

Fine Needle Aspiration Cytology of Thyroid Lesions: Diagnostic Accuracy and Limitations

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Abstract: Fine Needle Aspiration cytology (FNAC) of thyroid gland is firmly established as an important test for the evaluation of thyroid disease and an effective test for the preoperative diagnosis of solitary thyroid nodule. This study was undertaken to determine the correlation between the FNAC and histopathologic diagnosis of the thyroid lesions. Total 179 cases were included in this study. All had FNAC thyroid. Out of the total 179 patients studied, 123 were cases of benign thyroid lesions, 14 were malignant, 3 were inadequate, and 39 were follicular neoplasm. Histopathology of 48 thyroid specimens showed 17 colloid and nodular goiter, 3 colloid cyst, 1 thyroglossal duct cyst, 1 Hashimoto's thyroiditis, 1 granulomatous thyroiditis, 11 Follicular adenoma, 1 hurthle cell adenoma, 7 Papillary carcinoma and 4 Follicular carcinomas and 2 cases turned out to be false negative. By comparing the results of FNAC and histopathology, FNAC has sensitivity of 84.61% and specificity of 100% and an accuracy of 95.83% in the diagnosis of malignant thyroid diseases. FNAC is safe, inexpensive and less invasive diagnostic method with excellent patient compliance.

Its existence use can make the management of thyroid swelling cost effective to avoid unnecessary surgery on conditions like thyroiditis.

Keywords: Fine Needle Aspiration Cytology (FNAC), Follicular carcinoma, papillary carcinoma, thyroid gland, hurthle cell adenoma.

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I. Introduction

Thyroid cancers account for approximately 1% of all human malignancies. Thyroid nodules are the common clinical findings and have a reported prevalence of 4%-7% of the adult population and occur more commonly in women. Most nodules are nonmalignant and the malignancy rate range from 5%-12% in patients with single nodules and 3% in patients with multiple nodules. Most patients with thyroid cancers have a mass or nodule as a common presentation. The distinction of these nodules as benign and malignant cannot be based reliably on the clinical presentation alone. Fine needle aspiration of the thyroid is the mainstay of preoperative diagnosis of thyroid lesions, used as a triage procedure to distinguish lesions that require surgery from those that do not. Due to its simplicity, low cost and absence of major complications, this procedure is being performed on an increasing number of patients, which has led to the detection of thyroid cancers at earlier stages, resulting in better outcome of patient.

FNAC is highly accurate in the diagnosis of thyroiditis. Many studies of the accuracy of FNAC diagnosis of solitary nodules with the cytological correlation have been reported. The sensitivity of thyroid FNAC ranges from 65%-99% and its specificity from 72%-100%. Inadequate samples have been reported from 1%-5%. There are no contraindications to FNB of the thyroid. Never the less, like any other test FNAC has its limitations. It cannot distinguish follicular adenoma and carcinoma since distinction depends mainly on the demonstration of capsular /vascular invasions in tissue sections. This study aims at correlating the cytological diagnosis and final histopathological diagnosis to evaluate sensitivity, specificity & diagnostic accuracy there by its role in pre-operative diagnosis of thyroid swelling and planning the proper management.

II. Material And Methods

A retrospective study of 179 cases was conducted in the department of Pathology, Maharajaha's Institute of Medical Sciences, Vizianagaram from may 2012 to may 2014. Aspiration was done using 23Gauge needle. Several smears were made and were fixed in 95% ethyl alcohol and then stained with H & E stain. Out of 179 patients, 48 patients were treated with surgeries like total, subtotal and hemithyroidectomies. Histopathological examinations of these specimens were done. All the specimens were fixed in 10% formalin. Detailed gross examination was done. Slides were prepared and stained with H & E stain. Cytological diagnosis

was correlated with histopathology and the efficacy of FNAC was estimated by using methodology of Galen and Gambino.

III. Results

In our study, a total of 179 cases were included which were adequate for reporting. The clinical data as per the proforma and cytological interpretation were reviewed from all cases and histopathological correlation done wherever possible. The following observations were documented. Age of the patients ranged from 9 years (male) to 88 years (female). Maximum number of patients were noticed between 21-40 years of age (96 cases). Majority of the patients referred for FNAC thyroid were females accounted for 161 (90%) of the total 179 patients, with male to female ratio of 1:9; as shown in Table I & II

Table – I : Age Distribution

AGE DISTRIBUTION				
AGE (YRS)	BENIGN	MALIGNANT	UNSATISFACTORY	TOTAL
0-10	1	0	0	1
11-20	7	3	1	11
21-30	26	14	1	41
31-40	37	18	0	55
41-50	28	11	1	40
51-60	18	4	0	22
61-70	6	2	0	8
>70	0	1	0	1
TOTAL	123	53	3	179
%	68.7	29.6	1.7	100

Table – II : Age With Sex Distribution

AGE WITH SEX DISTRIBUTION						
AGE (YRS)	FEMALES		MALES		TOTAL	
	NO.	%	NO.	%	NO.	%
0-10	-	-	1	0.56	1	0.56
11-20	11	6.14	-	-	11	6.14
21-30	37	20.67	4	2.23	41	22.9
31-40	52	29.05	3	1.67	55	30.73
41-50	35	19.55	5	2.79	40	22.35
51-60	19	10.61	3	1.67	22	12.29
61-70	6	3.35	2	1.11	8	4.47
>70	1	0.56	-	-	1	0.56
TOTAL	161	89.9	18	10.1	179	100
INFERENCE	TWO THIRD OF THE PATIENT REFERRED ARE IN THE AGE GROUP OF <40YRS					

The duration of the complaints ranged from 7 days to 30 years. 88 patients presented in the first year and 86 patients in one to ten years and 5 patients came after 10 years of onset of swelling. Out of 179 cases of thyroid aspirates, 176 yielded satisfactory smears for cytological interpretation and the remaining 3 cases were unsatisfactory, showing only blood and acellularity. Out of 176 satisfactory smears, 123 were diagnosed as benign, 39 were diagnosed as follicular neoplasms, 14 were diagnosed as malignant based on cytological findings as shown in table III

Table- Iii : Lesions Of Fnac

LESIONS ON FNAC		
DIAGNOSIS	NO. OF CASES	%
UNSATISFACTORY/ INADEQUATE	3	1.7
BENIGN LESIONS	123	68.7
FOLLICULAR NEOPLASM	39	21.8
MALIGNANT	14	7.8
TOTAL	179	100

Among 123 benign lesions 77 cases were diagnosed as colloid/nodular goitre, 19 cases were diagnosed as colloid cyst, 4 were diagnosed as thyroglossal duct cyst, 18 were diagnosed as Hashimoto's thyroiditis and 5 were diagnosed as granulomatous thyroiditis as shown in table IV.

Table – IV : Benign Lesions Of Fnac

BENIGN LESIONS ON FNAC		
DIAGNOSIS	NO. OF CASES	PERCENTAGE
COLLOID / NODULAR GOITRE	77	43.02
COLLOID CYST	19	10.62
THYROGLOSSAL DUCT CYST	4	2.23
HASHIMOTO'S THYROIDITIS	18	10.06
GRANULOMATOUS THYROIDITIS	5	2.79
TOTAL	123	68.72

Out of 77 cases of colloid and nodular goitre , 18 cases were available for histopathological correlation. The cytological study was confirmative in 17 cases and one case was false negative which was diagnosed as papillary carcinoma. Out of 19 cases of colloid cyst, 4 cases were available for histopathological correlation. The cytological diagnosis were confirmative in 3 cases and one case was false negative which was diagnosed as papillary carcinoma. Out of 4 thyroglossal duct cyst , one case was available for histopathological correlation. Out of 18 cases of Hashimoto's thyroiditis, histopathological study was available in 1 cases and was consistent with the cytological diagnosis. Out of 5 cases of granulomatous thyroiditis, 1 case was available for histopathological correlation and the cytological diagnosis was confirmative.

Cytological diagnosis of follicular neoplasm was made in 39 (21.79%) cases. Histopathological study was possible in 16 cases. Cytological diagnosis was confirmative in all the cases. 12(75%) cases were diagnosed as follicular adenomas (includes one case of hurthle cell adenoma) and 4(25%) cases were diagnosed as follicular carcinomas.

In the present study 14 cases were diagnosed as malignant. All the cases were papillary carcinoma thyroid. The age ranged from 20-88 years. 2(14.29%) patients were males and 12(85.17%) were females. Histopathology was available in 7 cases and the diagnosis correlated with cytological diagnosis as shown in table no V

Table- V : Cytological Diagnosis Of Thyroid Lesions

CYTOLOGIC DIAGNOSIS	NO. OF CASES	%	NO. OF BIOPSY AVAILABLE	POSITIVE CYTOLOGY REPORT	ACCURACY (%)	NEGATIVE CYTOLOGY REPORT
SIMPLE/NODULAR COLLOID GOITRE	77	43.75	18	17	94.44	1
COLLOID CYST	19	10.79	4	3	75	1
THYROGLOSSAL DUCT CYST	4	2.27	1	1	100	-
HASHIMOTO'S THYROIDITIS	18	10.23	1	1	100	-
GRANULOMATOUS THYROIDITIS	5	2.84	1	1	100	-
FOLLICULAR NEOPLASMS	39	21.79	16	16	100	-
PAPILLARY CARCINOMA THYROID	14	7.96	7	7	100	-
TOTAL	176	100	48	46	95.83	2

Out of 48 histopathological cases ,46 cases correlated with the cytologic diagnosis. Only 2 cases diagnosed as benign on cytology proved to be malignant (Papillary carcinoma thyroid) on histopathology (2 false negative cases).

STATISTICAL ANALYSIS :

For statistical analysis, the inadequate (3)cases were excluded.

Table Vi

STATISTICAL ANALYSIS	
TRUE POSITIVES = 11	FALSE POSITIVE = 0
TRUE NEGATIVE = 35	FALSE NEGATIVE = 2
SENSITIVITY	84.61%
SPECIFICITY	100%
POSITIVE PREDECTIVE VALUE (PPV)	100%
NEGATIVE PREDECTIVE VALUE (NPV)	94.59%

FALSE POSITIVE RATE (FPR)	0%
FALSE NEGATIVE RATE (FNR)	15.38%
ACCURACY	95.83%

In the study of 179 cytologically positive thyroid lesions, 48 cases underwent histopathological correlation, 11 cases were true positive, 35 cases were true negative and 2 cases were false negative. Hence sensitivity of 84.61% and specificity of 100% is obtained. 2 false negative cases were reported cytologically as benign follicular lesions, was histopathologically proved to be malignant resulting in a false negative error rate of 15.38% and negative predictive value of 94.59%. The overall diagnostic accuracy of this study is 95.83% which is statistically significant.

IV. Discussion

In the management of thyroid swellings, the primary challenge is to separate benign (majority) from malignant lesions (few). Unfortunately, the diagnostic procedures previously available have not provided adequate criteria for selecting patients for operation. Selection of patients for thyroid surgery on the basis of history, clinical findings and ultrasonography results in a low yield of malignant diseases. The recent studies have emphasized the utility of FNAC in the diagnostic assessment of thyroid swellings.

Thyroid enlargement, whether diffuse or nodular, constitute the main indication for FNA, and the goal of this diagnostic procedure is to detect thyroid neoplasms for surgical resection and to identify non-neoplastic lesions that may be managed conservatively. This method of clinical investigation has reduced the number of diagnostic thyroid surgeries for thyroid nodules by 60-85%, and the difference in rates of thyroid surgery reflect the cytodiagnostic accuracy rates among different medical centers.

Obtaining an adequate cell sample is a prerequisite to the success of thyroid cytology. Therefore, immediate microscopic assessment of the needle aspirate by a pathologist is desirable. If the first sample is judged inadequate for cytological evaluation, the Thyroid nodules can be re-aspirated immediately. If a rapid evaluation is not available, multiple FNAs of different areas of the Thyroid nodules should be performed.

The cytodiagnosis of Thyroid nodules by FNA is complex for the following reasons: overlap of cytological patterns between neoplastic and non-neoplastic lesions, overlap of cytological features between various neoplasms, coexistence of non-neoplastic and neoplastic processes and multiple malignancies in the same gland.

The present study included 179 cases of thyroid lesions during a period of 2 years (May 2012 to May 2014) of which 48 of them underwent surgery subsequently. In this present study, age of the patient ranged from 9 years to 88 years. Age distribution of the present study was comparable to Bagga et al.¹

In this present study the maximum number of cases were seen between 21-40 years. The number of males in the present study were 18 (10.1%) and females were 161 (89.9%) with a male to female ratio of 1:9. Sex distribution was similar to study done by Tabaqchali et al (2000)⁴.

In the present study 123 cases were non-neoplastic and 53 cases were diagnosed as neoplastic with a non-neoplastic to neoplastic ratio of 2.32:1. The ratio in other studies varied from 2.67:1 to 7.57:1 as shown in table VII

TABLE VII : COMPARISON OF NON-NEOPLASTIC TO NEOPLASTIC RATIO^{3,5,6,7}

STUDIES	TOTAL CASES	NON-NEOPLASTIC (A)	NEOPLASTIC (B)	A:B
Safirullah et al (2004)	300	265	35	7.57:1
Saeed A M et al (2004)	125	91	34	2.67:1
H.A.Naggad et al (2006)	69	51	18	2.83:1
Swamy GG et al (2011)	120	98	22	4.45:1
Present study	176	123	53	2.32:1

In the present study of 179 cases of FNAC of thyroid, majority were benign lesions 123 (68.7%), follicular neoplasms were 39 (21.8%), malignant lesions were 14 cases (7.8%), and 3 cases (1.7) were unsatisfactory which is in comparison with Bagga PK et al (2010)¹.

Diffuse smooth thyroid swellings can be a presentation of Simple colloid goitre, Thyroiditis or Graves disease and Nodular thyroid swelling can be a presentation of multi nodular goitre and a Single thyroid nodule can be a cystic nodule, Dominant nodule of multi nodular goitre or a neoplastic nodule which needs to be differentiated on cytology.

In the present study , 123 (68.7%) were found to have benign thyroid lesions, the most common lesion was nodular/colloid goitre accounting for 77 cases (43.02%) followed by 19 colloid cyst (10.62%), 18 Hashimoto's thyroiditis (10.06%) , 5 Granulomatous thyroiditis (2.79%) , 4 thyroglossal duct cyst (2.23%). Distribution was compared with studies by Silverman et al , Sirpal et al and Afroze N et al.^{2,8,9} as shown in table VIII

A similar observation was made by Afroze N et al where 127 (74.70%) out of 170 cases had benign thyroid lesions.

TABLE VIII : Comparative Analysis Of Benign Cytological Diagnosis^{2,8,9}

CYTOLOGICAL DIAGNOSIS	SILVERMAN et al (1986)		SIRPAL et al (1996)		AFROZE N et al (2002)		PRESENT STUDY	
	NO.	%	NO.	%	NO.	%	NO.	%
NODULAR/COLLOID GOITRE	156	50.4	438	39	92	54.1	77	43.02
TOXIC GOITRE	5	1.6	111	9.88	-	-	-	-
HYPERPLASTIC/ADENOMATOID NODULE	-	-	-	-	27	15.88	-	-
COLLOID CYST	19	6.1	50	4.46	-	-	19	10.62
TGD CYST	-	-	10	0.89	-	-	4	2.23
HASHIMOTO'S THYROIDITIS	9	2.9	146	13	8	4.7	18	10.06
GRANULOMATOUS THYROIDITIS	-	-	2	0.18	-	-	5	2.79
FOLLICULAR NEOPLASMS	69	22.33	11	0.98	27	15.88	39	21.79
TOTAL	258	83.49	768	68.39	154	90.58	162	90.5
	309		1123		170		179	

Out of 77 cases of nodular/colloid goitre, 18 cases were available for histopathological correlation. The cytological study was confirmative in 17 cases and one case was false negative which turned out to be papillary microcarcinoma with multinodular goitre.

Usually papillary microcarcinoma is missed during ordinary FNA , unless its first manifestation is a cervical lymphnode metastasis or imaging studies of the head and neck region reveal suspicious echographic nodules¹⁰. Cytologically, cells with characteristic nuclear features of papillary carcinoma intermixed with some normal follicular cell and clear colloid are usually found¹¹.

It also indicates that every case of nodular goitre should be sampled from multiple sites to avoid missing of associated neoplastic lesion. Ultrasound guidance improves the efficacy.

Benign cysts account for the majority of thyroid cystic lesions. They are formed as the result of hemorrhagic degeneration of a benign colloid nodule. However, any thyroid neoplasm may undergo hemorrhagic necrosis and become a cystic lesion .Of the thyroid neoplasms, Papillary carcinoma thyroid tends to undergo marked hemorrhagic degenerative change.

The fluid aspirate from cystic papillary tumors is usually brown, darkly stained or haemorrhagic. The diagnosis can be easily be missed if well preserved epithelial cells are scarce^{12,13,14}. Even in apparently simple cysts, a small percentage harbour papillary carcinoma¹⁵. Very large number of macrophages, particularly if forming cohesive clusters, should raise a suspicion of papillary neoplasm.

However, sections from the cell block prepared from the needle aspirate may show diagnostic papillary tissue fragments with fibrovascular cores or nuclear features of a Papillary carcinoma thyroid while that of a benign colloid nodule will show no true papillary tissue fragments with fibrovascular cores or nuclear features of a thyroid PC¹⁷

The sensitivity of FNA diagnosis in cystic neoplasms may be as low as 40%^{13,14} and all cystic lesions should be managed cautiously. La Rosa et al¹⁶ found a false negative rate of 6.4% for cystic nodules whereas it was only 1.4% for solid nodules.

In the present study, cytologic diagnosis of Hashimoto's thyroiditis was made in 18 cases (10.06%) out of 123 benign lesions. Histopathological study was available in one case and was consistent with cytological diagnosis. It should be born in mind that Hashimoto thyroiditis may harbor hyperplastic follicular and Hurthle cell nodules, and these two nodules are cytologically indistinguishable from a cellular follicular neoplasm and a Hurthle cell neoplasm, respectively . Surgical excision of these lesions is usually required for histologic confirmation.¹⁷

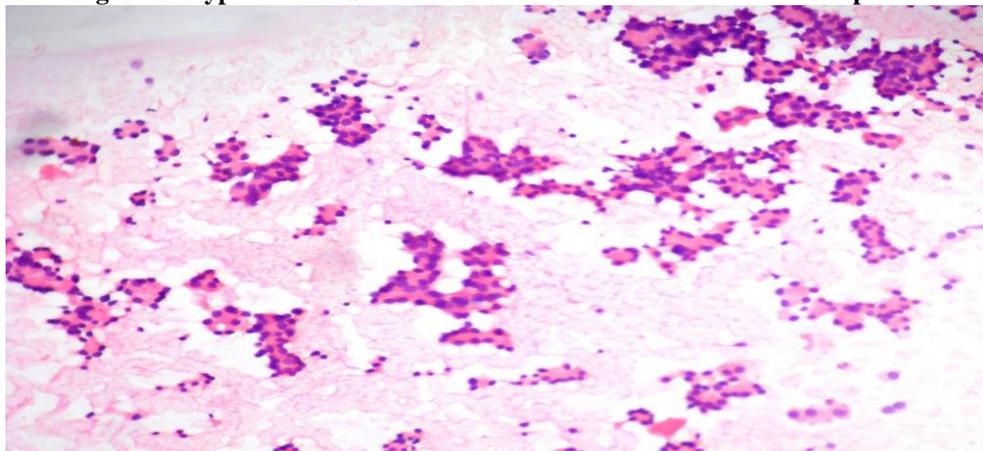
Cellular Microfollicular Lesion includes hyperplastic microfollicular nodules in a multinodular colloid goiter or Hashimoto thyroiditis, a microfollicular adenoma , and a well-differentiated follicular carcinoma . These lesions are the most challenging ones to diagnose cytologically. They are commonly reported as a microfollicular lesion or tumor with a recommendation for surgical excision.. FNA from a microfollicular

lesion usually reveals abundant follicular cells in clusters, acini and small monolayered sheets. The individual cells show scanty, ill-defined cytoplasm and oval nuclei with regular nuclear contours and inconspicuous or prominent nucleoli.

Cellular microfollicular lesions of the thyroid fall into the diagnostic category of indeterminate or suspicious lesions, and in one large series, 14% of microfollicular lesions were malignant¹⁸. In this present study cytological diagnosis of Follicular neoplasms was made in 39 cases (21.79%), majority of the patients were females accounting to 35 cases. One smear showed abundant hurthle cells [FIGURE 2] which was diagnosed as hurthle cell neoplasm. Histopathological study was possible in 16 cases. Cytological diagnosis was confirmative in all the cases. 12 (75%) cases were diagnosed as follicular adenomas (includes one case of hurthle cell adenoma) and 4 (25%) cases were diagnosed as follicular carcinomas confirming that histopathological examination is required for diagnosis of follicular carcinoma.

Smears from follicular neoplasms were hypercellular with prominent microfollicular pattern , colloid free background and nuclear crowding and overlapping.[FIGURE 1]

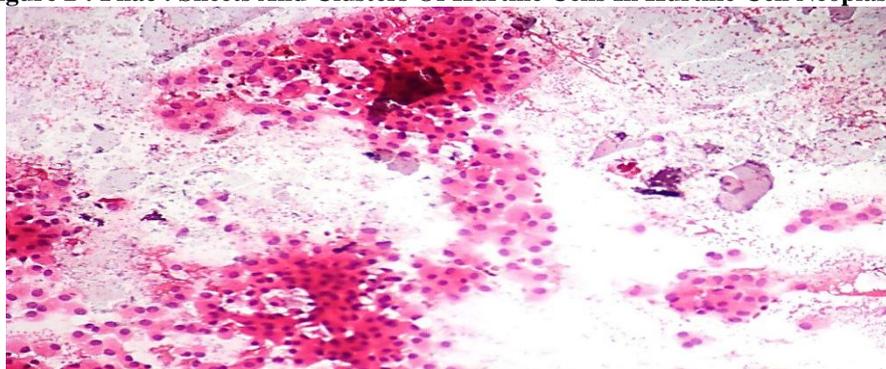
Figure 1 :Hypercellular Smear With Microfollicles In Follicular Neoplasm



Diagnosis of Hurthle cell lesions is a challenge in thyroid cytology. A hyperplastic Hurthle cell nodule in a Hashimoto thyroiditis or in a multinodular colloid goiter and a Hurthle cell neoplasm display similar cytologic findings . The presence of numerous lymphocytes or a large amount of thick colloid material in the needle aspirate may indicate a hyperplastic Hurthle cell nodule in Hashimoto disease or a multinodular colloid goiter, respectively .Hurthle cell adenoma and carcinoma usually show similar cytologic findings that are characterized by sheets and clusters of polygonal epithelial cells with abundant, granular, eosinophilic or basophilic cytoplasm, oval nuclei with regular nuclear contours and conspicuous or inconspicuous nucleoli . The presence of syncytial clusters of Hurthle cells with or without prominent nuclei and abundant naked tumor cell nuclei has been reported to be a feature of Hurthle cell carcinoma .¹⁹

In the present study one case of hurthle cell neoplasm was reported and histopathological examination revealed it to be an huthle cell adenoma. When a Hurthle cell lesion is detected by FNA, surgical excision is usually indicated for further histologic study . Thyroid Hurthle cell lesions fall into the cytodagnostic category of indeterminate lesions or suspected malignant lesions , and 13% of Hurthle cell lesions were malignant in one large series¹⁸.

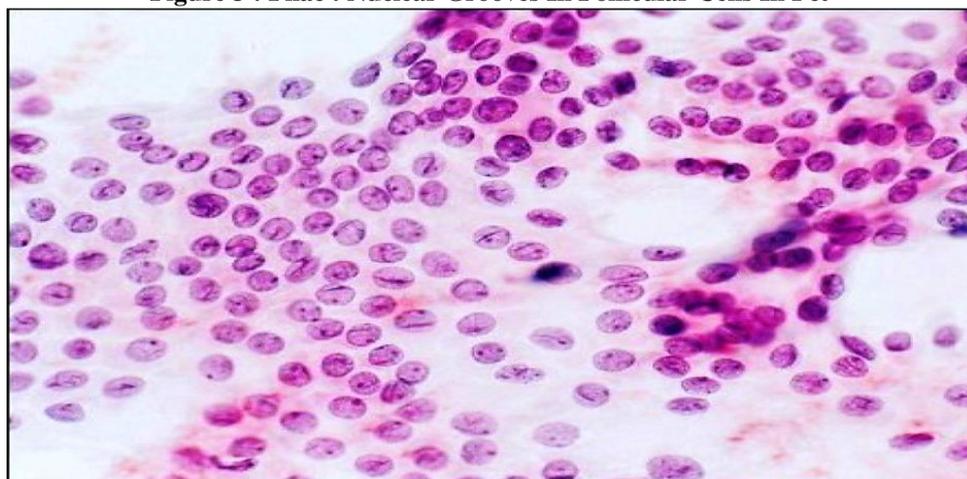
Figure 2 : Fnac : Sheets And Clusters Of Hurthle Cells In Hurthle Cell Neoplasm.



Primary Malignant Lesions includes papillary, high-grade follicular, insular, medullary and anaplastic carcinomas , and lymphoma . These lesions commonly show distinctive cytologic features that permit a correct identification in the majority of cases

In this present study out of 176 satisfactory aspirates from thyroid lesions, 14 cases were reported as malignant lesions on FNAC constituting 7.8% of thyroid lesions. All cases were papillary carcinoma thyroid . Histopathology was available in 7 cases and in all 7 cases the diagnosis correlated with cytological diagnosis. Smears showed the presence of thick or thin papillary tissue fragments with fibrovascular cores, sheets of tumor cells showing focal nuclear crowding and overlapping, irregular nuclear contours, powdery chromatin, intranuclear cytoplasmic inclusions (INCI) and nuclear grooves (NG).[FIGURE 3]

Figure 3 : Fnac : Nuclear Grooves In Follicular Cells In Pct



These nuclear changes are recognized with less difficulty in Papanicolaou-stained cell samples, but they may be difficult to identify in cell samples stained with the Romanowsky staining method.

Ko et al, have reported the predictive value of cytological diagnosis as 100% for papillary carcinoma.²⁰

One case of papillary carcinoma showed lymph node metastasis. Tsang et al have reported the occurrence of papillary carcinoma in the thyroid gland in 67.2%,thyroid plus cervical nodes in 13%, cervical lymph node only in 19.7%.²¹

Hyalinizing trabecular adenoma is indistinguishable from a PC cytologically, as these two lesions yield cells with similar nuclear features . Recent molecular studies have suggested that this tumor is actually an encapsulated trabecular variant of thyroid PC.²²

Tall-cell PC is characterized by the presence of tall tumor cells with well-defined, granular cytoplasm and nuclei with NGs and single or multiple INCIs, making at least 30% of the aspirated cells . Columnar-cell variant shows no classic cytologic features of thyroid PC, but presence of clusters of columnar cells with palisading nuclei and the absence of classic nuclear changes of thyroid PC are cellular features of this neoplasm . Diffuse sclerosing variant can be confidently suggested when abundant squamous cells admixed with lymphocytes, follicular epithelial cells with nuclear features of papillary carcinoma and a few psammoma bodies are noted .

Distribution of malignant lesions was compared with studies by Silverman et al and Afroze N et al.^{2,8,33} as shown in table IX

Table IX : Comparative Analysis Of Malignant Cytological Diagnosis^{2,8,33}

CYTOLOGICAL DIAGNOSIS	SILVERMAN et al (1986)		AFROZE N et al (2002)		CHETAN et al (2014)		PRESENT STUDY	
	NO.	%	NO.	%	No.	%	NO.	%
PAPILLARY CARCINOMA	2	0.6	11	6.47	18	1.9	14	7.82
MEDULLARY CARCINOMA	2	0.6	2	1.17	6	0.6	-	-
ANAPLASTIC CARCINOMA	-	-	-	-	2	0.2	-	-
METASTATIC CARCINOMA	-	-	2	1.17	-	-	-	-
TOTAL	4	1.29	15	8.82	26	2.75	14	7.82

FNAC of the thyroid swellings is reported to have a sensitivity range of 65-98% and a specificity of 72-100%.²³ In our study of 179 cytologically positive thyroid lesions, 48 cases were available for histopathological correlation, 46 cases correlated with the cytologic diagnosis , 11 cases were true positive, 35 cases were true negative and 2 cases were false negative. In our study , the analysis of the data revealed sensitivity of 84.61% , specificity of 100%, PPV of 100%, NPV of 94.59%, FPR of 0%, FNR of 15.38% and diagnostic accuracy of 95.83%.

The results of our study are comparable with the published data from different parts of the world as shown in table X

Table X : Comparison Of Diagnostic Value For Malignant Lesions^{1,2,3,7,29,30,33}

STUDIES	YEAR	SENSITIVITY	SPECIFICITY	PPV	NPV	ACCURACY
AFROZE N et al	2002	61.90%	99.31%	92.86%	94.74%	94.58%
SAEED A M et al	2004	98%	70%	91%	93%	91%
BAGGA PK et al	2010	66%	100%	100%	96%	96.20%
TARIQ et al	2010	75%	97.61%	85.71%	95.34%	94%
SWAMY GG et al	2011	75%	95.83%	81.81%	93.81%	96.60%
HEYDARALI et al	2012	91.60%	100%	100%	95.80%	97%
CHETAN et al	2014	89.5%	98%	84.6%	98.6%	97%
PRESENT STUDY	2014	84.61%	100%	100%	94.59%	95.83%

Our results coincides with the results of Tariq et al and Heydarali et al.^{29,30}

Even in the hands of experienced cytopathologist , approximately 10% of carcinoma excluding occult type will not be diagnosed by FNAC.²⁴

The false negative results may occur because of sampling error or misinterpretation of cytology and are of great concern because they indicate the potential to miss a malignant lesion²⁵. However it is difficult to calculate the true frequency of false negative results because only a small percentage (approx. 10%) of patients with benign cytological findings under go surgery²⁶.

Most of the authorities agree that the true false negative rate is below 5% if all the patients with thyroid FNAC also have a histological examination²⁶. In the present study false negative has occurred in two out of 123 patients with benign diagnosis accounting to 1.62%. This is consistent with reports in the literature that suggests a false negative rate of 2-7%²⁷ and other reported range from 1-16% in different series^{26,28}.

The false positive results were uncommon and it was 0% in our study, which was consistent with other reports that cite FPR results ranging from 0-9%²⁷.

Fine needle aspiration cytology has certain limitations on account of an inadequate sample and suspicious diagnosis. Intermediate FNAC results and cytodiagnostic errors are unavoidable due to overlapping cytological features, particularly among hyperplastic adenomatoid nodules, follicular neoplasms, and follicular variant of papillary carcinoma thyroid.

Inadequate samples may be because of sclerotic or calcified lesions and more commonly when there are large areas of cystic degeneration or necrosis. The advent of ultrasound guided FNA has improved sample acquisition from patients with small thyroid nodules, which are difficult or impossible to detect on physical examination. Borget et al. did an assessment of the cost of FNAC as a diagnostic tool in patients with thyroid nodules and concluded that in future, routine ultrasound guidance and on-site assessment of cytopathological adequacy would help reduce costs.³¹

Pitfalls in the FNAC of the thyroid as mentioned by Shaha (2000) are³²:

Adequacy of specimens (qualitative and quantitative), Accuracy of specimens (nonhomogeneity of needle placements), accuracy of cytopathological interpretation, Cysts (difficulties with degenerative nodules), Follicular lesions (benign vs malignant), Hurthle cell lesions (benign vs malignant), and Lymphocytic lesions (lymphocytic thyroiditis vs lymphomas).

The present study confirms the view that FNAC has potential ability to detect both benign and malignant lesions with high accuracy. Thus, FNAC can be effective and safe diagnostic method for defining thyroid disorders and is most useful tool in the diagnosis of thyroid nodules.

V. Conclusion

Fine needle aspiration cytology is a sensitive, specific, and accurate initial diagnostic test for the preoperative evaluation of patients with thyroid swelling. FNAC is an invaluable, minimally invasive, safe, highly accurate, cost effective, and easily performed OPD procedure. Surgical excision of all nodular thyroid lesions would entail a large number of unnecessary procedures. Thus, FNA of thyroid is basically a technique that helps in differentiating lesions that require surgery from those that be managed otherwise and it can be used as the initial modality in the evaluation of palpable thyroid nodules.

It seems that having one pathology increases the risk of developing another. All the palpable nodules in the same gland should be investigated by fine needle aspiration in order to improve diagnostic sensitivity to identify occult neoplasms. Geographical mass of neoplasms can be avoided by thyroid imaging prior to performance of the aspiration procedure so that cold nodules can be localized.

Cystic changes can occur in non-neoplastic and neoplastic lesions. In such cases, fluid should be aspirated completely and FNAC should be done from the residual mass. If there is no palpable mass, patient should be followed up with ultrasound examination and ultrasound guided FNAC should be done wherever necessary. Ultrasound guided FNAC improves the diagnostic yield in selected patients with unsatisfactory routine FNAC. Low rate of false positive and false negatives can be achieved by applying strict criteria for specimen adequacy. The correlation of cytological and histopathological diagnosis is an important quality assurance method, as it allows cytopathologists to calculate their false positive and false negative results.

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