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Original Research Article

A comparative study of different neck swellings by clinical radiological and pathological findings

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ABSTRACT

Background: Neck swellings are common clinical conditions encountered by ENT surgeons across all age groups and often present with variable duration of symptoms. This study aimed to classify the different types of neck swellings and assess the diagnostic accuracy of ultrasonography (USG), fine-needle aspiration cytology (FNAC), and computed tomography (CT) in comparison with histopathology. Age and gender distribution were also analyzed.
Methods: This study included patients with neck swellings who underwent appropriate surgical intervention after ethical approval and according to defined inclusion and exclusion criteria. All patients underwent clinical examination, radiological and pathological investigations, and subsequent surgical management. Histopathological examination of excised tissue was considered the gold standard for diagnosis.
Results: A total of 38 patients were included, with ages ranging from 9 to 68 years. There were 27 females and 11 males. The duration of swelling varied, with about 18 patients presenting within 12 months of symptom onset. Compared with histopathology, USG showed a sensitivity of 66.7%, specificity of 92.3%, and diagnostic accuracy of 84.2%. CT demonstrated a sensitivity of 75.0%, specificity of 92.3%, and diagnostic accuracy of 84.0%. FNAC showed the best diagnostic performance, with a sensitivity of 75.0%, specificity of 100%, and diagnostic accuracy of 92.1%.
Conclusions: FNAC was the most reliable diagnostic modality for neck swellings because of its highest specificity and accuracy. CT was a useful adjunct, particularly where FNAC facilities were limited. USG, although valuable as an initial investigation, had lower sensitivity and limited usefulness for definitive diagnosis.

Keywords: Neck swellings, Ultrasonography, Fine-needle aspiration cytology, Computed tomography, ENT surgery, Histopathology

INTRODUCTION

Neck swellings are a common clinical condition encountered by ENT surgeons in routine practice, affecting patients across all age groups with variable symptom duration. These may be congenital or developmental, inflammatory or reactionary, or neoplastic (primary or secondary) in nature.[1] Benign neck masses most frequently arise from lymph nodes, thyroid, parotid, and other salivary glands. Less common etiologies include thyroglossal cysts, branchial cleft cysts, carotid body tumors, cystic hygromas, pharyngeal pouch abnormalities, and lesions of skin appendages. The clinical diagnosis of neck masses is based on a detailed history, thorough head and neck examination, and appropriate investigations. These typically include blood tests, radiological imaging, and pathological evaluation. Further diagnostic steps and management often involve ultrasonography (USG), computed tomography (CT), fine-needle aspiration cytology (FNAC), and periodic

follow-up.[2] Key clinical clues such as patient age, site, size, onset, and duration of swelling assist in narrowing the differential diagnosis. In children, congenital and inflammatory swellings are common, whereas in adults, neoplastic lesions are more significant. Tuberculous lymphadenitis remains one of the most frequent causes of neck swellings in the Indian population. Other common causes include thyroid swellings, thyroglossal cysts, acute lymphadenitis, lymphomas, and salivary gland pathologies such as sialadenitis, cysts, and adenomas. Less frequent entities include carotid body tumors and cystic lesions such as cystic hygroma and branchial cysts.[3] USG is generally the first imaging modality performed after clinical examination. It is preferred as an initial screening tool owing to its non-invasive nature and absence of ionizing radiation. USG helps define the location, size, extent, internal characteristics, and relation of the mass to surrounding structures. However, it lacks specificity in differentiating between malignant and inflammatory lymphadenopathy in some cases.[4]

CT scanning, especially with contrast, is valuable in assessing bone details, calcifications, and soft tissue characterization, thereby improving diagnostic accuracy.[5] Pathologically, FNAC and histopathological examination (HPE) are the mainstay. FNAC, being minimally invasive, safe, inexpensive, and providing rapid results, plays an important role in the evaluation of neck swellings.[6] Histopathological examination of excised tissue remains the gold standard, as it provides a definitive diagnosis along with detailed architectural information.[7] The aim of our study was to evaluate different types of neck swellings using clinical, radiological, and pathological investigations, with the objectives of categorizing them, assessing the diagnostic accuracy of ultrasonography (USG), fine-needle aspiration cytology (FNAC), and computed tomography (CT), and analyzing their age and gender distribution.

METHODS

This study was conducted in the Department of ENT, from February 2023 to January 2024. It was a cross-sectional study including 38 patients who presented to the ENT outpatient department with neck swellings and underwent surgical intervention during the study period.

The sampling technique used in this study was convenient sampling. Patients of both sexes presenting, across all age groups with neck swelling, were evaluated, found fit for surgery, and willing to undergo surgery were included in the study. Patients who were unfit for general anesthesia or surgery were excluded from the study. After obtaining informed consent, each patient fulfilling the inclusion and exclusion criteria was enrolled. A detailed clinical history was taken, and a thorough local examination of the swelling was performed, noting its site, size, shape, extent, number, tenderness, margins, and consistency. Radiological evaluation was then carried out. USG was performed as the initial investigation in all cases, with examination in both longitudinal and transverse planes to assess the size, shape, consistency, echogenicity, internal architecture, presence of septations, calcification, necrosis, relation to surrounding structures, and extent of the mass. CT was performed in cases where USG findings were suspicious of malignancy, inconclusive, or where deeper involvement needed to be assessed. CT provided precise localization, information on solid or cystic consistency, tumour staging, and pre-surgical assessment.

FNAC was performed following radiological assessment. FNAC, a minimally invasive, cost-effective outpatient procedure, was carried out using an 18–23 gauge needle, employing either suction or capillary action to obtain cellular aspirates. Smears were prepared on glass slides, air-dried or alcohol-fixed, and examined microscopically for diagnosis. Following basic pre-operative investigations, patients underwent appropriate surgical intervention.

The excised tissue was sent for histopathological examination (HPE), which served as the gold standard for diagnosis. For statistical analysis, mean and standard deviation were calculated for continuous variables, and percentages for categorical variables. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and diagnostic accuracy of USG, CT, and FNAC were calculated using HPE as the reference standard. Data were analyzed using SPSS version 20.

RESULTS

A total of 38 patients fulfilling the inclusion criteria were observed, evaluated, and followed up during the study period.

Demographic distribution

The youngest patient was 9 years old, while the oldest was 68 years. Among the 38 patients, 2.63% were below 10 years, 18.42% were between 11–20 years, 26.32% were in the 21–30 years group, 15.79% were between 31–40 years, 23.68% belonged to 41–50 years, 7.89% were in the 51–60 years group, and 5.26% were above 60 years (Figure 1). Regarding gender distribution, 71.05% were females and 28.95% were males, with a female-to-male ratio of 2.8:1.

Types of neck swellings

In our study, 44.7% had thyroid swellings, 28.9% had salivary gland swellings, 7.9% had tubercular lymphadenitis, 5.3% had branchial cleft cysts, 5.3% had lymphangioma/cystic hygroma, and 2.6% had thyroglossal duct cysts. By anatomical site, 47.37% were midline swellings, 15.79% infra-auricular, 21.05% submandibular, 5.26% paramedian, 2.63% posterior

triangle, 2.63% submental, and 5.26% multiple swellings (Table 1).

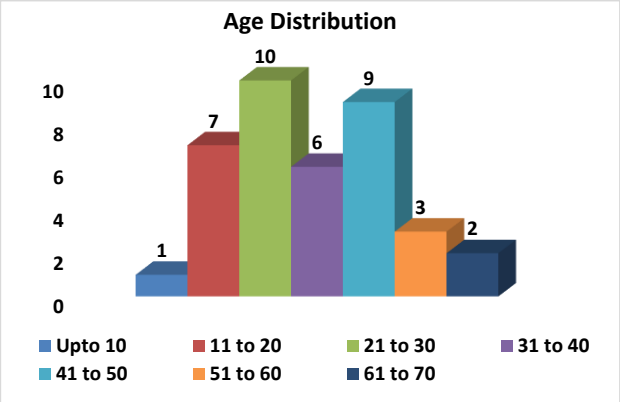

Figure 1: Distribution of study population according to age group.

Table 1: Distribution according to the site of swelling.

Site of swelling	Number	Percentage (%)
Infra auricular	6	15.79
Midline	19	50.00
Multiple	1	2.63
Paramedian	2	5.26
Posterior triangle	1	2.63
Submandibular	8	21.05
Submental	1	2.63

Duration of symptoms

Overall, 47.37% of patients presented within 1 year of onset, 34.21% had symptoms for 1–3 years, 5.26% for 3–5 years, and 13.16% for more than 5 years.

Preoperative diagnostic modalities

In our study, during pre-operative investigation of 38 patients of neck swellings, USG identified 73.68% benign swellings and 26.32% malignant swelling, FNAC identified 76.32% benign and 23.68% malignant while, CT identified 60.0% benign and 40.0% malignant. Finally, post-operatively, in histopathological examination; 68.42% was diagnosed as benign and 31.58% as malignant (Table 2).

Diagnostic performance of modalities

USG: On comparing USG findings with HPE, Of the 12 histopathologically confirmed malignant lesions, USG correctly identified 8, yielding a sensitivity of 66.7%, indicating that one-third of malignant lesions were missed. Among 26 benign lesions, USG correctly classified 24, resulting in a specificity of 92.3%, showing high reliability in confirming benign cases. The PPV was 80%, reflecting the likelihood that lesions identified as malignant by USG were truly malignant, while the NPV was 85.7%, indicating the probability that lesions deemed benign were truly benign. Overall, the diagnostic accuracy of USG was 84.2%. While the sensitivity for detecting malignancy was low, the specificity, predictive values, and overall accuracy were good (Table 3).

Table 2: Distribution of type of swelling based on USG, FNAC, CT and HPE findings.

Tests	Benign (%)	Malignant (%)	Benign	Malignant
Ultrasonography (USG)	73.68	26.32	28	10
Computed tomography (CT)	60.00	40.00	15	10
Fine needle aspiration cytology (FNAC)	76.32	23.68	29	9
Histopathology (HPE)	68.42	31.58	26	12

Table 3: Sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of ultrasonography (USG) in the diagnosis of malignant lesions compared to the histopathology findings.

Parameter	Percentage (%)
Sensitivity	66.7
Specificity	92.3
PPV	80.0
NPV	85.7
Diagnostic accuracy	84.2

CT: On comparing CT findings with HPE, CT correctly identified 9 malignant cases (true positives) and the 12 benign cases (true negatives). However, 3 malignant cases were missed (false negatives) and 1 benign case was incorrectly labeled as malignant (false positive). Thus, out of 25 cases, CT reported 13 as malignant and 12 as benign, while HPE confirmed 12 malignant and 13 benign lesions. Sensitivity 75.0%, Specificity 92.3%, Diagnostic Accuracy 84.0%. CT demonstrated good sensitivity and very good specificity, predictive values, and accuracy, with a low false positive rate (Table 4).

FNAC: On comparing FNAC findings with HPE, FNAC correctly identified 9 malignant cases (true positives) and 26 benign cases (true negatives). Three malignant cases were missed (false negatives), while no benign cases were incorrectly labeled as malignant (false positives). Thus, out of 38 cases, FNAC reported 9 as malignant and 29 as benign, while HPE confirmed 12 malignant and 26

benign lesions. Sensitivity 75.0%, Specificity 100%, Diagnostic Accuracy 92.1%. FNAC showed excellent diagnostic performance, with no false positives reported (Table 5).

Table 4: Sensitivity, specificity, PPV, NPV and diagnostic accuracy of CT in the diagnosis of malignant lesions compared to the histopathology findings.

Parameter	Percentage (%)
Sensitivity	75.0
Specificity	92.3
PPV	90.0
NPV	80.0
Diagnostic accuracy	84.0

Table 5: Sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of FNAC in the diagnosis of malignant lesions compared to the histopathology findings.

Parameter	Percentage (%)
Sensitivity	75.0
Specificity	100
PPV	100
NPV	89.
Diagnostic accuracy	92.1

DISCUSSION

A comprehensive understanding of neck masses and their potential etiology is crucial to an ENT Surgeon. A basic understanding of different pathologies in patients presenting with neck lump is essential to direct adequate investigations and conclude an accurate working diagnosis without compromising patient's clinical outcome.

In our diagnostic algorithm, Ultrasonography and Fine Needle Aspiration Cytology play crucial roles, providing a non-invasive approach to assess the nature of these swellings. Radiological assessments, including CT scans, complement the diagnostic strategy by offering detailed anatomical information and aiding in surgical planning. While ultrasonography excels in identifying superficial structures, CT images provide a deeper insight into the extent of the swelling and relationship thereof to adjacent structures. FNAC, known for its minimal invasiveness, proves valuable in confirming diagnoses and guiding treatment decisions, especially in cases considering surgical intervention. The optimal integration of these imaging modalities is crucial for achieving a comprehensive objectives and goals. Histopathological examination of surgically excised tissues remains the gold standard, offering detailed insights into the architecture of the swelling. This not only confirms the pre- operative diagnosis but also provides essential information guiding further management, particularly in cases involving neoplastic lesions.

The prevalence of neck swellings in various age groups was evident in our patient cohort, with paediatric cases having predominantly congenital and inflammatory aetiology where as in adults; neoplastic aetiology was more commonly noted. In our study involving 38 patients, 11 were males and 27 were females, yielding a female-to-male ratio of 2.4:1. This indicates that neck swellings were more common among females. Similar findings have been reported by Garud et al and Joshi et al, who also observed a female predominance. In contrast, studies by Karthikeyan et al and Goutam et al documented a male preponderance.[8-11] Such differences may be attributed to variations in patient availability and enrollment criteria across different studies. In our study, thyroid swellings were the most common, followed by salivary gland swellings. Garud et al also reported thyroid swellings as the most common, with salivary gland swellings being the second most frequent. Similarly, Joshi et al and Irfana et al observed thyroid swellings as the most common presentation; however, in their studies, lymph node swellings were the second most common.[12]

With respect to the site of lesion in our study, the most common locations were the midline (18 cases), followed by the submandibular region (8 cases) and the infra-auricular region (6 cases). In a study by Joshi et al, among 150 patients presenting with neck swellings, 117 (78.0%) had midline swellings, 18 (12.0%) had swellings on the right side, 11 (7.0%) on the left side, and 3 (2.0%) had bilateral involvement. Similarly, Gupta et al reported that the majority of swellings were located in the midline (49.0%), followed by the anterior triangle (35.0%) and posterior triangle (15.5%).[9,13]

In the present study, USG showed a sensitivity of 66.7% and a specificity of 92.3%. This indicates that while USG was quite reliable in correctly identifying benign cases (high specificity), it had relatively lower accuracy in detecting malignant lesions (lower sensitivity). In comparison, Vatsal et al reported much higher values, with both sensitivity and specificity at 94.9%, highlighting the strong diagnostic reliability of USG in their cohort.[14] Similarly, Rastogi et al documented a sensitivity of 87.5% and specificity of 98.7%, further supporting USG as an effective tool in evaluating neck swellings.[15] Garud et al found a sensitivity of 89.4% but a comparatively lower specificity of 75.0%, suggesting more false positives in their study.

CT demonstrated a sensitivity of 75.0% and a specificity of 92.3%. This suggests that CT was good at correctly identifying malignant cases and very reliable in excluding benign cases. In contrast, Siddique et al. reported higher values, with sensitivity of 94.6% and specificity of 95.0%, indicating excellent diagnostic accuracy. Charan et al documented a sensitivity of 95.7% but a lower specificity of 77.5%, suggesting more false-positive

diagnoses in their series. Kaur et al observed a sensitivity of 96.4% and a specificity of 100%, reflecting the highest diagnostic performance among the studies compared.[16,17]

FNAC demonstrated a sensitivity of 75.0% and a specificity of 100%. This indicates that FNAC was excellent in correctly identifying benign cases with no false positives, though a few malignant cases were missed, as reflected in the sensitivity value. Vatsal et al reported slightly higher sensitivity of 83.3% with an equal specificity of 83.3%, showing balanced but lower reliability in excluding benign lesions compared to our findings.[14] Singh et al observed lower diagnostic accuracy, with sensitivity of 66.3% and specificity of 70.4%, indicating both false positives and false negatives were relatively more common.[1] Khokle et al reported a sensitivity of 72.4% and specificity of 100%, closely aligning with our study, again emphasizing FNAC's strength in correctly ruling out benign conditions.[18]

To summerise the findings of our study, FNAC is found to have a better sensitivity, specificity, positive and negative predictive value and diagnostic accuracy against histopathology examination findings. CT is a better predictor than USG. In low resource settings, USG can also be used for identification of benign and malignant neck lesions, but care is needed as it has higher rate of false negative (FN) and false positive (FP) results, compared to that of CT and FNAC.

However, several limitations should be acknowledged. The study was constrained by a relatively small sample size, introducing potential limitations to the generalizability of the findings. Furthermore, selection bias may have influenced participant inclusion. Being a single-center study, it is essential to emphasize the need for validation through larger-scale investigations that encompass more diverse demographic distributions.

Despite these constraints, the present study's results align well with existing literature, showcasing varying percentages in sensitivity, specificity, positive and negative predictive values, as well as diagnostic accuracy for USG, FNAC, and CT.

CONCLUSION

Our study revealed a diverse spectrum of neck swellings. The diagnostic performance of the three modalities showed varying sensitivities, specificities, and accuracies. Notably, FNAC exhibited superior sensitivity, specificity and diagnostic accuracy compared to ultrasound and CT. Histopathological investigation of surgically excised tissue samples is the gold standard technique in diagnosing any swelling which also provides detailed architecture. In resource-scarce settings lacking FNAC facilities, CT proved valuable for assessing neck swellings with a relatively good accuracy. However, lower sensitivity of USG suggests limitations in certain diagnostic scenarios.

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