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Percutaneous Ultrasound-Guided Biopsy for Sampling Neck Lesions

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IMPORTANCE Studies suggest that percutaneous ultrasound-guided biopsy may be effective for diagnosing lymphoma, but the achievable effectiveness has not been reported. A clinical workflow eliminating percutaneous vs surgical biopsy referral biases and allowing measurement of up-front imaged-guided biopsy effectiveness is needed.

OBJECTIVE To assess diagnostic sufficiency of core-needle biopsy (CNB) and fine-needle aspiration (FNA) of neck lesions in a setting where all patients are referred for CNB or FNA prior to excisional biopsy.

DESIGN, SETTING, AND PARTICIPANTS This prospective cohort study was conduced at a quaternary care academic medical institution. Biopsy results of consecutive patients undergoing percutaneous ultrasound-guided neck biopsies and head/neck surgeon excisional neck biopsies performed from June 1 to August 31, 2024, were analyzed.

EXPOSURES CNB and FNA.

MAIN OUTCOMES AND MEASURES Primary outcomes included diagnostic yield overall and for lymphoma. Secondary outcomes included rate of subsequent excisional biopsy and yield stratified by biopsy type, location, and clinician type.

RESULTS Of 158 biopsies among patients (mean [SD] age, 60.0 [16.5] years; 82 [51.9%] female), which were performed by 7 neuroradiologists and 5 physician assistants, diagnostic yield was 94.3% (149 of 158 biopsies), with CNB yield higher than FNA (97.9% vs 88.5%; difference, 9.4 percentage points [pp]; 95% CI, −0.4 to 19.2 pp) and no missed lymphoma diagnoses. Diagnostic yield in cases with lymphoma as prebiopsy differential diagnosis was 97.4% (74 of 76 biopsies): 20 lymphoma, 27 inflammatory, 17 solid tumors, 10 benign lymphoid tissue, and 2 nondiagnostic. No immediate complications and 1 infection occurred. Only 2 patients underwent subsequent excisional biopsy, 1 due to pending pathology on the surgery date and the other to confirm a negative CNB result. Two additional excisional biopsies were performed during the study period, both by request due to insufficient tissue from outside hospital specimens. Neuroradiologist yield was slightly higher than physician assistant yield, with a wide confidence interval (95.3% vs 92.2%; difference, 3.1 pp; 95% CI, −6.7 to 13.0 pp). Flow cytometry analysis detected lymphoma signatures in 13 of 20 (65.0%) lymphoma specimens.

CONCLUSIONS AND RELEVANCE In this cohort study, up-front percutaneous ultrasound-guided biopsy was shown to be a highly effective and safe method for diagnosing neck lesions, with CNB providing a high diagnostic yield that may generally obviate the need for excisional biopsy, even when lymphoma is a prebiopsy differential diagnosis.

Supplemental content

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Studies have suggested that percutaneous image-guided core-needle biopsy (CNB) may be effective for diagnosing lymphoma in addition to other lymph node and salivary pathologies.[1-8] However, to our knowledge, studies have not addressed percutaneous vs excisional biopsy referral biases. It is therefore possible that upfront percutaneous ultrasound-guided CNB[9] of neck lesions could provide comparable diagnostic yield to excisional biopsy while reducing time to diagnosis, morbidities, and costs.

We report the diagnostic sufficiency of upfront percutaneous ultrasound-guided biopsy, including CNB and fine-needle aspiration (FNA),[10] for treatment decisions, including for lymphoma, from an operational experiment at a single institution over a 3-month period when all excisional biopsy requests were deferred. We secondarily report the rate of subsequent excisional biopsies and whether FNA vs CNB or neuroradiologist vs physician assistant operator were associated with differences in diagnostic yield.

Key Points

Question Is percutaneous ultrasound-guided core biopsy an effective sampling method for all new neck lesions, including when lymphoma is a differential diagnosis?

Findings In this cohort study of 158 biopsies among patients undergoing ultrasound-guided neck biopsies, core-needle biopsy diagnostic yield was 97.9%, with only 2 of 74 proceeding to excisional biopsy (both confirmatory) and no missed lymphoma diagnoses.

Meaning Image-guided core-needle biopsy may yield a diagnostic specimen sufficient for treatment and may obviate the need for excisional biopsy, even when lymphoma is a differential diagnosis.

Methods

Design, Setting, and Participants

This study was conducted at Brigham and Women's Hospital, a quaternary care academic hospital. We moved our practice away from surgeon-performed excisional biopsies to radiologist-performed percutaneous biopsies, with head/neck surgeons deferring all excisional biopsy requests, including from lymphoma oncologists and from the cancer diagnostic service, to percutaneous biopsy by June 1, 2024. We thus analyzed biopsy results of consecutive adult patients (≥18 years old) who underwent percutaneous ultrasound-guided neck biopsies (CNB, FNA, or both, including lymph node, salivary, and other soft-tissue targets) and head/neck surgeon excisional neck biopsies performed from June 1 to August 31, 2024. We excluded biopsies performed solely for research, cases where the targeted lesion had resolved or was not identifiable at the time of biopsy, and procedures in which tissue could not be obtained. Biopsy method details are provided in the eMethods in Supplement 1.

The institutional review board at Mass General Brigham approved this study. Need for patient informed consent was waived owing to use of deidentified data and no interaction with patients or clinicians outside of standard care. We followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines.

Variables

Primary study outcomes were diagnostic yield overall and for lymphoma. Secondary outcomes were rate of subsequent excisional biopsy, immediate and 30-day complications, and yields of CNB vs FNA, lymph node vs salivary, and neuroradiologists vs physician assistants.

Data Sources and Measurements

Lesion location, biopsy type, performing clinician, and immediate complications were extracted from procedure reports. Patient demographics, including age, sex, and race and ethnicity (American Indian or Alaska Native, Asian, Black or African American, Hispanic, and White) were extracted from the electronic health record. Pathology reports were reviewed by a postdoctoral physician researcher (A.A.S.) to determine diagnostic adequacy and final diagnosis. Expert neuroradiologists with 6 years (J.P.G.) and 3 years (J.K.) posttraining experience reviewed all 29 cases where the postdoctoral researcher was unable to confidently interpret report ambiguities. Biopsies were considered diagnostic when a conclusive pathological diagnosis was concordant with clinical history, imaging, and subsequent clinical care. The postdoctoral researcher performed electronic health record review and recorded information on any subsequent excisional biopsies and of all emergency, urgent care, primary care, oncology, and head and neck surgery visit notes for the 30 days after procedure to assess for procedural complications.

Statistical Analysis

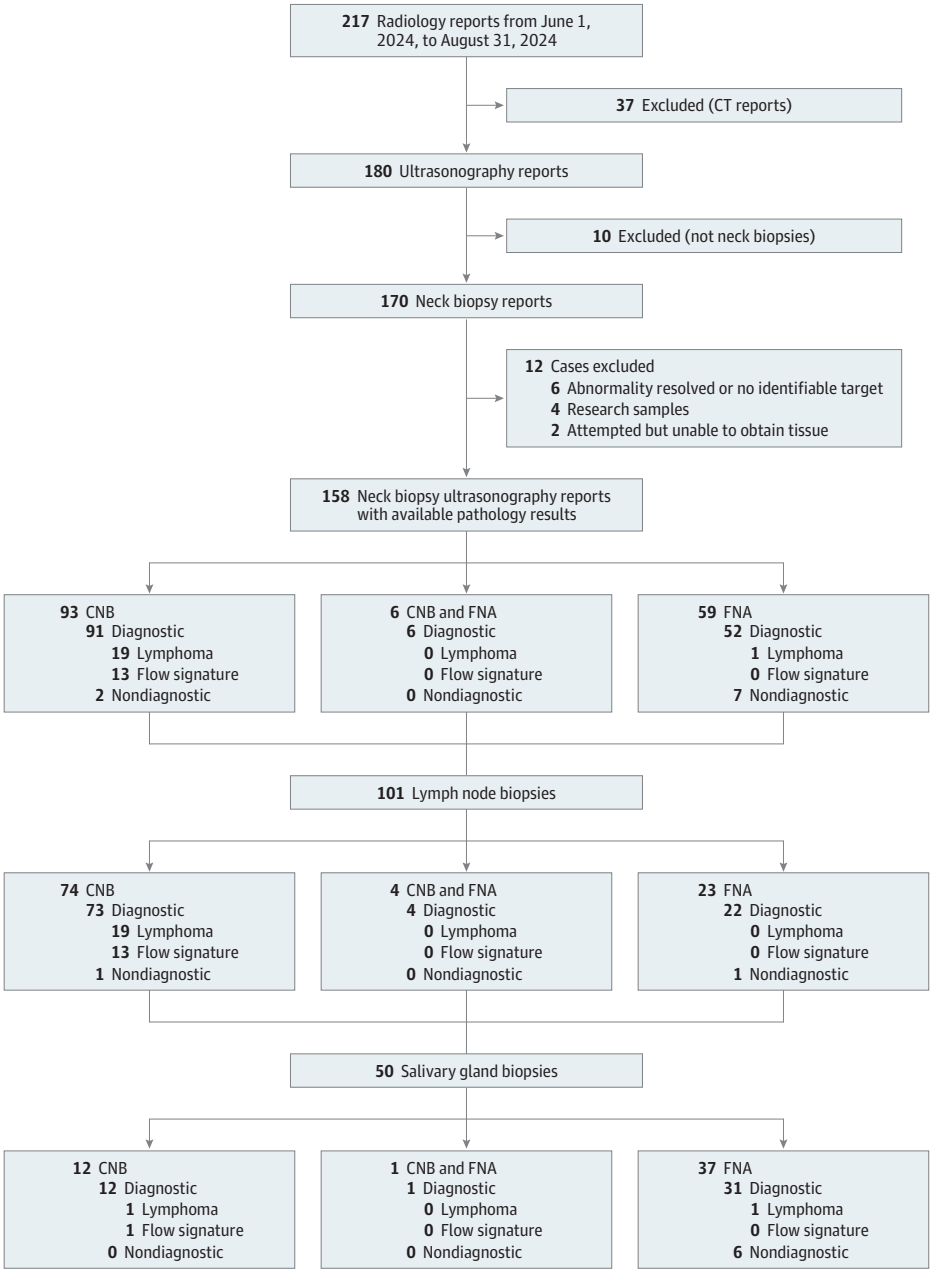
Descriptive statistics were used to summarize patient demographics, biopsy characteristics, and diagnostic yield. The magnitudes of the differences between groups were described with effect size measures, and 95% CIs around the differences were used to describe the precision of the estimate and whether the results were compatible with clinically meaningful differences. No a priori sample-size calculations were performed due to the exploratory design of the study. Confidence intervals were calculated in R, version 4.4.0 (R Project for Statistical Computing), using the prop.test function.

Results

Participants

A total of 158 ultrasound-guided neck biopsies, including 76 with lymphoma on the preprocedure differential diagnosis, were performed by 7 neuroradiologists and 5 physician assistants (**Figures 1** and **2**). CNB vs FNA was based on operator discretion, with CNB typically performed for any lesion 8 mm or larger. Of the 158 biopsies, 93 (58.9%) were CNB, 59 (37.3%) were FNA, and 6 (3.8%) included both CNB and FNA (**Table**).

Figure 1. Study Flow for Neck Biopsies



CNB indicates core-needle biopsy; CT, computed tomography; FNA, fine-needle aspiration.

Mean (SD) patient age was 60.0 (16.5) years, with 82 female patients (51.9%) and 76 male patients (48.1%). Based on self-reported race and ethnicity, 1 patient (0.6%) was American Indian or Alaska Native patient, 8 (5.1%) were Asian, 10 (6.3%) were Black or African American, 7 (4.4%) were Hispanic, and 130 (82.3%) were White (Table).

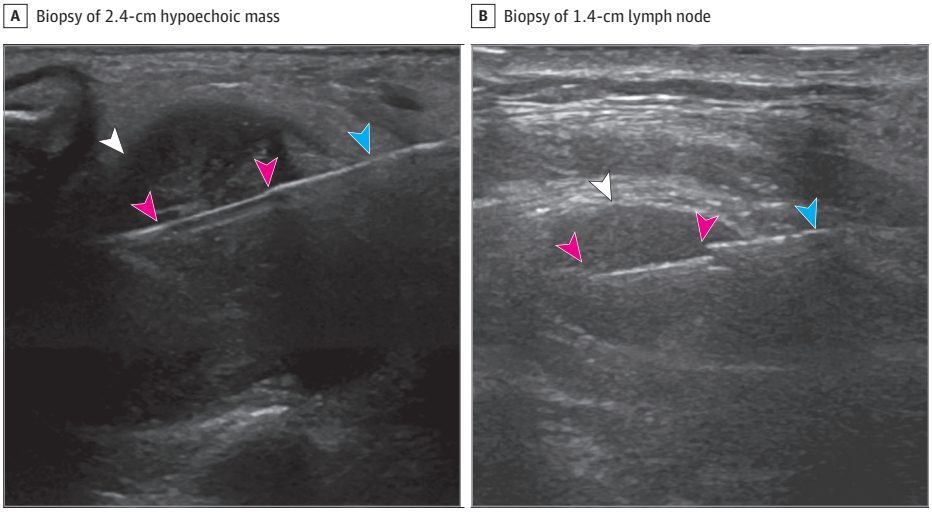
Biopsy Data

Among the 158 biopsies, the most common were of lymph nodes (101 [64.0%]) and salivary glands (50 [31.6%], including 43 parotid and 7 submandibular). Rate of CNB was higher for lymph nodes (78 of 101 biopsies [77.2%]) than salivary glands (13 of 50 biopsies [26.0%]) due to institutional salivary specimen preferences. CNB was predominantly performed when lymphoma was in the differential diagnosis (59 of 76 biopsies [77.6%]). Procedures were primarily performed by neuroradiologists (overall: 107 of 158 [67.7%]; CNB: 69 of 93 [74.2%]; FNA: 33 of 59 [55.9%]; combined CNB and FNA: 5 of 6 [83.3%]).

Primary Outcomes

Overall diagnostic yield was 94.3% (149 of 158 biopsies). Summary case-by-case results are provided in eTable 1 in Supplement 1. Diagnostic yield in cases with lymphoma as a differ-

Figure 2. Ultrasound-Guided Biopsy Examples



A, Procedural grayscale ultrasonography image showing an 18-gauge core biopsy needle (blue arrowhead) inserted into a 2.4-cm hypoechoic parotid mass (white arrowhead) spanning the superficial to deep lobes, with the 1-cm biopsy tray (pink arrowheads) fully within the mass. Pathology results revealed a biphasic salivary neoplasm suggestive of epithelial-myoepithelial carcinoma, which was confirmed on definitive resection. B, Procedural grayscale ultrasonography image showing an 18-gauge core biopsy needle (blue arrowhead) inserted into a 1.4-cm lymph node (white arrowhead), with the 1-cm biopsy tray (pink arrowheads) fully within the node. Pathology results revealed small lymphocytic lymphoma and a flow signature; the patient has been followed up with observation.

ential diagnosis (eTable 2 in Supplement 1) was 97.4% (74 of 76 biopsies): 20 lymphoma (subtypes in eTable 3 in Supplement 1), 27 inflammatory, 17 solid tumors, 10 benign lymphoid tissue, and 2 nondiagnostic.

Secondary Outcomes

Two of the 158 patients (1.3%) underwent subsequent excisional biopsy, 1 due to pending pathology on the surgery date and the other to confirm a negative CNB result in a patient with history of follicular lymphoma. Two additional excisional biopsies were performed during the study period by request due to insufficient tissue diagnosis from outside hospital specimens.

No immediate complications were reported. One patient (nondiagnostic parotid FNA performed by physician assistant) returned 3 days after biopsy with parotid inflammation; aspiration yielded *Staphylococcus*. The patient was treated with intravenous ampicillin/sulbactam, then oral amoxicillin/clavulanate. One patient (diagnostic parotid core biopsy showing IgG4-related disease performed by a neuroradiologist) noted transient worsened trismus. Four patients noted transient pain/swelling, and 1 noted transient numbness/swelling.

CNB yield was higher than FNA (97.9% vs 88.5%; difference, 9.4 percentage points [pp]; 95% CI, −0.4 to 19.2 pp). Diagnostic yield of lymph node sampling was higher (99 of 101 [98.0%]) than that of salivary gland lesions (44 of 50 [88.0%]; difference, 10.0 pp; 95% CI, −0.8 to 20.9 pp). Neuroradiologist yield was slightly higher than physician assistant yield, with a wide confidence interval, making interpretation uncertain (95.3% vs 92.2%; difference, 3.1 pp; 95% CI, −6.7 to 13.0 pp). Flow cytometry showed lymphoma signatures in 13 of 20 (65.0%) lymphoma specimens.

Discussion

In this study evaluating the diagnostic efficacy of up-front percutaneous ultrasound-guided CNB and FNA in neck lesions, overall diagnostic yield was 94.3% (CNB, 97.9%; FNA, 88.5%), with no missed lymphoma diagnoses. Two patients had subsequent excisional biopsies, 1 to confirm the CNB diagnosis and 1 because the CNB result had not returned by the surgical date. Two additional patients had surgical excisional biopsies, both by request due to nondiagnostic biopsies at outside hospitals. One postprocedure infection occurred.

Prior studies have focused on percutaneous biopsy in specific pathologies, often emphasizing the traditional preference for excisional biopsy for lymphoma to evaluate nodal architecture.[4] Excisional biopsy was not required for treatment in any of the 76 patients with lymphoma as a differential diagnosis in this study; all 20 patients with lymphoma underwent subtyping and were treated based on the percutaneous biopsy results. These findings align with emerging literature[1-4,11] suggesting that CNB can minimize the need for surgical procedures without compromising diagnostic accuracy.

Limitations

These results may not be generalizable to settings where ultrasound-guided neck biopsy and hematopathology experts are not routinely available. Although the overall cohort size was sufficient to address the primary questions, subgroup analyses were limited. Further research could elucidate whether up-front percutaneous ultrasound-guided biopsy reduces time to diagnosis, morbidities, and costs.

Table. Characteristics of the Cohort of Patients With Percutaneous Ultrasound-Guided Neck Biopsies[a]

Characteristic	No. (%)			
	CNB (n = 93)	FNA (n = 59)	CNB and FNA (n = 6)	Total (N = 158)
Age, y				
Mean (SD)	58.6 (16.2)	63.3 (15.6)	48.2 (22.9)	60.0 (16.5)
Median (IQR)	60.0 (47.0-71.0)	67.0 (56.0-73.5)	46.0 (36.5-55.5)	62.0 (49.0-72.0)
Sex				
Female	45 (48.4)	28 (47.5)	6 (100)	82 (51.9)
Male	48 (51.6)	31 (52.5)	NA	76 (48.1)
Race[b]				
American Indian or Alaska Native	1 (1.1)	NA	NA	1 (0.6)
Asian	6 (6.5)	2 (3.4)	NA	8 (5.1)
Black or African American	4 (4.3)	5 (8.5)	1 (16.7)	10 (6.3)
White	73 (78.5)	55 (88.1)	5 (83.3)	130 (82.3)
Declined to answer	3 (3.2)	NA	NA	3 (1.9)
Unavailable	6 (6.5)	NA	NA	6 (3.8)
Ethnicity[b]				
Hispanic	6 (6.5)	NA	1 (16.7)	7 (4.4)
Not Hispanic	81 (87.1)	55 (93.2)	5 (83.3)	141 (89.2)
Prefer not to say/declined to answer	2 (2.2)	NA	NA	2 (1.3)
Unavailable	4 (4.3)	4 (6.8)	NA	8 (5.1)
Clinician				
Neuroradiologist	69 (74.2)	33 (55.9)	5 (83.3)	107 (67.7)
Physician assistant	24 (25.8)	26 (44.1)	1 (16.7)	51 (32.3)
Location				
Lymph node	74 (79.6)	23 (39.0)	4 (66.7)	101 (64.0)
Salivary gland	12 (12.9)	37 (62.7)	1 (16.7)	50 (31.6)
Thyroid	3 (3.2)	NA	NA	3 (1.9)
Neck mass	3 (3.2)	1 (1.7)	NA	4 (2.5)
Diagnostic yield				
Diagnostic	91 (97.8)	52 (88.1)	6 (100)	149 (94.3)
Nondiagnostic	2 (2.2)	7 (11.9)	NA	9 (5.7)
Lymphoma diagnosis	19 (20.4)	1 (1.7)	NA	20 (12.7)
Flow lymphoma signature	13 (14.0)	NA	NA	13 (8.2)
Excisional	2 (2.2)	NA	NA	2 (1.3)

Abbreviations: CNB, core-needle biopsy; FNA, fine-needle aspiration; NA, not applicable.

[a] Percentages have been rounded and may not total 100.

[b] Race and ethnicity data were self-reported and extracted from electronic health records.

Conclusions

In this cohort study, findings suggest that up-front percutaneous ultrasound-guided biopsy can be a highly effective and safe method for diagnosing neck lesions, with CNB providing a high diagnostic yield that may generally obviate the need for excisional biopsy, even when lymphoma is a prebiopsy differential diagnosis.

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Concept and design: Huang, Armand, Rettig, Sethi, Guenette.
Acquisition, analysis, or interpretation of data: All authors.
Drafting of the manuscript: Satani, Huang, Guenette.
Critical review of the manuscript for important intellectual content: Kim, Flood, Loken, Huang, Bessnow, Armand, Rettig, Sethi, Guenette.
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