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CORRELATION OF FINE NEEDLE ASPIRATION CYTOLOGY WITH HISTO-PATHOLOGICAL FINDINGS IN THE DIAGNOSIS OF THYROID SWELLINGS

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The aim of the study: *the present study is to evaluate the accuracy of fine needle aspiration cytology (FNAC) of thyroid swellings and to correlate with histopathological findings to avoid unnecessary surgeries for benign lesions.*
Methods: *this is a prospective study. A total of 55 cases were studied in the Department of Pathology at A.C.S Medical College and Hospital. Fine needle aspiration cytology was done and correlated with histopathological examination. Sensitivity, specificity, and accuracy were calculated.*
Results: *majority were noted among 41–50 years (60 %). Females i.e., 78.1 % (43/55) outnumbered males 21.8 % (12/55). Solitary nodule thyroid in Right lobe is 54.5 % (30/55) and left lobe is 45.4 % (25/55). In the present study 65.4 % (36/55) presented with symptoms for 1month – 1 year. Non neoplastic lesions constituted 76.3 % (42/55) in our study on FNAC. Among non-neoplastic lesions, nodular goiter was most reported and constituted 36.6 % (20/55). Neoplastic lesions constituted 23.6 % (13/55) and among neoplastic lesions follicular neoplasm occupied 9.09 % (05/55). Nodular goiter was most reported and constituted 29.0 % (17/55). Follicular adenoma occupied 20 % (11/55), 9.09 % (05/55) as PTC and 5.4 % (02/55) reported as follicular carcinoma. 1.8 % (01/55) each reported as medullary carcinoma and anaplastic carcinoma. Non-neoplastic lesions constituted 76.3 % (42/55) in our study on FNAC and neoplastic lesions constituted 23.6 % (13/55).*
Conclusion: *FNAC is a minimally invasive, highly accurate and cost-effective procedure. FNAC helps the clinician to diagnose malignant lesions with confidence. It has high rates of specificity and accuracy but comparatively has less sensitivity to diagnose the solitary thyroid nodule. However, it is an important diagnostic tool for further management of patients with thyroid swelling*
Keywords: *fine needle aspiration, sensitivity, specificity, solitary thyroid nodule*

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1. Introduction

Solitary thyroid nodule is defined clinically as a localized thyroid enlargement with an apparently normal remaining gland, refers to an abnormal growth of thyroid cells that forms a lump within the thyroid gland. Although most thyroid nodules are benign, a small proportion of thyroid nodules contain thyroid cancer. To diagnose and treat thyroid cancer at the earliest stage, most thyroid nodules need some type of evaluation. Often these abnormal growths of thyroid tissue are located at the edge of the thyroid gland, so they could be felt as a lump in the front of the neck [1].

Thyroid nodules are common. Prevalence and incidence increase with age, with spontaneous nodules occurring at a rate of 0.08 % per year beginning early in life and extending into the eighth decade. Palpable thyroid nodules are found in 5 % of persons aged an average of 60 years. With the use of imaging techniques particularly ultrasound, the chance of detection of thyroid nodules has increased many folds about 20 % to 60 % [2, 3].

Thyroid nodules are more common in women than in men [3–5], its incidence in females is about one in 12–15 young women have a thyroid nodule, but in males is about one in 40 young men has a thyroid nodule. More than 95 % of all thyroid nodules are benign (non-cancerous growths) [4, 5]. The reported incidence of thyroid cancer in general population is low, being only about 1 %. Thyroid cancers occur in approximately 5 to 15 % of all thyroid nodules independent of their size [3, 6]. The recent data suggest that the incidence of thyroid malignancy is increasing over the years [2, 3] worldwide increase incidence of thyroid cancer partly due to increased detection by ultrasound and other imaging studies but also to true increase in incidence of papillary thyroid carcinoma (PTC) [7]. The occurrence of malignancy is more in solitary thyroid nodules (STN) compared to multinodular goiter [2].

Aetiology and classification [8, 9]: STN could be classified into benign and malignant nodules. Generally, most (90 %) thyroid nodules are benign and can be classified as adenomas, colloid nodules, cysts, infectious nodules, lymphocytic or granulomatous nodules, hyperplastic nodules, thyroiditis, and congenital abnormalities.

The aim of the study: The present study is to study cytology and histopathological correlation of solitary nodule thyroid.

2. Materials and methods

Prospective study was conducted in A.C.S Medical College and Hospital for duration of 2 years i.e., from April 2020 to April 2022 on 55 cases of solitary nodule thyroid in the department of pathology.

Inclusion criteria

Patient willing to participate.

Male or female patient with solitary thyroid nodule.

Presence of pressure symptoms or cosmetic problems.

Exclusion criteria

Patient not willing to participate.

Patient with diffuse swelling thyroid.

Methodology

All the cases were selected randomly. All patients were evaluated by thorough clinical examination followed by routine investigations including thyroid function tests, ultrasonography, FNAC and histopathological examination. All the patients were recorded for their demographic features i.e., age, sex, and address. History of present illness about symptoms and duration was recorded followed by general & local examination. All routine investigations and serum T3, T4, and TSH levels performed by radioimmunoassay (RIA). All these 55 patients admitted in departments of ENT and general surgery were subjected to FNAC and it was done on solitary nodule cases under all aseptic conditions and patients were subjected to lobectomy/ thyroidectomy (hemi/subtotal thyroidectomy). The surgical specimens were sent for histopathology. The results of FNAC and histopathology were compared. Histopathology was taken as gold standard.

Institutional clearance and informed consent was obtained (ECR/1182/inst/TN/2019: dated 11/2/2019).

Statical analysis

Statistical data were analyzed using the IBM Statistical Package for Social Sciences for Windows (version 20.0, IBM, Armonk, NY, USA). Values with distribution are presented as mean ± standard deviation.and following were used:

1. True positive (TP) = the number of cases correctly identified as having thyroid neoplasm.

2. False positive (FP) = the number of cases incorrectly identified as having thyroid neoplasm.

3. True negative (TN) = the number of cases correctly identified as not having thyroid neoplasm.

4. False negative (FN) = the number of cases incorrectly identified as not having thyroid neoplasm.

5. Sensitivity measures the percentage of patients who are correctly identified as having thyroid neoplasm. Thus, sensitivity = TP/(TP + FN).

6. Specificity measures the percentage of patients who are correctly identified as not having thyroid. Thus, specificity = TN/(TN + FP).

7. Accuracy measures ability of fine-needle cytology to correctly identify the cases that have thyroid neoplasm and the cases that do not have thyroid neoplasm. Thus, accuracy = (TP + TN)/(TP + FP + TN + FN)

8. Positive predictive value is the proportion of positives that correspond to the presence of the thyroid neoplasm. Thus, positive predictive value = TP/(TP + FP)

9. Negative predictive value is the proportion of negatives that correspond to the absence of the thyroid neoplasm. Thus, negative predictive value = TN/(TN + FN)

3. Results

In the present study age distribution ranges from 10–70 years. Majority were noted among 41–50 years (60 %), followed by 31–40 years (12.7 %). Least were noted among 10–20 years and 61-70 years (5.4 % and 3.6 % respectively). Females i.e., 78.1 % (43/55) outnumbered males 21.8 % (12/55). Solitary nodule thyroid was found in right lobe is 54.5 % (30/55) and in left lobe is 45.4 % (25/55). In the present study 65.4 % (36/55) had symptoms for 1 month – 1 year (Table 1).

Table 1

Distribution of cases on FNAC

Distribution on FNAC	No. of cases	Percentage
Colloid cyst	05	9.09
Colloid goiter	04	7.2
Nodular goiter	20	36.6
Autoimmune thyroiditis	09	16.3
Follicular neoplasm of uncertain significance (FNUS)	04	7.2
Follicular neoplasm	05	9.09
Suspicious of malignancy	04	7.2
Malignancy	04	7.2
Total	55	99.9 %

Non-neoplastic lesions constituted 76.3 % (42/55) in our study on FNAC.

Among non-neoplastic lesions, nodular goiter was most reported and constituted 36.6 % (20/55), autoimmune thyroiditis 16.3 % (09/55), and colloid goiter (04/55) 7.2 %.

Neoplastic lesions constituted 23.6 % (13/55) and among Neoplastic lesions Follicular neoplasm occupied 9.09 % (5/55), 7.2 % each (4/55) reported as suspicious of malignancy and malignancy.

Nodular goiter was most reported and constituted 29.0 % (17/55), hashimoto's thyroiditis 12.7 % (07/55), lymphocytic thyroiditis 3.6 % (02/55), colloid cyst 9.09 % (05/55) and colloid goiter (4/55) 7.2 %. Follicular adenoma occupied 20 % (11/55), 9.09 % (05/55) as PTC and 5.4 % (2/55) reported as follicular carcinoma. 1.8 % (01/55) each reported as medullary carcinoma and anaplastic carcinoma (Table 2, Fig. 1).

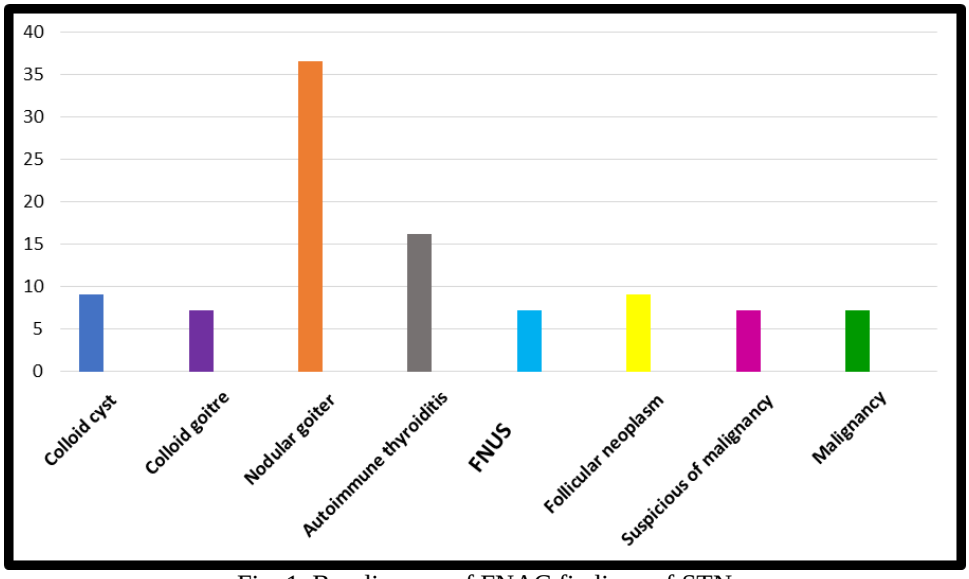

Fig. 1. Bar diagram of FNAC findings of STN

Table 2

Distribution of cases on HPE

HPE	No. of cases	Percentage
Colloid cyst	05	9.09
Colloid goiter	04	7.2
Nodular goiter	17	29.0
Hashimoto's thyroiditis	07	12.7
Lymphocytic thyroiditis	02	3.6
Follicular adenoma	11	20
Follicular carcinoma	02	5.4
PTC	05	9.09
Medullary carcinoma	01	1.8
Anaplastic carcinoma	01	1.8
Total	55	99.8 %

Correlation between cytological and histopathological analysis showed that there were 33 true negatives, 15 cases were true positives, 5 cases false negatives, 2 cases as false positives (Table 3).

On statistical analysis sensitivity of 75 % and specificity of 91.6 % was observed. Accuracy was 87.2 %, predictive value positive was 88.2 %, predictive value negative was 86.8 %, respectively.

Table 3

Statistical analysis – cytology and histopathology correlation

Distribution on FNAC	Distribution on HPE	REMARKS
Colloid cyst (05)	Colloid cyst (05)	True Negatives
Colloid goiter (04)	Colloid goiter (04)	True Negatives
Nodular goiter (20)	Nodular goiter (15)	True Negatives
	Follicular adenoma (05)	False Negatives
Autoimmune thyroiditis (09)	Hashimoto's thyroiditis (07)	True Negatives
	Lymphocytic thyroiditis (02)	True Negatives
Follicular neoplasm of uncertain significance (FNUS) (04)	Follicular adenoma (02)	True positives
	Nodular goiter (01)	False Positives
	PTC (01)	True positives
Follicular neoplasm (05)	Follicular adenoma (04)	True positives
	Nodular goiter (01)	True positives
Suspicious of malignancy (04)	Follicular carcinoma (01)	True positives
	PTC (02)	True positives
	Medullary carcinoma (01)	True positives
Malignancy (04)	PTC (02)	True positives
	Follicular carcinoma (01)	True positives
	Anaplastic carcinoma (01)	True positives

4. Discussion

Comparative studies on Age distribution

In the present study age distribution varied from 10–70 years. Majority were noted among 41–50 years (60 %) with mean age 43.5 years, followed by 31–40 years (12.7 %). Least were noted among 10-20 years and 61–70 years (5.4 % and 3.6 % respectively). Similar findings were observed in Venu et al [10] study where the age ranging from 10 years to 81years with a mean age of 43.24yrs. Whereas in Manoj et al [8] study age of the patients ranged from 22 to 58 years with mean age of 38.7 years. In Mohammed et al [11] the patients ranged in age from 17 to 65 years, with the majority ranging in age between 25 and 40 years (30 %). In Takur et al [12] the most common age group reported was 20–40 years accounting for 68.6 % of cases with the majority being female (92.2 %). Elderly age group above 60 years was confined to 5.9 %. In Kanyakumari et al study [13] the commonest age group affected was 31–40 years (44.4 %) and the least affected were in the age group 10–20 years (2.2 %) and 61-70yrs (2.2 %).

Comparative studies on sex distribution

In the present study females i.e., 78.1 % (43/55) were affected more than males 21.8 % (12/55). Similar findings were observed in below respective studies i.e., in Manoj et al [8] 6 (8 %) were males and 69 (92 %) were females. Kanyakumari et al study [13] female preponderance was noted with 39 (86.6 %) cases while only 6 (13.3 %) cases were encountered in males. In Mohammed et al [11] study there were 4 (20 %) men and 16 (80 %) women, with a male-to-female ratio of 1: 4. In Takur et al [12] study majority being females (92.2 %). In Venu et al [10] Females were 178 and males were 35 with a female: male ratio of 5.1:1. The Susmit et al [14] study included 9 males and 98 female patients. Hence our study findings were in collaboration with other studies.

Comparative studies on FNAC findings

In our study non-neoplastic lesions constituted 76.3 % (42/55) on FNAC. Among non-neoplastic lesions, nodular goiter was most reported and constituted 36.6 % (20/55), autoimmune thyroiditis 16.3 % (09/55) and colloid goiter (04/55) 7.2 %.

Neoplastic lesions constituted 23.6 % (13/55) and among Neoplastic lesions Follicular neoplasm occupied 9.09 % (05/55), 7.2 % (04/55) reported as Suspicious of malignancy. Kanyakumari et al study [13] results revealed 10 (22.2 %) cases as colloid goitre, 8(17.7 %) as hashimotos thyroiditis, 19(42.2 %) as follicular neoplasm, 4(8.8 %) as Papillary carcinoma and 2(4.4 %) as Anaplastic carcinoma, 2(4.4 %) Medullary carcinoma. In a study conducted by Manoja et al [8] FNAC results revealed 39 (52 %) cases as colloid nodular goitre, 12 (16 %) as follicular neoplasm, 9 (12 %) as papillary carcinoma, 6 (8 %) as hurtle cell lesions, 6 (8 %) as benign cystic lesions and 3 (4 %) cases as suspected of malignancy. In Mohammed et al [11] a total of 13 (65 %) cases were benign/non-neoplastic and seven (35 %) cases were malignant. The 13 benign/non-neoplastic aspirates (65 %) were diagnosed as follows: 5 cases (25 %) were colloid nodules, 4 cases (20 %) were hyperplastic follicular cells, 3 cases (15 %) were Hurthle cell tumour, and the last one case (5 %) were diagnosed as thyroid cyst. 6 cases (30 %) were papillary carcinoma and finally, the last case (5 %) was diagnosed as medullary thyroid carcinoma. In Susmit et al [14] study, colloid goiter (28.9 %), colloid goiter with secondary changes (6.5 %), nodular colloid goiter with cystic change (21.5 %), nodular colloid goiter with adenomatous hyperplasia (14.7 %), Hashimotos thyroiditis (3.7 %). Follicular neoplasm constituted 8.4 % of total cases whereas Papillary carcinoma, medullary carcinoma and anaplastic carcinoma accounted for 3.7 %, 1.9 % and 0.9 % respectively. In Venu et al [10] study aspirates classified as benign - included colloid goiter, hyperplastic nodule of nodular colloid goitre, hashimotos thyroiditis, lymphocytic thyroiditis and cysts of thyroglossal duct. Suspicious smear - included are of follicular neoplasm and hurthle cell neoplasm. Benign lesion comprised the maximum number of cases 191(85 %), followed by cases 10 (4.44 %) follicular neoplasm and suspicious of malignancy (IV and V).

Comparative studies on histopathology findings

In our study on Histopathological examination of excised specimens showed Nodular goiter as most commonly reported and constituted 29.0 % (17/55), Hashimotos thyroiditis 12.7 % (07/55), lymphocytic thyroditis 3.6 % (02/55), colloid cyst 9.09 %(05/55) and colloid goiter (04/55) 7.2 %. Follicular adenoma occupied 20 % (11/55), 9.09 % (05/55) as PTC and 5.4 % (02/55) reported as follicular carcinoma. 1.8 % (01/55) each reported as medullary carcinoma and anaplastic carcinoma. In Manoja et al study [8] 42 (56 %) cases as colloid nodular goitre, 12 (16 %) as follicular adenoma, 12 (16 %) as papillary carcinoma, 3 (4 %) as hurthle cell adenoma, 3 (4 %) as hurthle cell changes with capsular invasion and 3 (4 %) as hashimoto's thyroiditis. Kanyakumari et al study [14] on histopathology results were 20 (44.4 %) follicular adenoma, 2 (4.4 %) follicular carcinoma. 8 (17.7 %) hashimotos thyroiditis, 7 (15.5 %) colloid goitre, 4 (8.8 %) papillary carcinoma, 2 (4.4 %) anaplastic carcinoma, 2 (4.4 %) medullary carcinoma. Mohammed et al [11] reported 5 cases (25 %) as colloid nodules, 3 (15 %) as follicular adenomas, 2 (10 %) as hurthle cell tumour and one patient (5 %) as thyroid cyst. Among malignant lesions, 7 (35 %) were papillary carcinoma, one case (5 %) was a follicular variant of hurthle cell carcinoma and the last one (5 %) was medullary thyroid carcinoma. In Salma et al study [15] 36 (52.94 %) cases as colloid nodular goitre, 10 (14.70 %) as follicular adenoma, 10 (14.70 %) as papillary carcinoma, 6 (8.8 %) as hurthle cell adenoma, 2 (2.9 %) as hurthle cell changes with capsular invasion and, 4 (5.88 %) as hashimoto's thyroiditis. Susmita et al [14] showed nodular colloid goiter in 27 cases (67.5 %), follicular adenoma in 8 cases (20 %), papillary carcinoma in 4 (10 %), minimally invasive follicular carcinoma in 1 case (2.5 %).

In the present study statistical analysis of neoplastic lesions showed sensitivity, specificity, accuracy, positive predictive value, and negative predictive value of FNAC to be 75 %, 92.6 %, 87.2 %, 88.2 % , 86.8 % respectively and compared with other respective studies (Table 4).

Table 4

Comparative studies based on statistical analysis

Comparative Studies	Sensitivity	Specificity	Accuracy	Positive predictive value	Negative predictive value
Manoja et al study 11	80 %	86.6 %	84 %	80 %	86.6 %.
Kanyakumari et al study 14	73 %	100 %	100 %	92 %	93 %
Mostafa et al study 17	72.7 %	89.4 %	83.3 %	80 %	89.4 %
Salma et al study17	85.7 %	85 %	–	85.7 %	85 %
Present study	76 %	92.6 %	87.2 %	88.2 %	86.8 %

Research limitations. Maximum number of interpretative errors occur in the category with indeterminate or atypical cytological findings.

Prospects for further research: conduct studies to evaluate various diagnostic parameters are necessary in all cytology centres to improve upon technical as well as interpretative errors. It may be noted at this point that although follow-up observation of patients for at least a few years is necessary for determination of the true number of FN cases, this was not done in our study.

5. Conclusion

FNAC is a minimally invasive, highly accurate and cost-effective procedure. FNAC helps the clinician to diagnose malignant lesions with confidence. It has high rates of specificity and accuracy but comparatively has less sensitivity to diagnose the Solitary thyroid nodule. However, it is an important diagnostic tool for further management of patients with thyroid swelling.

FNAC is not a substitute for conventional surgical histopathology, it is regarded as an extremely valuable complement in diagnosis, and it is becoming just as indispensable. The study highlights that FNAC should be treated as a first-line diagnostic test for thyroid swellings to guide the management though it is not a substitute for histopathological examination as a need to improve primary healthcare in India.

Conflicts of interest

The authors declare that they have no conflicts of interest.

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