNAC): our experience and a systematic review. Diagnostic pathology. 2020 Jan 3;15(1):1.

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AUTHOR CONTRIBUTIONS

Principal author, Dr. Suraj Raj Uprety, designed the study. Dr. Kripesh Shrestha contributed to the image-guided FNAC procedure. All authors contributed equally to patient selection, cytological and histopathological examinations, reporting, data collection, drafting, and finalization of the manuscript.

CONFLICT OF INTEREST

The authors declare no competing interests

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