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A PROSPECTIVE STUDY OF CLINICOPATHOLOGICAL CORRELATION BETWEEN ULTRASONOGRAHY AND FINE NEEDLE ASPIRATION CYTOLOGY IN MIDLINE SWELLINGS

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Abstract

Introduction: Midline neck swellings are common clinical presentations with various etiologies, ranging from benign to malignant conditions. This prospective study aimed to evaluate the diagnostic accuracy of Ultrasonography (USG) and Fine Needle Aspiration Cytology (FNAC) in assessing midline neck swellings and to correlate these findings with Histopathological Examination (HPE), the gold standard.

Material & Method: After approval from IEC, this prospective study was conducted on 40 patients of all age groups who presented to OPD/IPD at Department of Otorhinolaryngology, IMCHRC, Indore with chief complain of palpable midline neck swellings. Patients qualifying the inclusion criteria were enrolled after obtaining a written informed consent and underwent clinical evaluation, followed by FNAC and USG. Routine blood tests, including TFT, were conducted, and surgical tissue specimens were analysed histopathologically to confirm the final diagnosis. The diagnostic accuracy of FNAC and USG were compared based on appropriate statistical analysis.

Results: Majority of the midline neck swelling were of thyroid swelling (70%). The diagnostic accuracy of FNAC, USG, and HPE for neck masses showed comparable results ($P \geq 0.05$)

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across inflammatory, cystic, benign, and malignant types. FNAC had a better sensitivity of 80.00%, specificity of 94.29%, PPV of 66.67%, NPV of 97.06%, and accuracy of 92.50% as compared to USG with 66.67% sensitivity, 97.30% specificity, 66.67% PPV. 97.30% NPV and 95% accuracy.

Conclusion: A comprehensive clinical evaluation combined with FNAC and USG enhances the diagnostic accuracy for neck swellings, though HPE remains the definitive method with 100% specificity. FNAC provides superior sensitivity and accuracy compared to USG, but HPE is essential for definitive diagnosis.

Keywords: Midline neck swellings, thyroid swelling, FNAC, USG

INTRODUCTION

Neck swellings or masses are frequently encountered by ENT surgeons and can arise from various structures in the neck, including the thyroid gland, salivary glands, lymph nodes, soft tissues, blood vessels, and neural structures, leading to diagnostic challenges. [1] Common pathologies presenting as neck lumps include lymphadenitis, metastatic carcinoma, thyroid swellings, and salivary gland lesions. Among congenital neck masses, the thyroglossal duct cyst is the most common midline lesion. [2] The prevalence of thyroid nodules is estimated to be as high as 64%, with the incidence of malignancy ranging from 5% to 10%, depending on the population being studied. [3]

Despite their superficial accessibility, the proximity of multiple organ systems in the neck often complicates diagnosis. A palpable neck mass is a frequent clinical concern. Although these masses can present overlapping features, differentiation is typically possible through specific imaging findings combined with relevant clinical information.[1]

Neck masses can be broadly categorized as inflammatory, cystic, benign, or malignant. [4] While a thorough case history and clinical examination are crucial in evaluating these masses, some cases—such as chronic inflammation, abscesses, deep-seated or infected cystic lesions, and neoplasms—require additional diagnostic modalities such as ultrasound (USG), fine-needle aspiration cytology (FNAC) and histopathology for a more precise assessment.[3]

For over a century, surgeons depended on histopathologists for diagnoses, but high costs and complexity prompted the shift to fine needle aspiration cytology (FNAC). FNAC, introduced as a rapid, minimally invasive method, became essential for diagnosing neoplastic,

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inflammatory, infectious, and degenerative conditions, and is now the primary test for evaluating thyroid disorders.

Fine Needle Aspiration Cytology (FNAC) has proven to be an invaluable diagnostic tool for neck swellings since its introduction by Martin & Ellis in 1930.[5] It is a minimally invasive, cost-effective procedure that delivers quick results with minimal trauma and few complications. FNAC is particularly useful for evaluating cervical masses and nodules when other diagnostic methods fail. The procedure is performed in an outpatient setting under local anesthesia, making it suitable for assessing a wide range of conditions, including neoplastic and inflammatory lesions. [6,7] FNAC offers significant benefits, including high sensitivity (52.6%-97%), specificity (86.6%-100%), and accuracy (79.1%-91.6%) for diagnosing head and neck swellings. Its effectiveness, however, depends on the skill of the operator and the context of clinical information. [8,9] While FNAC provides valuable cellular insights, it lacks the architectural detail of histology. Despite this limitation, FNAC remains a critical tool in the initial assessment and diagnosis of neck masses, complementing other diagnostic techniques.

Ultrasonography is the most valuable imaging modality for evaluating neck swellings, particularly midline neck swellings such as those involving the thyroid gland. [10] Ultrasonography (USG) is advantageous due to its safety, lack of ionizing radiation, wide availability, ease of use, non-invasive nature, and cost-effectiveness. It is particularly effective in differentiating cystic from solid lesions and distinguishing between malignant and benign masses. USG is also valuable for detecting multiple lymph nodes, tracking the progression of infectious diseases, observing regional lymph node metastasis in oral carcinoma, and identifying sialolithiasis and salivary gland conditions.[1]

The combination of USG and FNAC increases diagnostic accuracy, but histopathological examination (HPE) remains the gold standard for confirmation. While many studies have assessed the individual efficacy of FNAC, USG, and HPE, there is a lack of comprehensive studies comparing all three methods. Consequently, thorough evaluation using these modalities is crucial for accurate diagnosis and effective treatment planning.

In advent of same, the present study was undertaken to evaluate the effectiveness of USG and FNAC in diagnosing midline neck masses by calculating the sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of these tests across inflammatory, cystic, benign, and malignant conditions.

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MATERIAL AND METHOD

After approval from IEC, the present prospective study was undertaken on 40 patients visiting the OPD/IPD at Department of Otorhinolaryngology, Index medical college, Hospital & Research Centre, Indore with complaint of palpable midline neck swellings. All patients qualifying the inclusion criteria were enrolled after taking an informed written consent.

Inclusion Criteria

- Patients of all age and gender with clinically palpable midline neck swellings reporting to Index medical college hospital ENT OPD & IPD.

Exclusion criteria

- Patients not giving consent for the study
- Suspect neck masses of vascular origin on clinical examination.
- Patients with metastatic neck swelling
- Patients coming with neck abscess or open infected wounds.
- Patients with bleeding coagulopathy.
- Patients not willing for participating in study

Methodology

Patients with midline neck swellings who attended the ENT OPD and IPD at Index Medical College were thoroughly examined and clinically diagnosed based on history and physical examination. Following the initial clinical assessment, all 40 patients underwent Fine Needle Aspiration Cytology (FNAC) of the neck swelling in the Department of Pathology.

This was followed by an ultrasound (USG) examination of the neck swelling in the Department of Radiology. Routine blood investigations, including Thyroid Function Tests (TFT) for thyroid-related swellings, were conducted. Tissue specimens obtained during surgical procedures were sent for histopathological examination (HPE) in the Department of Pathology, where the final diagnosis of the neck swelling was confirmed.

Ultrasonographic evaluations were conducted using a GE Voluson S8 USG machine with a Superficial Transducer Probe operating at a frequency range of 7.5 to 11 MHz. The procedure involved applying a coupling gel to eliminate air layers and ensure proper sound transmission into the body. The transducer was then maneuvered in either transverse or longitudinal directions to assess the neck masses for various characteristics, including size, location,

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margins, echotexture, calcification, halo presence, vascularity, nodules, and consistency (solid, cystic, or mixed).

FNAC was performed using a 21–24-gauge needle, employing suction or capillary action to obtain samples from the swelling. These samples were then smeared onto glass slides, fixed with absolute alcohol, and dried for microscopic evaluation.

Statistical Analysis

The raw data was entered and analyzed using Microsoft Excel 2010 and SPSS 20.0 for Windows. Prevalence rates were calculated with 95% confidence limits, and a descriptive analysis of the population was conducted. Categorical variables were expressed in absolute values and percentages, with comparisons made using the Pearson test. Continuous variables with a normal distribution were described as mean ± SD. The diagnostic performance of Fine Needle Aspiration Cytology (FNAC) and Ultrasonography (USG) was assessed using statistical tests such as sensitivity, specificity, PPV, NPV, and accuracy, with Histopathological Examination (HPE) serving as the gold standard. Correlations between quantitative variables were evaluated using Pearson's or Spearman's coefficient of correlation, and associations between variables were determined by the Chi-Square test. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 40 patients with various midline neck swellings was enrolled in the study, among them 7 (17.5%) were male patients and 33 (82.5%) were female patients with a male to female ratio of 1:4.7. The youngest patient was 16 years old and the eldest patient was 61 years old. The most common age group with various neck swellings in this study was 31-40 years. Majority of patients (37; 92.5%) presented with swelling over the neck with no other symptoms. The largest swelling was (17x10) cm in size and the smallest was (2x2) cm in size. The majority (34; 85%) of neck swellings were firm in consistency and mobile (38; 95%).

Table 1. Distribution of patients based on clinical diagnosis

Clinical diagnosis	Number of patients	Percentage
Thyroid swellings	28	70
Parotid gland swellings	4	10

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Submandibular gland swellings	2	5
Other neck swellings		
Cervical lymphadenopathy	3	7.5
Cervical swelling	1	2.5
Submental swelling	1	2.5
Submandibular swelling	1	2.5
Total	40	100

According to clinical diagnosis, the most common diagnosis was thyroid swelling (28; 70%), followed by parotid gland swellings (4; 10%), 2(5%) submandibular gland swelling, and 6 (15%) were other midline neck swellings. In 6, other neck swellings' most common clinical diagnosis was cervical lymphadenopathy (3; 7.5%) followed by 1(2.5%) each of cervical swellings, submental swelling, and submandibular swelling (Table 1).

Table.2 Distribution of 80 cases diagnosed by FNAC, USG and HPE

Procedure	Benign	Malignant	Suspicious	Total
FNAC	33	2	5	40
USG	37	1	2	40
HPE	36	4	-	40

According to FNAC diagnosis majority (33; 82.5%) were benign neck swellings, followed by suspicious (5;12.5%) and 2(5%) were malignant. In benign neck swellings, the most common was the thyroid (20;50%), followed by the salivary gland (7;17.5%) and 6 (15%) were other midline neck swellings. In benign neck swellings, the most common histopathological finding was colloid goiter (15;37.50%) followed by pleomorphic adenoma parotid (7;17.5%) and 2(5%) were granulomatous lymphadenitis. In suspicious midline neck swellings, a majority (2; 5%) were the lymphoproliferative disorder of lymph node followed by 1(2.50%) were thyroid neoplasm, 1(2.50%) were follicular neoplasm, and 1 was parotid neoplasm. In malignant midline neck swellings, 1 (1.25%) was papillary carcinoma thyroid and 1 (1.25%) was metastatic SCC (squamous cell carcinoma) parotid.

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Based on USG diagnosis, 37 (92.50%) neck swellings were found benign, followed by 2 (5%) suspicious and 1 (2.5%) were malignant. In benign neck swellings, a majority (22;55%) were thyroid followed by the salivary gland (9;22.5%), and 6 (15%) were other midline neck swellings. In benign neck swellings, the most common diagnosis was colloid goiter (16;40%), solitary thyroid nodule was 10 (25%), pleomorphic adenoma parotid was 8 (20%), 2 (5%) were thyroglossal cyst, and 1(2.5%) were tubercular cervical lymph node. In suspicious neck swellings, 1(1.25%) was thyroid neoplasm and 1(1.25%) was right parotid mass. In malignant neck swelling, 1(1.25%) was malignancy of thyroid.

On HPE 36 (90%) were benign neck swellings and 4 (10%) were malignant. In benign neck swellings most common diagnosis was colloid goiter 16 (40%), the second most common was pleomorphic adenoma of parotid 7 (17.50%). In the malignant category, 1 (2.50%) was papillary carcinoma thyroid (most common malignancy of thyroid), 1(1.25%) was anaplastic carcinoma thyroid, 1(2.5%) was mucoepidermoid carcinoma parotid and 1(1.25%) was Hodgkin lymphoma.

For statistical analysis, cases assessed by FNAC and USG were categorized into positive (including malignant and suspicious cases) and negative (benign cases) groups and Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy of FNAC and USG was calculated. (Table 3 and Table 4)

Table.3 Distribution of cases diagnosed by FNAC and correlation with HPE

FNAC (n=40)	**HPE**		
	Malignant	Benign	Total
Positive	4(TP)	2(FP)	6
Negative	1(FN)	33(TN)	34
Total	**4**	**36**	40
Sensitivity	80.00%		
Specificity	94.29%		
PPV	66.67%		
NPV	97.06%		
Accuracy	92.50		

Table.4 Distribution of cases diagnosed by USG and correlation with HPE

USG (n=40)	**HPE**		
	Malignant	Benign	Total

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Positive	2 (TP)	1(FP)	3
Negative	1(FN)	36(TN)	37
Total	**3**	**37**	40
Sensitivity	66.67%		
Specificity	97.30%		
PPV	66.67%		
NPV	97.30%		
Accuracy	95%		

For Fine Needle Aspiration Cytology (FNAC), sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy were 80.00%, 94.29%, 66.67%, 97.06% and 92.50%, respectively. Whereas, for Ultrasonography (USG), these values were 66.67%, 97.30%, 66.67%, 97.30%, and 95%, respectively.

DISCUSSION

This study investigated the effectiveness of Fine Needle Aspiration Cytology (FNAC) and Ultrasonography (USG) when compared to the gold standard HPE among 40 patients aged 16 to 62 years, with a mean age of 34.45 years. The majority of the patients were female, with a male-to-female ratio of 1:4.7, and the most common midline neck swelling was thyroid-related (28;70%), particularly in the 31-40 age group.

FNAC was found to be a crucial tool in preoperative screening, effectively differentiating between benign and malignant lesions. The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy of FNAC were 80.00%, 94.29%, 66.67%, 97.06% and 92.50%, respectively. These results were consistent with study done by Tilak et al. [11], FNAC demonstrated a sensitivity of 90.91%, specificity of 93.18%, and accuracy of 92.73%. Similarly, Garud P et al. [12] reported sensitivity, specificity, and accuracy of FNAC as 90.32%, 86.66%, and 89.43%, respectively, which are close to the findings of this study. Jain S et al. [2] also reported sensitivity, specificity, PPV, NPV, accuracy of FNAC of all neck swellings were 85.71%, 91.78% ,50%, 98.53% and 91.25% respectively. However, Nautiyal S et al. [13] observed a lower sensitivity of 78.9%, while specificity (96.29%) and accuracy (95%) were comparable to this study's results. The variations in sensitivity, specificity, and accuracy between studies can be attributed to several factors. These include differences in the aspiration techniques, the adequacy of the specimen (both quantitatively and

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qualitatively), the precision in needle placement, and the interpretation of cytopathologic results. Specific challenges in FNAC of thyroid lesions, such as the evaluation of degenerative nodules, follicular lesions, Hurthle cell lesions, and distinguishing lymphocytic thyroiditis from lymphoma, contribute to these discrepancies. These factors highlight the importance of technical expertise and careful interpretation in FNAC to achieve accurate diagnoses.

USG has become the primary imaging modality for neck swellings due to its ability to visualize internal structures with high sensitivity, particularly for small swellings and cysts. In the present study, USG showed a sensitivity of 66.67%, specificity of 97.30%, PPV of 66.67%, NPV of 97.30%, and accuracy of 95%. Similar study done by Jain S et al. [2] showed sensitivity, specificity, PPV, NPV, and accuracy of USG of 71.43%, 98.63%, 83.33%, 97.29% 96.25% respectively which was comparable to our study. While Naaz F et al. [14], reported 86% accuracy of USG which is lower than our study. In a study by Alshoabi et al. [15] sensitivity of USG was 98.38% which was higher than our study and specificity was 71.42% which is lower than that of our study. The difference in the sensitivity, specificity, and accuracy of USG between our study and others may be due to associated with equipment, examination skills, anatomy, interpretation, and extrathyroidal abnormalities as mentioned by Chow et al.

Overall, FNAC and USG provided a comprehensive approach, offering high diagnostic accuracy for midline neck swellings. However, final confirmation of diagnoses required histopathological examination (HPE), which remains the gold standard. The study highlights the importance of these modalities in the early and accurate diagnosis of neck swellings, aiding in the appropriate management and treatment of patients.

CONCLUSION

A thorough clinical evaluation, supported by appropriate pathological and radiological tests, is crucial for the early and systematic diagnosis of neck swellings. Ultrasonography (USG) is useful pre-operatively, offering insights into the anatomy and extent of the disease. Fine Needle Aspiration Cytology (FNAC) stands out as a safe, accurate, simple, and cost-effective diagnostic tool for neck swellings, showing better diagnostic accuracy than USG. However, neither USG nor FNAC is entirely specific in distinguishing benign from malignant lesions before surgery. Histopathological Examination (HPE) remains the definitive method for accurate diagnosis, with 100% specificity. While FNAC shows superior sensitivity and accuracy over USG in diagnosing these swellings, HPE is essential for confirming the diagnosis.

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