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Original article

A study of difference between benign and malignant nodules of the thyroid gland using by ultrasonography with needle aspiration and its correlation

Govinda Raju B T[1*], Shafiyah[2], Natarajan Muninathan[3]

[1]Assistant professor, Department of Radiology, Meenakshi Medical College Hospital and Research Institute, Kanchipuram, Meenakshi Academy of Higher Education and Research, Kanchipuram-631552, Tamil Nadu, India.
[2]Department of Periodontics, Sree Balagi Dental College and Hospital, Bharath Institute of Higher Education and Research. Chennai, Tamil Nadu, India.
3Scientist, Central Research Laboratory, Meenakshi Medical College Hospital and Research Institute, Kanchipuram, Meenakshi Academy of Higher Education and Research, Kanchipuram-631552, Tamil Nadu, India.
**Corresponding Author: Dr. Govinda Raju B T.*

Abstract:
The aim of the study is to differentiate benign and malignant thyroid nodules using ultrasound and to correlate with FNAC/ Histopathology report. Nodular thyroid disease is relatively common; thyroid cancer is rare and accounts for less than 1% of all malignant neoplasms. The challenge is to distinguish the few clinically significant malignant nodules from the many benign ones. This is a Prospective study. 75 patients with clinical evidence of thyroid nodule diagnosed on the basis of thorough history, clinical examination and altered biochemical parameters being sent for ultrasound evaluation followed by guided FNAC / biopsy will be included in the study. Initially, after obtaining consent from the patient, the thyroid is evaluated by using high frequency ultrasound. The pattern, texture, vascularity, margins, calcifications and halo of the thyroid nodules is to be assessed. Subsequently FNAC excisional biopsy is to be done and specimen is sent for histopathology. Finally correlation of ultrasound and histopathology findings would be done. In our series, we observed that with high frequency ultrasound the sensitivity and specificity of thyroid malignancy were 72% and 100% respectively. The sensitivity of Ultrasound for 72 papillary carcinoma and follicular carcinoma was 62 % and 33% respectively. In the present study we conclude that the High frequency ultrasound is a useful technique in the evaluation of malignant thyroid nodules. High frequency ultrasound not only detects the presence, site, number and size of the thyroid nodule, it also clearly reveals the characteristics of the nodule, which could alter patient management.
Key Words: *Ultrasound, Thyroid gland, Histopathology report.*

Introduction

Thyroid gland plays a critical role in regulating metabolic functions such as cardiac rate and output, lipid catabolism, skeletal growth and heat production. Thyroid swelling is one of the common clinical problems routinely encountered in the outpatient department. Most of them are due to diffuse enlargement of thyroid gland (diffuse colloid goiter) commonly seen at puberty, lactation etc. In Indian subcontinent the "Himalayan goiter belt" is severely affected [1]. Other pathological lesions such as thyroid neoplasms also present in the form of enlarged thyroid mass or thyroid nodule. Various immunological diseases of the thyroid including euthyroid, hypothyroid and hyperthyroid states may present as thyroid enlargement [2]. Clinical evaluation of the thyroid is not always conclusive. Hence, the clinician has to depend on various other diagnostic modalities such as biochemistry, ultrasonography, FNAC and other modalities etc. to achieve a definitive diagnosis. Ultrasonography provides a better anatomical and structural detailed representation of the thyroid gland with remarkable resolution due to the superficial location of the gland. Ultrasound reveals the nature of the mass (cystic vs. solid) and the number of nodules that is whether the lesion is solitary or multiple. It helps to detecting intranodular calcification and its pattern. Lymph node status is better evaluated with ultrasound [3]. In spite of all the above advantages, ultrasound cannot, in few cases, reliably distinguish between benign and malignant masses. Hence it needs to be correlated with FNAC for achieving a definitive diagnosis. The overall sensitivity of FNAC for the detection of malignancy in both cystic and solid masses

is high, ranging from 90-100%. In the present study was investigated to differentiate the benign and malignant nodules of the thyroid gland using ultrasonography with needle aspiration and its correlation.

Materials and Methods

A study was conducted in Department of Radiodiagnosis, Meenakshi Medical College & Hospital, Kanchipuram, during period of Sep 2023 to Sep 2024. This study was approved by institutional ethical committee and all the included patients consent were collected. Ultrasound scan is performed with GE Logic pro P6, GE Voluson S6 and with GE Logic P5 ultrasound machine using a linear probe of 7-10 MHz frequency. The Study included 75 patients who presented with a swelling in front of the neck (near the region of thyroid). Longitudinal and transverse scans of the thyroid gland were done with the patient in supine position and head in hyperextension. The entire gland including the isthmus was examined. The examination has also been extended laterally to include the region of the carotid artery and the jugular vein in order to identify enlarged jugular chain lymph nodes, superiorly to visualize submandibular adenopathy and inferiorly to define any supraclavicular lymphadenopathy. FNAC was done and the smears were read by the pathologist after conducting appropriate staining techniques whenever necessary. All the patients were selected based on the inclusion and exclusion criteria. The patients were included both sexes and asymptomatic/ symptomatic patients with thyroid nodules. Results of the examination were interpreted on the basis of these findings and diagnosis was proposed after considering history and physical examination. The results were given as whether the lesion is benign or malignant and has solid, cystic or mixed characteristics.

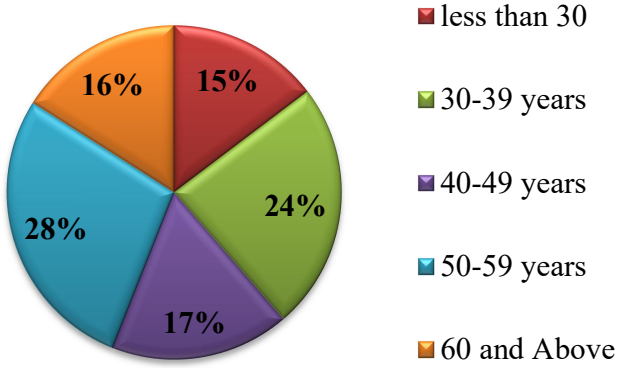
Results

The present study includes 75 patients referred to our department for Ultrasonographic examination of various thyroid swellings.

Age wise Distribution of Patients

Figure 1 show that the age wise distribution of patients with thyroid nodules. Major affected age group is between 50-59 years.

Fig.1. Age wise distribution of Patients



Sex wise Distribution of Patients

Table 1. Shows the male and female ratio of the patients referred to us for sonographic examination. In our study, the male to female ratio of 1 to 6.5, indicates that the incidence of thyroid lesions is significantly higher in female patients.

Sex	Frequency	Percentage
Female	62	82.7
Male	13	17.3
Total	75	100

Incidence of Benign and Malignant Lesions in 75 patients with Thyroid nodule

Table 2 shows indicate the incidence of Benign and Malignant lesions in patients with thyroid nodules. Out of 75 patients, 54 patients had been diagnosed to have benign and 21 had malignant lesion.

Total Number of Cases	Benign	Malignant	FNAC not done	Inadequate materials
75	54	21	-	-

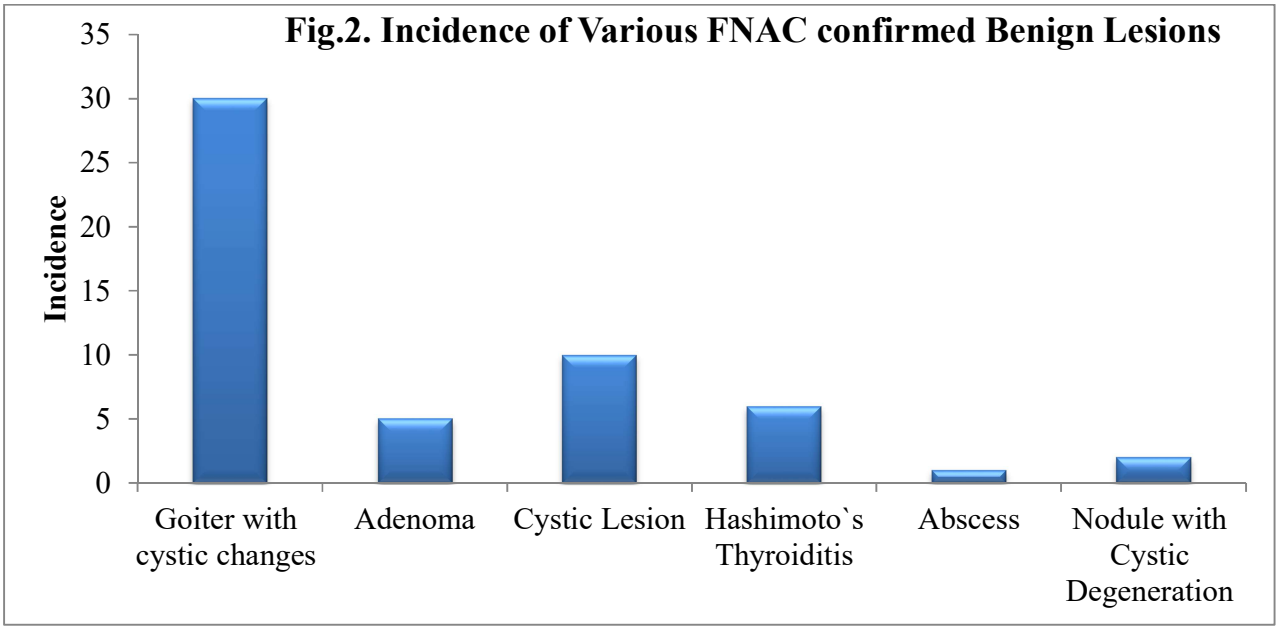
Clinical features of 75 patients presented with Thyroid Nodule

Table 3 represents that the incidence of clinical features of patients presented with thyroid nodule. Most common presentation was swelling in the neck (100%), followed by Dysphagia (9.3%), Pain and Hoarseness of voice was seen in 8% of the study.

Clinical Features	Numbers	Percentage
Swelling in the neck	75	100
Pain	6	8
Dysphagia	7	9.3
Hoarseness of voice	6	8
Weight loss	2	2.7
Menstrual irregularities	2	2.7
Palpitation	1	1.3
Dyspnea	1	1.3

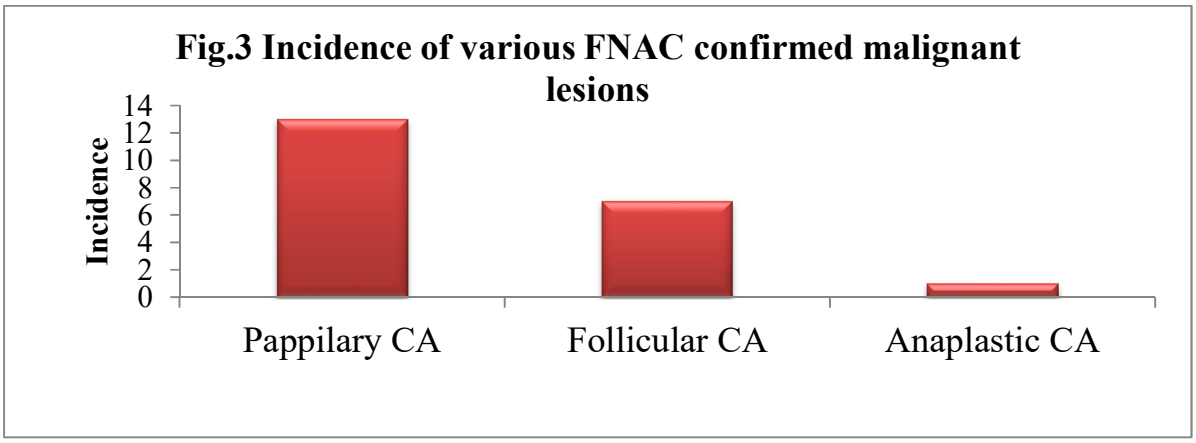
Incidence of various FNAC confirmed benign lesions

Figure 2 mentioned that the incidence of various FNAC confirmed benign lesions. Out of which highest incidence was Goiter with cystic changes (56%), followed by Cystic lesion (18%), Hashimoto's Thyroiditis (11%), Adenoma (9%), Nodule with cystic degeneration (4%), and Abscess seen in 2% of the study.



Incidence of various FNAC confirmed malignant lesions

Figure 3 indicated the incidence of various FNAC confirmed malignant lesions. Highest incidence was papillary carcinoma (62%), followed by Follicular carcinoma in 7% and Anaplastic carcinoma seen in 5% of the study.



Correlation of Ultrasonography diagnosis of various Benign and Malignant lesions with FNAC

Table 4 represents that the correlation of Ultrasonography diagnosis of various Benign and Malignant lesions with FNAC in 75 patients.

Diagnosis	**USG**		**FNAC**	
	Numbers	Percentage	Numbers	Percentage
Benign Nodules	62	81.3	54	72
Malignant Nodules	13	18.7	21	28

Discussion

Most of our cases diagnosed to have thyroid nodules were females (sex ration 4:1) and the commonly affected age group were between the 5th to 6th decades of life. Nodules, which occur in men and elderly people, are more likely to be cancerous. Belfiore et al [4] observed that the odds of cancer in men were quadrupled by the age of 64, reaching a frequency of more than 50% by 70 years. In our series five men with FNAC confirmed malignancy were over the age of 50 years.

The most common presentation of thyroid nodule was a painless mass within the gland, which can be benign or malignant. In our series, 75 cases had the history of painless swelling in the neck, 3 patients presented with a history of a painful thyroid swelling, were each diagnosed to have papillary carcinoma, follicular carcinoma and abscess respectively. The patients who presented with particular symptom of hoarseness of voice were seen in 6 patients and all of them were diagnosed to have malignancy. The chance of malignancy has been increased with history of radiation exposure and the chance of malignancy in solitary nodule increase upto 30-50% [5]. In our series no patients reported with radiation exposure history.

Clinical examinations were conducted and 75 patients diagnosed to have thyroid nodules and they were referred for ultrasound examination, in that 21 were found to have multiple nodules, which were not clinically palpable. Thus this shows that 28 % of clinically diagnosed nodules were in fact multinodular and the occurrence is marginally higher in females (71%) than in males (29%).

As per Spencer et al (1977) [6], stated that 92% of multinodular lesions, which were clinically labeled as solitary nodules, can be correctly diagnosed by using ultrasound. This gains its importance as the chance of malignancy in multinodular goiter significantly reduces to 1-6%.

It observed that 64% of patients with thyroid cancer showed at least one nodule, detected sonographically, in addition to the palpable dominant nodule. In our study out of 21 malignancies only 2 co-existed with multiple nodules, one was diagnosed as papillary carcinoma and the other as follicular carcinoma [7].

75 patients who were diagnosed to have thyroid nodule clinically, were subjected to US examination, all underwent fine needle aspiration. Ellen Marqusee et al in 1997, made a study and observed that 25 out of the 50 patients referred as solitary nodules had only small nodules (<1 cm), in spite of the results in physical examination, aspiration has not been done [8].

Even physicians may obtain insufficient aspirate as one in 5 patients. Insufficiency of FNAC is due to many factors, which includes recent operator experience, nodule vascularity, criteria used to judge adequacy, prevalence of cystic lesions in the population under study, small posteriorly located lesions in the study population were obese patients [9].

Totally 75 patients underwent ultrasound examinations and FNAC. Of these 75 patients, 32 patients had colloid nodules, which were detected by US and confirmed by FNAC. Mostly seen in female patients and this constituted 60% of all lesions. Out of 75 patients, 21(28%) were diagnosed to have neoplasms. These included 13 of them were diagnosed as papillary carcinomas (62%), 7 of them as follicular carcinomas (33%) and 1 anaplastic carcinoma (5%). It is noted that all seven cases of follicular carcinoma and the solitary case of anaplastic carcinoma has occurred only in female patients. The occurrence of papillary carcinoma was almost evenly distributed between male and female patients.

All 54 of our cases were confirmed as benign thyroid nodules i.e., 32 colloid nodules, 10 cystic lesions of thyroid, 6 thyroiditis, 5 adenomas and an abscess had well defined margins. Out of 21 cases that were proven to be malignant thyroid nodules, 3 cases of papillary carcinoma and 2 cases of follicular carcinoma showed well-defined margins and the rest of the nodules showed ill-defined margins. This stated that all benign nodules invariably have well defined margins and the majority of malignant nodules have ill defined margins. But study, stated that for any given nodule, the appearance of margins cannot be completely relied upon to confirm benignancy, because there are some exceptions. This is true in our series of cases also, out of the 21 malignant nodules, 5 nodules had well defined margins [10].

A complete thin halo was seen with seven colloid nodules, and with a papillary carcinoma and a follicular carcinoma. Thick irregular halo, which suggests malignancy, was not seen in our series of cases. There were 65 lesions without halo, out of which 46 were benign (70.8%) and 19 were malignant (29.2%). In our series of cases, it was found that the presence of complete regular thin halo favored us in diagnosing a benign lesion, when compared to a lesion without halo. As the halo sign is seen in two cases of malignant nodules, so the sign is not completely reliable in the diagnostic point. However, if the 'Halo sign' is present in a lesion with additional features of benignancy, there are more chances of that nodule being benign.

Out of the 75 solitary nodules 27 were hyperechoic. These 27-hyperechoic nodules included 24 nodules with minimal cystic changes within them, which were diagnosed as colloid goiter/goiter with cystic changes, and 3 were papillary carcinomas. Thus it was found that 88.9% of the hyperechoic nodules were benign and the rest 11.1 % were malignant. In addition to this 10 cystic lesions were found, and out of these six had internal septae. All of these 10 cystic lesions were diagnosed to be benign. The total number of isoechoic nodules was 13. Of these 8 were colloid nodules, 3 were papillary carcinoma and 2 were follicular carcinomas. This shows that 61.5% of the isoechoic nodules being benign and rest 38.5 % was malignant. Of the 24-hypoechoic nodules, 11 nodules were diagnosed to be benign (45.8%) and 13 were malignant (54.2%).

96% of hyperechoic lesions were benign. 74% of iso-echoic nodules are benign, and only 37% of hypoechoic nodules were benign. This probability of occurrence in descending order coincides well with our study [11].

A young female patient reported with a tense, tender nodule in front of neck. Ultrasound examination has been done and it revealed a nodule with mixed echogenicity & internal contents, which was interpreted by us as a colloid goiter. FNAC was done following this and proved this lesion to be abscess instead. Ultrasound may be useful in the follow up of patients with thyroid abscess [11]. Stated that 70% of solitary nodules are solid and the rest have cystic changes in it. The incidence of malignancy is low (8%) in nodules in which cystic changes has been demonstrated. Pure cystic lesions in thyroid are benign invariably. 5% of papillary and 4% of follicular carcinomas had cystic degeneration [10].

In our series, only 46% of the nodules had cystic degeneration. Of the solid lesions, 62 % were papillary carcinomas, 33 % were follicular carcinomas and 5% anaplastic carcinoma. The rest were benign lesions, namely adenomas and thyroiditis. Locations and patterns of calcification are more important and have more predictive value in differentiating benign and malignant lesions. The most reliable feature of benign nodule is peripheral or egg shell calcification, but in small percentage [12]. Microcalcifications are seen in malignant nodules while scattered coarse calcification is a feature of benign nodule.

In our series of cases, six cases with microcalcifications were confirmed to be malignant that includes five were papillary carcinomas and one follicular carcinoma. Out of the seven lesions showing coarse calcifications, five were colloid nodules with cystic degeneration, and the other two were papillary and follicular carcinoma. It was found that 38.5 % of papillary carcinomas had microcalcifications.

We observed that, presence of microcalcification correlates well with malignant lesion and presence of coarse calcification is predominantly seen in benign lesions.

In our series, there were 21 FNAC proven malignant cases, neck nodes were detected on palpation in two cases, one of them being a papillary carcinoma and other is a follicular carcinoma. When these cases were subjected to ultrasound, the cases in which the nodes were palpable were confirmed by ultrasound. A single patient who presented with an abscess was also suspected to have lymphadenopathy. In this case, when US examination was done, two enlarged cervical nodes were detected. All the palpable nodes were detected and not missed by ultrasound. The role of color flow imaging in the evaluation of thyroid lesions has significantly increased over the past two decades [11]. And observed that in US, 75% of cancers showed intra nodule blood flow pattern. The independent risk factor for malignancy includes irregular margins, intranodular vascular spots, and micro calcifications [13].

In our series, out of 54 benign lesions 42 lesions were confirmed by FNAC and showed peripheral blood flow pattern. Out of the 21 malignant nodules, 14 lesions displayed internal flow pattern and 3 lesions displayed peripheral flow pattern.

Thus peripheral flow pattern was seen 85.1 % of benign nodules and internal flow pattern was seen in 66.6 % of malignant nodules. Six cases which were diagnosed as benign nodular goiter on US examination was found to be Hashimoto Thyroiditis in FNAC. 71 Nodules appeared hypoechoic with complete absence of flow signals. This may be due to early presentation of these nodules as focal nodular thyroiditis [12].

On correlation of US diagnosis with FNAC report, out of 75 patients, 54 patients were diagnosed as benign lesion based on ultrasound characteristics and theses cases correlated well with FNAC report (Accuracy rate of 92%). In our series, very good accuracy rate (100%) was seen in nodules with cystic degeneration and cystic lesions. Out of the16 cases diagnosed as benign nodular goiter on US, seven cases turned out to be malignant, of that one being follicular carcinomas and six cases being papillary carcinomas. For benign lesions diagnostic accuracy of USG is 81.3%.

Okamato et al (1994) documented that sensitivity of 78% and specificity of 90% of ultrasound for thyroid cancers. The sensitivity of US for papillary carcinoma was 83% and for follicular carcinoma 25% [14].

Out of the 21 cases proved to be malignant by FNAC, US findings correlated with FNAC in 13 cases i.e. 9 out of 13 cases of papillary carcinomas, 3 out of 7 cases of follicular carcinomas and an anaplastic carcinoma. Thus the accuracy of US in predicting the thyroid malignancy was 72%.

In our series, we observed that with high frequency ultrasound the sensitivity and specificity of thyroid malignancy were 72% and 100% respectively. The sensitivity of US for 72 papillary carcinoma and follicular carcinoma was 62 % and 33% respectively.

In our study, in the evaluation of thyroid nodule, the overall diagnostic accuracy of high frequency ultrasound was 100%.

Conclusion

High frequency ultrasound is a useful technique in the evaluation of malignant thyroid nodules. High frequency ultrasound not only detects the presence, site, number and size of the thyroid nodule, it also clearly reveals the characteristics of the nodule, which could alter patient management. High frequency ultrasound coupled with Doppler helps in differentiating benign and malignant nodules in majority of the cases. However definite formula has yet to be derived based on ultrasound criteria. In our study High frequency ultrasound has an overall diagnostic accuracy rate of 100% in the evaluation of malignant thyroid nodule. High frequency ultrasound is an ideal imaging technique for characterizing thyroid nodules due to its superior anatomical resolution. Above all, it is safe because of its non-invasive nature and lack of ionizing radiation.

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