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EVALUATION OF NECK MASSES: THE SIGNIFICANCE OF ULTRASONOGRAPHY AND FINE-NEEDLE ASPIRATION CYTOLOGY

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ABSTARCT

The purpose of the research is to determine the effectiveness of fine-needle aspiration cytology (FNAC) and ultrasonography (USG) in evaluating neck masses and distinguishing between benign, malignant, inflammatory, and cystic neck masses using a correlation between histopathology. **Study Design:** Both observational and prospective research. **Location**: Dhiraj General Hospital, Waghodiya, Vadodara, Gujarat. **Study Period:** 1st december 2022- 30th November 2023. **Materials and Methods:** Neck masses were assessed sonographically, and a final diagnosis was reached based on the FNAC and the histology of removed samples. Lastly, using statistical techniques, the USG findings were compared (where feasible) with FNAC reports and histopathological reports in order to assess their sensitivity, specificity, and accuracy.

Results: The majority of patients fell into the age range of 31 to 60. Males outnumbered females among all cases, with a 1.5:1 M:F ratio. Lesions that were anechoic or hyperechoic indicated benign disease, while lesions that were hypoechoic had the highest likelihood of malignancy. According to USG diagnosis, the most common kind of lesion was benign (36.4%), then inflammatory (27.08%), cystic (20.83%), and malignant (15.63%). Benign mass (32.29%), inflammatory mass (26.04%), cystic mass (19.79%), and malignant mass (15.63%) were identified by FNAC impression. $P < 0.05$ was shown to be similar for the diagnostic accuracy of USG, FNAC, and Histopathological Examination (HPE) for inflammatory, cystic, benign, and malignant neck masses. **Conclusion**: high-resolution grayscale ultrasonography can distinguish between benign, malignant, inflammatory, and cystic neck tumours. When it comes to differentiating between benign and malignant neck tumours, FNAC is thought to be quite effective. The diagnostic efficacy of FNAC and USG is maximised when a cytopathologist, radiologist, and clinician collaborate as a team.

Keywords: Benign and malignant, cystic, fine-needle aspiration cytology, inflammatory, ultrasonography

INTRODUCTION

Neck masses encompass a broad range of pathologies. Due to the lesions' superficial location, they are easily accessible; yet, because the components of several organ systems are so close together in the neck, diagnosing them can be challenging. One typical clinical issue that is observed is a palpable neck tumour. Even though certain aspects of the lesions are similar, it is usually possible to distinguish between them based on particular imaging results and pertinent

clinical data. The head and neck regions are susceptible to certain disease processes that manifest as masses in clinical settings.
A thorough case history and clinical examination are essential in the evaluation of these masses. However, in certain cases—such as persistent inflammation, abscess formation, deep-seated or infected cystic lesions and neoplasms—clinical examination and palpation are insufficient to fully determine the precise origin and nature of the masses; in these cases, radiological imaging and fine-needle aspiration cytology (FNAC) are required.

Ultrasonography (USG) has a number of benefits, including the fact that it is safe, doesn't use any ionising radiation, is readily available, simple to use, noninvasive, affordable, and unaffected by metal objects like dental restorations. Without any preparation, it can be carried out on a large scale. There are no health risks associated with ultrasounds, and they can be used as often as needed. Ultrasound is useful in detecting benign versus malignant tumours and can distinguish solid lesions from cystic ones. It is useful in defining the existence of several lymph nodes and the manner in which infectious illnesses resolve. It is used to check for the presence of regional lymph node metastases in cases of oral cancer. Additionally useful in the identification of disorders affecting the salivary gland is ultrasound in the detection of sialolithiasis.
A broad variety of neck masses can be easily diagnosed by FNAC, and precise cytological analysis is crucial to the surgical planning process. Its goal is to quickly deliver a diagnosis that is as near to the histological examination result as feasible, allowing the surgeon to make an early treatment decision. The procedure can be carried out as an outpatient. The majority of patients find the operation to be acceptable. Anaesthesia is not required, and findings can be obtained quickly. It is a diagnostic instrument that is cost-effective, safe, and minimally intrusive. There isn't any proof that the tumour travels through the skin channel the hypodermic needle made.
Consequently, several investigative techniques must be added to the clinical examination in order to obtain a definitive diagnosis. This can support evidence-based treatment and proper documentation in legal disputes.
An assessment of the effectiveness of FNAC and USG in diagnosing neck masses has been attempted in the current investigation. The research study computed the test's sensitivity, specificity, accuracy, negative predictive value, and positive predictive value in relation to inflammatory, cystic, benign, and malignant masses.

MATERIALS AND METHODS

- **Study Setting:** Patients with neck masses visiting the Diagnostic Radiology Outpatient Department (OPD) at Dhiraj General Hospital, Waghodiya, Vadodara, Gujarat.
- **Study Design:** A prospective study aimed at evaluating diagnostic accuracy.
- **Study Duration:** December 1^{st} 2022- November 30^{th} 2023(1 year)
- **Sample Size:** 100

Determination of the sample size involved utilizing a sensitivity (SN) of 95% from a reference study and employing the following formulas:
Sample size N = Z^2 ((SN (1-SN))/E^2)/P for sensitivity

Sample size N = Z^2 (SP (1-SP))/(1-P) for specificity
Where SN denotes sensitivity, SP denotes specificity, E represents precision (usually 5% or 0.05), and Z signifies a constant value (1.96 for a 5% confidence level). By substituting these values, the sample size N was calculated to be 73. However, to augment the study's power, it was decided to set the sample size at 100.

Inclusion Criteria:

Patients with complaints of neck masses, being referred to the routine OPD at the Diagnostic Radiology department, irrespective of age and gender, who were willing to participate and provide written consent after being briefed about the study.

Criteria:

Patients with a history of prior neck surgeries, neck masses resulting from trauma, mandibular or bony lesions, extensive neck masses originating from apical chest lesions, vascular neck masses, and those previously diagnosed with neck masses before the study period, including follow-up cases during the study.

Methodology:

All patients with neck masses underwent clinical examination following a comprehensive history-taking. Basic hematological and relevant investigations were conducted as needed, followed by neck ultrasonography (USG). USG was performed with the patient in a supine position, neck hyperextended, using 3.5 MHZ convex and 5 MHZ linear probes. Various projections, including transverse, longitudinal, multiple angled, and oblique, were utilized. Neck masses were sonographically evaluated for parameters such as size, location, echotexture, margins, presence of halo, calcification, vascularity, nodules, associated cervical lymphadenopathy, and consistency (solid, cystic, or mixed).

These patients underwent further assessment via Fine Needle Aspiration Cytology (FNAC). Using strict aseptic measures, aspiration was carried out utilizing a disposable 5/10 ml syringe with a 23G needle. Each lesion underwent a minimum of two needle passes. FNAC procedures were performed without ultrasound guidance by various cytologists. Smears obtained from FNAC were stained with Papanicolaou (PAP), May-Grünwald-Giemsa (MGG), and specific stains as necessary. Final diagnoses were based on FNAC results and, when applicable, histopathological examination of excised specimens.

Subsequently, the findings from ultrasonography (USG) were compared with the FNAC and histopathology reports (wherever available) to assess their sensitivity, specificity, and overall accuracy using statistical methods.

Following National Ethical Criteria, the Ethical Review Committee granted ethical approval for the research to be conducted. Regardless of age or gender, the study included patients who presented to the Diagnostic Radiology department with neck masses and were willing to have a neck USG, and subsequently followed up for FNAC of the masses, and any necessary surgery. Before completing the USG and FNAC procedures, patients, guardians, or family members gave their written informed consent. A predetermined process was followed for the examination, investigation, and interviews with each participant. Aseptic conditions were maintained during investigations, and patients were positioned appropriately to prevent any conflicts of interest within the community.

Patients and attending physicians were promptly informed about the outcomes of the procedures once completed.

Statistical Analysis:

A computer running the Statistical Package for Social Sciences (SPSS) software Version 16.0 (International Business Machines (IBM) Corporation, HQ Armonk, New York) was used to do the statistical analysis. The frequency and percentage of the results were displayed.

Using category tables, the sensitivity, specificity, accuracy, negative predictive value, positive predictive value, and 95% confidence intervals of these USG and FNAC results were assessed in relation to neck masses.

OBSERVATION AND RESULTS

Age Distribution

The patients ranged in age from 31 to 60 years old, with the youngest being 6 months old and the oldest being 88 years old. 43 was the average age [Figure 1].

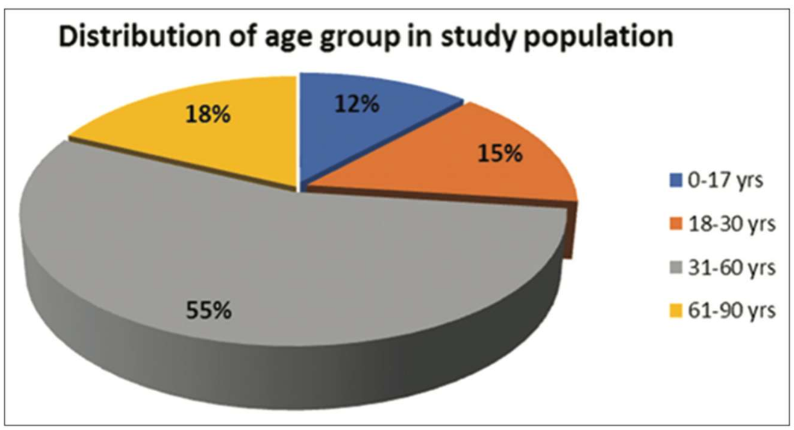


Figure 1: Distribution of age group in study population

Distribution of Sexes

Males were more frequently impacted than females in a 1.5:1 ratio. Out of the 35 instances of thyroid lesions, 12 cases (52.1%) were male and 23 cases (65.71%) were female [Figure 2].

Case distribution based on the site of lesion

The anterior midline accounted for 51% of cases of neck swelling, with the submandibular region (15%), anterolateral region (13%), posterior triangle (11%), angle of the jaw, and submental region (5%) following [Figure 3].

Table 1: Distribution of boundaries in different neck masses

Boundary	Inflammatory neck mass (n=27)	Cystic neck mass (n=20)	Benign neck mass (n=38)	Malignant neck mass (n=15)
Well-defined	19	19	25	5
Ill-defined	8	1	13	10

Table 2: Distribution of echogenicity in different neck masses

Echogenicity	Inflammatory neck mass (n=27)	Cystic neck mass (n=20)	Benign neck mass (n=38)	Malignant neck mass (n=15)
Hypoechoic	22	5	10	10
Anechoic	0	15	3	1
Hyperechoic	1	0	16	0
Isoechoic	1	0	5	1
Mixed echoic	3	0	4	3

Table 3: Distribution of consistency of different neck masses

Consistency	Inflammatory neck mass (n=27)	Cystic neck mass (n=20)	Benign neck mass (n=38)	Malignant neck mass (n=15)
Solid	0	0	10	12
Cystic	1	20	14	0
Mixed	26	0	14	3

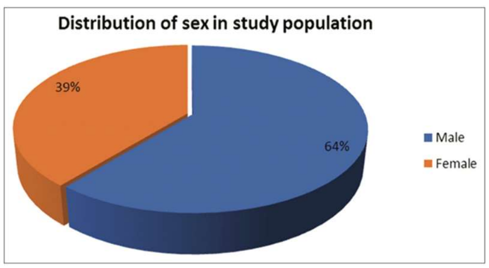


Figure 2: Distribution of sex in study population

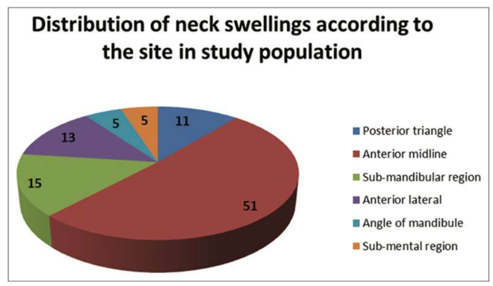


Figure 3: Distribution of neck swellings according to the site in study population

Distribution of ultrasonography characteristics:

Distribution of borders among various neck masses

Out of the fifteen cases of malignant neck masses, 5 cases (33%) and 10 cases (66.6%) had clearly defined boundaries [Table 1].

Echogenicity distribution in various neck masses

Of the 38 cases of benign neck masses that we examined, 16 (42.1%) had mixed echoic conditions, 10 (26.3%) had hypoechoic conditions, 5 (13.1%) had isoechoic conditions, 4 (10.5%) had mixed echoic conditions, and 3 (7.8%) had anechoic conditions.

Of the 15 instances of malignant neck masses, none exhibited hyperechoic echotexture; instead, 10 cases (66.66%) had hypoechoic echotexture, 3 cases (20%) had mixed echoic echostructure, and 1 case (6.66%) had both anechoic and isoechoic echotexture [Table 2].

Consistency distribution among various neck masses: Of the 27 inflammatory neck mass cases, 26 (96.2%) had mixed consistency, while 1 (3.7%) had a cystic character. Nevertheless, 20 cases (100%) of the cystic mass cases [Table 3] were indeed cystic in nature.

Distribution of calcification in various neck masses: Of 38 benign mass cases, 23 (60.5%) had no calcification, and 15 (39.5%) had calcification. Eight instances (53.3%) of the fifteen cases of malignant neck masses exhibited no calcification, while seven c cases (46.6%) had [Table 4].

Distribution of lymph node involvement in various neck masses: Of the 27 instances of inflammatory neck masses, 16 cases (59.2%) showed no involvement of any lymph nodes, while 11 cases (40.7%) showed involvement of blood vessels. None of the 20 cystic tumour cases, meanwhile, involved lymph nodes. Of the 38 cases of benign masses, 2 cases (5.2%) included lymph nodes, and 36 cases (94.7%) did not. Of the 15 instances of malignant neck masses, 8 cases (53.4%) showed no involvement of lymph nodes, while 7 cases (46.6%) showed lymph node involvement. [Table 5].

Identification of various neck masses based on the fine-needle aspiration cytology impression

Nineteen (76%) out of the twenty-five cases of inflammatory neck masses were caused by the involvement of lymph node and rest 6 (24%) had involvement of the salivary glands. Twenty cases of cystic masses, including thyroglossal cysts (45%), branchial cysts (20%), sebaceous cysts (20%), laryngocoele (10%), and cystic hygroma (5%), were included in the miscellaneous group. Out of the 38 benign mass cases, 22 cases (57.8%) had thyroid involvement, 5 cases (13.1%) had lipomas, 2 cases (5.2%) had salivary gland tumours, and 2 cases (5.2%) had neurogenic tumours, such as vagal schwannoma. Neoplastic neck mass was the classification given to five cases of follicular neoplasm. There were fifteen cases of malignant neck masses observed, of which seven cases (46.6%) involved metastatic lymph nodes, seven cases (46.6%) involved malignant thyroid enlargements, and one case (6.6%) involved malignant submandibular gland enlargements.

Four cases were classified as nondiagnostic; three of these cases had insufficient samples showing thyroid gland enlargement, and one case involved a lymph node with a hemorrhagic background and an ambiguous diagnosis.

Table 4: Distribution of calcification of different neck masses

Calcification	Inflammatory neck mass (*n*=27)	Cystic neck mass (*n*=20)	Benign neck mass (*n*=38)	Malignant neck mass (*n*=15)
Present	5	5	15	7
Not present	22	15	23	8

Table 5: Distribution of lymph node involvement in different neck masses

Lymph node involvement	Inflammatory neck mass (*n*=27)	Cystic neck mass (*n*=20)	Benign neck mass (*n*=38)	Malignant neck mass (*n*=15)
Present	11	0	2	7
Not present	16	20	36	8

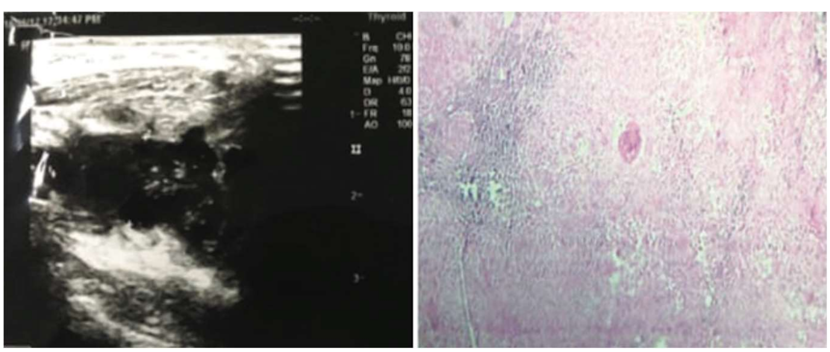


Figure 4: Tubercular lymphadenitis – a) Ultrasonography b)Histopath examination

Thyroid lesion diagnosis using the Bethesda system:

Out of 35 thyroid cases, the FNAC identified 18 cases (51.42%) as benign (Bethesda category II), which includes colloid/nodular goitre, and 6 cases (17.14%) as suspicious of malignancy (Bethesda category V). Additionally, 4 cases (11.42%) were reported as follicular neoplasm

(Bethesda category IV), 3 cases (8.57%) as nondiagnostic (Bethesda category I), 2 cases (5.71%) as malignant (Bethesda category VI), and 2 cases (5.71%) as follicular lesion of undetermined significance (FLUS) (Bethesda category III). [Table 6].

Comparing HPE, ultrasonography, and fine-needle aspiration cytology for the diagnosis of various neck masses

As demonstrated , $P \geq 0.05$ for inflammatory, cystic, benign, and malignant neck masses, the diagnostic accuracy of FNAC, USG, and HPE was equal. TABLE 7

Sensitivity, specificity, accuracy, negative predictive value, positive predictive value, and fine-needle aspiration cytology diagnosis using ultrasonography:

According to our research, the FNAC diagnosis of inflammatory neck masses had a sensitivity of 87.5% (81.02%–93.98%), a specificity of 100%, and an accuracy of 93.5% (88.67%–98.33%), while the USG diagnosis of inflammatory neck masses had a sensitivity of 75% (66.51%–83.48%), specificity of 98.55%, and test accuracy of 96.1%.

Whereas the FNAC test had 100% accuracy, 100% specificity, and 100% sensitivity for cystic neck masses, the USG test had 100% accuracy, 100% sensitivity, and 100% specificity for the same specimens.

When benign neck masses were diagnosed by USG, the test's accuracy was 96.4 percent, specificity was 96.76%, and sensitivity was 97.14%. In contrast, when benign swellings were diagnosed by FNAC, the test's accuracy was 93.5 percent (98.3%–88.7%), specificity was 100%, and sensitivity was 85.71% (81%–94%).

When it came to the USG test, the results showed that the sensitivity was 80% (72.46%–87.8%), specificity was 95.16%, and accuracy was 92.2% (86.95%–97.45%) for malignant neck masses, while the FNAC test showed 100%, 98.9%, and 98.7% for malignant swellings.

In contrast, FNAC diagnosis of malignant swellings had a 100% sensitivity, 98.9% specificity, and 98.7% accuracy. USG diagnosis of malignant neck masses had a sensitivity of 80% (72.46%–87.8%), specificity of 95.16%, and accuracy of the test was 92.2% (86.95%–97.45%).

Discussion

The age range of the participants in the current study was 6 months to 88 years old, with the majority of the cases falling between 31 and 60 years of age. Our study's sample age was 43 years old. In a related study, Amatya et al.[2] discovered that the age presentation ranged from 9 to 82 years, with a mean age of 40. Ages 31 to 40 were the most prevalent age group in their survey.

In a study of 200 patients with head and neck lesions, Rathod et al.[3] discovered that the age range of presentation was 1 to 70 years, with the age group of 21 to 30 years old being the most common.

With a male to female ratio of 1.5:1, there were 100 patients, of which 61 (or 61%) were male and 39 (or 39%). In a related study, Amatya et al.[2] examined 1229 cases and discovered a male: female ratio of 1:1.4. There were 54% men and 46% women in the Jasani et al. study [4], with a male to female ratio of 1.2:1.

Thyroid enlargement accounted for 35% of all clinical diagnoses in the current investigation, which was similar to the findings of Amatya et al.[2]

The most frequent USG results in our analysis were benign neck masses (36.46%), followed by inflammatory neck masses (27.08%), cystic masses (20.83%), and malignant masses (15.63%).

In our analysis, the frequency of head and neck illnesses is comparable to that of Sardar et al.[5]. [Table 8].

The majority of the inflammatory swellings in our investigation displayed uniform ultrasonography lesion architecture, hypoechoic echo intensity, and somewhat well-defined boundaries. The ultrasonography characteristics of the tissues were cystic or mixed, and the posterior echoes showed elevated characteristics. Our results corroborated those of Sivarajasingam et al.[6] and Baurmash[7], who reported that USG revealed a profound "underlying cystic change" and a decrease in echo intensity in abscess cases. There were mixed echoic areas in three cases of parotid abscess, isoechoic areas in one case of submandibular sialadenitis, and hyperechoic areas in the other.

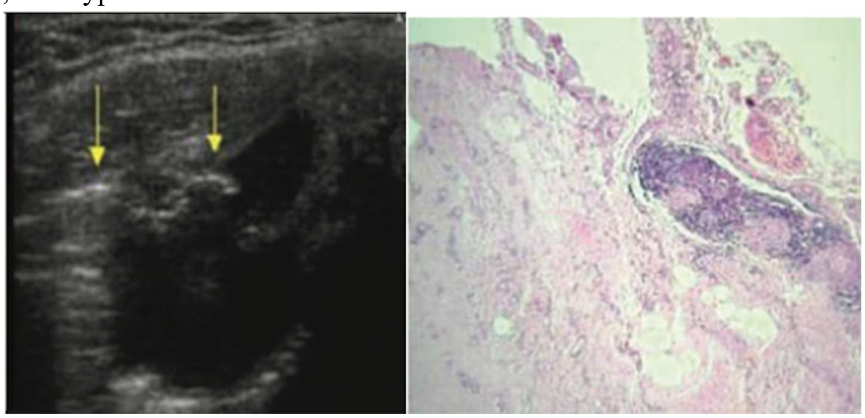
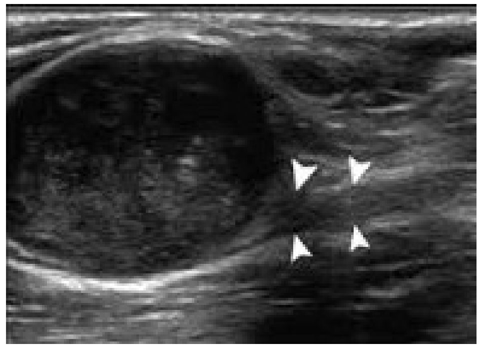


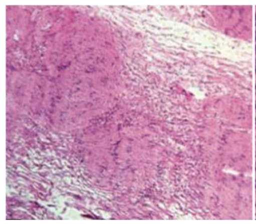
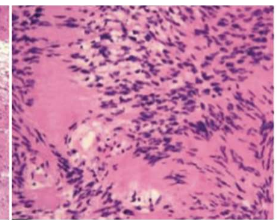
Figure 5: Laryngocoele- a) ultrasound b)histopathological specimen

In one case in this investigation, the ultrasonography revealed hyperechoic foci casting posterior acoustic shadowing and gland enlargement, together with duct dilation proximal to blockage. The patient was clinically diagnosed with submandibular lymphadenopathy. Submandibular sialadenitis with sialolithiasis was the diagnosis made.

In our investigation, the sonographic diagnosis of inflammatory swellings achieved a 96.1% test accuracy, a 98.5% specificity, and a 75% sensitivity. Our results aligned with those reported by Chandak et al. [1], who reported a sensitivity of 97.1%, specificity of 100%, and test accuracy of 98.5%.



a)

b) c)

Figure 6: Vagal Schwannoma a) iultrasonography
b)&c) Histopathological specimen

Table 7: Comparison of fine-needle aspiration cytology, ultrasonographic, and histopathological examination in the diagnosis of different neck masses

	Diagnosis by FNAC 1	Diagnostic accuracy ultrasonography 2	Diagnosis by HPE (gold standard) 3	*p*		
				1 versus 2	1 versus 3	2 versus 3
Inflammatory neck mass, *n* (%)	7 (9.09)	7 (9.09)	7 (9.09)	1.00	1.00	1.00
Cystic neck mass, *n* (%)	19 (24.68)	20 (25.98)	19 (24.68)	1.00	1.00	1.00
Benign neck mass, *n* (%)	30 (38.96)	35 (45.45)	35 (45.45)	0.51	0.51	1.00
Malignant neck mass, *n* (%)	16 (20.78)	15 (19.48)	6 (20.78)	1.00	1.00	1.00
Total, *n* (%)	77 (100.0)	77 (100.0)	77 (100.0)			

FNAC: Fine-needle aspiration cytology, HPE: Histopathological examination

Table 8: Comparison of disease-wise distribution of masses of our study with other studies with reference to ultrasonographic findings

USG impression	Sardar *et al.*[5] (*n*=73) (%)	Chandak *et al.*[1] (*n*=70) (%)	Present study (*n*=100) (%)
Inflammatory	27.4	50	27.08
Cystic	19.2	11.4	20.83
Benign	46.6	12.8	36.46
Malignant	6.8	25.7	15.63

USG: Ultrasonographic

On the ultrasonography, cysts have a homogenous echotexture and a well-defined border, giving the appearance of being anechoic. The lesion's content may produce some echoes, leading to hypoechoic structures, if the cysts become infected. Twenty cases of cystic neck tumours were examined in this investigation. Nineteen examples had homogenous interior echoes, posterior echoes that were increased, and very distinct boundaries. Sonographic diagnosis in the group of cystic swellings in our study had a 100% sensitivity, 98.28% specificity, and 98.7% test accuracy.

Our results aligned with those reported by Chandak et al. [1], who reported a 100% sensitivity, 98.3% specificity, and 98.5% test accuracy.

The two pleomorphic adenoma instances in this investigation were rounded in shape, had clearly defined boundaries, and exhibited hypoechoic echo intensity, which is indicative of diverse internal architecture. Lipoma was seen on ultrasonography as a homogeneous, solid mass with echogenicity comparable to subcutaneous fat.

As seen in Table 9, the sonographic diagnosis test in our investigation had a 97.4% accuracy rate, 100% sensitivity, and 98.3% specificity. Our results aligned with those reported by Chandak et al. [1], who reported a sensitivity of 97.14%, specificity of 97.62%, and test accuracy of 97.4%.

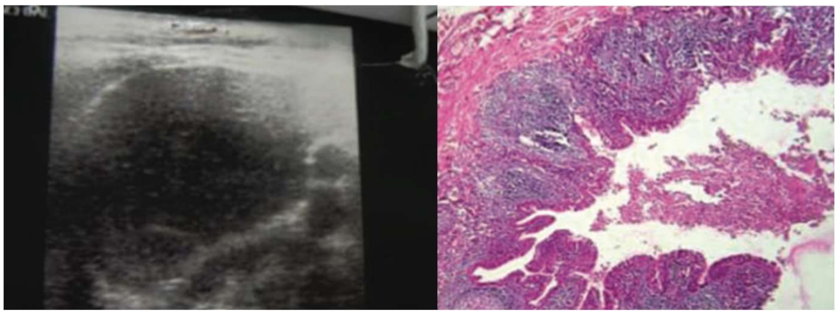


Figure 7: Branchial cyst: a) ultrasonography b) histopathological examination

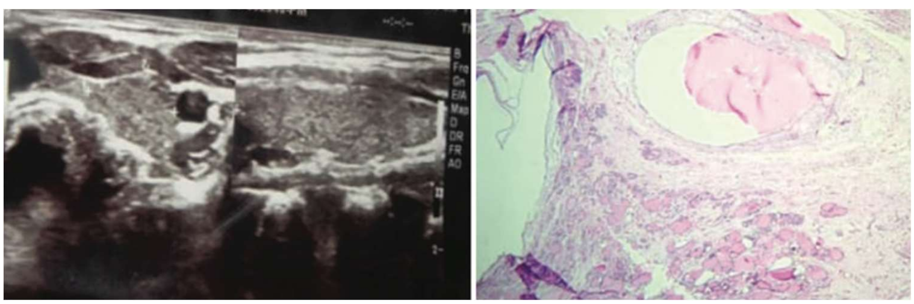


Figure 8: thyroglossal cyst: a) ultrasonography b) histopathological examination

Table 9: Comparison of ultrasonographic diagnosis of different neck masses on the basis of sensitivity, specificity, and accuracy with other studies

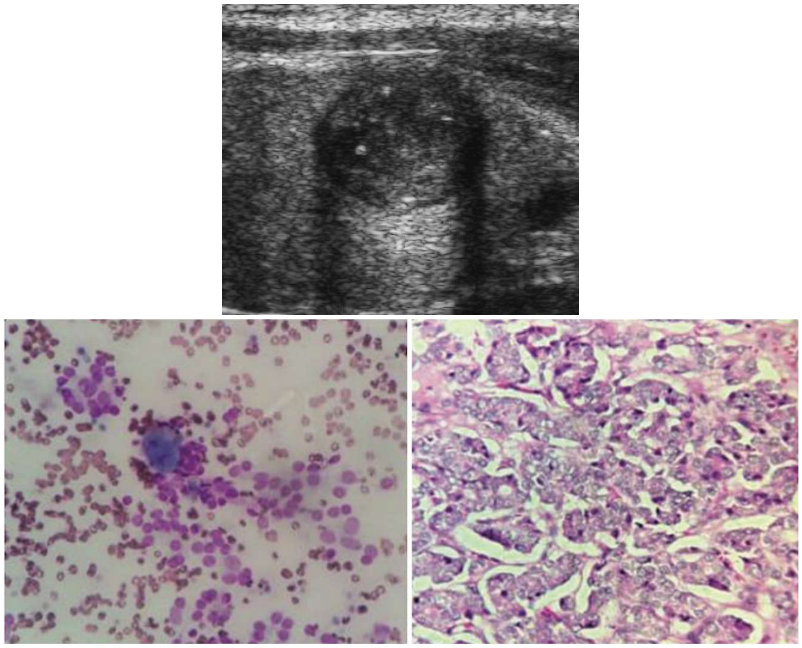
Type of lesion	Comparison	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
Inflammatory	Chandak *et al.*[1]	97.1	100	100	97.2	98.5
	Our study	75	98.55	85.71	97.14	96.1
Cystic	Chandak *et al.*[1]	100	98.3	88.8	100	98.5
	Our study	100	98.28	95	100	98.7
Benign	Chandak *et al.*[1]	100	98.3	90	100	98.5
	Our study	97.14	97.62	97.14	97.62	97.4
Malignant	Chandak *et al.*[1]	100	98	94.7	100	98.5
	Our study	80	95.16	80	95.16	92.2

PPV: Positive predictive value, NPV: Negative predictive value

Table 10: Comparison of disease-wise distribution of masses of our study with other studies with reference to fine-needle aspiration cytology finding

FNAC diagnosis	Sardar *et al.*[5] (*n*=73) (%)	HazmiMohd *et al.*[8] (*n*=47) (%)	Gogoi and Borgohain[9] (*n*=786) (%)	Present study (*n*=100) (%)
Inflammatory	24.7	46	36	26.04
Cystic	19.2	-	26	19.79
Neoplastic	17.8	-	-	5.21
Benign	26.0	4	2	32.2
Malignant	12.3	1	20	16.67

FNAC: Fine-needle aspiration cytology



a) b) c)

Figure 10:Papillary Carcinoma of Thyroid a) ultrasonography b) FNAC c)Histopathological examination

Table 11: Incidence of cystic neck lesions diagnosed by fine-needle aspiration cytology in different studies

Study	TGDC (%)	Branchial cyst (%)	Sebaceous cyst (%)	Laryngocoele (%)	Cystic hygroma (%)
Al-Khateeb and Al Zoubi[13]	53%	14%	11%	22%	Not seen
Hsieh *et al*.[14]	54%	5%	16%	Not seen	25%
Present study	45%	20%	20%	10%	5%

TGDC: Thyroglossal duct cyst

Eighty percent of the time, ultrasound can identify malignancy, but it cannot distinguish between its different types. Smaller lesions may seem as well-defined and similar to a benign tumour on ultrasounds of lower grade tumours. Larger lesions with more pronounced malignant characteristics, such as erratic and ill-defined margins and diverse interior architecture, emerged. Sonographic diagnosis in this study showed a sensitivity of 80%, specificity of 95.16%, and test accuracy of 92.2%. Our results aligned with those of Chandak et al., who reported 100% sensitivity, 98% specificity, and 98.5% test accuracy [Table 9].

In their research, Mohamed et al. [8] classified disorders into the three categories listed above solely on the basis of FNAC results. Based on FNAC results, Gogoi and Borgohain[9] classified neck masses into four groups. Our study's findings were comparable to those of Sardar et al. [5] [Table 10 and Figures 4–8].

Reactive hyperplasia accounted for 65 percent of the 19 cases of inflammatory lymphadenitis, followed by granulomatous tubercular lesions (26.3%) and nonspecific lymphadenitis in the remaining cases.

A granulomatous lesion was seen in 41% of instances after reactive hyperplasia in 59% of cases, according to findings by Lawrence et al. [10] in 2003. In a comparable study conducted in Saudi Arabia over a 5-year period including 225 patients, Hag et al.[11] found that 33% of instances of neck masses were caused by reactive/nonspecific lymphadenitis.

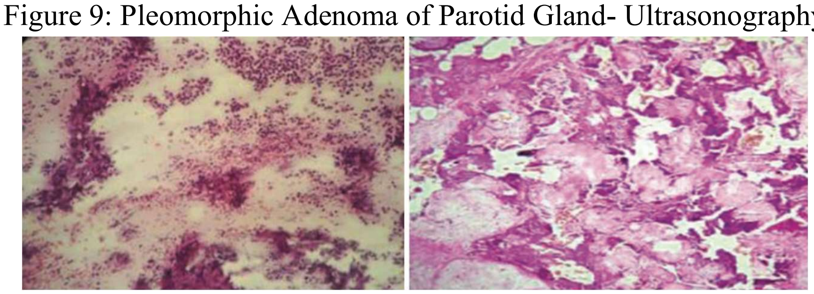
In our investigation, 10.53% of the cases exhibited tuberculous lymphadenitis [Figure 4], which was comparable to the research conducted in a Pakistani tertiary hospital by Fatima et al.[12] and had a majority of male patients (75%). Two cases of submandibular sialadenitis and three cases of parotid abscess comprised the remainder.

Thyroglossal duct cyst [Figure 8] is the most often occurring cystic lesion (20 instances), accounting for 45% of cases. Sebaceous cysts (4 cases) and branchial cysts (4 cases) each accounted for 20% of the total. There were two laryngocoele instances [Figure 5] (10%) and one cystic hygroma case (5%).

Table 11 compares the incidence of various neck lesions detected by FNAC with other studies conducted by Al-Khateeb and Al Zoubi [13] and Hsieh et al. [14].

The parotid gland was the most frequently affected gland among the salivary gland lesions. Our findings are in line with those of Cajulis et al. [16] and Cristallini et al.[15] . Pleomorphic adenoma was the most prevalent benign tumour [Figure 9]. Colloid goitre accounted for 71.54% of the 22 benign thyroid lesions, whereas follicular neoplasm made up 5.21% of the cases. One instance (1.1%) was classified as a follicular lesion of unknown significance, and five cases (5.21%) were diagnosed as follicular neoplasms. The primary drawback of FNAC in thyroid tumour instances is its inability to assess the neoplasm's type, which is determined by histology.

Figure 9: Pleomorphic Adenoma of Parotid Gland- Ultrasonography



Pleomorphic Adenoma of Parotid Gland- a) FNAC b) Histopathological Examination

Because the cytological appearances of follicular adenoma and follicular carcinoma are so similar, it might be difficult to distinguish between the two based on cytological parameters. The smears are unable to show capsular/vascular invasion, which is necessary to prove this.

All six patients underwent histopathological testing, which revealed five cases of follicular adenomas and one case of FLUS that turned out to be follicular carcinoma.

A cytological report, according to Löwhagen et al. [17], should just indicate the presence of a follicular neoplasm and not imply whether it is benign or malignant. In 1979, Friedman et al.[18] recommended histological testing in these instances in order to make a final diagnosis based on vascular and capsular invasion. Additionally, follicular neoplasms (type IV) are included in the Bethesda system (2007), where cytology does not distinguish between adenoma and carcinoma.

According to Antonello et al. (2005) and Klemi et al. (1991), there was a 57% case of multinodular goitre and a 29% case of follicular neoplasm. Tariq et al.'s 2007 study in Pakistan revealed 23.08% of follicular neoplasm and 56.9% of nodular goitre. Colloid goitre was the most frequent thyroid lesion in all of these investigations, as it was in ours, despite the fact that the percentage was noticeably higher. The higher proportion of female patients in our study could be the cause of this. However, all of the surgically treated instances of benign thyroid nodules in our investigation had histological results that agreed with FNAC data.

In our investigation, the majority of malignant neck mass patients (37.5%) with a male preponderance were found to have metastatic lymph nodes, which were classified as squamous cell carcinoma. 11.3% of cases in the Jasani et al. study[4] had a metastatic lymph node. Malignant submandibular gland lesion (HPE-inflammatory) was one of the cases in our investigation. The remaining portion of our study consisted of malignant thyroid lesions (62.5%), the most common of which were follicular type (10%), medullary type (20%), and papillary carcinoma (70% [Figure 10].

In the analysis of 100 patients on FNAC, 2 abnormal smears for malignancy were also observed, making up 5.71% of the total. The prevalence of questionable FNAC diagnoses for cancer ranges from 2% to 20% in the literature. (Kaur et al., 2002 = 20%; Wondwossen et al., 2002 = 2%). Out of these two worrisome (for malignancy) cytological diagnoses in our investigation, one was suspicious for papillary carcinoma, however in other cases, FNAC revealed a suspicious diagnostic of follicular variant of papillary carcinoma. Due to a high index of suspicion of malignancy, both cases were submitted for surgery, and a histological study identified papillary carcinoma in each case.

In our investigation, the sensitivity of FNAC for the identification of inflammatory neck masses was 87.5%, the specificity was 100%, and the test's accuracy was 93.5%. Cystic mass diagnosis with FNAC demonstrated 100% test accuracy, specificity, and sensitivity. The sensitivity of 85.71%, specificity of 100%, and test accuracy of 93.5% were observed in the FNAC diagnosis of benign swellings. Table 12 illustrates that the sensitivity, specificity, and accuracy of the FNAC test for malignant swellings were 100%, 98.9%, and 98.7%, respectively.

In a FNAC investigation, 641 cases of neck lesions were examined by Chauhan et al. [23]. Of them, 71 underwent a standard surgical biopsy, and the outcomes were histologically associated. Thirty-one thyroid lesions, twenty salivary gland lesions, four hundred lymph node lesions, and thirty-one neck cystic lesions were found among the five hundred acceptable smears. They found that for neck lesions, the total FNA sensitivity, specificity, accuracy, positive predictive value, and negative predictive value were, respectively, 93.1%, 100%, 98.4%, 90.1%, and 100%.

Inadequate samples and dubious diagnoses are further reasons why FNAC has significant limitations. Inadequate aspiration techniques and a shortage of qualified cytopathologists lead to subpar aspirates. Another factor contributing to inadequacy is the small size of the lesions.
As per the guidelines of the Papanicolaou Society of Cytopathology for fine-needle aspiration procedure and reporting, the percentage of cytology that was deemed poor in our study was 3.71% (n = 4). This figure is still below the permissible level for an unsatisfactory sample, which is 15% [Table 13]. As a result, the study's insufficient samples were similar to those of Bajaj et al. [27] and Kaur et al. [22].

Table 13: Incidence of inadequate smears as observed in other studies

Study	Godinho-Matos *et al.* (1992)[25]	Gharib and Goellner (1993)[26]	Kaur *et al.* (2002)[22]	Wondwossen *et al.* (2002)[11]	Bajaj *et al.* (2006)[27]	Present study
Inadequate smears (%)	13	17	6	0.87	5.6	3.71

One major challenge to conducting a thorough cytologic assessment of neck tumours is inadequate aspirates. When small neck masses (less than 2 cm) are accurately located, at least two distinct locations are sampled, and excessive pressure is avoided throughout the process, the outcome is more often than not a good specimen that can be used to establish a diagnosis.[18] Regarding the definition of the sufficiency of FNAC specimens, writers disagree.[28, 29]

Conclusion

It is possible to distinguish between benign, malignant, cystic, and inflammatory neck tumours using high-resolution grayscale ultrasonography.

FNAC is quite effective in differentiating between benign and malignant neck masses and is helpful for final confirmation of the diagnosis in cases when a worrisome neck mass is discovered sonographically.
Compared to USG, FNAC is more specific and sensitive in identifying inflammatory neck masses.
When it comes to diagnosing cystic masses, FNAC and USG results are nearly identical in terms of sensitivity, specificity, and accuracy.
When it comes to the diagnosis of benign masses, USG is more sensitive and accurate than FNAC, although FNAC has a higher specificity.
Compared to USG, FNAC demonstrated superior sensitivity, specificity, and accuracy in the diagnosis of malignant neck masses.
The diagnostic potential of FNAC and USG is enhanced when a cytopathologist, radiologist, and physician collaborate effectively.

Declaration of patient consent: The authors attest that they have all necessary patient permission paperwork in their possession. The patient(s) has(have) consented in writing to the publication of his/her photos and other clinical data in the journal. The patients are aware that although every attempt will be made to hide their identity and that their names and initials will not be published, anonymity cannot be ensured.

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