

Association of Fine Needle Aspiration Cytology with Histopathology and Thyroid-stimulating Hormone in the Diagnosis of Thyroid Lesions

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ABSTRACT

Introduction: Diseases of the thyroid gland include both benign and malignant conditions. Benign conditions include goiter, thyroiditis, and follicular adenoma. Malignant conditions include follicular, papillary, medullary, anaplastic carcinoma. Fine needle aspiration cytology (FNAC) of the thyroid gland is the first-line diagnostic test for the evaluation of diffuse thyroid lesions as well as thyroid nodules. The main purpose it serves is in confirming benign lesions and avoiding surgery in benign lesions. The most common investigations, a patient of thyroid lesion undergoes, include thyroid assay and FNAC.

Materials and methods: This prospective hospital-based observational study includes all patients from January 2019 to June 2019, with thyroid lesions who will undergo FNAC, excisional biopsy of thyroid, and serum thyroid-stimulating hormone (TSH) level. In the department of pathology Mahatma Gandhi Medical College and Hospital, Sitapura, Jaipur (Rajasthan).

Results: The study was undertaken on 60 patients with clinically thyroid lesions during a period of approximately January 2019 to June 2019. Most thyroid lesions in our study were benign (62%). Out of 39 cytological benign lesions, 2 on histopathological follow-up were found malignant, i.e., 5%, and the rest 37 cases were found benign, i.e., 95%. All of the 16 cytological malignant lesions on histopathological follow-up were found malignant, i.e., 100%. All of the five cytologically suspicious for malignancy were found malignant on histopathological follow-up, i.e., 100%. In the present study, maximum number of benign cases, i.e., 14 cases (38%), were found to have serum TSH levels in the range of 0.40–1.39 μ IU/mL, and the maximum number of malignant, i.e., 13 cases (53%), were found TSH in the range of 5 μ IU/mL or more on the basis histopathological diagnosis. In the present study, maximum number of benign, i.e., 15 cases (38.4%), were found to have TSH in the range of 0.40–1.39 μ IU/mL, and a maximum number of malignant cases, i.e., 12 (57.14%), were found in the TSH range of 5 μ IU/mL or more on the basis cytology diagnosis.

Conclusion: There is a significant association between TSH and malignancy, TSH within high normal range and higher serum concentration TSH both are associated with a higher risk of thyroid malignancy.

Keywords: Fine needle aspiration cytology, FNAC sensitivity, Histopathology, Specificity, Thyroid gland, Thyroid-stimulating hormone.

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INTRODUCTION

Thyroid-stimulating hormone (TSH) plays a major role in thyroid hormone secretion, maintenance of thyroid-specific gene expression as well as in gland growth.¹ It is also involved in the regulation of thyroid function, such as, secretion of thyroid hormones, maintenance of thyroid-specific gene expression (differentiation), and gland growth.²

Diseases of the thyroid gland include benign and malignant conditions. Benign conditions include goiter and thyroiditis follicular adenoma. Malignant conditions include follicular, papillary, medullary, and anaplastic carcinoma. A detailed physical examination and history are necessary and important. Points in history include family history, previous neck irradiation, a sudden increase in the size of the nodule and detailed examination include consistency of nodule, change in voice, and cervical lymphadenopathy. Next comes serum levels of T3, T4, and TSH not only for the categorization of the condition into the hyper- or hypothyroid but also for the proper treatment plan of the patient.

Hashimoto's thyroiditis (HT) is frequently diagnosed especially in females and is the most common cause of hypothyroidism in iodine-sufficient areas of the world, with an increasing prevalence in older patients.³ Thyroid cancer is the most common malignant tumor of the endocrine system being about 0.1–0.2% in relative

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frequency and the incidence is around 1 for males and 1.8 for females per 100,000. Papillary thyroid carcinoma constitutes about 80% of these cancers.⁴

The most common investigations a patient of thyroid lesion undergoes include thyroid assay and fine needle aspiration cytology (FNAC). Thyroid assay includes a quantitative analysis of serum levels of T3, T4, and TSH. Apart from inferring a hypothyroid condition, higher TSH levels have also been associated with advanced-stage thyroid cancer and it has been suggested that TSH may play a central role in its development and progression.⁵

Fine needle aspiration cytology of the thyroid gland is the first-line diagnostic test for the evaluation of diffuse thyroid lesions as well as thyroid nodules. The main purpose it serves is in confirming benign lesions and avoiding surgery in benign lesions.⁶ Thyroid FNAC is a simple, safe, reliable, cost-effective, and minimally invasive technique for detecting malignant nodules and has been purported to be the diagnostic method of choice in the initial approach to patients with solitary thyroid nodules.⁷ Fine needle aspiration has also been shown to have similar or higher sensitivity and accuracy levels than the frozen section examination.

Multiple organizations have proposed diagnostic guidelines for reporting thyroid FNAC results including the Papanicolaou Society of Cytopathology Task Force and the American Thyroid Association, however, none have been universally accepted.^{8,9}

The Bethesda system for reporting thyroid cytopathology (TBSRTC) was introduced to standardize the communication of FNAC interpretation between clinicians and pathologists.¹⁰ The Bethesda system for reporting thyroid cytopathology was first introduced in 2007 and has been modified recently in 2017 to incorporate categories to further impart uniformity and diagnosis and guiding management principles. Each category has an implied cancer risk that ranges from 0 to 3% for the “benign” category to virtually 100% for the “malignant” category, and, in the 2017 revision, the malignancy risks have been updated based on new (post-2010) data.¹¹

The risk of malignancy described by TBSRTC for various categories was found to be inconsistent and thus further research on the risk attributable to each category is required.¹⁰ After estimation of malignant potential of the thyroid lesions using TBSRTC after FNAC, the surgeon decides on whether the lesion needs to be removed or not. Histopathological examination (HPE) of the excised lesion finally confirms the diagnosis and thus is considered the gold standard in the pathological diagnosis of the lesion. The decision to excise the nodule in case of malignant and suspicious lesions is clear and the risk of malignancy in the benign and non-diagnostic categories of TBSRTC has been described differently by various researchers. In our study, we will try to understand this difference also during our research.

Other background tests that can be done include radionuclide scanning to determine hot (hyperfunctioning), warm (normal), and cold (hypofunctioning) nodules and ultrasonography to determine the size and number of thyroid nodules. Serum antithyroid peroxidase antibody and antithyroglobulin antibody levels are helpful in the diagnosis of Hashimoto's disease especially if serum TSH is increased. Its value lies in serial determination after thyroidectomy following the treatment of thyroid cancer. In patients with a family history of medullary carcinoma thyroid-specific genetic testing and calcitonin levels should be determined.¹²

MATERIALS AND METHODS

Aims and Objectives

- To determine the overall diagnostic sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of FNAC in thyroid lesions.
- To assess the diagnostic accuracy of FNAC in thyroid lesions.
- To study the role of TSH in various thyroid lesions.
- To study the correlation of FNAC with histopathology and TSH in various lesions of the thyroid.

All patients from January 2019 to June 2019, with thyroid lesions who will undergo FNAC, excisional biopsy of thyroid and TSH, will be included in the study.

Eligibility Criteria

Inclusion Criteria

- Patients with thyroid swelling.
- Patient giving informed consent.

Exclusion Criteria

- Patients who refused to give consent.
- Patients who will undergo only FNAC or excisional biopsy.
- Patients who did not have a TSH test done.

Patients with thyroid swelling admitted in various surgical wards or attending the outpatient department of Mahatma Gandhi Hospital, Jaipur were included in the study. Case history and clinical examination were recorded. Thyroid-stimulating hormone, FNAC, and HPE of the same patient performed on an indoor basis in our hospital were included in this study. The general data of each patient were also recorded. Examination of thyroid lesion with regards to site, size, consistency, and mobility with deglutition was documented.

The patient's serum was processed on Ortho Clinical Diagnostics VITROS 5600 and TSH value was estimated.

Fine needle aspiration of thyroid swelling was performed by standard methods. Smears were prepared on a glass slide, stained by hematoxylin and eosin (H&E) and May-Grunewald-Giemsa (MGG) stains. Stained smears were examined under a microscope and reported. Depending on the cytomorphologic features, the lesions were categorized into sixth main categories according to TBSRTC.

The cytological diagnosis was correlated with the HPE.

OBSERVATIONS AND RESULTS

According to TBSRTC, in this study, no lesion fell in category I, 58% in category II, 2% in category III, 25% in category IV, 7% in category V, and 8% in category VI (Table 1).

Benign lesions included colloid goiter 20%, nodular colloid goiter 25%, thyroglossal fistula 1%, HT 3%, follicular adenoma 12%, whereas malignant lesions included follicular carcinoma 14%, follicular carcinoma with papillary nuclear features 5%, papillary thyroid carcinoma 8%, medullary thyroid carcinoma 8%, and anaplastic carcinoma 3%. Out of a total of 62% benign cases, colloid goiter was 20%, nodular colloid goiter 25%, HT 3%, thyroglossal fistula 2%, and follicular adenoma 12%. Out of a total of 32% malignant cases, 14% were follicular carcinoma, papillary carcinoma was 8%, follicular carcinoma with papillary nuclear features 5%, medullary carcinoma 8%, and anaplastic carcinoma 3% (Table 2).

Out of 39 FNAC-proven cases on HPE, 2 cases were found malignant, i.e., 5%, and the rest 37 cases were found benign, i.e., 95%. All of the 16 FNAC-proven malignant cases on HPE were found malignant, i.e., 100%. Out of five FNAC-proven suspicious for malignant were found malignant on HPE, i.e., 100% (Table 3).

The overall sensitivity of FNAC to detect malignancy in the present study was 88.8%, specificity 100%, PPV 100%, NPV 94.87%, and diagnostic accuracy 96.3% (Table 4).

Table 1: Distribution of cases according to the Bethesda system for reporting thyroid cytology pathology: diagnostic categories

Categories	Include	Cytodiagnosis	
Category I	Non-diagnostic or unsatisfactory	–	
Category II	• Benign	Adenomatoid nodule	19
	• Benign follicular nodule	Colloid nodule	15
	• Chronic lymphocytic thyroiditis		1
	• Granulomatous thyroiditis	–	
Category III	Follicular lesion of undermined significance	1	
Category IV	Suspicious for follicular neoplasm	Follicular adenoma	3
		Follicular neoplasm	12
Category V	• Suspicious for malignancy	3	3
	• Suspicious for papillary thyroid carcinoma	1	1
	• Suspicious for medullary thyroid carcinoma		
	• Suspicious for metastatic carcinoma		
	• Suspicious for lymphoma		
Category VI	• Other		
	• Malignant		1
	• Papillary thyroid carcinoma		
	• Poorly differentiated carcinoma		
	• Medullary thyroid carcinoma		2
	• Differentiated (anaplastic) carcinoma		2
	• Squamous cell carcinoma		
	• Carcinoma with mixed features		
	• Metastatic malignancy		
	• Non-Hodgkin lymphoma		
• Other			

The maximum number of 14 (37%) benign cases were found with TSH in the range of 0.40–1.39 (µIU/mL), next in order were 9 (25%) cases with TSH in the range of 1.04–2.49 (µIU/mL). The maximum number of malignant cases, i.e., 13 (56%), were found with TSH in the range of 5 or more (µIU/mL), next in order was 4 (18%) cases with TSH in the range of 2.05–4.99 (µIU/mL) (Table 5).

Table 2: Percentage distribution of lesions on histopathology

Histopathological diagnosis	Total no. of cases (%)
Benign	37 (62)
Colloid goiter	12 (20)
Nodular colloid goiter	15 (25)
Thyroglossal fistula	1 (2)
Hashimoto thyroiditis	2 (3)
Follicular adenoma	7 (12)
Malignant	23 (38)
Follicular carcinoma	8 (14)
Follicular carcinoma with papillary nuclear features	3 (5)
Papillary thyroid carcinoma	5 (8)
Medullary carcinoma	5 (8)
Anaplastic carcinoma	2 (3)
Total	60

Table 3: Statistical data

Cytodiagnosis	No. of cases	Histological diagnosis	
		Positive	Negative
Benign	39	2 fn 5%	37 tn 95%
Malignant	16	16 tp 100%	00 fp
Suspicious of malignancy	05	05 100%	
	60	23 (38)	37 (62)

Table 4: Overall sensitivity, specificity, PPV, NPV, and diagnostic accuracy to detect malignancy

S. no.	Statistical analysis	Percentage
1	Sensitivity	88.8
2	Specificity	100
3	Positive predictive value	100
4	Negative predictive value	94.87
5	% False-positive	0
6	% False-negative	11.1
7	Diagnostic accuracy	96.3

Table 5: Distribution of histopathology benign and malignant cases with TSH level

TSH level (µIU/mL)	Benign (n = 37) (%)	Malignant (n = 23) (%)
<0.06	3 (8)	0
0.06–0.39	3 (8)	1 (5)
0.40–1.39	14 (37)	2 (9)
1.40–2.49	9 (25)	3 (13)
2.50–4.99	7 (20)	4 (18)
5 or more	1 (3)	13 (56)

Thyroid-stimulating hormone level has a statistically significant association with malignancy. Thyroid-stimulating hormone levels were significantly higher in malignancies as compared to the benign conditions. Hence, *p* value is <0.000 is statistically significant (Table 6). The overall sensitivity of TSH to detect malignancy in the present study was 73.90%, specificity 78%, PPV 68%, and NPV 82.30% (Table 7).

Table 6: Distribution of cases with low normal TSH level and high normal TSH level

TSH level	Malignant	Benign	χ^2 (df)	p value
>2.50	8FP	17TP	16 (1)	0.000
<2.50	29TN	6FN		

Table 7: Overall sensitivity, specificity, PPV, and NPV of TSH levels

S. no.	Statistical analysis	Percentage
1	Sensitivity	73.90
2	Specificity	78
3	Positive predictive value	68
4	Negative predictive value	82.30

Table 8: Distribution of FNAC of benign and malignant cases with TSH level

TSH level (μ U/mL)	Benign (n = 39) (%)	Malignant (n = 21) (%)
<0.06	3 (8)	0
0.06–0.39	3 (8)	1 (5)
0.40–1.39	15 (37)	1 (5)
1.40–2.49	8 (21)	4 (20)
2.50–4.99	8 (21)	3 (14)
5 or more	2 (5)	12 (56)

Table 9: Association of FNAC and histopathology and TSH in thyroid lesion

Group	TSH	FNAC	B (%)	M (%)
I	N	B37	36 (97)	1 (3)
II	N	M9	0	9 (100)
III	H	B2	1 (50)	1 (50)
IV	H	M12	0	12 (100)

A maximum number of benign cases, i.e., 15 (37%), were found in TSH in the range of 0.40–1.39 (μ U/mL), next in order were 8 (21%) cases in TSH in the range of 1.04–2.49 (μ U/mL). The maximum number of malignant cases, i.e., 12 (56%), were found in TSH in the range of 5 or more (μ U/mL), next in order was 4 (20%) cases in TSH in the range of 1.40–2.49 (μ U/mL) (Table 8). Out of 37 benign lesions with normal TSH levels, 36 (97%) were found benign and 1 (3%) malignant. Out of nine malignant lesions, all nine (100%) were found malignant. Out of two benign lesions with high TSH levels, one (50%) were found benign and one (50%) were malignant. Out of 12 (100%) with a high TSH level, all were malignant (Table 9).

DISCUSSION

Fine needle aspiration cytology of the thyroid gland is an accurate diagnostic test routinely done in the initial evaluation of lesions of the thyroid gland. This technique is a sensitive, specific, minimally invasive, cost-effective, and efficient method of differentiating various lesions of the thyroid gland. Fine needle aspiration cytology was done under aseptic precautions and smears were prepared. Smears fixed in 95% alcohol were stained with H&E and the air-dried smears were stained with MGG.

Depending on the cytomorphological features in the FNAC, the lesions were accordingly categorized. Our study was designed to assess the role of FNAC in diagnosing various lesions of the thyroid gland and to calculate the sensitivity, specificity, PPV, NPV, and diagnostic accuracy in detecting malignancy.

The present study was carried at the Department of Pathology, Mahatma Gandhi Medical College and Hospital, Sitapura, Jaipur. Age group analysis: mean age of patients in our study was found to be 41.6 and most commonly they were in the range of 30–39 years.

In our study, benign lesions, such as, cystic lesion were 3%, thyroiditis 3%, colloid goiter 20%, follicular adenoma 12%, whereas Bhojani et al.¹³ found cystic lesion 3%, thyroiditis 6%, colloid goiter 76%, follicular adenoma 4%, and malignant lesion, such as, papillary carcinoma 8%, follicular carcinoma 14%, medullary carcinoma 8%, anaplastic carcinoma 3%, whereas Bhojani et al.¹³ found papillary carcinoma 2%, follicular carcinoma 2%, medullary carcinoma 0%, and anaplastic carcinoma 1%. As compare with Bhojani et al.¹³ study, malignant cases are more in our study (Table 10). Bhojani et al.¹³ studied a total number of 100 cases, out of which 94 were benign in FNAC were found 93 benign in histopathology and 1 case was found malignant as compare in our study total number of cases 60 out of which 40 were benign in FNAC was found 37 benign in histopathology and 3 cases were found malignant, i.e., 1.07% false-negative and 7.5% false-negative in FNAC was found in Bhojani et al.¹³ study, respectively (Table 11). In our study, the total number of cases was 60, out of which 20 cases that were malignant in FNAC were subsequently found malignant in histopathology, i.e., 100%. Similarly, Bhojani et al.¹³ observed that out of a total number of 100 cases cytologically 6 cases were malignant and subsequently found malignant in histopathology also, i.e., 100% (Table 12). Several false-negative cases in the present study are 5% as compare with Gupta et al.¹⁷ A total of 13% were false-negative cases (Table 13). In the present study, total number of cases was 60, sensitivity is 88.8%, specificity 100%, and diagnostic accuracy of 96.3%, whereas in the study by Shrish et al.,²⁴ total number of cases was 606, sensitivity 85.7, specificity 98.6%, and diagnostic accuracy 97.1%. This is almost comparable to this study and the slight variation could be due to the smaller sample size (Table 14).

In the present study, maximum number of 13 cases in TSH 5 or more, next in order 4 cases TSH is high normal range 2.50–4.99 as compared with Choi et al.²⁵ the maximum number of 38 cases in TSH is the high normal range, next in order 37 cases in TSH 5 or more. The present study is correlating with Choi et al.²⁵ In Haymart et al.⁵ maximum number of cases, 13 cases in TSH is high normal range 2.50–4.99 and only 1 case in TSH 5 or more and in Sathyanarayana et al.²⁶ maximum number of 6 cases in TSH is high normal range 2.50–4.99, next in order 3 cases TSH in range of 5 or more. The present study correlating with Haymart et al.⁵ and Sathyanarayana et al.²⁶ in TSH within the high normal range (Table 15).

CONCLUSION

The present study was done to determine the overall diagnostic sensitivity, specificity, PPV, and NPV, the diagnostic accuracy of FNAC in thyroid lesions, understanding of TSH level in estimating the risk of malignancy, and to study the association of FNAC with histopathology and TSH.

- The study was undertaken on 60 patients with clinically thyroid lesions during a period of approximately January 2019 to June

Table 10: A comparison of benign and malignant thyroid lesions found in various studies can be made by the following table

Studies	Benign				Malignant			
	Cystic lesion	Thyroiditis	Colloid goiter	Follicular adenoma	Papillary ca.	Follicular ca.	Medullary ca.	Anaplastic ca.
Tabaqchali ¹⁴	2 0.4%	7 2.9%	136 56.9%	60 25.1%	19 7.9%	10 4.2%	3 1.3%	1 0.4%
Afroze ¹⁵	0 0%	10 5.88%	111 65.3%	27 15.88%	11 6.47%	07 4.11%	02 1.18%	02 1.18%
Handa ¹⁶	2 3.03%	0 0%	45 68.2%	13 19.70%	3 4.55%	0 0%	2 3.03%	1 1.52%
Gupta ¹⁷	0 0%	3 4%	42 56%	15 20%	12 16%	3 4%	0 0%	0 0%
Sengupta ¹⁸	0 0%	15 8.43%	135 75.8%	11 6.18%	0 0%	14 8.99%	0 0%	7 3.93%
Bhojani ¹³	3 3%	6 6%	76 76%	4 4%	2 2%	2 2%	0 0%	1 1%
Present study	2 3%	2 3%	12 20%	7 12%	5 8%	8 14%	5 8%	2 3%

Table 11: A comparison of the cyto-histo correlation of benign lesions in our study as compared to other studies in past is described in the following

Studies	Total	Benign on FNAC	Benign on HPE	Malignant on HPE
Afroze et al. ¹⁵	170	115 (67.64%)	113 (98.26%)	02 (1.74%)
Handa et al. ¹⁶	66	60 (90.09%)	59 (98.33%)	1 (1.66%)
Gupta et al. ¹⁷	75	63 (84%)	60 (95.24%)	3 (4.76%)
Bhojani et al. ¹³	100	94 (94%)	93 (98.3%)	1 (1.07%)
Present study	60	39 (65%)	37 (92.5%)	2 (5.1%)

Table 12: A comparison of the cyto-histo correlation of malignant lesions in our study as compared to other studies in past is described in the following table

Studies	Total	Malignant on FNAC (%)	Benign on HPE (%)	Malignant on HPE (%)
Afroze et al. ¹⁵	170	13 (7.64)	1 (7.69)	12 (92.3)
Handa et al. ¹⁶	66	6 (9.09)	0	6 (100)
Gupta et al. ¹⁷	75	12 (16)	3 (25)	9 (75)
Bhojani et al. ¹³	100	6 (6)	0	6 (100)
Present study	60	21 (35)	0	21 (100)

Table 13: Comparison of the total number of false-negative cases in our study with other studies in in past described in the following table

Cytodiagnosis	No. of cases	Histological diagnosis	
		Positive	Negative
Benign	39	2FN 5%	37TN 95%

2019 who were admitted, outpatient, inpatient in Mahatma Gandhi Medical College and Hospital Sitapura, Jaipur.

- The age group ranged between 15 years and 72 years with a mean age of 41.6. Male patients comprised 21.6% and female patients 78.3%.
- The majority of the patients were in the age range of 30–39 years.
- All thyroid lesions were categorized into six categories according to the Bethesda system for reporting.
- Most of the thyroid lesions in our study were benign (62%).
- The maximum number of benign lesions fell in category II (58%).

- Suspicious for follicular neoplasm/follicular neoplasm was diagnosed in 15 cases (25%).
- Malignant thyroid lesions were included 32%.
- Out of 39 cytologically benign lesions, 2 on histopathological follow-up were found malignant, i.e., 5%, and the rest 37 cases were found benign, i.e., 95%.
- All of the 16 cytologically malignant lesions on histopathological follow-up were found malignant, i.e., 100%.
- All of the 5 cytologically suspicious for malignant were found malignant on histopathological follow-up, i.e., 100%.
- The statistical analysis in the present study revealed sensitivity of 83.3%, specificity 100%, PPV 100%, NPV 92.5%, % false-positive 0%, % false-negative 16.6%, and the diagnostic accuracy was 94.5%. These findings are comparable with the results carried out by other studies reported earlier.
- In the present study, maximum number of benign 14 cases (38%) were found to have serum TSH levels in the range of 0.40–1.39 µIU/mL and the maximum number of malignant, i.e., 13 cases

Table 14: Comparison of sensitivity, specificity diagnostic accuracy of our study with other studies in past described in the following table

Author's name	Year of publication	Number of cases	Sensitivity	Specificity	Accuracy
El Hag et al. ¹⁹	2003	303	86.7	97.6	–
Sangalli et al. ²⁰	2006	5496	93.4	74.9	95.4
Aravinthan et al. ²¹	2007	110	80.2	87.2	98.0
Handa et al. ¹⁶	2008	434	97	100	
Mandal et al. ²²	2011	120	90	100	
Bamanikar et al. ²³	2014	300	50	100	94.2
Nandedkar et al. ²⁴	2019	606	85.7	98.6	97.1
Present study		60	88.8	100	96.3

Table 15: Comparison of TSH level in our study with other studies in past described in the following table

TSH level ($\mu\text{U}/\text{mL}$)	Present study	Sathyararayanan et al. ²⁶	Haymart et al. ⁵	Choi et al. ²⁵
	23	14	54	97
<0.06	0	0	3	0
0.06–0.39	1	0	4	0
0.40–1.39	2	0	17	
1.40–2.49	3	5	16	24
2.50–4.99	4	6	13	38
5 or more	13	3	1	37

(53%) were found TSH in the range of 5 $\mu\text{U}/\text{mL}$ or more on the basis histopathological diagnosis.

- In the present study, maximum number of benign, i.e., 15 cases (38.4%), were found to have TSH in the range of 0.40–1.39 $\mu\text{U}/\text{mL}$, and a maximum number of malignant cases, i.e., 12 (57.14%) were found in the TSH range of 5 $\mu\text{U}/\text{mL}$ or more on the basis cytology diagnosis.
- In the present study, maximum number of malignant cases was found in TSH >5 as compared with other studies also showing similar results.
- Thyroid-stimulating hormone level has a statistically significant association with malignancy. Thyroid-stimulating hormone level in malignancy higher in comparison with a benign lesion ($p < 0.05$).

In conclusion, FNAC is the first line, simple, cost-effective, reliable, outpatient procedure, less invasive investigation, and can be used as a partial screening of thyroid lesion.

There is a significant association between TSH and malignancy, TSH within high normal range and higher serum concentration TSH both are associated with a higher risk of thyroid malignancy.

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