ISSN: 2091-2331 (Print) 2091-234X (Online)

Journal of Nobel Medical College

Volume 15, Number 01, Issue 28, January-June 2026, 23-28

Original Article

Diagnostic Yield and Complications of Transthoracic CT-Guided Biopsies

Ganesh Devkota[1]*, Mahesh Gautam[1], Ashish Mohan Bhattarai[1], Pratikshya Tripathi[2]

[1] Department of Radiology, Nobel Medical College and Teaching Hospital, Biratnagar, Nepal
[2] Department of Nursing, Nobel Medical College and Teaching Hospital, Biratnagar, Nepal

Article Received: 7th March, 2026; Accepted: 28th May, 2026; Published: 30th June, 2026

DOI: https://doi.org/10.3126/jonmc.v15i1.96137

Abstract

Background
Transthoracic computed tomography-guided lung biopsy is a minimally invasive and reliable procedure for evaluating pulmonary lesions. This study aimed to determine the diagnostic yield and analyze complications related to transthoracic Computed Tomography -guided lung biopsy.

Materials and Methods
A prospective study was conducted on 65 patients undergoing computed tomography-guided transthoracic lung biopsy using a 128-slice Siemens scanner. A 17-gauge coaxial introducer and an 18-gauge semi- automated core needle were used. Lesion size, depth, diagnostic adequacy, histopathological outcomes, and complications were recorded.

Results
Among 65 patients who underwent the computed tomography biopsies of lung lesions, adequate tissue was obtained in 63/65, i.e. diagnostic yield was 96.9%. Among these, 52 cases (82.5%) were malignant, with adenocarcinoma (n=26, 41.3%) and squamous cell carcinoma (n=14, 22.2%) being the most frequent. Benign lesions accounted for 11 cases (17.5%), including 9 cases of pulmonary tuberculosis and 2 of organizing pneumonia. Lesion characteristics affected diagnostic success: smaller lesions (<2 cm) and deeper lesions (>5 cm from pleura) were associated with lower yield. Complications occurred in 18 patients (27.7%), with pneumothorax being the most common (10/18, 55.5%), though only 2 cases required chest tube insertion. Other complications included hemoptysis (5 cases) and parenchymal hemorrhage (3 cases). Increased complication risk was observed in patients with emphysematous lungs, smaller lesions, and greater lesion depth.

Conclusion
The findings of this study suggest that, computed tomography-guided percutaneous biopsy of pulmonary lesions using an 18-gauge coaxial semi-automated core needle is a safe, minimally invasive, and reliable diagnostic technique, demonstrating high accuracy with a low rate of clinically significant complications, and is well-suited for the evaluation of suspected lung pathology.

Keywords: *Core needle biopsy, Lung cancer, Pneumothorax*

***Corresponding Author:**
Dr. Ganesh Devkota
Lecturer
Email: ganesh.swatantra@gmail.com
ORCID: https://orcid.org/0009-0007-2081-3104

Citation
Devkota G, Gautam M, Bhattarai AM, Tripathi P, Diagnostic Yield and Complications of Transthoracic CT-Guided Biopsies, JoNMC. 15:1 (2026) 23-28. DOI: https://doi.org/10.3126/jonmc.v15i1.96137

Introduction

Lung cancer remains one of the most frequently diagnosed malignancies worldwide and is a leading cause of cancer-related death [1]. Accurate tissue diagnosis is essential for determining appropriate treatment strategies, particularly with the increasing use of targeted therapies and immunotherapy. While centrally located tumors can often be sampled via bronchoscopy, peripheral lesions or those separated from the pleural surface by aerated lung tissue frequently require percutaneous approaches [2,3]. Computed tomography (CT)-guided percutaneous transthoracic needle biopsy (PTNB) has become a standard minimally invasive technique for obtaining tissue from pulmonary lesions. This method allows not only histopathological evaluation but also immunohistochemistry and molecular testing, which are critical for personalized management of lung cancer [4,5]. Compared with surgical biopsy methods such as video-assisted thoracoscopic surgery (VATS) or open lung biopsy, CT-guided PTNB offers the advantage of reduced invasiveness, lower morbidity, and shorter recovery time.

Despite its safety and efficacy, CT-guided biopsy carries potential risks, including pneumothorax, hemoptysis, and parenchymal hemorrhage. Factors such as lesion size, depth, and underlying lung pathology can influence both diagnostic yield and complication rates [6–9]. Understanding these variables is important for procedural planning, risk stratification, and patient counseling.

This study aims to evaluate the diagnostic performance of CT-guided transthoracic lung biopsy using an 18-gauge coaxial core needle, while analyzing the incidence and determinants of procedure-related complications in a tertiary care setting.

Materials and Methods

This prospective study was conducted in the department of Radiology at Nobel Medical College over a period of 1 year, from January to December 2024, following approval from the Institutional Review Committee [Ref- 908/2023]. Written informed consent was obtained from all participants prior to enrollment.

All adult patients (age >18 years) of either sex referred for CT-guided transthoracic lung biopsy during the study period were considered for inclusion. Exclusion criteria included uncorrectable coagulopathy, inability to maintain required positioning, or refusal to consent. A consecutive convenience sampling approach was used. The minimum sample size (n=65) was calculated using Cochran's formula for estimating proportions, based on previously reported diagnostic yield of 92.3% and a margin of error of 6.5% [6]. Pre-procedural evaluation was done which included a review of hematology and coagulation parameters, and temporary cessation of anticoagulants or antiplatelet agents according to standard guidelines [7]. Lesion characteristics, including size and distance from the pleural surface, were determined using initial CT imaging.

All biopsies were performed using a 128-slice Siemens CT scanner. Procedures were carried out under strict aseptic precautions. Patients were positioned (supine, prone, or lateral) according to the most suitable access route to the lesion. An initial CT scan was performed to identify the lesion and plan a safe needle path, avoiding vessels, fissures, and emphysematous areas as much as possible. After marking the entry site, local anesthesia was given using 1% lignocaine. A small skin nick was made, and a 17-gauge coaxial introducer needle was carefully advanced under stepwise CT guidance to the edge of the lesion. Once satisfactory positioning was confirmed, an 18-gauge automated core biopsy needle was passed through the coaxial needle to obtain tissue cores. Multiple samples (3-4) were taken through the same coaxial tract, minimizing repeated pleural punctures. Following the procedure, the needle assembly was removed, and a repeat CT scan was obtained to check for immediate complications such as pneumothorax or hemorrhage. Patients were subsequently observed clinically and managed as required. Small, asymptomatic pneumothoraces were managed conservatively with supplemental oxygen, while larger or symptomatic cases were managed with pigtail catheter drainage. Hemoptysis was treated as clinically indicated, often with intravenous tranexamic acid.

Tissue adequacy, histopathological diagnosis, and procedure-related complications were recorded. Lesion size, depth, and underlying lung pathology were analyzed to identify factors affecting diagnostic yield and complication rates. Data were entered and analyzed using SPSS version 27. Descriptive statistical methods were applied to summarize demographic, procedural, and outcome variables. Associations between lesion characteristics (size and depth) and diagnostic adequacy were evaluated using Fisher's Exact Test because of the small number of inadequate samples and the presence of cells with expected frequencies less than five. All tests were two-tailed, and a p-value <0.05 was considered statistically significant.

Results

A total of 65 patients underwent biopsy procedures. Of these, 42 (64.6%) were male and 23 (35.4%) were female. The majority of patients were older adults, with 27 (41%) falling in the 70–79 years age group, followed by 22 (34%) aged 60–69 years. A smaller number of patients, 11 (17%), were between 50–59 years, and only 5 (8%) were under the age of 49, shown in figure 1.

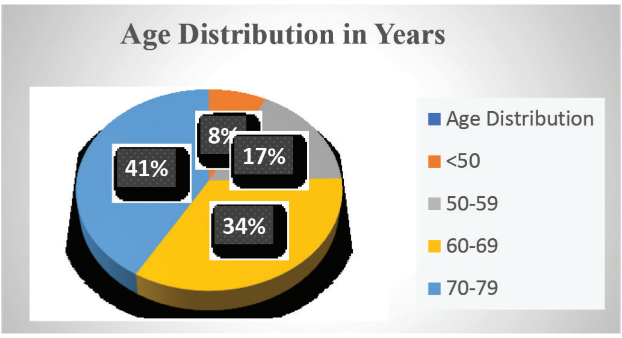

Figure1: Age Distribution of patients included in the study

Table 1: Diagnostic Yield of CT-Guided Lung Biopsies According to Lesion Size

Lesion Size (cm)	Total Lesions	Adequate (n)	Inadequate (n)	Diagnostic Yield (%)
< 2	7	5	2	71.4
2–5	26	26	0	100
> 5	32	32	0	100
Total	65	63	2	96.9

Table 2: Diagnostic Yield of CT-Guided Lung Biopsies According to Depth

Distance from Parietal Pleura (cm)	Total Lesions	Adequate (n)	Inadequate (n)	Diagnostic Yield (%)
< 1	13	13	0	100
1–5	23	23	0	100
> 5	29	27	2	93.1
Total	65	63	2	96.9

Table 1 and table 2 demonstrate diagnostic yield of CT-guided lung biopsies according to lesion size and depth, showing non-diagnostic cases in small, deep lesions (<2 cm & >5 cm).

Furthermore, to evaluate the association of lesion size and lesion depth with diagnostic adequacy, the data were recategorized as presented in the table 3 below.

Table 3. Association of lesion size and lesion depth with diagnostic adequacy

Variable	Category	Adequate n (%)	Inadequate n (%)	Total (n)	p-value
Lesion size	<2 cm	5 (71.4)	2 (28.6)	7	0.010*
	≥2 cm	58 (100.0)	0 (0.0)	58	
Lesion depth	>5 cm	27 (93.1)	2 (6.9)	29	0.195
	≤5 cm	36 (100.0)	0 (0.0)	36	

Note: *Fisher's Exact test; p < 0.05 considered statistically significant.

Diagnostic adequacy was significantly lower in lesions measuring <2 cm compared with lesions ≥2 cm (71.4% vs. 100.0%, Fisher's Exact test, p = 0.010). Lesions located at a depth >5 cm demonstrated a lower adequacy rate than lesions located at a depth ≤5 cm (93.1% vs. 100.0%); however, this difference was not statistically significant (Fisher's Exact test, p = 0.195).

Of the 65 biopsy attempts, adequate tissue material was obtained in 63 cases (96.9%). Among these, 52 cases (82.5%) were diagnosed as malignant, with adenocarcinoma (n=26, 41.3%) being the most common histological subtype, followed by squamous cell carcinoma (n=14, 22.2%). Non-malignant diagnoses accounted for 11 cases (17.5%), among which pulmonary tuberculosis (n=9,14.2%) was the most frequent, which is shown in table 4.

Table 4: Tissue Adequacy, Diagnostic Outcomes, and Histopathological Distribution of Image-Guided Biopsy Procedures (n = 65)

Parameter	Category	Number (n)	Percentage (%)
Total Procedures	–	65	100
Tissue Adequacy	Adequate samples	63	96.9
	Inadequate samples	2	3.1
Diagnostic Outcome	Malignant lesions	52	82.5
	Benign lesions	11	17.5
Malignant Subtypes	Adenocarcinoma	26	41.3
	Squamous cell carcinoma	14	22.2
	Small cell carcinoma	7	11.1
	Metastasis	5	7.9
Benign Subtypes	Pulmonary tuberculosis	9	14.2
	Organizing pneumonia	2	3.1

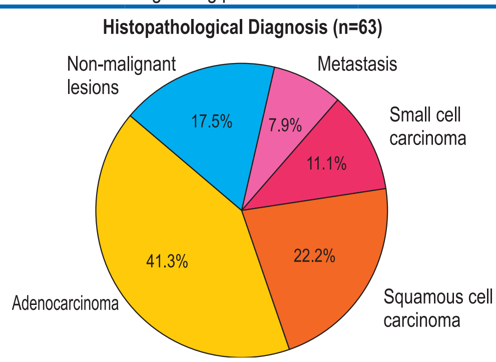

Figure 2: Histological diagnosis

The pie chart illustrates the distribution of histopathological diagnoses among 63 biopsy cases. Adenocarcinoma was the most common diagnosis, accounting for 41.3% of cases, followed by squamous cell carcinoma (22.2%), small cell carcinoma (11.1%), metastasis (7.9%), and non-malignant lesions (17.5%). This highlights the predominance of malignant lesions, particularly adenocarcinoma, in the study population.

Table 5: Types and Frequency of Complications

Complication Type	Number of Cases	Percentage (%)
Pneumothorax	10	55.6
Hemoptysis	5	27.8
Parenchymal Hemorrhage	3	16.7
Total	18	100

Table 5 shows types and frequency of complications, where complications occurred in 18 of 65 cases (27.7%). The most common complication was pneumothorax, observed in 10 cases. Among these, 2 cases required pigtail catheter drainage; both involved lesions that were smaller than 2 cm, located at depth more than 5 cm, and with emphysematous changes in lung. This highlights the increased risk associated with small, deep lesions in compromised lung parenchyma. Hemoptysis was reported in 5 cases, out of which 2 cases were managed with IV tranexamic acid and supplemental oxygen. Parenchymal hemorrhage occurred in 3 cases. Overall, the majority of complications were manageable, with only a small subset requiring intervention.

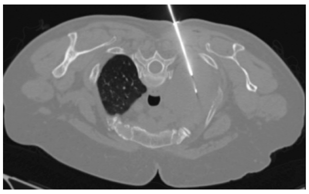

Figure: 3

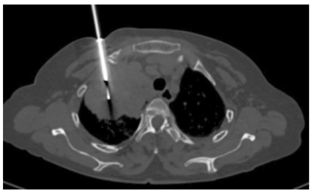

Figure:4

Figure:5

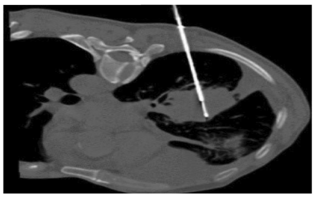

Figure: 6

Figure 3-6: showing CT guided 18G core needle biopsy of various lung lesions.

Discussion

Percutaneous CT-guided needle biopsy is a well-established technique for obtaining tissue from intrathoracic lesions for histopathological evaluation and ancillary diagnostic studies. Although it is considerably less invasive than surgical biopsy methods, it is not without risk. The close anatomical relationship of the lungs to vital structures such as the heart, major vessels, ribs, and mediastinal organs necessitates precise technical execution and a thorough understanding of thoracic anatomy to minimize procedure-related complications.

In the present study, CT-guided transthoracic biopsy demonstrated a high diagnostic yield, with adequate tissue obtained in 96.9% of cases. This result is consistent with previously published studies, where reported diagnostic accuracy ranges from 85% to 95%, depending on lesion characteristics, biopsy technique, and operator experience [6–9]. For example, Thapa et al. reported a diagnostic yield of 92% using an 18G coaxial semi-automatic core needle in a series of lung biopsies [6], while Poulou et al. achieved an overall accuracy of 90% in 1,000 procedures [7]. Similarly, Choi et al. demonstrated a diagnostic yield of 88% for pulmonary nodules smaller than 1 cm, highlighting the challenges posed by small lesion size [8], and Takeshita et al. reported an accuracy of 94% in 750 procedures, emphasizing the importance of operator experience and technique [9]. A study conducted by Jelitto-Gorska et al. reported that CT-guided core biopsy had higher sensitivity for malignancy (89%) than FNAB (75%) in lung tumors, with high accuracy in other thoracic lesions as well. While haemoptysis was more common with core biopsy, pneumothorax rates were similar, confirming its safety and diagnostic effectiveness [10]. The slightly higher diagnostic yield observed in this study may be attributed not only to the consistent use of a coaxial technique combined with a core biopsy needle, which allows multiple samples through a single pleural puncture, but also to the high proportion of larger lesions (>5 cm) in the cohort. Larger lesions provide a more accessible target and reduce the likelihood of sampling error, contributing to the high overall tissue adequacy.

The study population was predominantly composed of elderly patients, with more than 75% aged above 60 years and a male predominance (64.6%). This demographic profile reflects the known epidemiological pattern of lung malignancy, which is more common in older individuals and males [1]. The high proportion of malignant diagnoses (82.5%) in this study likely contributed to the elevated diagnostic yield, as malignant lesions are generally larger, more cellular, and easier to target compared to benign or inflammatory conditions. Lesion characteristics, particularly size and depth, influenced diagnostic success. Most lesions in this study were >5 cm and located >5 cm from the pleura, providing a larger target and increasing the likelihood of adequate tissue sampling. In contrast, smaller lesions (<2 cm), which represented a minority of cases, are more difficult to localize and sample, resulting in a higher risk of non-diagnostic specimens, consistent with previous reports [8,9]. Lesion depth also affects procedural accuracy, as deeper lesions can be technically challenging due to longer needle paths and potential respiratory motion. Nevertheless, the high overall yield observed here demonstrates that careful planning and CT guidance can overcome these difficulties. Comparable studies have reported similarly high diagnostic success rates despite variations in lesion size and depth [7–9].

The distribution of histopathological diagnoses in this study further supports its diagnostic effectiveness. Adenocarcinoma was the most common subtype (41.3%), followed by squamous cell carcinoma (22.2%), which is consistent with global trends in lung cancer histology [1]. Among benign conditions, pulmonary tuberculosis was the most frequent diagnosis, reflecting regional disease prevalence and emphasizing the importance of tissue sampling in differentiating malignant from infectious etiologies, particularly in tuberculosis-endemic settings [6]. In this study, complications occurred in 27.7% of patients (n = 18), with pneumothorax being the most frequent (55.5%, n = 10). Only 20% of pneumothoraces (n = 2) required chest tube placement, while the remainder were managed conservatively. Hemoptysis was observed in 27.8% (n = 5) and parenchymal hemorrhage in 16.7% (n = 3) of complicated cases. These rates are comparable to previously published data [11,12]. Analysis revealed a higher incidence of complications in lesions that were small (<2 cm) or located deeper (>5 cm from the pleural surface). Smaller lesions are technically more challenging to target, often necessitating multiple needle passes, which increases disruption of surrounding lung tissue and the risk of pneumothorax or hemorrhage [7–9]. Similarly, deeper lesions require longer needle paths through aerated lung parenchyma, predisposing to alveolar injury and air leaks [11,12].

Patients with underlying emphysematous changes in lung also experienced a greater frequency of complications. Structural lung alterations in emphysema, including bullae formation and reduced elastic recoil, render the parenchyma more fragile, thereby increasing susceptibility to pneumothorax and hemorrhage during needle traversal [11,13]. These findings underscore the importance of careful pre-procedural planning, including selection of the shortest and safest needle trajectory, avoidance of interlobar fissures and major vessels, and optimization of patient positioning. Such strategies are critical to maximize diagnostic yield while minimizing procedural risks, particularly in high-risk lesions and patients with compromised lung architecture [14].

This study is limited by its small sample size and single-center design, which may affect generalizability. The use of convenience sampling introduces potential selection bias. Lack of long-term follow-up, particularly in non-diagnostic or benign cases, limits assessment of false-negative rates. Additionally, no comparison with other biopsy techniques was performed, and procedural variables such as needle path length and number of passes were not systematically analyzed. Larger, multicenter studies are recommended to validate these findings. Inclusion of long-term follow-up would improve assessment of diagnostic accuracy. Comparative studies with other biopsy techniques are warranted. Emphasis on careful patient selection, procedural planning, and operator expertise is essential to enhance diagnostic yield and minimize complications.

Conclusion

In conclusion, CT-guided percutaneous biopsy of pulmonary lesions using an 18-gauge coaxial semi-automated core needle represents a safe, reliable, and minimally invasive diagnostic approach. Its high diagnostic accuracy, combined with a low incidence of significant complications, emphasizes its value as an effective modality for the evaluation of suspected lung pathology and supports its continued use in clinical practice.

Acknowledgement: None
Conflict of interest: None

References

[1] Spira A, Halmos B, Powell CA, Pulmonary, sleep, and critical care update in lung cancer, Am J Respir Crit Care Med. 194:6 (2016) 661–71. DOI:10.1164/rccm.201604-0898UP

[2] Chojniak R, Nicoletti P, Pinto V, Ting CJ, Cohen MP, Yu LS, Computed tomography-guided transthoracic needle biopsy of pulmonary nodules, Radiol Bras. 44:5 (2011) 315–20. DOI:10.1590/S0100-39842011000500010

[3] Li Y, Du Y, Yang HF, Yu JH, Xu XX, CT-guided percutaneous core needle biopsy for small (≤20 mm) pulmonary lesions, Clin Radiol. 68:1 (2013) e43–8. DOI:10.1016/j.crad.2012.09.008

[4] Klein JS, Salomon G, Stewart EA, Transthoracic needle biopsy with a coaxially placed 20-gauge automated cutting needle: results in 122 patients, Radiology. 198:3 (1996) 715–20. DOI:10.1148/radiology.198.3.8628859

[5] Manhire A, Charig M, Clelland C, Gleeson F, Miller R, Moss H, et al, Guidelines for radiologically guided lung biopsy, Thorax. 58:11 (2003) 920–36. DOI:10.1136/thorax.58.11.920

[6] Thapa A, Subedi K, Suwal S, Chataut D, CT-guided lung biopsy: diagnostic yield and complications using an 18G coaxial semi-automatic core needle, Nep J Med Sci. 4:1 (2019) 20–5. DOI:10.3126/njms.v4i1.24122

[7] Poulou LS, Tsagouli P, Ziakas PD, Politi D, Trigidou R, Thanos L, Computed tomography-guided needle aspiration and biopsy of pulmonary lesions: a single-center experience in 1,000 patients, Acta Radiol. 54:6 (2013) 640–5. DOI:10.1177/028418511348159

[8] Choi SH, Chae EJ, Kim JE, Kim EY, Oh SY, Hwang HJ, et al, Percutaneous CT-guided aspiration and core biopsy of pulmonary nodules smaller than 1 cm: analysis of 305 procedures, AJR Am J Roentgenol. 201:5 (2013) 964–70. DOI:10.2214/AJR.12.10156

[9] Takeshita J, Masago K, Kato R, Hata A, Kaji R, Fujita S, et al, CT-guided fine-needle aspiration and core needle biopsy of pulmonary lesions: experience with 750 procedures, AJR Am J Roentgenol. 204:1 (2015) 29–34. DOI:10.2214/AJR.14.13151

[10] Jelitto-Gorska M, Studniarek M, Durawa A, Marjański T, Szurowska E, Percutaneous lung needle biopsies: utility and complications in various chest lesions, Pol J Radiol. 23:83 (2018) e103–e108. DOI:10.5114/pjr.2018.75825.

[11] Ozturk K, Soylu E, Gokalp G, Topal U, Risk factors for pneumothorax and chest tube placement after CT-guided core needle biopsy of lung lesions, Pol J Radiol. 3:83 (2018) e407–e414. DOI:10.5114/pjr.2018.79205.

[12] Heerink WJ, de Bock GH, de Jonge GJ, Groen HJ, Vliegenthart R, Oudkerk M, Complication rates of CT-guided transthoracic lung biopsy: a meta-analysis, Eur Radiol. 27:1 (2017) 138–48. DOI:10.1007/s00330-016-4357-8

[13] Tuna T, Ozkaya S, Dirican A, Findik S, Atici AG, Erkan L, Diagnostic efficacy of CT-guided transthoracic needle aspiration and biopsy in pulmonary disease, Onco Targets Ther. 5:6 (2013) 1553–7. DOI:10.2147/OTT.S45013

[14] Chintapalli KN, Montgomery RS, Hatab M, Katabathina VS, Guiy K, Radiation dose management: part 1, minimizing radiation dose in CT-guided procedures, AJR Am J Roentgenol. 198:4 (2012) W347–51. DOI:10.2214/AJR.11.7958