ISSN 2822-2032 (Print) 2822-2040 (Online)

Medical Journal of Eastern Nepal

Volume 05, Number 01, Issue 09, January-June 2026, 42-46

***Original Research Article***

# ULTRASOUND-GUIDED FINE NEEDLE ASPIRATION CYTOLOGY OF SUPRACLAVICULAR LYMPH NODES IN SUSPECTED LUNG CANCER: A DIAGNOSTIC STUDY

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***Received Date: 1st-March-2026, Accept Date: 30th-May-2026, Published Date: 29th-June-2026***

## ABSTRACT

### Background

Accurate staging of lung cancer is essential for appropriate treatment planning. Supraclavicular lymph nodes are commonly involved in advanced disease and are easily accessible for sampling. Ultrasound-guided fine needle aspiration cytology (US-FNAC) provides a minimally invasive method for their evaluation.

### Objectives

This study aims to evaluate the diagnostic performance of ultrasound-guided fine needle aspiration cytology (US-FNAC) of supraclavicular lymph nodes in patients with suspected lung cancer.

### Methods

This prospective study included 40 patients with suspected lung cancer and detectable supraclavicular lymph nodes. US-FNAC was performed under ultrasound guidance. Cytological findings were compared with histopathology from lung biopsy in 27 patients. Diagnostic indices were calculated.

### Results

Among 40 patients, initial US-FNAC diagnosed 28 malignant, 5 suspicious, 6 benign/reactive, and 1 inadequate. Repeat FNAC of suspicious cases yielded 4 malignant and 1 benign; the inadequate case was excluded. Histopathology (n = 27) confirmed 24 malignant and 3 benign lesions. Final FNAC correctly identified all malignant cases, misclassifying 1 benign case. The diagnostic performance showed a sensitivity of 100%, specificity of 66.7%, positive predictive value of 96%, negative predictive value of 100%, and an overall accuracy of 96.3%.

### Conclusions

US-FNAC is a highly sensitive and reliable technique for detecting metastatic lung cancer. Despite occasional false-positive findings, it remains a valuable tool for staging and guiding clinical management.

**Keywords**: *Cytology, Diagnostic accuracy, Lung cancer, Supraclavicular lymph nodes, Ultrasound-guided fine needle aspiration*



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**Citation**
Devkota G, Tripathi P, Gautam M, Shrestha R. Ultrasound-Guided Fine Needle Aspiration Cytology of Supraclavicular Lymph Nodes in Suspected Lung Cancer: A Diagnostic Study, MJEN. 2026 June;5(1); (42-46)

## INTRODUCTION

Lung cancer remains one of the leading causes of cancer-related death worldwide, primarily due to delayed diagnosis at advanced stages [1]. The presence of lymph node metastasis plays a critical role in determining disease stage, guiding prognosis, and informing treatment decisions, with supraclavicular lymph node involvement often indicating advanced disease that may limit surgical options [2].

Accurate and timely assessment of lymph node status is therefore essential. While mediastinoscopy and excisional biopsy are considered the gold standards for diagnosis, these procedures are invasive, require specialized resources, and may not be feasible for all patients [3]. In contrast, ultrasound-guided fine-needle aspiration cytology (US-FNAC) provides a minimally invasive, rapid, and safe alternative that can be performed on an outpatient basis, yielding adequate specimens for diagnosis and therapeutic planning [4,5]. The superficial location of supraclavicular lymph nodes makes them particularly suitable for ultrasound evaluation and guided sampling, allowing for real-time imaging and targeted biopsies. Several studies, have demonstrated high sensitivity and specificity of US-FNAC in detecting metastatic disease in supraclavicular lymph nodes, although diagnostic accuracy may vary depending on operator experience and patient characteristics [5-8].

This study was undertaken to evaluate the diagnostic performance of US-FNAC in supraclavicular lymph nodes in patients with suspected lung cancer and to correlate cytological findings with histopathology from lung biopsy.

## METHODS

This prospective observational study was carried out in the Department of Radiology at Nobel Medical College Teaching Hospital, Biratnagar, Nepal, over a one-year period from March 2025 to February 2026. Ethical approval was obtained from the Institutional Review Committee (IRC Ref: 04/2025), and written informed consent was obtained from all participants prior to enrollment.

Patients (≥18 years) with a pulmonary nodule or mass considered suspicious for primary lung malignancy on thoracic imaging (CT or PET/CT) by a registered radiologist and palpable or radiologically identifiable supraclavicular lymph nodes were included. Patients with bleeding disorders, those unfit for the procedure, or those unwilling to provide consent were excluded. The lymph node with the most suspicious characteristics for disease was selected for FNAC.

A consecutive sampling method was followed, including all patients who met the inclusion criteria and presented for FNAC during the study period. Patients were included consecutively as they presented, without any selective recruitment, to reduce bias and ensure comprehensive inclusion. Altogether, 40 eligible patients were identified, and all were included in the final analysis.

US-guided Fine Needle Aspiration Cytology (FNAC) of supraclavicular lymph nodes was performed under strict sterile conditions. The patient was positioned in a supine, with the head extended and turned slightly to the opposite side to provide better access to the supraclavicular region. The skin over the target lymph node was thoroughly cleaned with an antiseptic solution (such as chlorhexidine or iodine). A local anesthetic (e.g., lidocaine) was injected at the puncture site to minimize pain during the procedure. Under USG (Samsung HS60: Liner probe 2-14) guidance a fine needle (22–25 gauge) was carefully inserted into the lymph node under real-time ultrasound guidance. The needle was advanced slowly, ensuring that the needle tip was precisely positioned within the lymph node. Tissue aspiration was carried out by applying gentle suction with a syringe. Two to three needle passes per lesion were made and aspirations were performed from different areas of the lymph node to ensure an adequate sample for cytological analysis.

Once the tissue sample was obtained, it was expelled onto glass slides and spread evenly to create a smear. These slides were immediately fixed and sent to the pathology laboratory for detailed examination. After completing the procedure, a sterile dressing was applied to the puncture site.

Following the FNAC, the patients were observed for 15–30 minutes for any immediate signs of complications, such as bleeding, dizziness, or any discomfort. The puncture site was checked for hematoma, and the patient was given clear instructions regarding post-procedure care. The procedure was well tolerated, and no significant complications were observed. Patients were advised to apply ice to the area to reduce swelling and bruising and to monitor for any signs of infection, such as redness, warmth, or discharge at the site of the aspiration. They were also instructed to avoid heavy lifting or strenuous activities for the rest of the day.

Cytology results were categorized as malignant, benign/reactive, suspicious, or inadequate. Suspicious cases underwent repeat FNAC.

Histopathological confirmation from lung biopsy was available in 27 patients and served as the surrogate reference standard. Excisional lymph node biopsy

was avoided due to its invasiveness, procedural risks, and limited feasibility in advanced lung cancer. Lung histology served as the surrogate reference standard, while supraclavicular lymph node FNAC offered a minimally invasive and reliable diagnostic alternative.

Data were entered and analyzed using SPSS version 27. Diagnostic parameters including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy were calculated.

## RESULTS

A total of 40 patients underwent US-FNAC. The study included 28 males (70%) and 12 females (30%). Among these, the highest proportion was observed in the 45–54 years age group (37.5%). This was followed by the 65–74 years group (27.5%) and the 75–84 years group (22.5%), whereas the 55–64 years age group comprised the smallest proportion of patients (12.5%). The mean age was 62.5 ± 12.5 years (range 45–84 years). The age distribution is shown in the table 1 below:

**Table 1: Age distribution of patients undergoing US-FNAC (N = 40)**

| Age group (years) | No. of patients | Percentage (%) |
|---|---|---|
| 45–54 | 15 | 37.5 |
| 55–64 | 5 | 12.5 |
| 65–74 | 11 | 27.5 |
| 75–84 | 9 | 22.5 |

**Table 2: Distribution of FNAC categories among the study patients (N = 40)**

| FNAC Category | Number of Patients | Percentage (%) |
|---|---|---|
| Malignant | 28 | 70 |
| Suspicious | 5 | 12.5 |
| Benign/Reactive | 6 | 15 |
| Inadequate | 1 | 2.5 |

**Table 2** Shows the distribution of FNAC categories among the study patients revealed that malignant lesions constituted the majority of cases (70%). Benign / reactive lesions accounted for 15% of the cases, while suspicious cytology was observed in 12.5% of patients. Inadequate aspirates were reported in 2.5% of the study population.

Five cases initially categorized as suspicious underwent repeat FNAC. On repeat sampling, four cases were reclassified as malignant and one as benign. The single inadequate case was excluded from further analysis.

After repeat FNAC, the final cytological diagnosis was:

- Malignant: 32 cases
- Benign/reactive: 7 cases

**Table 3: Comparison between FNAC and histopathological diagnoses.**

| Histopathology | FNAC Malignant | FNAC Benign | Total |
|---|---|---|---|
| Malignant | 24 | 0 | 24 |
| Benign | 1 | 2 | 3 |

**Table 3** shows the comparison between FNAC of SCLN and histopathological diagnoses from lung biopsies (the surrogate reference standard), which was available in 27 patients. Among these, on histopathology 24 were malignant and 3 were benign. Comparison of final FNAC results with histopathology showed all 24 malignant cases were correctly identified. Among three benign cases in histopathology, two were correctly diagnosed as benign, while one was reported as malignant in FNAC.

**Table 4: Diagnostic performance of FNAC compared with histopathological diagnosis.**

| Parameter | Value (%) |
|---|---|
| Sensitivity | 100 |
| Specificity | 66.7 |
| Positive Predictive Value | 96 |
| Negative Predictive Value | 100 |
| Accuracy | 96.3 |

**Table 4** Shows the high diagnostic efficacy of FNAC in comparison with histopathological diagnosis. The sensitivity and negative predictive value were both 100%, indicating accurate identification of all positive cases and absence of false-negative results. The specificity was 66.7%, while the positive predictive value was 96%. Overall, FNAC demonstrated a diagnostic accuracy of 96.3%.

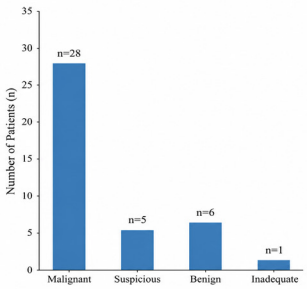


Figure 1(a): Initial USG guided FNAC

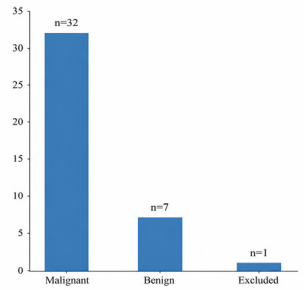


Figure 1(b): Final result after repeat FNAC of suspicious ones

**Figure 1: (a) and (b): Bar charts showing the distribution of cases according to initial cytological diagnosis and final cytological diagnosis after repeat FNAC of suspicious cases.**

Of these 39 patients who underwent USG guided FNAC of SCLN and were included in the study, lung biopsy reports were available only for 27 cases. Histopathological diagnosis from these 27 cases was used as the surrogate reference standard for evaluating

the diagnostic performance of supraclavicular lymph node FNAC.

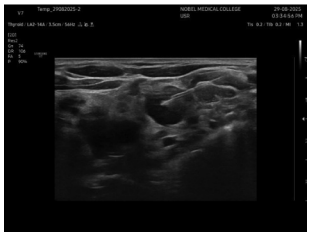

Figure 2

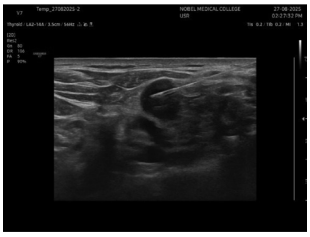

Figure 3

**Figure: 2 and 3 demonstrating Ultrasound-guided fine needle aspiration cytology (USG-FNAC) of a supraclavicular lymph node showing real-time needle placement within the lesion.**

## DISCUSSION

The present study demonstrated, US-FNAC of supraclavicular lymph nodes in patients with suspected lung cancer demonstrated high diagnostic accuracy. Initial FNAC categorized 28 of 40 patients (70%) as malignant, 5 (12.5%) as suspicious, 6 (15%) as benign/reactive, and 1 (2.5%) as inadequate/non-diagnostic. Repeat FNAC of suspicious cases clarified 4 as malignant and 1 as benign, resulting in a final classification of 32 malignant and 7 benign/reactive nodes. Histopathological confirmation from the primary lung biopsy was available in 27 patients. Comparison of the final FNAC results with histopathological findings showed that all 24 malignant cases were correctly identified by FNAC. Of the three cases confirmed as benign on histopathology, two were correctly diagnosed as benign by FNAC, while one case was reported as malignant. Based on these data, the sensitivity of FNAC in our study was 100%, specificity of 66.7%, positive predictive value (PPV) of 96%, negative predictive value (NPV) of 100%, and an overall accuracy of 96.3%. These values indicate that US-FNAC is highly reliable in detecting metastatic involvement while accurately confirming benign nodes. The high sensitivity and NPV demonstrate the excellent diagnostic performance of US-FNAC in detecting malignancy and excluding disease when results are negative. The slightly lower specificity was attributable to a single false-positive case, highlighting the need for clinical correlation and confirmatory testing in selected cases.

Findings of this study are consistent with prior literature demonstrating the high diagnostic utility of US-FNAC in supraclavicular lymph node assessment. Large institutional studies of lymph node FNAC, have demonstrated high diagnostic performance, with reported sensitivity ~97.8%, specificity ~97.5%, PPV ~98.7%, NPV ~96.0%, and overall accuracy ~97.7% in lymph node cytology correlated with histology [9]. This finding is consistent with our current study. Similarly, another study which was done in 218 palpable SCLNs, reported sensitivity of 92.7% and specificity of 98.5%, reinforcing FNAC as a reliable diagnostic modality for lymph node evaluation [10]. Another study done in UK also demonstrated that, US-guided FNAC correctly identified malignancy in 75.4% of sampled SCLNs and allowed avoidance of more invasive procedures in 42.6% of patients, supporting the value of minimally invasive cytological evaluation [2]. Similarly, another study further demonstrated 100% concordance between FNAC and histopathology in FDG-PET–positive SCLNs, confirming the excellent diagnostic performance of image-guided sampling [11]. In the context of lung cancer staging, a systematic and metaanalysis studies confirmed that endoscopic ultrasoundguided fineneedle aspiration (EUSFNA) offers high diagnostic accuracy in nonsmall cell lung cancer, with pooled sensitivity estimates often in the 80–90% range for mediastinal lymph node involvement, reinforcing the utility of minimally invasive ultrasoundguided sampling techniques for evaluating lymphatic spread in NSCLC [12].

Another similar study on fine needle aspiration cytology of palpable supraclavicular lymph node showed that the right supraclavicular lymph node was more frequently involved, while bilateral involvement was uncommon. Cytological analysis revealed metastasis in 44.9% and tuberculosis in 41.6% of cases, with squamous cell carcinoma and adenocarcinoma being the most common malignancies. The lung was the primary site in 43.3% of metastatic cases, highlighting the diagnostic and staging utility of fine-needle aspiration cytology of palpable supraclavicular lymph nodes. [13].

Collectively, these studies demonstrate reproducible diagnostic accuracy across different centers, patient populations, and clinical settings, and our results align closely with these observations.

Repeat FNAC of initially suspicious or borderline nodes clarified 80% of ambiguous cases, enhancing diagnostic confidence. This aligns with cytopathology guidelines recommending re-sampling of indeterminate nodes to reduce false negatives and ensure accurate staging [14]. In our study, repeat FNAC avoided unnecessary invasive procedures and enabled timely initiation of appropriate therapy.

US-guided FNAC is minimally invasive, performed under local anesthesia, and suitable for outpatient settings, reducing procedural risk and resource use compared to surgical staging. It also provides material adequate for immunocytochemistry and molecular testing, which is increasingly important in precision lung cancer care. The high concordance

with histopathology, along with excellent sensitivity, specificity, and accuracy in our study, supports US-FNAC as a safe and effective tool for confirming supraclavicular metastasis, guiding management, and facilitating timely staging and treatment.

In conclusion, in resource-constrained settings such as Nepal, where advanced staging techniques like EBUS or mediastinoscopy are not widely accessible, US-FNAC serves as a cost-effective and easily available diagnostic alternative.

The study is limited by its single-center design, relatively small sample size, and the use of primary lung biopsy as a substitute for direct excision of supraclavicular lymph nodes for histopathological confirmation.

Future studies should include larger, multicenter cohorts and consider using excisional lymph node histology as the reference standard to validate FNAC findings. Integration of molecular or immunocytochemical analysis of FNAC samples, as well as correlation with PET-CT, could further enhance diagnostic accuracy and guide personalized treatment strategies

## CONCLUSIONS

In summary, our study demonstrated that US-FNAC of supraclavicular lymph nodes is safe, minimally invasive, and highly accurate for suspected lung cancer. Its high sensitivity, strong correlation with histopathology, and favorable safety profile make it invaluable for staging and treatment planning, especially in patients unsuitable for surgical procedures.

## ACKNOWLEDGEMENTS

The authors sincerely thank the Institutional Review Committee (IRC) and the Departments of Radiodiagnosis, Pulmonary Medicine, and Pathology for their guidance and support throughout the study. We are grateful to the technical and nursing staff for their assistance, and especially to all the patients who participated in this study.

**Funding**: None
**Conflict of Interest**: None
**Ethical Approval**: Yes.

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