

Role of Ultrasonographic Evaluation of Thyroid Gland Lesions and FNAC Correlation

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Received: 25-05-2024 / Revised: 23-06-2024 / Accepted: 26-07-2024

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Conflict of interest: Nil

Abstract:

Introduction: Thyroid gland plays a critical role in regulating metabolic functions such as cardiac rate, cardiac output, lipid metabolism, skeletal growth, other metabolic activity such as heat production. Thyroid swelling is one of the common clinical problems routinely encountered in the outpatient department (OPD). Most of them are due to diffuse enlargement of thyroid gland (diffuse colloid goiter) commonly seen at puberty and lactation, predominantly in females. Clinical evaluation of the thyroid is not always sufficient. Hence, the clinician has to depend on various other diagnostic modalities such as Thyroid profile study, ultrasonography, FNAC etc. to achieve a confirm diagnosis.

Aims and Objectives: To assess the validity of ultrasonography findings of thyroid lesions by correlating with FNAC findings. To study the ultrasonographic features of various thyroid lesions in patients with thyroid disorders. Correlate the sonographic findings with FNAC in the diagnosis of thyroid lesions.

Methodology: It was prospective observational type study conducted in Jehangir hospital, Pune. Total 62 candidates were selected, who came for Ultrasonography of neck for thyroid gland swelling or who are having abnormal thyroid profile study. Ultrasonography of neck for thyroid was done after getting informed consent regarding study. Mapping of findings like anatomy, size, shape and morphology were recorded and compared later with the FNAC findings.

Results: In this study of 62 patients, female preponderance (71%) was noted. Among the study population, maximum patients were in the age group of 50 to 60 years. Out of 62 patients, most of the patients were having thyroid swelling. In most of cases physical examination can give limited information regarding thyroid lesions. Therefore, ultrasonographic examination can provide accurate characteristic of thyroid lesions. The ultrasonographic findings were correlated with FNAC findings. Strong correlation was observed between ultrasonography and FNAC results.

Conclusion: Ultrasound has a clear cut utility in evaluating thyroid lesions and can be used as an adjunct to clinical examination and should be offered to all patients presenting with thyroid nodules. It has got other added advantages of being safe, reproducible, economical and portable technique without hazards of radiation. Sonographic diagnostic accuracy of thyroid lesions was 88.7% in our series, when correlated with FNAC suggest strong agreement between ultrasonography and FNAC.

Keywords: Fine needle aspirationcytology, Ultrasonography, Carcinoma, Thyroid, Outpatient department.

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Introduction

Thyroid gland plays a critical role in regulating metabolic functions such as cardiac rate, cardiac output, lipid metabolism, skeletal growth, other metabolic activity such as heat production. Thyroid swelling is one of the common clinical problems routinely encountered in the outpatient department (OPD). Most of them are due to diffuse enlargement of thyroid gland (diffuse colloid goiter) commonly seen at puberty and lactation,

predominantly in females. In Indian subcontinent, the "Himalayan goiter belt" is most affected. Other pathological lesions such as thyroid neoplasms are also present in the form of enlarged thyroid mass or thyroid nodule. Various immunological diseases of the thyroid including hypo and hyperthyroid states may present as thyroid enlargement. Clinical evaluation of the thyroid is not always sufficient. Hence, the clinician has to depend on various other

diagnostic modalities such as Thyroid profile study, ultrasonography, FNAC etc. to achieve a confirm diagnosis. Advantages of ultrasonography over clinical examination: Ultrasonography provides a better anatomical presentation of the thyroid gland with good clarity due to the superficial location of the gland, It can reveal the nature of the mass (solid vs. cystic vs. mixed), Ultrasound can reveal the number of nodules i.e. whether the lesion is a solitary nodule or is it multiple nodules that is a part of multinodular goiter, Ultrasound is helpful in detecting calcification and the pattern of calcification, Ultrasound is useful in assessing the vascularity of the lesion/nodule, Invasion of the adjacent structures by the thyroid mass can be known by ultrasonography, Lymph node status is better evaluated with ultrasound. Advantages of ultrasound over FNAC: Ultrasound is popular due to its low price, easy availability and non-invasive nature, Ultrasound can pinpoint the location of lesion for which guided FNAC can easily planned, Blind FNAC without guidance can sometimes sample a non-representative part of the thyroid and can lead to misdiagnosis or trauma and hematoma, Invasion and involvement of the adjacent structures can be evaluated by ultrasound, In spite of all the above advantages, ultrasound cannot, in few cases, dependably differentiate between benign and malignant lesions. Hence, it has to be correlated with FNAC for achieving a much better confirms diagnosis. The overall sensitivity of FNAC for the detection of malignancy in both cystic and solid masses is high, ranging from 90-100%.

Materials and Methods

It was a cross sectional study conducted in radiodiagnosis out-patient department (OPD) and pathology department in Jehangir hospital, pune for 1 year in Patients with thyroid lesions on sonography of age group from 10-75 years. Using the formula, $4pq/d^2$, Ankush Dhanadia et al study, within India and with the lowest prevalence, used as reference, taken as the value of p, the sample size was calculated to be 62.

Sample size (n) = $4pq/d^2$, Where (p = prevalence, q = 1 – prevalence, d = precision is 15% Substituting in the formula,

$$\begin{aligned} (n) &= 4pq/d^2 \\ &= 4 \times 74 \times 26 / 11.12 \\ &= 7696 / 123.2 \\ &= 62 \end{aligned}$$

Patients with bleeding disorders, Patient refusal for FNAC and Patient having short neck torticollis excluded from study. After approval by institutional ethical committee, patients of age group between 10 to 75 years of both gender (males and females) who had thyroid disorders

which were clinically symptomatic (viz dysphagia, hoarseness of voice, weight gain, altered menstrual cycles etc.) with altered levels of thyroid hormones or clinically symptomatic but with normal thyroid hormone levels or clinically suspected cases with no specific symptoms and had thyroid lesions on ultrasonography were enrolled in the study with a written informed consent. Convenient sampling technique is used to select 62 patients with thyroid lesions which were referred to the Department of Radio diagnosis, Jehangir hospital, pune. All scans are done using Philips iU-22 and GE Volusion E8 with a linear array high frequency (3-12 MHz) transducer. Patients who were fulfilling the inclusion criteria of age group, thyroid disorders underwent sonographic evaluation. Data were analyzed using the SPSS software for Windows (version 26.0, IBM Corporation, USA), JASP (version 0.12.2, University of Copenhagen). Normality of the variables was tested using skewness, kurtosis, one sample Kolmogorov-Smirnov test and Shapiro-Wilk test before performing statistical analysis. A chi-square test was used to explore relationship between categorical variables. Cohen's κ was used to test inter-test reliability (measuring agreement)

Results

Major affected age group is between 50-60 years. Based on the data we can say that 44 females patients and 18 were male patients. Thyroid gland lesions affect more females than males. Out of total of 62 cases, 83.9 % patients are having painless neck swelling and 16.1% have painful neck swelling. 87.1 % patients are having diffuse thyroid involvement and 12.9% have only right lobe involvement. Out of 100 %, 87% thyroid lesions are multiple and 12.9 % solitary lesion. Out of 100 %, 58% lesions are solid, 37% lesions are mixed and 4.8% lesions are cystic in nature. Out of 100 %, 56.5% lesions are homogenous, and 43.5 % lesions are heterogeneous. Out of 100 %, 72.6% lesions are negative for calcification and 27.4% lesions are positive for calcifications. Out of 100 %, 43.5 % lesions are isoechoic, 30.6% lesions are mixed echoic, 16.1% are hypoechoic, 6.5% are hyperechoic and 3.2% are anechoic. Out of 100%, 66% lesions are negative for vascularity and 34% were positive with vascularity. Out of 100%, 80.6% lesions are negative for adjacent tissue invasion and 19% lesions were positive for adjacent tissue invasion. 100% lesions are negative for cervical enlarged lymph nodes. Table 1 shows the distribution of thyroid lesions based on its sonographic appearance. Out of 100%, 30.6% lesions were colloid goiter with cystic degeneration, 30.6% lesions were hashimoto's thyroiditis, 21% were colloid goiter, 14.5% were multinodular goitre, 1.5% was hemorrhagic cyst and papillary carcinoma. Table 2 shows the

distribution of thyroid lesions based on its FNAC results. Out of 100%, 29% lesions were colloid goiter with cystic degeneration, 25.8% lesions were hashimoto's thyroiditis, 21% were colloid goiter, 16% were multinodular goiter, 3.2% were haemorrhagic cyst, 3.2% were papillary carcinoma and 1.6% was suspicious for malignancy. Table 3. Shows of ultrasonography in comparison with FNAC in diagnosing and characterizing thyroid lesions- Out of 19 cases of colloid goiter with cystic degeneration, 18 cases were diagnosed correctly and one case diagnose as hemorrhagic cyst by FNAC. Out of 13 cases of colloid goiter, all cases (100%) were correctly diagnosed. Out of 9 cases of multinodular goiter, 7 cases were correctly diagnosed. One case diagnosed as hashimoto's thyroiditis and other diagnosed as papillary carcinoma by FNAC. There was 1 case of

hemorrhagic cyst diagnosed on ultrasound found correctly correlating by FNAC.

Out of the 1 cases of malignant etiology of thyroid (papillary) suggested on ultrasound one case was correctly diagnosed as papillary carcinoma of thyroid by FNAC. Out of 19 cases of Hashimoto's thyroiditis (diffuse thyroid disease), 15 cases were correctly diagnosed as hashimoto's thyroiditis, one found to be suspicious for malignancy and other 3 found to be multinodular goiter by FNAC.

Cohen's κ was run to determine if there was agreement between USG Diagnosis and FNAC Diagnosis on 62 individuals. There was strong agreement between USG Diagnosis and FNAC Diagnosis, $\kappa = 0.852$ (95% CI, 0.75-0.954), $p < 0.05$.

Table 1: Case Wise Distribution of Cases Based on USG

USG Diagnosis	Female	Male	Total
	Frequency (%)	Frequency (%)	Frequency (%)
Colloid goiter	08 (18.2 %)	05 (27.8 %)	13 (21 %)
Colloid goitre with cystic degeneration	13 (29.5 %)	06 (33.3 %)	19 (30.6 %)
Hashimoto's thyroiditis	15 (34.1 %)	04 (22.2 %)	19 (30.6 %)
Hemorrhagic cyst	01 (2.3 %)	0	01 (1.6 %)
Multinodular goiter	06 (13.6 %)	03 (16.7 %)	09 (14.5 %)
Papillary carcinoma	01 (2.3 %)	0	01 (1.6 %)
Suspicious formalignancy	0	0	0
Total	44 (100%)	18 (100 %)	62 (100 %)

Table 2: Case Wise Distribution of Cases Based on FNAC

FNAC Diagnosis	Female	Male	Total
	Frequency (%)	Frequency (%)	Frequency (%)
Colloid goiter	08 (18.2 %)	05 (27.8 %)	13 (21 %)
Colloid goitre with cystic degeneration	12 (27.3 %)	06 (33.3 %)	18 (29 %)
Hashimoto's thyroiditis	12 (27.3 %)	04 (22.2 %)	16 (25.8 %)
Hemorrhagic cyst	02 (4.5 %)	0	02 (3.2 %)
Multinodular goiter	07 (15.9 %)	03 (16.7 %)	10 (16.1 %)
Papillary carcinoma	02 (4.5 %)	0	02 (3.2 %)
Suspicious formalignancy	01 (2.3 %)	0	01 (1.6 %)
Total	44 (100%)	18 (100%)	62 (100%)

Table 3: Comparison Study between USG and FNAC For Thyroid Lesions

USG Diagnosis	FNAC Diagnosis							Total
	Colloid goitre	Colloid goitre with cystic degeneration	Hashimoto's thyroiditis	Hemorrhagic cyst	Multinodular goitre	Papillary carcinoma	Suspicious for malignancy	
Colloid goitre	13	0	0	0	0	0	0	13
Colloid goitre with cystic degeneration	0	18	0	1	0	0	0	19
Hashimoto's thyroiditis	0	0	15	0	3	0	1	19
Hemorrhagic cyst	0	0	0	1	0	0	0	1
Multinodular goitre	0	0	1	0	7	1	0	9
Papillary carcinoma	0	0	0	0	0	1	0	1
Suspicious for malignancy	0	0	0	0	0	0	0	0

Total	13	18	16	2	10	2	1	62
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Table 4: Cohen's kappa - Percent agreement: 85.2% (Based on statistical method)

Symmetric Measures						
		Value	Asymptotic Standard Error a	Approximate Tb	Approximate Significance	95% CI, p < 0.05
Measure of Agreement	Kappa	0.852	0.052	12.462	0	0.75-0.954
N of Valid Cases		62				

Discussion

The study comprised of 62 patients between age group 21 to 80 years. Majority of the cases affected were in the age group of 50 to 60 years. Watters DA et al [5] reported their experience with 120 patients whose age group were between 13 to 84 years. Majority of the cases affected were in the age group of 30-40 years. Among the 62 patients in our study group, females constituted 71% and males 29%. Solbiati et al [2] reported their experience with 401 cases in which 71.3% were females and 28.7% were males. Differentiation of a mass lesion into cystic, solid or mixed is probably the most important application of US evaluation of thyroid. Our yield was 100% in this respect. Out of 62 patients, we categorized 3 cases as cystic, 36 as solid and 23 cases as mixed lesions which were later proved to be correct by FNAC. The solid lesions were more in our study group than the cystic or mixed lesions. In a study by Rosen IB et al [8], out of 174 cases, an accuracy rate of 96% was observed. Our accuracy of 100% may be because of lesser number of cases. We encountered 2 types of cystic lesions namely colloid goiter with cystic degeneration and the hemorrhagic cyst. Out of these, majority of the cases were constituted by colloid goiter with cystic degeneration. There were 18 cases presenting with colloid goiter with cystic degeneration and 1 case as hemorrhagic cyst. All these cases were proved by FNAC. Hence, the accuracy in diagnosing the type of cystic lesions was 98.3%. Solbiati L et al [2] found 26(6%) cystic lesions out of 401 cases. None of these were malignant lesions. They concluded that most cystic lesions are hyperplastic nodules that have undergone extensive liquefactive degeneration with accumulation of blood, serous fluid or colloid substance. In the course of this cystic degenerative process, calcification may develop. Our findings are consistent with their findings.

We encountered 36 (58.1%) solid lesions in our study. Among the solid lesions, 19 cases (36.6%) were Sonographically diagnosed as Hashimoto's thyroiditis, 13 cases (21%) as colloid goiters, 9 cases (14.5%) as multinodular goiter and 1 case (1.6%) as papillary carcinoma. One case of papillary carcinoma was correctly diagnosed. In the case of solid lesions, our accuracy is high. Rosen IB et al [8] reported 100% accuracy rate for solid

lesions. They studied 174 cases out of which 130 (75%) were solid both by sonography as well as FNAC. Out of these 130 cases 26 (20%) were carcinomas, 68 (52%) were adenomas, 2 (1.5%) were cyst adenoma, 16 (12.5%) were colloid nodule, 7 (5.3%) were thyroiditis and 11 (8.5%) were diagnosed as goiter. Cox MR et al [4] have performed ultrasonographic examination of 68 cases of thyroid nodules and they found 18 (26.5%) of them as solid nodules, 3 (17%) of the 18 cases were found to have a malignant thyroid nodules. Consorti F et al [7] studied 196 patients out of which 33 cases were found to be malignant, 9 cases as follicular adenomas and 154 cases as colloid goiters. We encountered 23 cases of mixed (both solid and cystic) lesions in our study group. 19 cases were diagnosed by USG as colloid goiter with cystic degeneration, 4 cases of multinodular goiter. Total 10 cases of multinodular goiter are noted of which most of them shows solid component and 4 cases showed mixed echo texture on USG. Rosen IB et al [8] in a study of 174 patients, found 14 cases of mixed echotexture nodules by ultrasound evaluation. All of them were found to be correct by FNAC. 4 cases of mixed lesions were falsely diagnosed as cystic and solid lesions by ultrasound which proved to be of mixed echotexture by FNAC. In a separate study of 139 cases, they found 8 cases of mixed echotexture lesions. Out of these 8 cases, 75% were benign nodules and 25% were proved to be malignant. Calcification within the lesion is very important for characterizing a lesion. In our study we found 3 types of lesions in which calcification was present. Out of total 17 cases of calcifications 7 cases were colloid goiters, 5 cases were hashimoto's thyroiditis, 1 case of papillary carcinoma, 1 case of multinodular goiter, 3 cases were colloid goiter with cystic degeneration. Calcification in benign thyroid lesions was (16 out of 62) and in malignant lesion was (1 out of 1). Solbiati L et al [2] in their study on thyroid gland with low uptake lesions described that calcification may be present in both benign and malignant nodules. In their study calcification in benign thyroid lesions was 11% and in malignant lesions it was 17%. Peripheral or eggshell like calcification is perhaps the most reliable feature of a benign nodule but occurs in only a small percentage of benign nodules. When these calcifications are large and coarse, the lesion is most likely to be benign.

Fine and punctate micro calcification is mostly seen in malignant lesions. But we were not able to determine the exact nature of calcification in all lesions; also however not much variation was present among the lesions. Presence and nature of hypo echoic halo is one of the important features that help in differentiating benign from malignant lesion. In our study, 10 cases (6.2%) presented with hypo echoic halo, all of which were benign.

Out of these, colloid goiter constituted the maximum 8 cases followed by multinodular goiter 2 cases. Propper RA et al [1] conducted a study on 28 patients with solitary thyroid masses out of which 10 patients had hypoechoic halo. [8] Of these lesions were benign being either adenomas or benign nodules. Two lesions were malignant. Micro nodulation is highly diagnostic of Hashimoto's thyroiditis and was confirmed by Yeh HC et al [6] in which the positive predictive value for diagnosing Hashimoto's thyroiditis basing on this characteristic finding was 94.7%.

Micronodules are 0.1 to 0.65cm in size, hypoechoic and surrounded by an echogenic rim. In our study 15 cases out of 19 were diagnosed to be Hashimoto's thyroiditis with confirmed ultrasonographic and FNAC correlation. Most of the cystic lesions are benign in nature (in our study among 3 pure cystic lesions all cases proved to be benign). In our study 95.2% of solid lesions were benign and rest 4.8% was malignant. Among mixed lesions 100% were benign. Total benign lesions constitute 95.2%. (59 out of 62) and malignant lesions constitute 4.8% (3 out of 62). Our study includes 62 patients presenting with various thyroid masses which were evaluated with ultrasound and the findings were subsequently correlated with FNAC.

Almost all the cases of Hashimoto's thyroiditis presented with micro nodulations which are highly diagnostic of the disease. Rosen IB et al [8] found 96% accuracy rate with 7 errors made in the ultrasonographic assessment of physical character of the thyroid lesion. Jones AJ et al [3] found 75% sensitivity rate with 61% specificity and 19% positive predictive value in study of comparison of Fine Needle Aspiration Cytology (FNAC); radioisotope scanning and ultrasound in the management of thyroid nodule. Watters DA et al [5] found sensitivity rate of 74%, specificity 85% and positive predictive value of 51% in the study of role of ultrasound in the management of thyroid nodules.

Our diagnostic yield was in between them. We have not come across any case of thyrotoxicosis, follicular carcinoma, medullary carcinoma, lymphoma, simple thyroid cyst or thyroid abscess.

Conclusion

Ultrasound is a cost-effective, non-invasive, easily available, accessible and valuable diagnostic modality with high correlation score to FNAC in diagnosing thyroid lesions. Ultrasound & FNAC are complimentary to each other in diagnosing thyroid lesions and pathologies. Ultrasound can demonstrate the number of nodules, whether solitary or multiple nodules in a goiter with their nature (solid, cystic and mixed). Ultrasound can demonstrate various secondary degenerative changes in thyroid lesions namely, cystic changes, calcifications, hemorrhages and necrosis etc. Ultrasound is helpful in differentiating benign from malignant lesions in most of the cases.

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