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FINE-NEEDLE CLARITY: CT-GUIDED FNAC IN LUNG CANCER DIAGNOSIS

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Abstract

Background: Lung cancer remains a significant global health concern, necessitating advanced diagnostic tools for precise and timely interventions. This study explores the diagnostic efficacy and safety profile of Computed Tomography (CT)-guided Fine Needle Aspiration Cytology (FNAC) in suspected lung lesions, aiming to contribute valuable insights to the evolving landscape of lung cancer diagnosis.

Materials and Methods: We conducted a retrospective analysis of 45 patients who underwent CT-guided lung FNAC for suspected lung lesions. Demographic data, lesion characteristics, and diagnostic performance metrics were systematically collected. Comparative analyses with alternative diagnostic modalities, cytological examination findings, and post-procedure complications were meticulously assessed.

Results: The study cohort exhibited a diverse demographic profile with a mean age of 58 years and a balanced gender distribution. CT-guided lung FNAC demonstrated a commendable diagnostic yield of 80%, with a sensitivity of 85%, specificity of 90%, and positive and negative predictive values of 78% and 92%, respectively. Comparative analyses revealed significantly higher sensitivity compared to bronchoscopy and transthoracic needle biopsy. Cytological examination identified various histological subtypes, with adenocarcinoma being the predominant finding. Minor complications occurred in 9% of cases, with no statistically significant differences compared to alternative diagnostic methods.

Conclusion: Our findings underscore CT-guided lung FNAC's diagnostic efficacy and safety in identifying lung cancer. The high diagnostic yield, sensitivity, and reliability, coupled with a favorable safety profile, position CT-guided lung FNAC as a crucial diagnostic tool for pathologists in evaluating suspected lung lesions. These results contribute to the growing body of evidence supporting the clinical utility of CT-guided FNAC in lung cancer diagnosis.

Keywords: Lung cancer, CT-guided FNAC, Diagnostic efficacy, Histological subtypes, Comparative analysis

Introduction

Lung cancer remains a formidable global health challenge, with a relentless impact on morbidity and mortality. Early and accurate diagnosis is paramount for optimizing therapeutic interventions and improving patient prognosis. Computed Tomography (CT)-guided Lung Fine Needle Aspiration Cytology (FNAC) has emerged as a pivotal diagnostic tool, revolutionizing the landscape of lung cancer diagnostics.[1] This paper investigates the crucial role of CT-guided lung FNAC in empowering pathologists with a precise and minimally invasive means of obtaining tissue samples from suspicious lung lesions.

Traditional diagnostic methods, while effective, often involve invasive procedures and may pose risks to patients.[2] CT-guided lung FNAC offers a less invasive alternative, providing real-time imaging

guidance to target lesions with unparalleled precision. [3] This technique enables the collection of cytological material from suspicious nodules or masses, facilitating the identification and classification of lung cancers. [1, 3] As advancements in instrumentation, imaging technology, and navigation systems continue, the potential for CT-guided lung FNAC to enhance diagnostic accuracy and contribute to personalized treatment strategies becomes increasingly evident.[4, 5]

Through an exploration of the technical nuances, diagnostic accuracy, clinical utility, and future perspectives of CT-guided lung FNAC, this research aims to underscore its pivotal role in modern lung cancer diagnostics. By illuminating the strengths and potential areas for improvement, this study contributes to the ongoing evolution of lung cancer diagnostic strategies, ultimately striving for earlier detection and more effective patient care.

Materials and Methods:

A prospective observational study was performed on 45 patients at the Department of Pathology from December 2022 to August 2023.

Detailed clinical and radiological data were systematically collected from the records of all the patients who underwent CT-guided lung FNAC for suspected lung lesions between December 2022 and August 2023. Inclusion criteria encompassed patients with radiologically identified lung lesions, availability of CT-guided lung FNAC results, and subsequent confirmation through histopathology or clinical follow-up.

Before the procedure, each patient obtained informed consent after thoroughly explaining the risks and benefits associated with CT-guided lung FNAC.

CT-Guided Lung FNAC Procedure:

A 22-gauge lumbar puncture needle was employed for CT-guided lung FNAC procedures. The specific CT-guided instruments, imaging equipment, and navigation systems were documented. The exact location of each lesion was determined by CT scan, ensuring precision during the FNAC procedure. FNAC samples were obtained using the lumbar puncture needle, and subsequent smears were stained with May Grunwald Giemsa (MGG) after dry fixation. After wet fixation, hematoxylin and eosin staining were performed for comprehensive cytological evaluation.

All patients were kept under observation for 2 hours post-procedure. If indicated, a repeat CT scan was conducted, particularly in cases where complications or adverse events were suspected.

Pathologists blinded to clinical details examined the prepared smears under a microscope. Cytological diagnoses were made based on established criteria.

Statistical Analysis:

Statistical analyses, including descriptive statistics and diagnostic performance metrics (e.g., sensitivity, specificity, positive predictive value, and negative predictive value), were conducted using appropriate software (e.g., SPSS Ver. 25). Statistical analyses, including chi-square tests and t-tests, were employed to evaluate the significance of observed differences and associations.

Results:

In this investigation, encompassing 45 patients who underwent CT-guided lung FNAC for suspected lung lesions, the study population exhibited a diverse demographic profile with a mean age of 58. Gender distribution revealed 55% male and 45% female patients. Lesion characteristics were equally varied, with lesions ranging from 2.5 cm to 6.8 cm in size.

CT-guided lung FNAC demonstrated a commendable diagnostic yield of 80%, accurately identifying lung cancer in 36 out of 45 cases. The procedure's sensitivity was 85%, indicating its effectiveness in detecting positive cases, while specificity was 90%, signifying its ability to identify true negatives correctly. The positive predictive value (PPV) and negative predictive value (NPV) were 78% and 92%, respectively.

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Table 1: Diagnostic Performance of CT-guided Lung FNAC

Diagnostic Performance	Value (%)
Diagnostic Yield	80
Sensitivity	85
Specificity	90
Positive predictive value	78
Negative predictive value	92

Comparative analysis with alternative diagnostic modalities, such as bronchoscopy and transthoracic needle biopsy, revealed a significantly higher sensitivity of CT-guided lung FNAC ($p < 0.05$). The specificity, however, showed no statistically significant difference ($p > 0.05$).
Cytological examination of FNAC smears uncovered various histological subtypes of lung cancer: adenocarcinoma (n = 18, 40%), squamous cell carcinoma (n = 12, 27%), and small cell carcinoma (n = 6, 13%).
During the 2-hour post-procedure observation, four patients experienced minor complications, constituting 9% of the total cohort. Repeat CT scans were conducted in three cases where complications or adverse events were suspected, revealing localized pneumothorax in one case. Notably, there were no statistically significant differences in complication rates between CT-guided lung FNAC and alternative diagnostic methods ($p > 0.05$).
Histopathological confirmation through subsequent surgical procedures or biopsy validated the cytological diagnoses made through CT-guided lung FNAC in 82% of cases, highlighting the reliability of this diagnostic modality.
Subgroup analyses based on lesion size, location, and patient demographics demonstrated no statistically significant differences in diagnostic performance ($p > 0.05$).

Table 2: Comparison with Alternative Diagnostic Modalities

Diagnostic Modality	Sensitivity (%)	Specificity (%)
CT-guided Lung FNAC	85	90
Bronchoscopy	70	85
Transthoracic Needle Biopsy	75	88

Discussion:
The findings of our study contribute to the ongoing discourse surrounding the diagnostic utility of CT-guided lung Fine Needle Aspiration Cytology (FNAC) in suspected lung lesions, presenting a comprehensive analysis of its performance compared to alternative diagnostic modalities.

Our diverse patient cohort, representative of the real-world demographic profile, aligns with existing literature on the subjects. [1] The mean age of 58 years and an equal gender distribution reflect the typical characteristics of individuals undergoing diagnostic evaluations for lung abnormalities. [2]

Our study's observed diagnostic yield of 80% is consistent with or exceeds the reported values in previous studies. [3] This emphasizes the reliability and effectiveness of CT-guided lung FNAC in accurately identifying lung cancer. The sensitivity of 85%, a key metric for assessing the test's ability to identify true positive cases, aligns with the range reported in recent literature.[4] Notably, the specificity of 90% surpasses or is comparable to findings in similar investigations, signifying the robustness of CT-guided lung FNAC in correctly identifying true negatives.[5]

Our comparative analysis with bronchoscopy and transthoracic needle biopsy revealed a significantly higher sensitivity of CT-guided lung FNAC ($p < 0.05$). This corroborates earlier studies suggesting the superiority of CT-guided lung FNAC in detecting malignancies, particularly in cases where

bronchoscopy may yield false negatives.[6] While the specificity did not exhibit a statistically significant difference ($p > 0.05$), the overall diagnostic performance of CT-guided lung FNAC underscores its clinical relevance in lung cancer diagnosis.[7]
The diverse histological subtypes identified through cytological examination of FNAC smears, including adenocarcinoma, squamous cell carcinoma, and small cell carcinoma, resonate with established literature emphasizing the varied nature of lung cancer.[8] This molecular characterization aligns with the current emphasis on precision medicine and targeted therapies in lung cancer management.[9]

The manageable minor complications observed in our study (9%) during the post-procedure observation period align with the safety profile reported in the literature for CT-guided lung FNAC. [10] The lack of statistically significant differences in complication rates between CT-guided lung FNAC and alternative diagnostic methods ($p > 0.05$) supports its safety and feasibility in routine clinical practice.[11]

The histopathological confirmation validating cytological diagnoses in 82% of cases reflects the consistency and reliability of CT-guided lung FNAC results, corroborating findings from previous studies. [12]
Subgroup analyses based on lesion size, location, and patient demographics demonstrated no statistically significant differences in diagnostic performance ($p > 0.05$). This aligns with existing literature, suggesting that CT-guided lung FNAC maintains consistent diagnostic accuracy across diverse clinical scenarios.[13]

Conclusion

This study substantiates the evidence supporting the efficacy and safety of CT-guided lung FNAC in diagnosing lung cancer. The comparison with previous literature underscores the reliability and consistency of our findings, positioning CT-guided lung FNAC as a valuable and versatile diagnostic tool in managing suspected lung lesions.

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