



TO STUDY THE ASSOCIATION OF FINE NEEDLE ASPIRATION CYTOLOGY (FNAC) FINDINGS WITH THYROID FUNCTION TEST (ANTI-TPO, TSH) IN CASES OF LYMPHOCYTIC THYROIDITIS AT SMS MEDICAL COLLEGE JAIPUR

Pathology

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ABSTRACT

Background-Chronic lymphocytic thyroiditis is the second most common thyroid lesion diagnosed on FNAC after goiter. FNAC is a reliable tool in the diagnosis of thyroid lesions. **Objective**-Grading of lymphocytic thyroiditis based on the cytomorphology, the association between FNAC grading with thyroid function tests (Anti-TPO, TSH) and Correlation of the cytological pattern of lymphocytic thyroiditis with age and sex. **Materials & Methods**- Consists of thyroid swelling (lymphocytic thyroiditis) FNAC obtained from patients referred to the Department of Pathology at SMS Medical College, Jaipur. This is an observational prospective study of 150 cases of HT. Detailed cytological parameters were observed, graded and correlated with the serological parameters. **Results**- In our study, out of 150 patients, 141 (94%) were females while 9 (6%) were males. Male: Female ratio among study population was 9(6%):141 (94%) = 1:15. The most common grade found was grade 3 with 69 (46%) cases, followed by grade 2 with 52 cases (34.67%), and 29 (19.33%) were of grade 1 severity. Most of the patients were hypothyroid followed by euthyroid, and hyperthyroid. Anti-TPO antibodies were raised in 18.46%, 30.77%, and 50.77% cases of grade I, II, and III respectively. Anti-TPO and TSH levels were elevated in 57% (19/33) of the cases with grade 3 lymphocytic thyroiditis, 30.30% (10/33) of the cases with grade 2, and 12.12% (4/33) of the cases with grade 1 lymphocytic thyroiditis. **Conclusion**- Lymphocytic thyroiditis should be diagnosed by a multidisciplinary approach. However, in spite of the availability of different diagnostic modalities, the demonstration of lymphocytic infiltration by fine needle aspiration cytology still remains the gold standard. A correct cytological diagnosis can prevent the need for surgical intervention. The biochemical parameters are an adjunct to cytomorphological diagnosis to be used to increase diagnostic accuracy and reproducibility.

KEYWORDS

Fine needle aspiration cytology, Lymphocytic thyroiditis, Cytological grading, Thyroid hormonal status

INTRODUCTION

Thyroid diseases are among the commonest endocrine disorders diagnosed worldwide with about 42 million people in India suffering from them.^{1,2,3} A thyroid swelling is an enlargement of thyroid gland which is a common clinical presentation. The most common causes of thyroid swellings include iodine deficiency, ageing, autoimmune disease, and benign or malignant tumors.^{4,5,6} Asymptomatic thyroid swelling is a common occurrence affecting 5 to 20% of patients in endemic areas.^{4,7} Majority of thyroid swellings are benign, whereas fewer than 5% of thyroid swellings are malignant.^{4,8}

Hashimoto's thyroiditis was described for the first time by Hakaru Hashimoto in 1912.^{2,4,10,12,24} HT is an organ-specific immunologically mediated inflammatory disease.¹² It is, a synonym for chronic lymphocytic thyroiditis or autoimmune thyroiditis and is more common in women with a prevalence rate of 1-4% and incidence of 30-60/100000 population one year.¹³⁻¹⁷

Hashimoto's thyroiditis (HT), may be associated with hypothyroidism, euthyroidism, or occasionally hyperthyroidism with most cases presenting with hypothyroidism. Although the most common cause of hypothyroidism is iodine deficiency worldwide, the commonest cause of spontaneous hypothyroidism in areas of adequate iodine intake remains lymphocytic thyroiditis.¹⁸ The most important antibody directed against the thyroid tissue is thyroid peroxidase.¹⁹

Chronic lymphocytic thyroiditis is the second most common benign thyroid FNA diagnosis next to the benign follicular nodule, and also overall the second most common thyroid lesion diagnosed on FNAC after goiter.^{2,9,11,13,20} FNA is highly sensitive in diagnosing HT, with a diagnostic accuracy rate of 92%. Hence FNAC remains the gold standard.^{2,7,12,21} Hurtle cell change and an increased number of mature and transformed lymphocytes impinging on follicular cells is the characteristic feature of Hashimoto's thyroiditis.^{11,13,22}

Cytological grading on FNAC smears using predefined sets of criteriae

was for the first time done by Bhatia et al. who tried to correlate the lymphoid density with clinical, radiological, and biochemical parameter.^{3,11,12,13}

The diagnosis of the disease on fine needle aspiration cytology (FNAC) smears is made by finding the oxyphilic transformation of follicular epithelial cells (Hurthle cells), infiltration of follicles by lymphocytes and plasma cells, presence of the moderate number of lymphoid cells in the background with scanty or absent colloid in the background.^{18,22}

The thyroid hormone profile of patients who present with any thyroid enlargement is of crucial significance. Detailed evaluation of clinical features along with hormonal assays reveals the therapeutic significance. The patients are categorized as Euthyroid, Hypothyroid and hyperthyroid based on their serum TSH, T₃, and T₄ levels.^{2,3}

The purpose of the study is to diagnose the subclinical cases of lymphocytic thyroiditis in the early stage with a combined approach of investigations and to correlate the efficacy of the Thyroid function test (Anti-TPO, TSH) in diagnosing lymphocytic thyroiditis.

MATERIALS AND METHODS

This was a prospective time bound descriptive type of observational study. After submission of the plan to the ethics committee and approval, this study was conducted in the department of Pathology, SMS Medical College & Hospital, Jaipur, Rajasthan, India. All the relevant information regarding the method of study was explained to the patient or the patient's attendant and proper written consent was taken. 150 patients diagnosed with lymphocytic thyroiditis fulfilling the inclusion criteria were included in this study. A proforma sheet was prepared to get information on age, sex, and residence and a complete history was taken including relevant past history, personal history, family history, and treatment history.

Fine-needle aspiration cytology (FNAC) of thyroid was done by using

22/23G needle attached to 10 mL syringe by the non-aspiration and aspiration technique.²⁹ Both air dried and wet fixed smears were prepared. Air-dried smears were stained with Giemsa (MGG) stain and wet ethanol fixed smears were stained with hematoxylin and eosin. 150 cases were diagnosed as lymphocytic (Hashimoto's) thyroiditis on cytology. The grading was done independently based on the presence of impingement or infiltration by lymphocytes and plasma cell into the thyroid follicles, Hurthle cell change, multinucleated giant cell, epithelioid cell clusters and/or formation of lymphoid follicles. Grading of thyroiditis was done on the smears based on a set of predefined criteria as described by Bhatia A et al¹¹, into Mild (Grade-1) with few lymphocytes infiltrating the follicles, Moderate (Grade-2) with moderate lymphocytic infiltration along with Hurthle cell change and Severe (Grade-3) with florid lymphocytic infiltration and formation of germinal centers. These were statistically analysed for correlation with anti-thyroid peroxidase (anti-TPO) antibodies and TSH.

OBSERVATIONS AND RESULTS

A total of 150 cases of lymphocytic thyroiditis were reported as per Bethesda System in our study. The most frequent patients were between the age group 21-30 years 42(28%) followed by 36(24%) in the age group 31-40yrs. The study had majority of 141(94%) females while 9 (6%) were male. Male: Female ratio among study population was 1:15.

In this study, among 150 cases, lymphocytic thyroiditis was graded cytologically into four grades, Grade 0,1,2,3 as per Bhatia et al criteria. The most common grade found among the cases was grade 3 with 69 (46%) cases, followed by grade 2 with 52 (34.67%), and 29 (19.33%) cases were of grade 1 severity. None of the patients were grade 0 in our study. (Table 1) (Figure1-8)

Table No-1 Cytological Grading Of Lymphocytic Thyroiditis On FNAC (150 Cases)

Grade	Morphological features	No. of Cases (N-150)
Grade 0	No lymphoid cells	0
Grade 1 (Mild)	Few lymphoid cells infiltrating the follicles/increased number of lymphocytes in the background	29 (19.33%)
Grade 2 (Moderate)	Moderate lymphocytic infiltration or mild lymphocytic infiltration with Hurthle cell change/giant cells/anisonucleosis	52 (34.67%)
Grade 3 (Severe)	Florid lymphocytic inflammation with germinal center formation, very few follicular cells left	69 (46%)

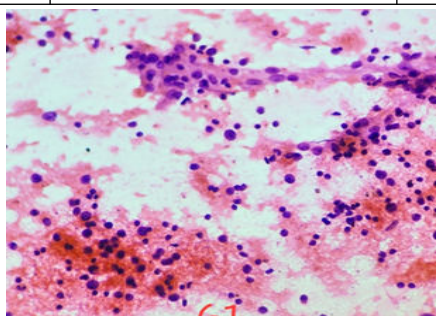


Figure 1: Grade I Lymphocytic Thyroiditis Showing Thyroid Follicular Epithelial Cells With Mild Lymphocytic Infiltration. (H&E, 400X).

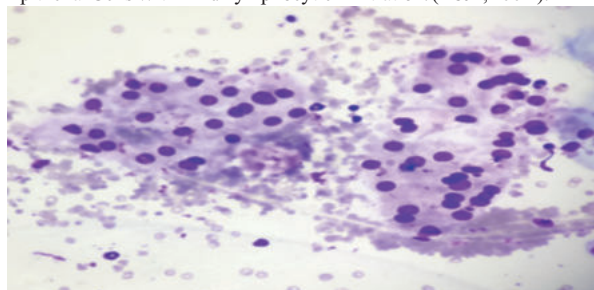


Figure 2: Grade I Lymphocytic Thyroiditis Showing Thyroid Follicular Epithelial Cells With Mild Lymphocytic Infiltration. (MGG, 400X).

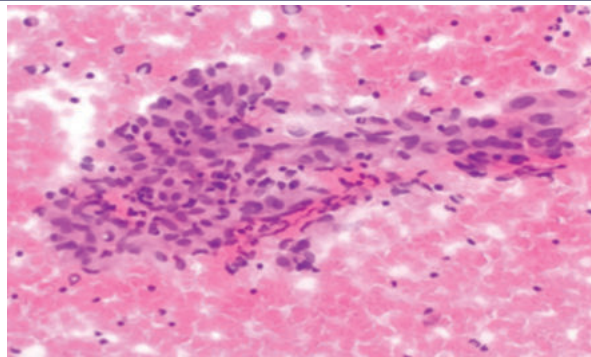


Figure 3: Grade II Lymphocytic Thyroiditis Showing Thyroid Follicular Epithelial Cells With Moderate Lymphocytic Infiltration In The Background. (H&E, 400X).

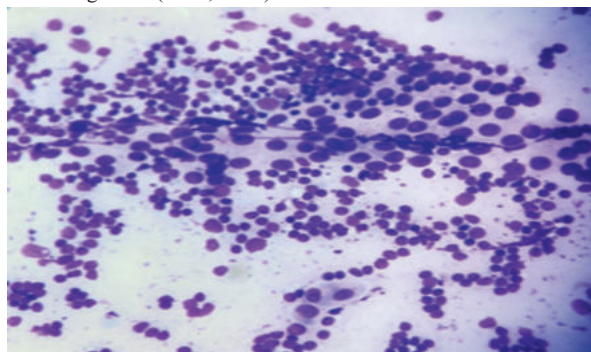


Figure 4: Grade II Lymphocytic Thyroiditis Showing Thyroid Follicular Epithelial Cells With Moderate Lymphocytic Infiltration In The Background And Hurthle Cell Changes. (MGG, 400X)

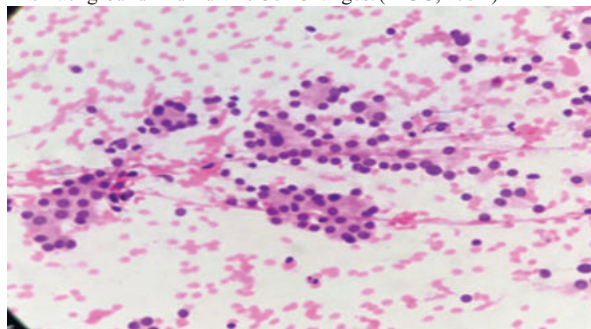


Figure 5: Grade II Lymphocytic Thyroiditis Showing Thyroid Follicular Epithelial Cells With Hurthle Cells Changes And Anisonucleosis. (MGG, 400X)

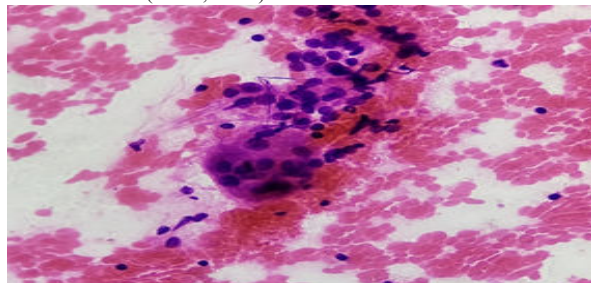


Figure 6: Grade II lymphocytic thyroiditis showing giant cells with few follicular cells

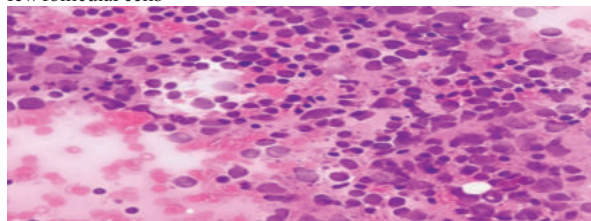


Figure 7: Grade III lymphocytic thyroiditis with florid lymphocytic infiltration. (H&E, 400X).

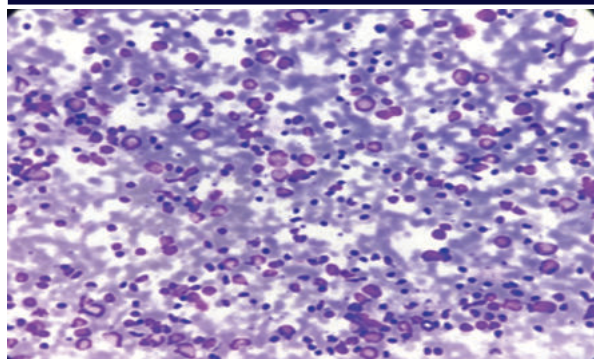


Figure 8: Grade III Lymphocytic Thyroiditis Showing Total Destruction Of Follicle With Dense Infiltration By Lymphoid Cells. (MGG, 400X).

Out of 150, TSH levels were available in 116 patients. Among 116 patients, most of the patients were hypothyroid 54 (46.56%) followed by euthyroid 43 (37.06%), and hyperthyroid 19 (16.38%). TSH profile on further analysis according to different cytological grades:- Among the 43 euthyroid patients, most of them were of grade 3, 17 (39%) followed by 14 (32.5%) of grade 1. Out of 54 hypothyroid patients, the majority of them 31 (57.40%) were found in grade 3, followed by 16 (29.6%) in grade 2. Among the least numbers of hyperthyroid patients 19, 11 (57.8%) were of grade 2 which was most common followed by 5 (26.5%) of grade 3.

Table No-2 TSH Levels Among Different Grades-

GRADES	EUTHYROID (n-43)	HYPOTHYROID (n-54)	HYPERTHYROID (n-19)
Grade 1	14 (32.56%)	7 (12.97%)	3 (15.79%)
Grade 2	12 (29.91%)	16 (29.62%)	11 (57.89%)
Grade 3	17 (39.53%)	31 (57.41%)	5 (26.32%)
Total	43 (100%)	54 (100%)	19 (100%)

Out of 150, Anti-TPO levels were available in 87 patients. Among the 87 patients, anti-TPO levels were positive (increased level) in 65 and negative (normal level) in 22 patients.

Table No 3. Correlation Between Cytomorphological Grading With Increased Anti-TPO antibodies level (n-65):-

	Grade 1	Grade 2	Grade 3
Number of cases with Increased Anti-TPO antibodies	12	20	33
Percentage %	18.46%	30.77%	50.77%

In this study, Anti-TPO antibodies were raised in 18.46%, 30.77%, and 50.77% of cases of grade I, II, and III respectively.

Table No -4 Grading Of Lymphocytic Thyroiditis And Anti-TPO And TSH Relation (-87)

	Grade 1	Grade 2	Grade 3	Total
Anti-TPO increase TSH increase	4	10	19	33
Anti-TPO increase TSH normal	7	4	10	21
Anti-TPO increase TSH low	1	5	5	11
Anti-TPO normal, TSH increase	1	1	1	3
Anti-TPO normal, TSH normal	5	5	8	18
Anti-TPO normal, TSH decreased	0	0	1	1
Total	18	25	44	87

Anti-TPO and TSH levels were elevated in 57% (19/33) of cases with grade 3, 30.30% (10/33) of cases with grade 2, and 12.12% (4/33) of cases with grade 1 lymphocytic thyroiditis. 21 Cases showed raised Anti-TPO with normal TSH levels, 47.6% (10/21) was of grade 3 followed by 33.3% (7/21) of grade 1, and 19.1% (4/21) of grade 2. Raised Anti-TPO levels were also found among 11 hyperthyroid patients (TSH low). 3 cases reveal only raised TSH without raised Anti-TPO level.

DISCUSSION

Hashimoto's thyroiditis (HT) is an autoimmune disease that results in the destruction of the thyroid gland and gradual and progressive thyroid failure. (2) The first report of chronic thyroiditis, Struma lymphomatosa was described by Haku Hashimoto in 1912. (2,11)

Cytological findings of lymphoid cells in the background and infiltration of follicular cells by lymphoid cells are characteristic. Variable features include Hurthle cells, plasma cells, epithelioid cells granuloma, and multinucleated giant cells. (2,23)

The pathogenesis of the HT organ-specific form of thyroiditis is sensitization of the cluster differentiation 4 (CD4+) T-helper cells to the antigens in the thyroid follicular cells. (3)

HT is characterized by an initial transient phase of hyperthyroidism followed by a chronic phase of hypothyroidism. In the initial phase, there is antibody-mediated destruction of thyroid follicles and lymphocytic infiltration. In the chronic phase, there are only minimal residual and atrophic follicles with fibrosis of the thyroid parenchyma. (11,12,13)

Age group comparison of the patient with lymphocytic thyroiditis

Study Name	Total Cases of lymphocytic thyroiditis	Most Common Age group
Neelam Sood et al ¹³	55	21-30yrs
P. Uma et al ²⁴	309	21-30yrs
Nibedita Sahoo et al ²⁷	102	21-30yrs
Bhardwaj A et al ⁷	58	<40yrs
Ishani Gupta et al ¹⁸	65	<40yrs
Bhatia et al ¹¹	76	31-40yrs
Chhavi Gupta et al ²	162	31-40yrs
Present Study	150	21-30yrs

In the present study, the most common age group was 21-30yrs which is similar to other studies conducted by Neelam Sood et al¹³, P Uma et al²⁴, Nibedita Sahoo et al²⁷ and Bhatia et al¹¹, Chhavi Gupta et al² found common age group to be 31-40yrs.

Gender comparison among the patient of lymphocytic thyroiditis

	Bhatia et al (n-76) ¹¹	Neelam Sood et al (n-175) ¹³	Chhavi Gupta et al (n-162) ²	Manish et al (n-29) ⁴	Prajna et al (n-115) ²⁶	Present Study (n-150)
Male	6 (7.89%)	16 (9.14%)	16 (9.88%)	2 (6.9%)	4 (3.5%)	9 (6%)
Female	70 (92.11%)	159 (90.86%)	146 (90.12%)	27 (93.1%)	111 (96.5%)	141 (94%)

In the present study, female patients were 141 (94%) and male patients 9 (6%) which was in concordance with the other study conducted by Bhatia et al¹¹, Neelam Sood et al¹³, Chhavi Gupta et al², Manish et al⁴ and Prajna et al²⁶ with female preponderance.

Cytological grading of lymphocytic thyroiditis-

The grading of chronic lymphocytic thyroiditis using the criteria adopted by Bhatia et al^{11,24}

Cytological grading comparisons among the patient of lymphocytic thyroiditis in the different studies are

Study Name	Grade 0	Grade 1	Grade 2	Grade 3
Neelam Sood et al (n-55) ¹³	15.38%	18.47%	26.15%	40%
Neha Singh et al ²⁵ (n-150)		18%	26%	56%
Manish et al ⁴ (n-29)	13.80%	17.24%	24.13%	44.83%
Bhatia et al ¹¹ (n-76)		38.67%	44%	17.33%
Anila KR et al ¹² (n-60)		45%	36.67%	18.33%
Present Study (n-150)		19.33%	34.67%	46%

In our study, most of the patients presented with grade- III which is supported by the studies done by Neelam Sood et al¹³, Neha Singh et al²⁵, and Manish et al⁴. However, in the study by Anila KR et al¹², the most common patients presented with grade-I, and in Bhatia et al¹¹, the maximum number of patients presented with grade II.

Measurement of serum TSH levels is generally considered the best screening test for thyroid disease; with increased values indicating hypothyroidism, and decreased values usually indicate hyperthyroidism. (24,28)

TSH values were available in 116 patients out of 150 chronic lymphocytic thyroiditis patients in our study.

On performing hormonal assay in the present study, 46.56% of the

patients were found to be hypothyroid, 37.06% of the patients were biochemically euthyroid and 16.38% were hyperthyroid.

It was observed that biochemically hypothyroid cases showed a high association with grade II and grade III thyroiditis with the majority of the grade III thyroiditis cases showing hypothyroidism. The majority of the biochemically euthyroid cases were seen in grade I lesions.

Anti-TPO antibody levels were available in our study in 87 patients out of 150 patients.

Sero-positivity for anti-TPO antibodies was seen in 74.71% of cases and the negative serology (25.29%) can be explainable, as localized immune destruction occurs much earlier before serological findings.[18-20] In this way, cytological evidence is superior to hormonal and serological findings, which is similar to the study done by Nibedita Sahoo et al(2020).²⁷

Correlation between Grading of lymphocytic thyroiditis with anti-TPO and TSH:-

In the present study, Anti-TPO and TSH levels were elevated in 57% (19/33) of cases with grade 3 lymphocytic thyroiditis, 30.30% (10/33) of cases with grade 2, and 12.12% (4/33) of cases with grade 1 lymphocytic thyroiditis which is supported by the studies done by Neelam Sood et al (2014)¹³ and Ishani Gupta et al (2022).¹⁸

Correlations of grading of lymphocytic thyroiditis with anti-TPO and TSH relation.

	Lymphocytic grade		Chi-Square with degrees of freedom	P value
Anti-TPO increase, TSH increase	1+	Total	1.385	0.239
Anti-TPO increase, TSH normal	4	33		
	7	21		
Anti-TPO increase, TSH increase	2+	Total	0.162	0.682
Anti-TPO increase, TSH normal	10	33		
	4	21		
Anti-TPO increase, TSH increase	3+	Total	0.025	0.875
Anti-TPO increase, TSH normal	19	33		
	10	21		

Out of the 33 patients with raised Anti-TPO antibodies and TSH levels, we found 19 cases with grade 3 Lymphocytic Thyroiditis (Chi Squire-0.025, P-value-0.875), 10 cases with grade 2 (Chi Squire-0.162, P-value-0.687), and 4 cases with grade1 Lymphocytic Thyroiditis (Chi Squire-1.385, P-value-0.239). Thus, raised Anti-TPO antibodies and TSH levels were found not significantly related to any grade of Lymphocytic Thyroiditis. A study done by Bhatia et al¹¹ also showed no significant statistical correlation between grades and clinical, biochemical, and ultrasonography parameters.

On analysing the cytomorphological spectrum of Hashimoto's thyroiditis on FNAC and correlating cytological findings with serologic parameters though they observed that grading of thyroiditis and lymphocytic infiltration showed no correlation with the clinical severity of the disease, but a high lymphoid: epithelial ratio was strongly correlated with thyroid peroxidase positivity and thyroid peroxidase positivity is statistically strongly associated with HT as compared to HT coexisting with follicular hyperplasia/ Hashitoxicosis/ Neoplasm as per Neelam Sood et al.¹³ and Neha Singh et al.⁴

SUMMARY

- Total 150 cases of lymphocytic thyroiditis were diagnosed on FNAC, which were further analyzed and categorized.
- Hashimoto's thyroiditis is an autoimmune disorder affecting predominantly females in the second to 3rd decades with a male: female ratio of 1:1.5.
- Cytologically lymphocytic thyroiditis on FNAC, Categorised in 3 grades, Grade 1, 2, 3. The most common grade found was grade 3 (Severe) showing florid lymphocytic inflammation with the germinal center formation with very few follicular cells.
- Hypothyroid patients were predominantly present with lymphocytic thyroiditis.
- Anti-TPO levels were raised with the chronicity of lymphocytic

infiltration.

- Thyroid function test (TSH) levels correlatively increased in significant proportion with lymphocytic thyroiditis.
- Raised Anti-TPO antibodies and TSH levels were found not significantly related to any grade of lymphocytic thyroiditis.

CONCLUSION

Lymphocytic thyroiditis should be diagnosed by a multidisciplinary approach. However, in spite of the availability of different diagnostic modalities, the demonstration of lymphocytic infiltration by fine needle aspiration cytology still remains the gold standard. A correct cytological diagnosis can prevent the need for surgical intervention. The biochemical parameters are an adjunct to cytomorphological diagnosis to be used to increase diagnostic accuracy and reproducibility. It was observed that as the grade of HT increases, the probability of hypothyroidism increases. This suggests that the chronicity of the disease increases the chances of hypothyroidism. Though there is a strong association of antithyroid antibodies, especially Anti-TPO with Lymphocytic thyroiditis, the present study, and previous similar studies have failed to establish any significant correlation between the cytological grades and these biochemical parameters.

Financial support & Sponsorship: Nil

Conflict of Interests: None

REFERENCES

- Unnikrishnan A, Menon U. Thyroid disorders in India: An epidemiological perspective. *Indian J Endocr Metab*. 2011;15(6):78-81.
- Gupta C, Bhardwaj S, Sharma S. Cytological grading of lymphocytic thyroiditis and its correlation with thyroid hormonal status. *Indian J Pathol Oncol* 2020;7(3):369-373
- Shetty A, Chowdappa V. Cytomorphological Spectrum of Hashimoto's Thyroiditis and Its Correlation with Hormonal Profile and Hematological Parameters. *J Cytol*. 2019;36(3):137-141.
- Manish Kumar Das, Meenakshi Basnet. Cytological evaluation of thyroid and its correlation with thyroid function test and anti-thyroid peroxidase in a patient of Hashimoto's thyroiditis. *Journal of Nobel Medical College*. 2019;8(15):57-61.
- Chehade JM, Lim W, Silverberg AB, et al. The incidence of Hashimoto's disease in nodular goiter, the concordance in serological and cytological findings. *Int J Clin Pract*. 2010;64:29-33.
- Laurberg P, Pedersen KM, A Hreidarsson et al. Iodine intake and the pattern of thyroid disorders: a comparative epidemiological study of thyroid abnormalities in the elderly in Iceland and in Jutland Denmark. *J Clin Endocrinol Metab*. 1998;89:765-9.
- Bhardwaj, A., Kumar R., Acharya S. Cytomorphologic Study of Lymphocytic Thyroiditis: A Correlation between Cytological Grade and Biochemical Parameters. *Journal of Clinical & Diagnostic Research*. 2019;13(6).
- Krohn K, Fuhrer D, Bayer Y, et al. Molecular pathogenesis of euthyroid and toxic multinodular goiter. *Endocr Rev*. 2005;26:504-24.
- Mondal SK, Sinha S, Basak B et al. The Bethesda system for reporting thyroid fine needle aspirates: A cytologic study with histologic follow-up. *J Cytol*. 2013;30(2):94-9.
- Lalitha Reddy G, Begum Z, Patil A. Bethesda reporting of thyroid FNACS with T3, T4, TSH correlation in a medical college of North Karnataka. *IP J Diagn Pathol Oncol*. 2020;5(4):405-409
- Bhatia A, Rajwanshi A, Dash RJ, et al. Lymphocytic thyroiditis is cytological grading significant? A correlation of grades with clinical, biochemical, ultrasonographic, and radionuclide parameters. *Cytojournal*. 2007;4:10.
- Anila KR, Nayak N, Jayasree K. Cytomorphologic spectrum of lymphocytic thyroiditis and correlation between cytological grading and biochemical parameters. *J Cytol*. 2016;33(3):145-149.
- Sood N, Nigam JS. Correlation of fine needle aspiration cytology findings with thyroid function test in cases of lymphocytic thyroiditis. *J Thyroid Res*. 2014;430-510.
- B. N. Gayathri, R. Kalyani, M. L. Harendra Kumar et al. Fine needle aspiration cytology of Hashimoto's thyroiditis—a diagnostic pitfall with review of literature. *Journal of Cytology*. 2011;28(4):210-213.
- Vanderpump MP, French JM, Appleton D et al. The prevalence of hyperprolactinaemia and association with markers of autoimmune thyroid disease in survivors of Whickham survey cohort. *Clin Endocrinol (Oxf)*. 1998;48(1):39-44.
- Vanderpump MP, Tunbridge WM, French JM et al. Incidence of thyroid disorders in the community: a twenty year follow up of the Whickham survey. *Clin Endocrinol (Oxf)*. 1995;43(1):55-68.
- Pradhan SP, Choudhury S, Dash A et al. Cytomorphological and serological studies in Hashimoto's thyroiditis. *Journal of Evidence-Based Medicine and Healthcare*. 2016;3(93):5111-5115.
- Ishani Gupta, Jyotsna Suri. Lymphocytic thyroiditis: A correlation between cytological grading and thyroid function tests. *International Journal of Health Sciences*. 2022;6(S1):481-488.
- Rathi M, Ahmad F, Budania SK, et al. Cytomorphological Aspects of Hashimoto's Thyroiditis: Our Experience at a Tertiary Center. *Clin Med Insights Pathol*. 2014;16(7):1-5.
- Mehra P, Verma AK. Thyroid Cytopathology Reporting by the Bethesda System: A Two-Year Prospective Study in an Academic Institution. *Pathol Res Int*. 2015;
- Kocjan G. Lymphoid infiltrates. 1st ed. Fine needle aspiration cytology-diagnostic principles and dilemmas. In: Schroder G, editor. Germany: Springer; 2006:99-101.
- Jayaram G, Marwaha RK, Gupta RK, Sharma SK. Cytomorphologic aspects of thyroiditis. *Acta Cytol* 1987;31:687-93.
- Orell, S. R., Sterrett, G. F., & Whitaker, D. (2005). Fine needle aspiration cytology. Churchill Livingstone.
- Uma P., Kartheek B. V. S., Himaja S et al. Lymphocytic thyroiditis: a correlation of cytological grades with clinical, biochemical and ultrasound findings. *Int J Res Med Sci*. 2013;1(4):523-531.
- Singh N, Kumar S, Negi VS et al. Cytomorphologic study of Hashimoto's thyroiditis and its serologic correlation: a study of 150 cases. *Acta Cytol*. 2009;53(5):507-16.
- Prajna das, Goutami Dasnayak. Cytomorphological Spectrum Of Hashimoto's Thyroiditis And Its Correlation With Clinical Presentation, Thyroid Function Test And

- Antibody Levels. International Journal of Scientific Research.2018;7(7).
27. Sahoo N, Naik S, Mohanty P et al. The cytomorphological spectrum of Hashimoto thyroiditis and its correlation with serological parameters: A study in the coastal region. JNTR Univ Health Sci. 2020;9:25-31.
 28. Krishna M. Saxena, John D: Juvenile Lymphocytic Thyroiditis. Crawford Pediatrics.1962;9
 29. Orell SR, Vielh P. The techniques of FNA cytology: i) Basic techniques ii) Miscellaneous techniques. In: Orell SR, Sterrett GF, editors. Fine Needle Aspiration Cytology. 5th ed. Gurgaon: Reed Elsevier India Private Limited; 2012; p. 8-27.