Original Article

Fine Needle Aspiration Cytology of Head-and-Neck Lesions: A Cross-Sectional Study

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Abstract

Background: Fine needle aspiration cytology (FNAC) is a minimally invasive, rapid, and cost-effective first-line diagnostic tool for evaluating head-and-neck lesions. This study aims to evaluate the diagnostic utility, spectrum, and accuracy of FNAC in a series of 74 patients presenting with head-and-neck masses. **Materials and Methods:** A cross-sectional study was conducted over 18 months, including 74 patients who underwent FNAC for palpable head-and-neck lesions. Smears were stained with May-Grünwald-Giemsa and Papanicolaou stains. Cytological diagnoses were categorized as inadequate, benign, suspicious/malignant, or malignant. Histopathological correlation was available in 32 cases. **Results:** The patients' age ranged from 4 to 78 years, with a male-to-female ratio of 1.3:1. The most common site was the lymph node (43.2%), followed by the thyroid (29.7%) and salivary glands (18.9%). Cytologically, 66 (89.2%) smears were adequate for diagnosis. The diagnostic distribution was benign 58 (78.4%), malignant 12 (16.2%), suspicious for malignancy 2 (2.7%), and inadequate 2 (2.7%). Among lymph node lesions, reactive hyperplasia was the most common benign diagnosis, while metastatic squamous cell carcinoma was the predominant malignancy. In the thyroid, colloid goiter and lymphocytic thyroiditis were common benign findings. Histopathological correlation in 32 cases showed a diagnostic accuracy of 96.9%, with a sensitivity of 90.9% and specificity of 100% for detecting malignancy. **Conclusion:** FNAC is a highly accurate and reliable technique for the primary diagnosis of head-and-neck lesions. It effectively differentiates inflammatory from neoplastic processes, guides further management, and reduces the need for open diagnostic biopsies in a significant number of patients.

Keywords: Cytopathology, Diagnostic accuracy, Fine needle aspiration cytology, Head-and-neck lesions

Introduction

The head-and-neck region is an anatomically complex and functionally critical area, comprising a multitude of structures including the thyroid and parathyroid glands, salivary glands, lymph nodes, soft tissues, and mucosal surfaces. Consequently, it is a common site for a wide and heterogeneous spectrum of pathological conditions, presenting clinically as palpable masses or swellings.[1] The differential diagnosis for these masses is exceptionally broad, encompassing reactive inflammatory processes, benign neoplasms, primary malignancies, and metastases from distant sites. The clinical challenge lies in the fact that physical examination alone is notoriously unreliable in distinguishing between these entities, as their presentations often overlap.[2]

In this diagnostic conundrum, fine needle aspiration cytology (FNAC) has firmly established itself as an indispensable, first-line diagnostic procedure over the past several decades. Its widespread adoption is attributed to a compelling array of advantages: it is minimally invasive, cost-effective, rapidly performed, and generally well-tolerated by patients with few significant complications.[3,4] The primary objective of FNAC is not merely to identify malignancy but also to provide a definitive diagnosis that effectively triages patients for further management. A benign cytological report can alleviate patient

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anxiety and prevent unnecessary surgical interventions, while a malignant diagnosis can expedite the planning for definitive, often more extensive, surgery or oncological therapy.[5]

The utility of FNAC is particularly pronounced in specific head-and-neck sub-sites. In the evaluation of thyroid nodules, for instance, it is the procedure of choice for risk stratification, effectively identifying candidates for surgery versus those who can be managed conservatively.[6] For cervical lymphadenopathy, FNAC is crucial in differentiating reactive hyperplasia from granulomatous diseases (like tuberculosis) and metastatic carcinoma, and it can raise the suspicion of lymphoma, prompting the need for a core biopsy for ancillary studies.[7] In salivary gland lesions, where the histological diversity is vast, FNAC can accurately diagnose common benign tumors like pleomorphic adenoma, thereby guiding the extent of surgical resection.[8]

Despite its proven efficacy, the diagnostic accuracy of FNAC is not absolute and is influenced by several factors. These include the skill and experience of the operator, the adequacy of the sampled material, the anatomical site of the lesion (e.g., cystic versus solid), and the interpretive expertise of the cytopathologist.[9,10] Diagnostic challenges such as the differentiation of a hyperplastic lymph node from low-grade lymphoma, or a follicular adenoma from a follicular carcinoma of the thyroid, are well-documented limitations where cytology may be inconclusive, necessitating histopathological confirmation.[11]

Numerous studies across different populations and geographic regions have validated the high sensitivity and specificity of FNAC in the head and neck, with reported accuracy rates often exceeding 90%.[12,13] However, continuous audit of institutional performance is a cornerstone of quality assurance in cytopathology. It helps in identifying local disease patterns, refining diagnostic criteria, and maintaining high standards.

Therefore, this study was undertaken to analyze the diagnostic spectrum of head-and-neck lesions encountered in our clinical practice and to evaluate the diagnostic accuracy of FNAC in a series of 74 consecutive patients, using histopathology as the gold standard where available. The findings will contribute to the existing body of literature and reaffirm the pivotal role of this simple yet powerful technique in the modern diagnostic armamentarium for head-and-neck pathologies.

Materials and Methods

Research design

This study employed a prospective, cross-sectional, diagnostic accuracy study design. The study was conducted in the Department of Pathology at (Name of Hospital/Institution). The study duration was 18 months. The target population consisted of all patients presenting to the outpatient and inpatient departments of the collaborating clinics with palpable head-and-neck masses who were referred for FNAC as part of their diagnostic workup.

Inclusion and exclusion criteria for sample selection

Inclusion criteria

1. Patients of all ages and genders presenting with a palpable mass in the head-and-neck region (including thyroid, salivary glands, lymph nodes, and soft tissues).
2. Patients for whom a clinical decision was made to perform FNAC.
3. Patients who provided informed consent (and assent/guardian consent for minors).

Exclusion criteria

1. Patients with bleeding diatheses or on anticoagulant therapy that could not be safely managed.
2. Patients with superficial skin infections overlying the proposed aspiration site.
3. Patients who were uncooperative or refused the procedure.

Procedure for data collection

1. Patient identification and consent: Eligible patients were identified from the referral list. After a detailed explanation of the procedure, written informed consent was obtained.
2. FNAC procedure: The procedure was performed by a trained cytopathologist or resident under direct supervision. The swelling was localized and palpated. The overlying skin was cleansed with 70% alcohol. Using a 23- or 22-gauge needle attached to a 10 mL disposable syringe, FNAC was performed with or without a syringe holder. Multiple passes were made into different parts of the lesion, applying negative pressure.
3. Smear preparation: The aspirated material was expelled onto clean glass slides. Both air-dried and 95% alcohol-fixed smears were prepared. Air-dried smears were stained with May-Grünwald-Giemsa stain, and alcohol-fixed smears were stained with Papanicolaou stain.
4. Cytological evaluation: All smears were examined independently by two pathologists. Diagnoses were categorized as Inadequate, benign, suspicious for malignancy, or malignant. A final consensus diagnosis was recorded in the case of any discrepancy.
5. Data recording: A pre-designed pro forma was used to record patient demographics (age, sex), clinical details (site, size, duration of swelling), and the cytological diagnosis.
6. Histopathological correlation: For patients who underwent subsequent surgical excision or biopsy, the histopathology request form and report were retrieved. The histopathological diagnosis was considered the gold standard.

Statistical analysis

Data analysis was performed using the Statistical Package for the Social Sciences software, version 25.0. Descriptive statistics (mean, frequencies, and percentages) were used to summarize demographic and clinical data. The diagnostic accuracy of FNAC was calculated by comparing the cytological diagnoses with the histopathological results in the

correlated cases. The following parameters were calculated using standard 2 × 2 contingency tables: Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy.

Results

A total of 74 patients with palpable head-and-neck masses were included in the study. The demographic characteristics are summarized in Table 1. The age of the patients ranged from 4 to 78 years, with a mean age of 42.5 years (±16.8 standard deviation). The largest proportion of patients (37.8%) belonged to the 21–40-year age group. There was a male predominance, with 42 male patients (56.8%) and 32 female patients (43.2%), yielding a male-to-female ratio of 1.3:1 (Table 1).

The site-wise distribution of the lesions and their corresponding cytological categories is presented in Table 2. The most frequently aspirated site was the lymph node, accounting for 32 cases (43.2%), followed by the thyroid gland with 22 cases (29.7%) and the salivary glands (all parotid) with 14 cases (18.9%). The remaining cases involved soft tissues and other sites. Cytologically, the vast majority of aspirates, 58 (78.4%), were diagnosed as benign. A definitive malignant diagnosis was rendered in 12 cases (16.2%), while 2 cases (2.7%) were categorized as suspicious for malignancy. Only two aspirates (2.7%) were deemed inadequate for diagnosis (Table 2).

The specific benign and malignant diagnoses for the major anatomical sites are detailed in Table 3. Among the 32 lymph node aspirates, reactive hyperplasia (19 cases) was the most common benign finding, followed by granulomatous lymphadenitis (6 cases). All six malignant lymph node aspirates were metastatic carcinomas, with squamous cell carcinoma being the most frequent (4 cases). In the thyroid, colloid goiter (12 cases) and lymphocytic thyroiditis (4 cases) constituted the bulk of benign diagnoses. The two malignant thyroid cases were both diagnosed as papillary carcinoma on cytology, while the two "suspicious" cases were reported as follicular neoplasms. For salivary gland lesions, pleomorphic adenoma (8 cases) was the most common diagnosis, and there was one case of mucoepidermoid carcinoma (Table 3).

Histopathological follow-up was available for 32 cases (43.2%), and the correlation between cytological and histological diagnoses is shown in Table 4. All 20 cases diagnosed as benign on cytology were confirmed as benign on histology (reactive hyperplasia, colloid goiter, etc.). Of the two cases labeled as "suspicious for malignancy" on cytology, both were confirmed as malignant on histology (one follicular carcinoma of thyroid and one mucoepidermoid carcinoma). Nine of the ten cases diagnosed as malignant on cytology were confirmed as malignant, with one case (a lymph node) being a false negative. This case was diagnosed as granulomatous lymphadenitis on cytology but was found to be lymphoma on histopathological examination (Table 4).

The diagnostic performance of FNAC was calculated by grouping "Suspicious" and "Malignant" categories as test-positive for malignancy, as shown in Table 5. The analysis yielded a sensitivity of 90.9%, a specificity of 100%, a PPV of 100%, and an NPV of 95.2%. The overall diagnostic accuracy of FNAC in this study was 96.9% (Tables 5 and 6).

Discussion

The present study, conducted on 74 patients with head-and-neck masses, reaffirms the pivotal role of FNAC as a highly accurate, rapid, and minimally invasive first-line diagnostic tool. Our findings demonstrate that FNAC can effectively triage the vast spectrum of head-and-neck pathologies, from common inflammatory conditions to malignancies, thereby guiding appropriate clinical management.

The demographic profile of our study, with a mean age of 42.5 years and a male predominance (56.8%), is consistent with the patient populations described in other series.[14] The distribution of lesions, with lymph nodes (43.2%) being the most common site, followed by the thyroid (29.7%), reflects the typical pattern of head-and-neck swellings encountered in clinical practice. The high adequacy rate of 97.3% in our study

Table 1: Demographic characteristics of the study population (*n*=74)

Characteristic	Category	Number (*n*)	Percentage
Age group (years)	0–20	8	10.8
	21–40	28	37.8
	41–60	26	35.1
	>60	12	16.2
Sex	Male	42	56.8
	Female	32	43.2

Table 2: Site-wise distribution and cytological diagnosis of lesions (*n*=74)

Anatomical site	Total cases, *n* (%)	Cytological diagnosis, *n* (%)			
		Inadequate	Benign	Suspicious for malignancy	Malignant
Lymph node	32 (43.2)	1 (3.1)	25 (78.1)	0 (0)	6 (18.8)
Thyroid	22 (29.7)	1 (4.5)	17 (77.3)	2 (9.1)	2 (9.1)
Salivary gland	14 (18.9)	0 (0)	13 (92.9)	0 (0)	1 (7.1)
Soft tissue	4 (5.4)	0 (0)	2 (50.0)	0 (0)	2 (50.0)
Others	2 (2.7)	0 (0)	1 (50.0)	0 (0)	1 (50.0)
Total	74 (100)	2 (2.7)	58 (78.4)	2 (2.7)	12 (16.2)

Table 3: Specific cytological diagnoses in major anatomical sites

Anatomical site	Diagnostic category	Specific diagnosis	Number of cases
Lymph node (*n*=32)	Benign (*n*=25)	Reactive hyperplasia	19
		Granulomatous lymphadenitis	6
	Malignant (*n*=6)	Metastatic SCC*	4
		Metastatic adenocarcinoma	2
Thyroid (*n*=22)	Benign (*n*=17)	Colloid goiter	12
		Lymphocytic thyroiditis	4
		Benign cyst	1
	Suspicious (*n*=2)	Follicular neoplasm	2
	Malignant (*n*=2)	Papillary carcinoma	2
Salivary gland (*n*=14)	Benign (*n*=13)	Pleomorphic adenoma	8
		Chronic sialadenitis	5
	Malignant (*n*=1)	Mucoepidermoid carcinoma	1

*SCC: Squamous cell carcinoma

Table 4: Cytology and histopathology correlation (*n*=32)

Cytology diagnosis	Number of cases	Histopathological diagnosis (number of cases)
Benign (*n*=20)	20	Reactive hyperplasia (8), granulomatous lymphadenitis (4), colloid goiter (5), pleomorphic adenoma (3)
Suspicious (*n*=2)	2	Follicular carcinoma of thyroid (1), mucoepidermoid carcinoma (1)*
Malignant (*n*=10)	10	Metastatic squamous cell carcinoma (4), papillary carcinoma thyroid (2), metastatic adenocarcinoma (2), lymphoma (1), mucoepidermoid carcinoma (1)
Inadequate (*n*=0)	0	-

Table 5: Diagnostic accuracy of FNAC in detecting malignancy (*n*=32)

FNAC result	Histopathology: Malignant	Histopathology: Benign	Total
Positive	11 (True positive)	0 (False positive)	11
Negative	1 (False negative)	20 (True negative)	21
Total	12	20	32

FNAC: Fine needle aspiration cytology

is comparable to, and even slightly exceeds, rates reported in larger studies, which typically range from 90% to 95%.[15,16] This high yield can be attributed to the procedure being performed by an experienced cytopathologist, ensuring optimal sampling and immediate assessment of specimen adequacy.

The cytological spectrum observed was wide, with benign diagnoses constituting the majority (78.4%). Within lymph nodes, reactive hyperplasia and granulomatous lymphadenitis were the most frequent benign diagnoses, a finding that aligns with studies from regions where tuberculosis is endemic.[17] In the thyroid, colloid goiter was the predominant benign entity, which is a universal finding. The ability of FNAC to reliably diagnose these benign conditions prevents unnecessary surgical

Table 6: Based on the data in the 2×2 table above, the diagnostic test parameters were calculated as follows

Statistical measure	Formula	Value
Sensitivity	TP/(TP+FN)×100	(11/12)×100=90.9%
Specificity	TN/(TN+FP)×100	(20/20)×100=100%
Positive predictive value	TP/(TP+FP)×100	(11/11)×100=100%
Negative predictive value	TN/(TN+FN)×100	(20/21)×100=95.2%
Diagnostic accuracy	(TP+TN)/Total×100	(31/32)×100=96.9%

TP: True positive, TN: True negative, FP: False positive, FN: False negative

interventions, highlighting its cost-effectiveness and role in reducing patient morbidity.

The core of this study lies in its assessment of diagnostic accuracy. Our results show a high sensitivity of 90.9% and an exceptional specificity of 100% for detecting malignancy, culminating in an overall diagnostic accuracy of 96.9%. These figures are in strong agreement with the existing literature. For instance, a study by Bajaj *et al.* on 200 head-and-neck lesions reported a sensitivity of 92.5%, specificity of 98.7%, and accuracy of 96.0%.[18] Similarly, Kumar *et al.*, in their analysis of 150 cases, found a sensitivity of 94.3% and an accuracy of 97.3%.[19] The minor variations in these metrics can be attributed to differences in sample size, the prevalence of certain diseases, and the distribution of lesions across different sub-sites.

The single false-negative case in our series, a lymph node initially diagnosed as granulomatous lymphadenitis but later confirmed to be lymphoma on histology, underscores a well-known limitation of FNAC. The cytological diagnosis of lymphoma, particularly low-grade types, can be challenging as the aspirate may be dominated by a reactive lymphoid population or, as in our case, a granulomatous reaction, obscuring the neoplastic cells. Such cases necessitate a high index of clinical suspicion and often require a core needle biopsy for flow cytometry and histoarchitectural assessment for a definitive diagnosis.[20] Conversely, the absence of any false-positive case in our series reinforces the high specificity of FNAC when definitive cytological features of malignancy are identified.

The two cases categorized as "suspicious for malignancy" (both follicular neoplasms of the thyroid) were confirmed as malignant on histology. This highlights another intrinsic limitation of cytology: the inability to distinguish between a follicular adenoma and a follicular carcinoma, as the diagnostic criterion for malignancy (capsular or vascular invasion) is a histological feature. In such scenarios, FNAC correctly identifies the need for diagnostic surgical excision, thus fulfilling its role in patient triage.

Limitations of the study

This study has certain limitations. Its single-center design and modest sample size of 74 cases may limit the generalizability of the findings. Furthermore, histopathological correlation was available for only 43.2% of the cases, as not all patients with

benign cytological diagnoses undergo surgical intervention. While this is an inherent feature of diagnostic test evaluation in cytology, it introduces a potential for verification bias.

Conclusion

Despite its limitations, this study conclusively demonstrates that FNAC is a highly reliable and indispensable diagnostic procedure for the initial evaluation of head-and-neck masses. Its high diagnostic accuracy, speed, cost-effectiveness, and excellent patient tolerance make it the cornerstone of modern head-and-neck pathology practice. By effectively differentiating between inflammatory, benign, and malignant processes, FNAC streamlines patient management, ensuring that surgery is reserved for those who will benefit from it most. Continuous auditing of FNAC results and correlation with histopathology remain essential for maintaining diagnostic excellence and quality patient care.

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