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A Retrospective Comparative Study of Accuracy of USG Guided FNAC with Conventional FNAC for Diagnosis of Thyroid Nodule

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Abstract: ***Nodular thyroid lesions are frequently encountered in clinical practice, particularly among women and individuals above forty years of age. Although most nodules are benign, a small but important proportion carries malignant potential, which makes early and precise diagnosis essential. Conventional fine needle aspiration cytology has long been used as a primary diagnostic tool, yet it is often limited by sampling errors and inadequate smears. This study assessed the diagnostic accuracy of ultrasound guided fine needle aspiration cytology in comparison with the conventional technique at a tertiary care centre over a one-year period. A total of 124 patients with thyroid swelling were evaluated, and histopathological findings were used as the reference standard wherever available. Ultrasound guidance reduced the rate of inadequate samples and improved detection of neoplastic lesions. Sensitivity and overall diagnostic accuracy were higher with the guided method, while false negative results were not observed in this group. The findings support the routine use of ultrasound guidance in evaluating thyroid nodules, particularly in cases with suspicious sonographic features, to assist in appropriate surgical planning and patient management.***

Keywords: Thyroid nodules, Ultrasound guided FNAC, Conventional FNAC, Cytology accuracy, Thyroid malignancy

1. Introduction

Nodular thyroid lesions are abnormal growths within the thyroid gland, which may be solitary or multiple. These nodules can be classified as benign (such as colloid nodules, thyroid cysts, or adenomas) or malignant (thyroid cancer). The majority of thyroid nodules are asymptomatic and detected incidentally during routine clinical examinations or imaging studies. However, some may present with symptoms such as neck swelling, dysphagia, hoarseness, or compressive symptoms. The prevalence of thyroid nodules varies depending on factors such as iodine deficiency, age, gender, and the diagnostic method used. In India, the overall prevalence of thyroid nodules is estimated to be around 8.5%, 1 though this varies significantly:[1]

- Palpation-based detection: 2%–6%
- Ultrasound-based detection: 19%–35%
- Autopsy studies: 8%–65%

Studies from different regions of India show variable prevalence rates. For example, a sonographic study in Kerala found a 14% prevalence of thyroid nodules ≥1 cm, [2] while a study in South India reported a 19.2% prevalence of palpable thyroid nodules. [3] In iodine-deficient regions, the prevalence can be as high as 80%, compared to 18.9% in iodine-sufficient areas. [1] Thyroid nodules are more common in females, with a female-to-male ratio of approximately 4:1. The incidence increases with age, particularly in individuals over 40 years old.[1] Although most thyroid nodules are benign, the risk of malignancy varies from 7% to 15%, necessitating further evaluation through fine-needle aspiration cytology (FNAC) and histopathological examination.[2] Nodular thyroid lesions are a significant public health concern in India, particularly in iodine-deficient areas. Early detection and appropriate evaluation through imaging and cytological studies are crucial to distinguishing benign from malignant nodules and ensuring timely management. Pathologic lesions of the thyroid gland exhibit varied morphologies. Despite many lesions, they can be conveniently classified into two major types: diffuse and nodular lesions. Diffuse thyroid lesions are associated with conditions affecting the entire gland, such as hyperplasia and thyroiditis. A thyroid nodule is a clinically or radiologically discernible lesion within the thyroid gland.[5] Thyroid nodules are detected clinically in 4-7% in the general population and found incidentally on ultrasonography in 19-67 %. The majority of thyroid nodules are asymptomatic, but 5% of all palpable thyroid nodules are malignant.6Although thyroid function tests, scintigraphy, and ultrasound were routinely used to diagnose thyroid nodules, they could not discriminate between benign and malignant lesions.[7]

Different workers reported that failure to aspirate from the proper site was the major cause of misdiagnosis during cytological evaluation.[8] Also, a high inadequacy rate, ranging from 6.4 to 32.4%, as found in various studies, is another major limitation of conventional FNAC.[9]

Ultrasound-guided FNAC (USG-FNAC) was first introduced by Rizatto et al. in 1973. Since then, several studies have reported that USG-FNAC reduces the inadequacy rate of conventional FNAC. 10, 11, 12, 13. Now, at our tertiary referral centre, Calcutta National Medical College, we are evaluating the accuracy of USG-guided FNAC compared with conventional FNAC for the diagnosis of thyroid nodular lesions.

2. Materials and Methods

The study was conducted from 1st January 2024 to 31 December 2024, in the department of Pathology of our institution. Informed consent was taken from 224 patients having nodular thyroid lesions. Among them, 208 patients gave consent to undergo both conventional and USG-guided FNAC. All patients presenting to our department with complaints of thyroid swelling were included in the study. T3T4TSH profiles for every patient, along with USG of the thyroid gland, were obtained, and the records were kept.

Conventional FNAC (C-FNAC) was performed in the Department of Pathology. Subsequently, USG was performed with a 10 MHz transducer probe in the Department of Radiology at our institution. USG findings were noted, with special attention to the number of nodules, size, echogenicity, margins, and calcification. FNAC was then repeated under USG guidance in a representative or suspicious area or nodule. In both methods, FNAC was performed under aseptic precautions using a 25-gauge needle attached to a 10 ml syringe, with the patient in a supine position and neck extended. We followed the no-aspiration technique. The material was collected in the needle by capillary action. The aspirate was then expressed onto clean glass slides and fixed with 95% alcohol using the air-dry technique. A minimum of 5 slides was smeared from each aspirate. The smears were then stained with Papanicolaou (Pap) (2 slides) and May-Grunwald-Giemsa (MGG) (3 slides). The slides prepared from conventional FNAC and USG-guided FNAC were reported separately by the same pathologist. Smears with at least six clusters of follicular cells, each containing at least ten follicular cells, were considered adequate for reporting following standard recommendations. 13 of 208 cases; 168 patients underwent surgery, allowing histopathological correlation. Histopathological results (used as the gold standard) were collected and correlated with those of conventional FNAC and USG-guided FNAC. Finally, all clinical data, thyroid profile reports, imaging findings, and histopathological reports were recorded, cross-checked, and tabulated for statistical analysis and comparative study by standard statistical methods.

3. Results

The FNAC of the thyroid was performed on a total of 124 patients aged 10 to 70 years, with the majority.

Of them, 30 to 60 years of age, and most patients were females, accounting for 105 cases (84.67%) (age-sex distribution shown in Fig 1). Most of the patients were females, accounting for70 cases (83.33%). (Fig 1)

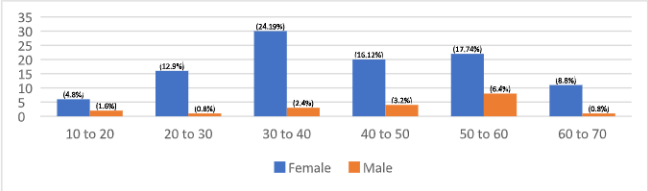

Figure 1: Bar diagram showing distribution of study subjects according to their age and sex (n = 124)

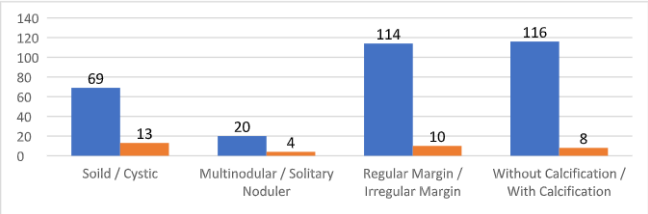

Figure 2: Ultrasonography Findings of patients undergoing guided fine needle aspiration cytology (n-)

In 124 patients, among them, 69 (55.64%) lesions were predominantly solid, 13 (10.48%) were predominantly cystic, 4 (3.22%) were multinodular, and 20 (16.12%) were solitary nodules. Margin was irregular in 10 (8.06%) lesions. Calcification was present in 8(6.45%) cases. (Fig. 2) Table 3 shows the results of C-FNAC and USG- FNAC. 74 patients underwent only C-FNAC and50underwentbothC-FNAC&USG-FNAC.The number of inadequate smears was 8 in C-FNAC (10.42%) and 1 in USG-FNAC (2.78%). C-FNAC results included 60 non-neoplastic lesions, 2 follicular neoplasms, and 4 malignant lesions. USG-FNAC results showed 42 non-neoplastic, 5 follicular neoplasms, and 2 malignant lesions.

Table 1: Results of fine needle aspiration cytology of study subjects. (n-124)

Category of Diagnosis	Only C-FNAC No (%)	C-FNAC + USG-FNAC No (%)	Total No (%)
Inadequate	8(10.81%)	1(2%)	9
Non-Neoplastic	60(81.08%)	42(84%)	102
Follicular Neoplasm	2(2.7%)	5(10%)	7
Malignancy	4(5.4%)	2(4%)	6
Total	74(59.7%)	50(40.3%)	124 (100%)

[C-FNAC–conventional fine needle aspiration cytology, USG-FNAC–ultrasound guided fine needle aspiration cytology]

Table 4 shows the cyto-histological correlation in all possible cases. 60 patients underwent surgery: 28 in the C-FNAC group and 34 in the USG-FNAC group; thus, histology was available for all. The histological findings in 28 cases that had undergone conventional FNAC showed 18 non-neoplastic lesions and 10 neoplastic lesions, including 4 follicular adenomas and 6 malignancies. Histological findings of 34 patients who underwent both conventional and USG-guided FNAC showed 22 nonneoplastic lesions and 12 neoplastic lesions (6 follicular adenomas &6 malignancies).

Table 2: Cyto-Histological correlation in all possible cases (n=62)

Total Cases with Histology	Category of Cases According to Method of Cytology	No.	Cyto diagnosis	No.	Histopathological Diagnosis	Histopathological Diagnosis	Histopathological Diagnosis
Total Cases with Histology	Category of Cases According to Method of Cytology	No.	Cyto diagnosis	No.	Nn	Fn	M
62	C-Fnac	28	Nn	18	12	4	2
62	C-Fnac	28	Fn	4	1	2	1
62	C-Fnac	28	M	6	1	2	3
62	C-Fnac + Usg-Fnac	34	Nn	22	22	-	-
62	C-Fnac + Usg-Fnac	34	Fn	6	1	3	2
62	C-Fnac + Usg-Fnac	34	M	6	-	-	6

[NN- non-neoplastic; FN- follicular neoplasm; M-malignancy]

Among 34 patients undergoing USG-FNAC, accurate diagnosis was possible in 32 cases, with 2 false positives and no false negatives. In C-FNAC, 18 accurate diagnoses were obtained out of 28 cases, with 2 false positives and 3 false negatives. (Table-5)

Table 3: Comparison of diagnostic accuracy of conventional & guided cytology

Category of cytology where histology available	No.	No. of cases with Accurate diagnosis	%	No. and % of false Positive cases	No. and % of false negative cases
Conventional cytology	28	17	78.57	3(10, 71%)	2 (7.14 %)
Guided cytology	34	31	94.11	2(5.88%)	0(0%)

Table 4: Comparison of diagnostic accuracy of C-FNAC and USG-guided FNAC cases

Type of Test	Type of Test	Histopathological Report	Histopathological Report	Total
Type of Test	Type of Test	+ve	-ve	Total
Conventional cytology	+ve	3	3	6
Conventional cytology	-ve	3	13	16
Conventional cytology	Total	6	16	22
Guided cytology	+ve	6	2	8
Guided cytology	-ve	0	22	22
Guided cytology	Total	6	24	30

From the above tables, go for sensitivity, specificity, & accuracy of both C-FNAC & USG- Guided FNAC.
Sensitivity of C-FNAC is 50% & USG-Guided FNAC is 100%
Specificity of C-FNAC is 81.25% & USG-Guided FNAC is 91.67%

Table 5: Cyto-histologically discordant cases (11Cases)

No. of Cases	Method of FNAC	Cytodiagnosis	Histological Diagnosis
2	C-Fnac	Adenomatoid goitre	Papillary carcinoma
4	C-Fnac	Adenomatoid Goitre	Follicular neoplasm
1	C-Fnac	Follicular Neoplasm	Papillary Carcinoma
1	C-Fnac	Follicular Neoplasm	Adenomatoid Goitre
2	Usg-Fnac	Follicular Neoplasm	Papillary Carcinoma
1	USG-FNAC	Follicular Neoplasm	Adenomatoid goitre

Microscopic Picture of Some Cyto-histologically Discordant Cases
Diagnosed as Follicular Neoplasm. Diagnosed as Adenomatoid Goitre
in C-FNAC in Histopathology
Diagnosed as Follicular Neoplasm. Diagnosed as Papillary Carcinoma
in USG Guided FNAC in Histopathology

4. Discussion

FNAC is now an established diagnostic test for evaluating thyroid lesions. (14)

According to The Bethesda System for Reporting Thyroid Cytology, the clinician will receive information on whether the Thyroid Lesion is benign or malignant. (15)

Although the conventional procedure has a high rate of inadequacy. The inadequacy is due to failure to aspirate from the proper site (nodule), and there is also a technical error due to excessive blood aspiration. (16)

Differentiating Thyroid Follicular Lesions from benign to malignant is very difficult in cytology, and the distinction can be made by histology based on vascular and Capsular invasion. (17)

From the USG report of the thyroid and neck, we will get information on the thyroid gland's parenchymal structure, its extension into other parts of the neck, and its involvement with the surrounding tissues, especially cervical lymph nodes. Modern high-resolution and Doppler ultrasound can show the solid or cystic character of thyroid lesions, whether they are multicyclic/multiloculated or exhibit irregular nodular margins, and whether microcalcifications are present. And also, about the vascularity of the lesions. (17)

USG-guided FNAC can increase cytology accuracy to almost histologic levels, as proposed by various workers. (18)
This study was conducted to assess the accuracy & usefulness of USG-FNAC at our institution, which provides tertiary care to people of West Bengal.

In our study, the FNAC of the thyroid was done on a total of 124 patients with an age range of 10 to 70 years, with the

majority of them being in the age group of 30 to 50 years, and most of the patients were females, accounting for 105 cases (84.67%). Our study shows similarities in the results of studies by B.R. Ashwini (15) & Amita K. Hingway S. (19). USG findings were available in 50 out of 124 cases (40.32%). Features suggesting malignancy, like predominantly solid, solitary lesions having irregular margins, were found in 10 cases (8.06%), and evidence of microcalcification was found in 8 cases (6.45%). This study is consistent with other workers that margin irregularity & micro calcification are reliable predictors of malignancy. (14) (19) (20)

The insufficiency rates for ultrasound-guided FNAC (USG-FNAC) and conventional FNAC (C-FNAC) in this investigation were 2% and 10.81%, respectively. Thyroid FNAC insufficiency rates ranged from 6.4 to 32.4% across investigations conducted by various personnel. (21) Similar to B.R. Ashwini et al.'s experience, we had a comparatively low insufficiency rate. They suggested that this low rate might have resulted from fewer technical errors because the FNAC was performed by a skilled cytopathologist under the supervision of a highly qualified ultrasonologist (15). In our setup, we are using high-resolution USG.

There were 62 cases with histological diagnosis (28 C-FNAC and 34 USG-FNAC). Compared with previous studies, the percentage of non-neoplastic lesions undergoing histological examination was lower. Due to patient burden, surgical intervention was not offered for suspected non-neoplastic lesions. Both methods were found to be sufficient in identifying malignant lesions in the cytohistological correlation of the two forms of FNAC. The rate of incorrect diagnosis was greater in the groups with follicular and nonneoplastic neoplasms than that of malignant lesions in conventional FNAC. This result correlates with the study of Amita K. et al., which had similar outcomes (21).

Among 34 USG-FNAC patients, accurate diagnosis was achieved in 31 cases, with 6 true positives, 6 false positives, and no false negatives. In C-FNAC, 15 accurate diagnoses were obtained from 28 cases, with 3 false positives and 3 false negatives. Discrepancy was found in11cases (8 in C-FNAC and 2 in USG-FNAC) as shown in Table 6. 2 cases of papillary carcinoma & 1 case of Adenomatoid goitre diagnosed as Follicular neoplasm in USG-guided FNAC. 2 cases of Papillary Carcinoma & 4 cases of Follicular Neoplasm diagnosed as Adenomatoid Goiter & 1 case of Papillary Carcinoma &1 case of Follicular Neoplasm diagnosed as Adenomatoid Goitre in C-FNAC.

5. Limitation

The study population is small, and the study may not yield a definitive conclusion; a larger sample size is required.

6. Conclusion

In case of Thyroid Malignancy, the type of surgery depends entirely on the pre-surgical diagnosis by Cytology, from which the type of malignancy and its extension (extra-thyroid), if any, should be clear before contemplating surgery. So, the surgeon is completely dependent on cytological diagnosis and, nowadays, solely follows the Bethesda System for Reporting Thyroid Cytopathology (TBSRTC). From the present study, it can be concluded that USG-guided FNAC is more accurate for cytological diagnosis of thyroid nodules, reduces patients' discomfort, improves patient compliance, and is cost-effective and time-saving. It also saves cytologists' and surgeons' time.

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