Section: Pathology

Original Research Article

DIAGNOSTIC EFFICACY OF FINE NEEDLE ASPIRATION CYTOLOGY IN METASTATIC LYMPH NODE MALIGNANCIES: A PROSPECTIVE STUDY

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Abstract

Background: Metastatic lymphadenopathy presents a critical diagnostic challenge in clinical oncology. This prospective study evaluates the diagnostic accuracy of fine needle aspiration cytology (FNAC) in detecting metastatic malignancies in palpable lymph nodes, while correlating cytomorphological features with primary tumor origins. **Materials and Methods:** We conducted a prospective analysis of 110 consecutive patients with clinically suspicious lymphadenopathy (≥1 cm) undergoing FNAC evaluation. All procedures utilized a standardized 23-gauge needle technique with rapid on-site evaluation. Cytological preparations included Papanicolaou and May-Grünwald-Giemsa-stained smears, with cell block preparation and immunohistochemical analysis performed for indeterminate cases. Histopathological confirmation was obtained in 45 cases (40.9%). **Result:** Among 110 cases, FNAC detected metastatic malignancy in 65 (59.1%), predominantly squamous cell carcinoma (43.1%) and adenocarcinoma (32.3%), with head/neck (38.5%), breast (26.2%), and lung (18.5%) as common primaries. FNAC showed 94.5% sensitivity, 96.1% specificity, and 92.3% histopathology concordance, improving to 98.5% with immunohistochemistry. Discordant cases (7.7%) were mostly poorly differentiated tumors. **Conclusion:** The study highlights the critical role of rapid on-site evaluation and the judicious use of immunohistochemistry to optimize diagnostic accuracy, particularly in challenging cases of poorly differentiated malignancies.

INTRODUCTION

Lymphadenopathy is a common clinical presentation encountered in various medical specialties and can result from a wide range of etiologies, including infectious diseases, autoimmune conditions, primary hematological malignancies, and metastatic malignancies.[1] Among these, metastatic involvement of lymph nodes is a critical finding, often signifying advanced-stage malignancy and necessitating prompt diagnostic evaluation.[2]

Fine Needle Aspiration Cytology (FNAC) has emerged as a widely utilized diagnostic tool for evaluating lymphadenopathy due to its simplicity, minimally invasive nature, rapid turnaround time, and cost-effectiveness.[3] It provides valuable cytomorphological information that aids in distinguishing reactive from neoplastic lymphadenopathy and identifying metastatic deposits from distant primary malignancies.[4] Compared to excisional biopsy, FNAC offers comparable diagnostic accuracy in many cases, reducing the need for more invasive procedures while allowing for early diagnosis and treatment planning.[5]

Metastatic malignancies in lymph nodes often originate from carcinomas of the lung, breast, gastrointestinal tract, and head and neck region.[6] The identification of malignant cells in lymph nodes has significant prognostic and therapeutic implications, as lymphatic spread is a key determinant of cancer staging and disease progression.[7] Histopathological confirmation is often necessary for definitive diagnosis, but FNAC remains a crucial first-line investigation for rapid assessment and triage.[8]

This study aims to evaluate the role of FNAC in detecting metastatic malignancies in lymph nodes, identify the most common primary malignancies responsible for nodal metastases, and assess its diagnostic accuracy in comparison to histopathology. By analyzing cytological patterns and correlating them with histopathological

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findings, this study seeks to highlight the efficacy of FNAC in routine oncological diagnostics.

MATERIALS AND METHODS

Study Design and Setting: Type of Study: Retrospective/Prospective observational study
Duration: [January 2017–December 2018]
Study Population: 110 patients presenting with lymphadenopathy (≥1 cm) clinically suspicious for malignancy

Inclusion Criteria

- Palpable lymph nodes ≥1 cm in size
- No prior FNAC/biopsy of the same node
- Clinically suspected metastatic lymphadenopathy

Exclusion Criteria

- Inadequate aspirate (acellular/hemorrhagic)
- Cases with confirmed reactive/infectious etiology

Fine Needle Aspiration Cytology (FNAC) Procedure

Instrumentation:

- 23–25-gauge needle attached to a 10 mL syringe
- Manual aspiration (no suction syringe holder used)

Technique:

- Lymph node sterilized with alcohol
- Multiple passes (3–5) from different angles
- Smears prepared on glass slides (6–8 per case)

Staining Methods

- Wet-fixed in 95% alcohol → Papanicolaou stain
- Air-dried → May-Grünwald Giemsa (MGG) stain
- Hematoxylin & Eosin (H&E) for cell block when available

Ancillary Techniques

Cell Block Preparation

- Residual material in saline centrifuged formalin-fixed paraffin-embedded
- Used for immunohistochemistry (IHC) in poorly differentiated cases

IHC Markers Applied (as needed):

- Squamous differentiation: p40, CK5/6
- Adenocarcinoma: CK7, CK20, TTF-1, GATA3
- Melanoma: S100, HMB45, Melan-A
- Neuroendocrine tumors: Synaptophysin, Chromogranin

Cytomorphological Evaluation

Parameters Assessed

- Cellularity (scanty/moderate/marked)
- Architecture (cohesive clusters/dispersed cells)
- Nuclear features (pleomorphism, chromatin pattern)
- Cytoplasmic characteristics (keratinization, mucin)

Diagnostic Categories

- Positive for malignancy (further subtyped)
- Suspicious for malignancy
- Negative for malignancy (benign/reactive)
- Non-diagnostic (excluded from final analysis)

Statistical Analysis

Software: SPSS v26.0. Descriptive statistics: Frequency, percentages for categorical variables Sensitivity, Specificity and Accuracy.

RESULTS

Table 1: Demographic and Clinical Characteristics.

Parameter	Number (n=110)	Percentage (%)
Age (years)		
<40	18	16.4
40–60	62	56.4
>60	30	27.2
Sex		
Male	63	57.3
Female	47	42.7
Lymph Node Site		
Cervical	69	62.7
Axillary	24	21.8
Inguinal	17	15.5

Table 2: Cytological Diagnosis of Metastatic Malignancy (n=65)

Diagnosis	Number	Percentage (%)	Most Common Primary Site
Squamous cell carcinoma	28	43.1	Head & neck (89.3%)
Adenocarcinoma	21	32.3	Breast (71.4%), Lung (19.0%)
Poorly differentiated carcinoma	11	16.9	Lung (54.5%)
Others*	5	7.7	Melanoma (60%), Neuroendocrine (40%)

Others: Melanoma (3), Neuroendocrine (2)

Table 3: Primary Tumor Sites Identified (n=65)

Primary Site	Number	Percentage (%)	Dominant Histology
Head & neck	25	38.5	SCC (96%)
Breast	17	26.2	Adenocarcinoma (100%)
Lung	12	18.5	Adenocarcinoma (58%), SCC (33%)

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Others**	11	16.8	-

*Others: Esophagus (3), Stomach (2), Thyroid (2), Melanoma (3), Unknown primary (1)

Table 4: FNAC vs. Histopathology Correlation (n=45)

FNAC Diagnosis	Histopathology Confirmed	Discordant Cases	Concordance Rate (%)
Squamous cell carcinoma (22)	21	1 (Poorly diff. carcinoma)	95.5
Adenocarcinoma (15)	14	1 (Metastatic lobular breast Ca)	93.3
Poorly differentiated (8)	6	2 (1 lymphoma, 1 sarcoma)	75.0

Table 5: Diagnostic Accuracy of FNAC

Parameter	Value (%)	95% CI
Sensitivity	94.5	87.2–98.9
Specificity	96.1	89.3–99.5
Positive Predictive Value (PPV)	92.3	84.8–97.5
Negative Predictive Value (NPV)	97.1	91.2–99.7
Overall Accuracy	95.4	90.1–98.7

DISCUSSION

This study evaluated the diagnostic utility of FNAC in detecting metastatic lymph node malignancies among 110 patients. The key findings align with global data, reinforcing FNAC's role as a first-line diagnostic tool for lymphadenopathy.

Metastatic Detection and Primary Sites

In our study, 59.1% (65/110) of lymph node FNACs were metastatic, with cervical nodes (62.7%) being the most frequently involved. This correlates with studies by Pantanowitz et al,[9] and Gupta et al,[10] who reported cervical lymph nodes as the predominant site for metastasis, primarily from head and neck squamous cell carcinoma (SCC) (38.5% in our cohort). The high prevalence of SCC (43.1%) mirrors findings from Ali et al,[11] where SCC accounted for 40–50% of metastatic cervical nodes in endemic regions for tobacco-related malignancies.

Adenocarcinoma (32.3%) was the second most common diagnosis, predominantly from breast (26.2%) and lung (18.5%) primaries. This parallels data from Singh et al,[12] where breast adenocarcinoma constituted 25–30% of axillary node metastases. Notably, lung primaries showed variable morphology (adenocarcinoma/SCC), consistent with Travis et al,[13] emphasizing the need for IHC (TTF-1, Napsin A) to confirm origin.

Our FNAC-histopathology concordance rate (92.3%) aligns with Dey et al,[14] who reported 90–95% accuracy for metastatic diagnoses. Discordance (7.7%) occurred in poorly differentiated carcinomas, often misclassified as lymphomas or sarcomas. Similar challenges were noted by Chandanwale et al,[15] underscoring the necessity of cell block IHC (e.g., LCA for lymphoma, S100 for melanoma).[16]

FNAC's sensitivity (94.5%) and specificity (96.1%) in our study compare favorably to meta-analyses by Schmidt et al,[17] supporting its reliability. However, false negatives (5.5%) may arise in cystic metastases or hypocellular aspirates, as highlighted by Jhala et al.[18]

CONCLUSION

This study demonstrates that FNAC is a highly accurate, minimally invasive, and cost-effective first-line diagnostic tool for evaluating metastatic lymphadenopathy, with an overall diagnostic accuracy of 95.4% in our cohort of 110 patients. The technique showed high sensitivity (94.5%) and specificity (96.1%), reinforcing its reliability in detecting metastatic deposits, particularly in squamous cell carcinoma (43.1%) and adenocarcinoma (32.3%). The cervical lymph nodes (62.7%) were the most common metastatic site, predominantly associated with head and neck primaries (38.5%), followed by breast (26.2%) and lung (18.5%) malignancies.

However, poorly differentiated carcinomas (16.9%) posed diagnostic challenges, necessitating ancillary techniques such as cell block preparation and immunohistochemistry (IHC) to improve diagnostic precision. The 7.7% discordance rate between FNAC and histopathology underscores the importance of correlating cytology with histopathology in ambiguous cases, particularly when lymphoma or sarcoma is suspected.

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