Research Article

Accuracy of fine needle aspiration cytology (FNAC) in comparison to histopathological examination for the diagnosis of thyroid swellings

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Received April 30, 2016. Accepted June 21, 2016

Abstract

Background: Fine needle aspiration cytology (FNAC) is simple, readily available, reliable, time saving, and minimally invasive procedure. Hence, it is widely accepted as a diagnostic tool in recent years. Histopathological examination of surgically excised thyroid swelling is also one of the accurate ways to determine the pathology. However, it requires preparation and long procedure like anesthesia, hospitalization, and sometime even over treatment.

Objectives: Primary objective of this study was to evaluate the result of FNAC in diagnosis of various thyroid lesions and correlate the result of FNAC with histopathological examination in diagnosis of various thyroid lesions.

Material and Methods: A prospective study was carried out for the duration of 2 years. Data collected were detailed history of participants, general physical examination, and local examination. Investigations like thyroid function test, FNAC and whenever it was possible histopathological examination was done. Correlation of FNAC with histopathological examination was done in those patients.

Results: Out of total 150 recruited patients 132 (82%) were female. Common age group of presentation was 21–40 years of age with > 60% were presented during this period. Non-neoplastic non-inflammatory lesions were common (76.67%) with common lesion were colloid goiter (36.67%), benign cystic lesion (10.67%), and adenomatous goiter (10.67%). Briefly, 15 (10%) cases diagnosed as inflammatory lesion and 15 (10%) were neoplastic lesions. While 5 lesions were undiagnosed. Out of 60 correlated cases of FNAC with histopathological examination four were incorrectly diagnosed. The sensitivity of the FNAC was 85.71% and specificity was 96%. While positive predictive value (PPV) was 85.71% and negative predictive value was 96%.

Conclusion: FNAC could be considered as a primary investigational tool for diagnosis and to differentiate thyroid lesions and so for the selection of patients for surgery.

KEY WORDS: Thyroid swellings, fine needle aspiration cytology (FNAC), histopathological examination

Introduction

Thyroid diseases are common problem of enormous magnitude now a day all over the world. And it is necessary in the clinical practice is to distinguish reliably the few malignant thyroid tumors from the harmless thyroid lesions, so that a definitive preoperative tissue diagnosis of the malignancy allows planning of appropriate surgery and relevant patient counseling.

Access this article online	
Website: http://www.ijmsph.com	Quick Response Code:
DOI: 10.5455/ijmsph.2017.30042016536	

Fine needle aspiration cytology (FNAC) is simple, readily available, reliable, time saving, and minimally invasive procedure.[1] Hence, it is widely accepted as a diagnostic tool in recent years. Various literatures and articles have been published during the last 50years, which have put the cytology in first line. In 1993, Stewart had stated that "diagnosis by FNAC is reliable as combined intelligence of the clinicians and pathologists make it".[2] It is useful for diagnosis of pathological lesions of multiple organs such as lymph node, breast, thyroid, etc. Being superficial and easily accessible thyroid is an ideal

organ for FNAC. Moreover, it has a wide range of pathological behaviors. It is vital for surgeon to know the morphological nature of the lesion before any surgery. With FNAC, thyroid function tests are also helpful in diagnosis in thyrotoxicosis and thyroiditis. It also helps in deciding the line of treatment and taking decision about the surgical procedure.[3]

Another procedure, like histopathological examination of surgically excised thyroid swelling is also one of the accurate ways to determine the pathology. However, it requires preparation and long procedure like anesthesia, hospitalization and sometime even over treatment.[4]

Primary objective of this study was to evaluate the result of FNAC in diagnosis of various thyroid lesions and correlate the result of FNAC with histopathological examination in diagnosis of various thyroid lesions.

Material and Methods

A prospective study carried out at P.D.U. Medical College and Hospital, Rajkot. Institutional ethics committee permission was taken before starting the study.

All the patients with thyroid enlargement visiting surgery and other departments were included in the study. There were no any specified exclusion criteria. During study duration of 2 year, a total of 150 patients with thyroid enlargement were recruited in the study. Informed written consent from all patients was taken before recruitment in the study.

Detailed history of participants like demographic data, history of present thyroid swelling, weight loss, diplopia, mood, and drug history were taken. Patients' general examination and local examination of swelling was performed. Routine investigations and thyroid function test like Serum T3, T4, and TSH as well as FNAC examination was performed in each patient. Among all participants only 60 participants undergo operative procedure. Histopathological examination of the tumor could be done only in operated patients. Correlation of FNAC with histopathological examination was done in those patients.

FNAC diagnosis was classified in following categories:

1. *Non-neoplastic and non-inflammatory lesion*: Colloid goiter, adenomatous goiter, benign cystic lesion, hyperplasia, thyroglossal cyst, thyrotoxicosis.
2. *Inflammatory lesion*: Thyroiditis.
3. *Neoplastic lesion*: Follicular neoplasm including benign and malignant
   a. *Intermediate*: All follicular neoplasm and lesions having suspicious cells with atypical features.
   b. *Malignant*: Carcinoma and follicular neoplasm with malignant cytology.
4. *Non-diagnostic*: Material was inadequate for diagnosis.

For correlation of FNAC diagnosis and histopathological diagnosis of lesion following criteria were used:[5]

True positive: Positive for malignancy or suspicious for malignancy with subsequent confirmation by final histopathological examination.

True negative: Negative for malignancy with subsequent benign confirmation by final histopathological examination.

False positive: Positive for malignancy or suspicious diagnosis for malignancy with no evidence of malignancy on final histopathological examination.

False negative: Negative for malignancy but diagnosed as malignant by final histopathological examination.

Accuracy, sensitivity, specificity, positive predictive value (PPV), and negative predictive value were calculated.

Results

Within 2 year of the study duration total 150 patients of thyroid swelling could be included. FNAC was performed in all patients; while histopathological examination could be perform in only 60 patients. And correlation of FNAC and histopathological examination wasdone only in those patients. In 5 patients inadequate FNAC material was obtained. Hence, they were undiagnosed by FNAC examination.

The incidence of non-inflammatory non-neoplastic lesions was 115 (76.66%). Among them colloid goiter was 36.66% followed by benign cystic lesion (24.66%), and adenomatous goiter (10.66%). Inflammatory lesion like thyroiditis was seen in 15 (10%) patients. Neoplastic lesions were seen in 15 (10%) patients. Among them 11 (7.33%) cases were of benign and malignant follicular lesions. Out of which 6 cases were follicular adenoma and 2 cases were adenomatous goiter. While 3 cases required histopatholigical confirmation. The frequencies of malignant thyroid tumors like papillary carcinoma (1.33%), medullary carcinoma (0.66%), and anaplastic carcinoma were (0.66%) (Table 1). Among 55 cases of goiter 35 were euthyroid, 10 were hyperthyroid, and 10 were

Table 1: Distribution of various lesions diagnosed by FNAC

Thyroid lesions	No. of cases	Percentage
Non-neoplastic non-inflammatory lesions	**115**	**76.67**
Colloid goiter	55	36.67
Adenomatous goiter	16	10.67
Benign cystic lesions	37	24.67
Thyrotoxicosis	5	3.33
Thyroglossal cyst	2	1.33
Inflammatory lesion	**15**	**10**
Thyroiditis	15	10
Neoplastic lesions	**15**	**10**
Follicular neoplasm: benign and malignant	**11**	**7.33**
Malignant tumors	**4**	**2.67**
Papillary carcinoma	2	1.33
Medullary carcinoma	1	0.67
Anaplastic carcinoma	1	0.67
Non-diagnostic	**5**	**3.33**
Total	**150**	**100**

hypothyroid. Among 37 cases of benign cystic thyroid lesion patients 30 were euthyroid, 4 were hyperthyroid, and 3 were hypothyroid. While out of 16 patients of adenomatous goiter 14 were euthyroid and 2 were hyperthyroid. Among 11 patients of follicular neoplasm 8 were euthyroid and 3 were hyperthyroid. Patients diagnosed with medullary and anaplastic carcinoma were euthyroid. While among 2 cases of papillary carcinoma 1 was euthyroid and 1 was hyperthyroid.

Age-wise distribution shows that most of the patients with thyroid disease (i.e., nearly 70%) presented during 3rd and 4th decade of life (Table 2). Non-neoplastic non-inflammatory lesions like goiter shows same distribution with highest number of patients presented during 21–40 years of age. Same result was seen with adenomatous goiter and benign cystic lesion. Neoplastic lesions shows highest incidence during 31–40 years of age with commonest tumor was follicular neoplasm. Table 3 shows gender-wise distribution of all thyroid lesions. It shows that the ratio of male:female was 1:7.3. Tables 4 and 5 show both age- and gender-wise distribution of thyroid lesions. The most common age group for thyroid lesion was 31–40 years of age in both male and female.

Out of total 150 cases 50 undergo surgery and classification by histopathological examination of the lesion is given in Table 6. Non-neoplastic non-inflammatory lesions were the commonest type of lesion. Among them colloid goiter was the most common followed by benign cystic lesion. Other common lesions were benign tumors (8), inflammatory lesions (6) and malignant tumors (4). Figure 1 shows pseudopapillae formation in adenomatous goiter. Figure 2 shows lymphocytes with Hurthle cells in Hashimoto's thyroiditis. Figure 3 shows nuclear crowding and overlapping in papillary carcinoma.

The correlation of diagnosis was carried out between histopathological examination and FNAC as seen in Table 7. Total 60 cases diagnosed by HPE correlated with FNAC examination. Among NNNI lesions, out of total 55 cases of colloid goiter, histopathological correlation done in 20 cases. Out of 16 cases of adenomatous goiter, 4 cases were confirmed by HPE, while 2 cases were incorrect, in which final diagnosis was follicular adenoma. All other types of NNNI and inflammatory lesions were correctly diagnosed by FNAC as compared with histopathological examination. In neoplastic lesions HPE was performedin 12 cases out of 15 cases. All

Table 2: Age-wise distribution of various thyroid lesions diagnosed by FNAC

Age in years	1–10	11–20	21–30	31–40	41–50	51–60	61–70	71–80	Total	Percentage
NNNI lesions	**1**	**12**	**32**	**42**	**13**	**12**	**2**	**1**	**115**	**76.67**
Colloid goiter	–	7	13	23	3	7	1	1	55	36.67
Adenomatous goiter	–	3	8	3	2	–	–	–	16	10.67
Benign cystic lesions	–	2	8	14	7	5	1	–	37	24.67
Thyrotoxicosis	–	–	2	2	1	–	–	–	5	3.33
Thyroglossal cyst	1	–	1	–	–	–	–	–	2	1.33
Inflammatory lesion	**–**	**4**	**3**	**6**	**2**	**–**	**–**	**–**	**15**	**10.00**
Thyroiditis	–	4	3	6	2	–	–	–	15	10.00
Neoplastic lesions	**–**	**2**	**3**	**5**	**3**	**1**	**1**	**–**	**15**	**10.00**
Follicular neoplasm	**–**	**2**	**2**	**4**	**2**	**1**	**–**	**–**	**11**	**7.33**
Malignant tumors	**–**	**–**	**1**	**1**	**1**	**–**	**1**	**–**	**4**	**2.67**
Papillary carcinoma	–	–	1	1	–	–	–	–	2	1.33
Medullary carcinoma	–	–	–	–	1	–	–	–	1	0.67
Anaplastic carcinoma	–	–	–	–	–	–	1	–	1	0.67
Non-diagnostic	**–**	**–**	**2**	**3**	**–**	**–**	**–**	**–**	**5**	**3.33**
Total	**1**	**18**	**40**	**56**	**18**	**13**	**3**	**1**	**150**	**100.00**
Percentage	0.67	12.00	26.67	37.33	12.00	8.67	2.0	0.07	100	

Table 3: Gender-wise distribution of thyroid lesions diagnosed by FNAC

Gender	Non-inflammatory non-neoplastic lesions	Inflammatory lesions	Neoplastic lesions		Total	Percentage
			Follicularneoplasm	Malignant neoplasm		
Male	14	1	2	1	18	12
Female	101	14	9	3	127 (+5)*	88
Total	115 (76.67%)	15 (10%)	11 (7.33%)	4 (2.77%)	150	100
M:F ratio	1:7.21	1:14	1:4.5	1:3	1:7.3	

*Undiagnosed by FNAC because of inadequate sample.

Table 4: Age- and gender-wise distribution in non-neoplastic non-inflammatory and inflammatory lesions

Age-wise distribution	Gender-wise distribution												
	Colloid goiter		Adenomatous goiter		Benign cystic lesion		Thyrotoxicosis		Thyroglossal cyst		Thyroiditis		Total
	M	F	M	F	M	F	M	F	M	F	M	F	
1–10	–	–	–	–	–	–	–	–	1	–	–	–	1
11–20	–	7	–	–	–	2	–	–	–	–	–	4	16
21–30	–	13	2	3	1	7	–	2	–	1	1	2	35
31–40	5	20	–	6	3	9	–	2	–	–	–	6	48
41–50	–	3	–	3	1	6	–	1	–	–	–	2	15
51–60	–	6	–	2	1	5	–	–	–	–	–	–	12
61–70	–	–	–	–	–	2	–	–	–	–	–	–	2
71–80	–	1	–	–	–	–	–	–	–	–	–	–	1
Total	5	50	2	14	6	31	0	5	1	1	1	14	130
M:F ratio	1:10		1:7		1:5.1		–		1:1		1:14		

Table 5: Age- and gender-wise distribution in neoplastic lesions

Age-wise distribution	Gender-wise distribution								
	Follicular neoplasm		Papillary carcinoma		Medullary carcinoma		Anaplastic carcinoma		Total
	M	F	M	F	M	F	M	F	
1–10	–	–	–	–	–	–	–	–	–
11–20	–	2	–	–	–	–	–	–	2
21–30	–	2	–	1	–	–	–	–	3
31–40	1	3	–	1	–	–	–	–	5
41–50	1	1	–	–	–	1	–	–	3
51–60	–	1	–	–	–	–	–	–	1
61–70	–	–	–	–	–	–	1	–	1
71–80	–	–	–	–	–	–	–	–	–
Total	2	9	0	2	0	1	1	0	15
M:F ratio	1:4.5		–		–		–		

Table 6: various types of thyroid lesions diagnosed by histopathological examination

Thyroid lesions	No. of cases	Percentages
Non-neoplastic non-inflammatory lesions	**42**	**71.67**
Colloid goiter	20	33.33
Adenomatous goiter	6	10
Benign cystic lesions	10	16.67
Thyrotoxicosis	4	6.67
Thyroglossal cyst	2	3.33
Inflammatory lesion	**6**	**10**
Thyroiditis	6	10
Neoplastic lesions	**12**	**20**
Benign tumors	**8**	**13.33**
Follicular adenoma	8	13.33
Malignant tumors	**4**	**6.67**
Papillary carcinoma	2	3.33
Medullary carcinoma	1	1.67
Anaplastic carcinoma	1	1.67
Total	**60**	**100**

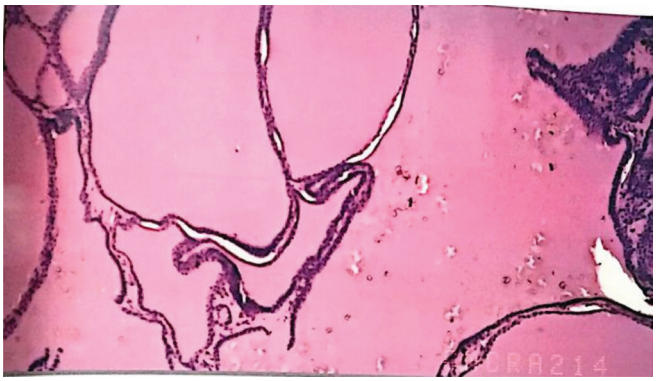

Figure 1: Pseudopapillae formation – adenomatous goiter

malignant lesions were correctly diagnosed by FNAC, while out of 8 follicular neoplasms diagnosed by FNAC, 6 turned out correct while 2 were incorrect while compare with HPE. They turned out adenomatous goiter by HPE.

In the present study, the sensitivity of the FNAC found out 85.71% and specificity 96%. While positive predictive value (PPV) was 85.71% and negative predictive value was 96%.

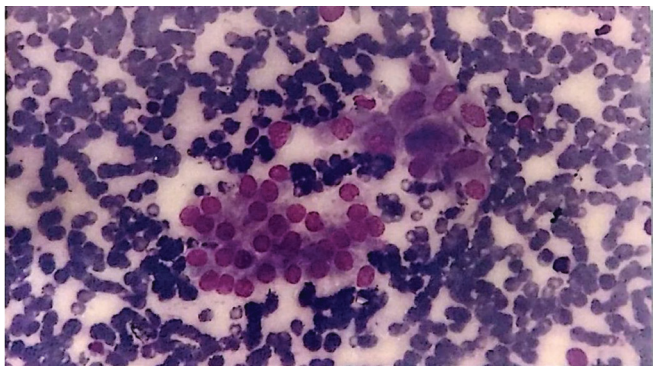

Figure 2: Hurthle cells with lymphocytes in Hashimoto's thyroiditis

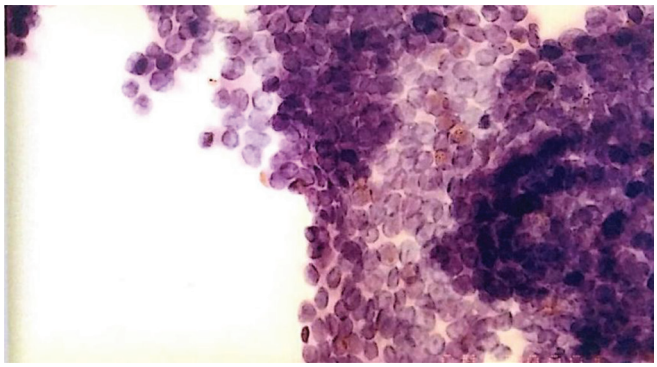

Figure 3: Nuclear crowding and overlapping in papillary carcinoma

Discussion

Clinical assessment of thyroid lesions by means of physical examination, hormone study, and ultrasonography is not completely reliable. A surgeon must have knowledge about nature of lesion before performing total or subtotal thyroidectomy for any type of thyroid lesion. As diagnosis of thyroid lesion concern FNAC and histopathological examination (HPE) are common investigation.[6] Among them FNAC is commonly used as primary investigation for diagnosis.

In the present study, total 150 patients were aspirated for FNAC and out of them 60 underwent surgery. Operative treatment was avoided in many patients after performing FNAC. It was helpful in segregating those cases of thyroid nodule which can be followed clinically, from those requiring surgical intervention.

In present study, it was observed that the frequency of thyroid lesions was maximum during 3rd and 4th decades of life, and mean age of patient was 33 years. In the study performed by different researchers, mean age of patients were ranging from 34 to 54 years. Most of the studies from outside India had mean age of more than 40 years like study by Hall,[7] Godhinos-Matos et al,[8] and Rodriguez et al[9] had mean age of 45, 51, and 41 years, respectively. However, most of the Indian studies have mean age is less than 40 years like Bapat et al,[10] Prasad,[11] and Mira and Pathak[12] had mean age of presentation for thyroid lesion are 35, 34.54, and38 years, respectively. Gender-wise distribution shows that thyroid lesions are predominant in female with ratio of M:F and in the present study it was 1:7.3. Most of the other studies also have same findings with M:F ratio ranges from 1:3.84 to 1:11.2.

As seen in Table 7, in the present study, 56 cases were diagnosed as non-malignant lesion and 4 malignant lesions by FNAC. On comparison with HPE examination, all malignant

Table 7: FNAC correlation with histopathological examination for various types of thyroid lesions

Thyroid lesions	No. of cases by FNAC	Histopathological examination	Cytological diagnosis		Accuracy
			Correct	Incorrect	
Non-neoplastic non-inflammatory lesions	**115**	**42**	**40**	**2**	**95.23**
Colloid goiter	55	20	20	–	100
Adenomatous goiter	16	6	4	2	66
Benign cystic lesions	37	10	10		100
Thyrotoxicosis	5	4	4		100
Thyroglossal cyst	2	2	2		100
Inflammatory lesion	**15**	**6**	**6**		**100**
Thyroiditis	15	6	6		100
Neoplastic lesions	**15**	**12**	**10**	**2**	**83.33**
Follicular neoplasm	**11**	**8**	**8**	**2**	**75**
Malignant tumors	**4**	**4**	**4**		**100**
Papillary carcinoma	2	2	2		100
Medullary carcinoma	1	1	1		100
Anaplastic carcinoma	1	1	1		100
Non-diagnostic	**5**	**–**	**–**		**–**
Total	**150**	**60**	**56**	**4**	**93.33**

lesions were correctly diagnosed. While among non-malignant lesions, out of 56 lesions, 4 were not diagnosed correctly. Although, cytodiagnosis in some cases were incorrect or differ by their subtype, e.g., FNAC diagnosed lymphocytic thyroiditis, which was Hashimoto's thyroiditis on HPE. However, final diagnosis remains in the same group, did not affect the management of the patient. Hence, these cases were considered as diagnosed correctly. Accuracy rate of correct diagnosis by FNAC was achieved in 92.85%cases in non-malignant lesion. In other studies, Prasad,[11] Kamaljit Kaur et al,[12] and Mitra and Pathak[13] accuracy of diagnosis by FNAC was found between 94% and 97% among non-malignant thyroid lesions. In the present study, among the group of non-neoplastic non-inflammatory (NNNI) lesions out of 42 lesions 2 were incorrect with accuracy of 95.23% was observed. These two cases were of adenocarcinoma, which were misdiagnosed as follicular neoplasm, because of hyperplastic nodule mimics follicular neoplasm. While in Prasad's study 2 cases of colloid goiter was misdiagnosed, and in Mitra and Pathak's study and Kamaljit Kaur's study 2 and 1, respectively, cases of adenomatous goiter were misdiagnosed. The apparent accuracy in diagnosis of inflammatory lesion in present study was 100%. However, out of 4 Hashimoto's thyroiditis and 2 lymphocytic thyroiditis cases and 1 Hashimoto's thyroiditis were misinterpreted as lymphocytic thyroiditis, and one lymphocytic thyroiditis was misdiagnosed as subacutegranulomatous thyroiditis.

Among the neoplastic lesions, in the present study, follicular adenomas were diagnosed with 100% accuracy by FNAC. While accuracy for diagnosis of follicular carcinoma was 75% with 2 out of 8 cases were misdiagnosed as follicular adenoma. All malignant lesions were diagnosed accurately by FNAC. While other studies like Mitra and Pathak's[12] study accuracy level for malignant neoplasm was 92.3% and Karamjit Kaur's[13] study had 62.5%.

Briefly, 5 out of 150 FNAC of thyroid (3.3%) were remaining undiagnosed because of inadequate material or faulty procedure. It is lowest among the other studies. The sensitivity and specificity of FNAC to detect the various thyroid lesions in present study were 85.71% and 95%, respectively. Sensitivity in other studies like Mandell[14] and Duek[15] found to be 89% and 79.1%, respectively. While their specificity were 97% and 96.5%, respectively. The positive predictive value and negative predictive value for FNAC were 85.75% and 96%, respectively.

Conclusion

The results of the present studyshow that the FNAC could be consider as primary investigational tool for diagnosis and to differentiate thyroid lesions and so for the selection of patients for surgery.

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How to cite this article: Goswami D, Agrawal P, Shinde P. Accuracy of fine needle aspiration cytology (FNAC) in comparison to histopathological examination for the diagnosis of thyroid swellings. Int J Med Sci Public Health 2017;6:6-11

Source of Support: Nil, **Conflict of Interest:** None declared.