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Image-Guided Fine Needle Aspiration Cytology of Pulmonary Lesions at a Tertiary Care Hospital

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ABSTRACT
Lung cancer is the leading cause of cancer-related mortality worldwide. Patients usually present at an advanced stage, so early diagnosis is important for better prognosis and management. Ultrasound-guided fine needle aspiration cytology (FNAC) is the diagnostic procedure of choice in lung lesions for timely diagnosis and better prognosis. Our study aimed to determine the specificity and sensitivity of FNAC in the diagnosis of pulmonary tumors and to assess the morphological features of various lung tumors. A retrospective study was carried out from June 2020 to August 2021 at a tertiary care center in Jabalpur, Madhya Pradesh, India. A total of 81 cases presenting with clinical and radiological features suggestive of lung malignancies were studied. Image-guided FNAC was done in all cases, and smears were stained using PAP and Giemsa stain. Typing was conducted on cytological evaluation, and histopathological correlation was obtained wherever possible. Immunohistochemistry was performed in a few cases where necessary. Eighty-one cases of ultrasound-guided FNAC of lung lesions were studied. Lung cancers were found to be more common in males, with a male-to-female ratio of 5.75:1, and the mean age at presentation was 55 years. Neoplastic lesions were 86.41%, and non-neoplastic lesions were 7.40%. Squamous cell carcinoma (60.49%) was found to be most common malignancy, followed by adenocarcinoma (11.11%) and small cell carcinoma (8.64%). Diagnostic specificity and sensitivity of FNAC were 100% and 95.65%, respectively. Image-guided FNAC is a safe, rapid, inexpensive, highly sensitive, and specific diagnostic procedure with fewer complications when performed by trained personnel. It helps in the early diagnosis and management of patients with pulmonary lesions leading to a better prognosis.

KEYWORDS: fine needle aspiration cytology; lung carcinoma; lung lesions

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1. Introduction

Lung cancer is the most common cause of cancer-related mortality worldwide [1]. The incidence of lung malignancy was found to be 6.9 %, while cancer-related mortality was 9.3% in both males and females [1]. Patients with lung cancer usually present at an

advanced stage and are treated with systemic therapies. Early diagnosis is essential for better prognosis and management of patients. Ultrasound-guided FNAC is the diagnostic procedure of choice for pulmonary lesions at the apex or periphery. It is instrumental in evaluating small lesions of a few centimeters in diameter [2]. It is a sensitive and accurate technique for diagnosing lung mass lesions [3,4]. It helps in distinguishing benign and malignant lesions. So, the decision about specific treatment like surgery or chemotherapy can be taken. FNAC is very helpful in typing of cancers like small cell carcinoma and lymphomas treated by chemotherapy rather than surgery [5]. FNAC is a safe, rapid, inexpensive, easy-to-perform procedure with fewer complications when performed by trained personnel [6,7]. This study aimed to assess the specificity and sensitivity of FNAC in diagnosing pulmonary lesions and to describe the cytomorphological features of various lung tumors. FNAC allows non-traumatic, non-operative, and timely diagnosis of lung masses, which outweighs the complication of pneumothorax associated with the procedure [7].

2. Materials and Methods

A retrospective analytical study was conducted at the Department of Pathology in a tertiary care hospital from June 2020 to August 2021. The Institutional Ethics Committee of the Netaji Subhash Chandra Bose Medical College, Jabalpur, approved the study protocols, with reference number IEC/2022/6547.

Samples were selected randomly from all the patients coming to the out-patient and in-patient departments of pulmonary medicine and suspected of lung masses clinico-radiologically. A total of 81 cases were enrolled for the study using simple random sampling technique Patients clinically and radiologically suspected of having pulmonary masses were included in the study. Informed consent was obtained from all the patients before performing the procedure.

Ultrasound-guided FNAC was performed in all the patients except in cases where the lesion was not approachable because of proximity to great vessels. A computed tomography scan was used in such cases. Ultrasound was performed using Samsung RS 80 machine, and computed tomography (CT) scan was accomplished using GE ACT 16-slice machine. Patients with bleeding diathesis were excluded from the study for the risk of local hematoma at the FNAC site. Under all aseptic precautions, 20-22 gauze needles were used with a 10-mL syringe to aspirate the material under image guidance by the radiologist. Biopsy was taken wherever possible. Patients were advised to wait for 30 min outside the procedure room to observe for any procedure-related complications. Post-procedure X-ray was taken in all the cases to look for hematoma or pneumothorax.

At the time of specimen collection, clinical details were recorded through the patient's clinical records, and the gross appearance of the aspirate was noted. Ethanol-fixed and air-dried smears were immediately prepared and assessed for cellularity, and aspiration was repeated whenever needed. Giemsa stain was used for air-dried smears, and Papanicolaou (PAP) stain for ethanol-fixed smears for cytological evaluation of the lesions. Special stains like Ziehl-Neelsen (ZN) and auramine rhodamine were used to detect acid-fast bacilli wherever required. Two different pathologists evaluated smears

without bias. On cytomorphology, cases were divided into neoplastic and non-neoplastic based on their cellular features like pleomorphism, nuclear irregularity, high nuclear-to-cytoplasmic ratio, prominent nucleoli, coarse chromatin, and mitotic figures pointing towards neoplastic pathology. Neoplastic cases were further divided into non-small cell, small cell, and other tumor categories. Histopathological correlation was done wherever available, and immunohistochemistry was perfomed in some cases. Specificity, sensitivity, positive predictive value, negative predictive value, and diagnostic accuracy of FNAC were calculated. The SPSS 22.0 software was used for the statistical analysis.

3. Results

In the present study, a total of 81 cases of image-guided FNAC from pulmonary lesions were analyzed. CT scan was used in 10 cases (12.34%), while ultrasound was performed in 71 cases (87.66%).

Out of 81 cases, 12 (14.82%) were females, and 69 (85.18%) were males, with a male-to-female ratio of 5.75:1. Mean age of presentation was 55 years. The youngest and oldest patients were 30 and 80 years old, respectively; both were males. Lesions were more common on the right side (66 cases, 81.48%). Gender-wise distribution of cases is given in Table 1.

Cytological patterns of various pulmonary lesions are given in Table 2. Neoplastic lesions (70 cases, 86.41%) were more common than non-neoplastic lesions (6 cases, 7.40%). FNAC was inadequate for opinion in five cases (6.17%). The overall diagnostic yield among pulmonary lesions was 93.83%.

Among neoplastic pulmonary lesions, squamous cell carcinoma (49 cases, 60.49%) was the most common malignancy (Figures 1.1 and 1.2), followed by adenocarcinoma (9 cases, 11.11%) (Figures 2.1 and 2.2), small cell carcinoma (7 cases, 8.64%) (Figure 3), and non-Hodgkin's lymphoma (3 cases, 3.70%) (Figure 4). There was a single case (1.23%) of large cell carcinoma (Figure 5) and spindle cell lesion. Cytological diagnoses among various pulmonary lesions are given in Table 3. Out of six non-neoplastic lesions, three cases (3.70%) were of tuberculosis, one case (1.23%) of a non-caseating granulomatous lesion, one case (1.23%) was an acute inflammatory lesion, and one case (1.23%) yielded non-specific findings.

Out of 81 cases of pulmonary lesions diagnosed on FNAC, we obtained histopathological correlation in 25 cases (30.86%). Concordance was seen in 22 cases (Table 4), and two cases were inadequate for an opinion on biopsy and showed inflammatory cells and necrosis only. Five cases were also inadequate for an opinion on cytology. Transthoracic biopsy was done in a case that was diagnosed as a germ cell tumor on histopathology and confirmed to be non-Hodgkin's lymphoma on immunohistochemistry. One case, which was diagnosed as a non-caseating granulomatous lesion on cytology, was confirmed to be sarcoidosis on histopathology. The specificity of image-guided FNAC was found to be 100%, and the sensitivity was 95.65% (Table 5). No major complication occurred while performing FNAC during our study. True positive and negative, as well as false positive and negative diagnoses of FNAC for pulmonary lesions, are shown in Table 6.

Table 1. Age distribution of cases.

Age group (in years)	Number of cases	Percentage (%)
< 30	5	6.17
31 – 40	4	4.93
41 – 50	16	19.75
51 – 60	33	40.74
61 – 70	16	19.75
> 70	7	8.64
Total	81	100.00

Table 2. Cytological patterns in pulmonary lesions.

Pulmonary lesions	Number of cases	Percentage (%)
Inadequate for opinion	5	6.17
Non-neoplastic lesions	6	7.40
Neoplastic lesions	70	86.41
Total	81	100

Table 3. Cytological diagnoses among various pulmonary lesions.

Cytological diagnoses	Number of cases	Percentage (%)
Non-small cell carcinoma		
Squamous cell carcinoma	49	60.49
Adenocarcinoma	9	11.11
Large cell carcinoma	1	1.23
Small cell carcinoma	7	8.64
Others		
Non-Hodgkin's lymphoma	3	3.70
Spindle cell lesion	1	1.23

Table 4. Correlation between FNAC and histopathological diagnoses.

FNAC diagnoses	Histopathological diagnoses	Total number of concordant cases	Total number of discordant cases
Squamous cell carcinoma	Squamous cell carcinoma	16	0
Adenocarcinoma	Adenocarcinoma	4	0
Large cell carcinoma	Large cell carcinoma	1	0
Small cell carcinoma	Small cell carcinoma	1	0
Inadequate	Germ cell tumor	0	1
Inadequate	Inadequate	2	0
Total		24	1

Table 5. Sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy of FNAC.

Test	Value (%)
Sensitivity	95.65
Specificity	100
Positive Predictive Value	100
Negative Predictive Value	66.66
Diagnostic Accuracy	96

Table 6. True positive and negative and false positive and negative diagnoses of FNAC for pulmonary lesions.

Test	Positive for malignancy on histopathology	Negative for malignancy on histopathology	Total
Positive for malignancy on FNAC	22	0	22
Negative for malignancy on FNAC	1	2	3
Total	23	2	25

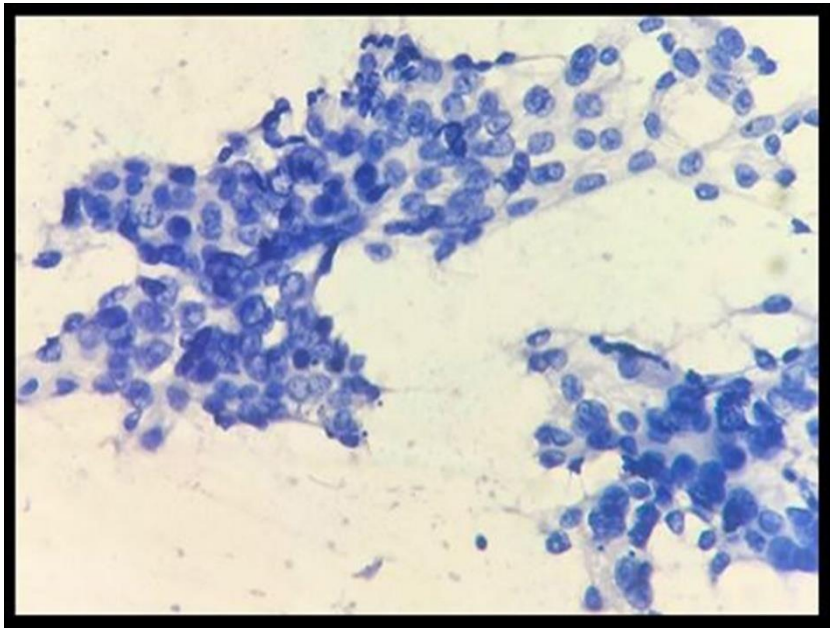

Figure 1.1 Smear shows squamous cell carcinoma with neoplastic squamous cells arranged in sheets (PAP stain, x40).

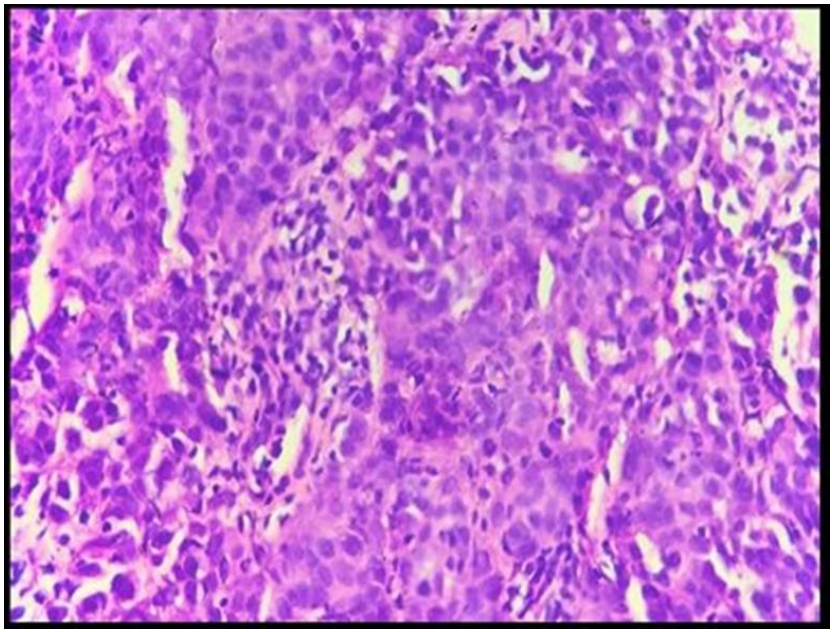

Figure 1.2 Smear shows the nests and sheets of neoplastic squamous cells having cytoplasmic keratin and intercellular bridging (H&E stain, x40).

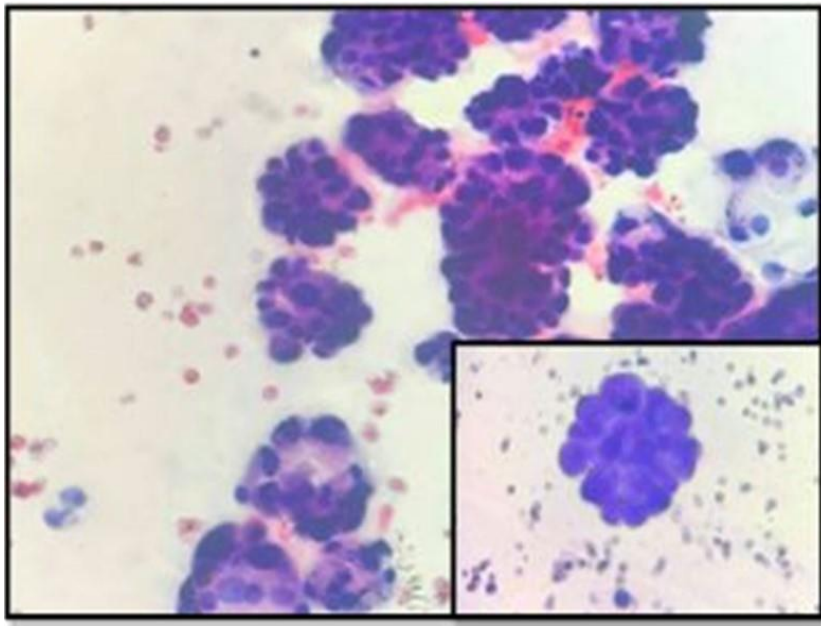

Figure 2.1 Smear shows adenocarcinoma; inset shows neoplastic cells arranged in glandular and acinar patterns (PAP stain, x40).

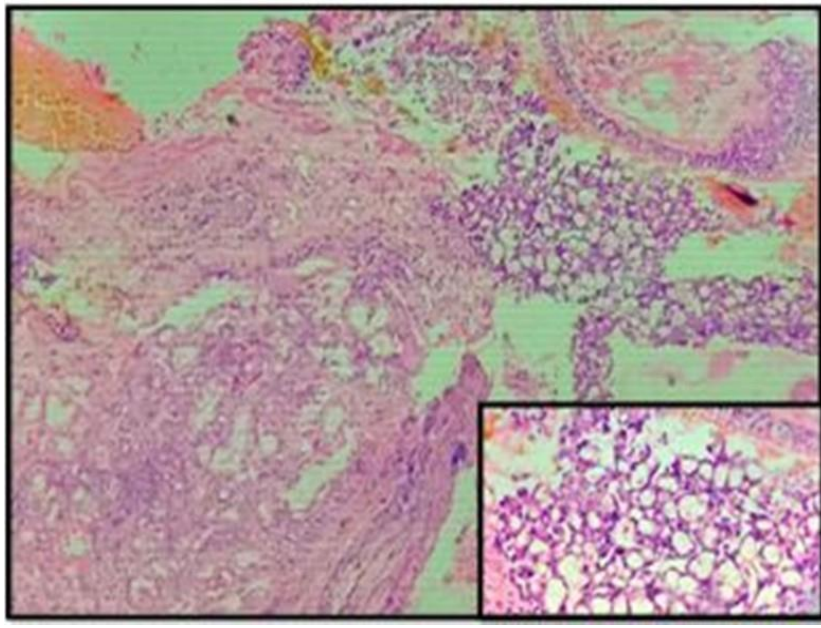

Figure 2.2 Smear shows neoplastic cells forming glandular and acinar patterns; inset shows an intracellular mucoid material among cells with eccentric nucleoli (H&E stain, x40).

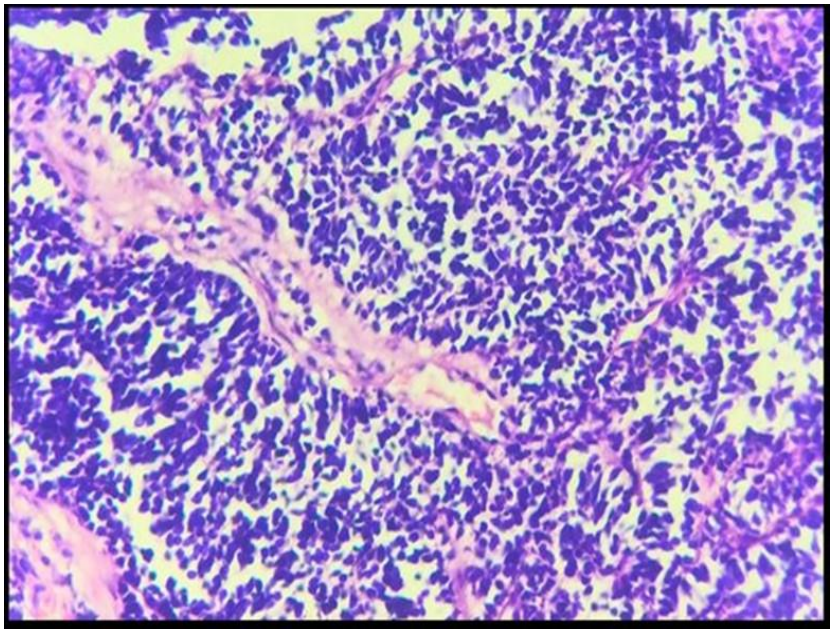

Figure 3. Smear shows clusters of small cells characteristic of small cell carcinoma exhibiting hyperchromasia and nuclear moulding (H&E stain, x40).

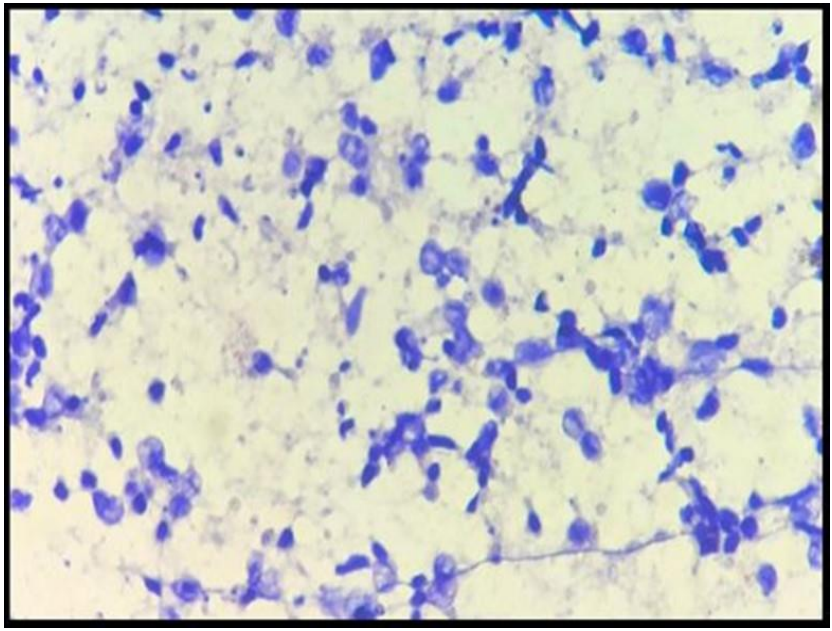

Figure 4. Smear shows non-Hodgkin's lymphoma characterized by a monotonous population of uniformly distributed atypical lymphoid cells (PAP stain, x40).

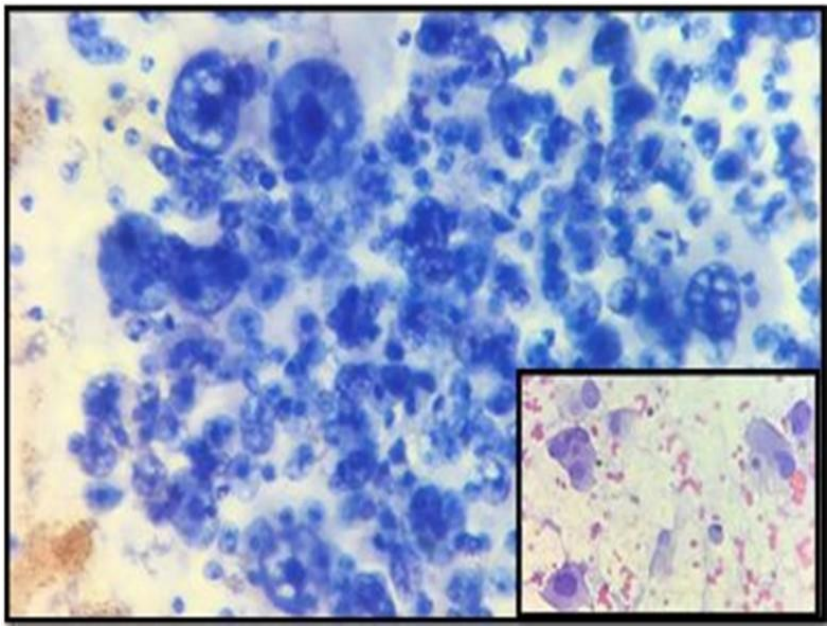

Figure 5. Smear shows large cell carcinoma (PAP stain, x40); inset shows discohesive singly dispersed cells with bizarre pleomorphic nucleus (Giemsa stain, x40).

4. Discussion

Ultrasound-guided FNAC is a safe and reliable method to diagnose pulmonary lesions. It is more useful in diagnosing localized lesions than diffuse parenchymal lung disease diagnosis [2]. It helps to differentiate malignant lesions from non-malignant ones and also helps in sub-typing the malignancies.

In our study, out of 81 cases, 12 cases (14.82%) were females, and 69 cases (85.89%) were males. Male predominance was seen as found in other studies [6]. As documented in other studies, the most common age group for lung malignancies was 51-60 years [8,9]. The mean age of presentation in our study was 55 years, which conformed to a previous study [9]. Most lung lesions involved the right side, similar to that found in the study by Saha et al. [9].

The neoplastic lesions (86.41%) outnumbered the non-neoplastic (7.40%) cases. Among the neoplastic lesions, the most common malignancy was squamous cell carcinoma (60.49%), and adenocarcinoma (11.11%) was the second most common. This result corroborated with other studies [7,9-11].

Among the non-neoplastic lesions, we found three cases of tuberculosis which were confirmed by special stains like Auramine rhodamine and Ziehl Neelsen. One case which was diagnosed as a non-caseating granulomatous lesion on cytology, was

diagnosed as sarcoidosis on histopathology. Anti-tuberculous treatment can be started in cases of tuberculosis early as it can be diagnosed easily on FNAC. Tuberculosis was found in other studies ranging from 5% to 7% [10,11]. One case was diagnosed as an acute inflammatory lesion. Antibiotics were started based on the cytology report, and the patient responded well to the treatment without needing further workup.

In the present study, five cases (6.17%) were inadequate for an opinion on cytology. The reasons for inadequacy may be the skill of the person doing FNAC and the lesion site. One case which was found to be hemorrhagic on cytology and inadequate for an opinion was diagnosed as a germ cell tumor on histopathology and confirmed to be non–Hodgkin's lymphoma on immunohistochemistry. The yield of the specimen, which in turn affects the accuracy of diagnosis and the rate of complications, were comparatively lesser when done by expert medical personnel, as stated in a study done by Prashant et al. [12]. It also indicated that the complication rate was higher in deeper lesions [12]. In the present study, FNAC showed concordance with histopathological diagnosis wherever available except in one case, which was inadequate for an opinion on FNAC and was diagnosed as a germ cell tumor on histopathology. FNAC was found to be a highly accurate method in the diagnosis of pulmonary lesions.

The major drawback of this research was its retrospective nature and the unavailability of histopathology correlation and immunohistochemistry in all cases, which affected the statistical parameters of the study. However, FNAC is a safe, rapid, highly sensitive, and specific procedure with fewer complications when performed by trained personnel. Radiological guidance has enabled accurate localization of pulmonary lesions, which helps in better yield on FNAC. It helps in the early diagnosis of lung malignancies with further subtyping in most cases, thus hastening the time at which therapy can be started. Inflammatory lesions like tuberculosis can be diagnosed accurately on FNAC using special stains like Ziehl Neelsen and Auramine rhodamine. FNAC diagnosis helps to decide treatment modalities for pulmonary lesions and to avoid unnecessary surgical management of lung malignancies.

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Conflict of Interest Statement

The authors declare no conflict of interest.

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