İstanbul Med J 2023; 24(3): 246-50
DOI: 10.4274/imj.galenos.2023.31698

Evaluation of Salivary Glands by Ultrasonography and Inflammatory Markers in Children with Autoimmune Thyroiditis

Sevgi Demiröz Taşolar[1], Ahmet Sığırcı[1], Nurdan Çiftçi[2], Aslınur Cengiz[1], Güleç Mert Doğan[1], Ayşehan Akıncı[2]

[1]İnönü University Faculty of Medicine, Department of Pediatric Radiology, Malatya, Turkey
[2]İnönü University Faculty of Medicine, Department of Pediatric Endocrinology, Malatya, Turkey

ABSTRACT

Introduction: Although more common in adults, autoimmune thyroiditis (AT) is one of the most common thyroid diseases in children and adolescents. Salivary gland involvement has been described in many studies of patients with AT. Several inflammatory scores are used to assess the inflammatory status of patients with systemic autoimmune diseases. We aimed to sonographically evaluate the parotid and submandibular salivary glands with inflammatory parameters in patients with AT in our study.

Methods: Our study population consisted of 37 consecutive pediatric AT patients and 29 healthy control subjects. Ultrasonographic and laboratory evaluations of the study population were performed. Jamovi and MedCalc software were used to analyze the data.

Results: The volume of the thyroid gland in the patients was significantly higher than that in the control group (p=0.030), while there was no difference in the volume of the salivary glands. Multiple logistic regression analysis was planned to assess the predictability of salivary gland involvement in patients with the disease. Both systemic immune-inflammation index (SII) and pan-immune inflammation value (PIV) were found to be predictors of salivary gland involvement in AT patients.

Conclusion: We found that both SII and PIV inflammatory markers are predictive of salivary gland parenchymal changes in patients with AT, and SII is likely to be more valuable than PIV at this time.

Keywords: Autoimmune thyroiditis, gland, parotid, submandibular, SII, PIV

Introduction

Autoimmune thyroiditis (AT) is the most common disease of the thyroid gland in the pediatric age group. Although a combination of genetic, environmental, and immune factors are thought to play a role, the exact cause of AT is not fully understood. While AT can occur at any age, including pediatric age, the mechanisms underlying its development in children are similar to those in adults. AT can occur on its own or can be associated with other autoimmune diseases. The combination of AT with specific autoimmune disorders is known as autoimmune polyglandular syndromes (1,2). However, in some cases, there can be associated to the involvement of the salivary glands. The involvement of the salivary glands in AT is relatively rare but has been the subject of reports in the literature (3-5). However, as far as we know, salivary glands in patients with AT have not been sonographically evaluated in the literature.

Ultrasound (US) is an excellent choice for the initial evaluation of the salivary gland in pediatric patients and is an easily accessible and non-invasive method for evaluating superficial structures with good resolution. It is the first choice for pediatric patients as it does not contain the radiation. Normal submandibular and parotitis glands have homogeneous parenchyma on US and are hyperechoic compared to adjacent muscles, and the degree of echogenicity may vary in proportion to the amount of glandular adipose tissue (6).

In recent years, several leukocyte-based inflammatory markers have been identified that can provide valuable insight into an individual's inflammatory status, including the systemic immune-inflammation index (SII), monocyte/high-density lipoprotein ratio, platelet/lymphocyte ratio (PLR), lymphocyte/monocyte ratio, neutrophil/lymphocyte ratio (NLR) and pan-immune value (PIV). There is evidence that these inflammatory markers may also be useful in assessing the inflammatory status of patients with systemic autoimmune diseases (7-9).

No US-based study has been conducted on parotid and submandibular gland involvement in AT disease in pediatric patients. The main objective of this study was to evaluate parotid and submandibular gland parenchyma in patients with AT using US and inflammatory parameters.

Address for Correspondence: Sevgi Demiröz Taşolar MD, İnönü University Faculty of Medicine, Department of Pediatric Radiology, Malatya, Turkey
Phone: +90 422 341 06 60 **E-mail:** drsevgidemiroz@gmail.com **ORCID ID:** orcid.org/0000-0002-9836-6814

Cite this article as: Demiröz Taşolar S, Sığırcı A, Çiftçi N, Cengiz A, Mert Doğan G, Akıncı A. Evaluation of Salivary Glands by Ultrasonography and Inflammatory Markers in Children with Autoimmune Thyroiditis. İstanbul Med J 2023; 24(3): 246-50.

Received: 19.06.2023
Accepted: 23.07.2023

Methods

The study participants consisted of patients followed up with a diagnosis of AT in the pediatric endocrinology clinic and a control group. Consecutive patients with AT who were under 18 years of age and had parental consent were eligible for inclusion in the study. AT was diagnosed using radioimmunoassay results for anti-thyroid peroxidase (anti-TPO), anti-thyroglobulin (ATG), and thyroid-stimulating hormone (TSH). The control group consisted of participants who were examined with neck US for any reason and whose thyroid function tests (TFT) and TSH values were normal for the last 1 month. Patients who had another systemic disease and were receiving drug therapy were excluded from the study. The study was conducted in accordance with the Declaration of Helsinki and the guidelines for good clinical practice. The study was approved by the İnönü University Scientific Research and Publication Ethics Committee (approval number: 2020/491, date: 17.03.2020).

Ultrasonographic Evaluation

US was examined with a Logiq s8 (GE healthcare, USA) device using a linear probe with a frequency of 14 MHz. US was performed on all participants by the same pediatric radiologist unaware of their clinical and biochemical status. In the US examination, parenchyma echo structures and dimensions of the thyroid gland, submandibular gland, and parotid gland were evaluated with gray scale. Vascularity of the thyroid gland, submandibular gland, and parotid gland was evaluated subjectively with Doppler US. The thyroid gland was evaluated in the supine position and the neck in extension. The gain settings of the US scanner were adjusted so that the lumens of the carotid artery and internal jugular vein were echo-free. Normal thyroid parenchyma was defined as homogeneous and relative hyperechogenicity compared with adjacent muscle tissue. On gray scale US, abnormal parenchymal features of the thyroid gland were evaluated as heterogeneous echo and/or hypoechoic areas.

For each thyroid lobe, the mediolateral length (MLL) and the anteroposterior length (APL) were measured in the axial section and the inferior superior length (ISL) in the sagittal axis. The volume of each lobe was estimated using a standard geometric formula of APL x MLL x ISL x 0.523. The volume of the whole thyroid gland was calculated as the sum of the two lobes.

The submandibular glands were evaluated by US with the patient's head slightly raised and the parotid gland in the supine position with the patient's head facing the contralateral side. Each salivary gland size was evaluated for its echogenicity in at least two perpendicular planes. For each gland, MLL and APL were measured in the axial section and ISL in the sagittal axis. The standard geometric formula APL x MLL x ISL x 0.523 was used to estimate the volume of each gland. Gland volume was calculated as the average of both gland volumes. In the gray scale US, coarse echoes and hypoechoic areas in the gland parenchyma were considered abnormal parenchymal features (Figure 1).

Laboratory Evaluation

The results of complete blood count and TFT were obtained from the files of patients who were examined in the pediatric endocrine clinic. Two biomarkers of inflammation were calculated using the following formulae:

SII = platelet count x neutrophil count/lymphocyte count (10),

PIV = platelet count x neutrophil count x monocyte count/lymphocyte count (11).

Statistical Analysis

Jamovi (version 2.3.28) and MedCalc (version 20.027) software were used to analyze the data. The Kolmogorov-Smirnov test was used for the data distribution. Student's t-test or Mann-Whitney U test was used for continuous variables and chi-square test for categorical variables, depending on the distribution of the data. Multiple logistic regression analysis was used to assess the salivary gland involvement. Age, sex, SII, and PIV parameters were included as univariate parameters in the regression analysis. Since SII and PIV parameters are obtained from similar variables, two modeling (for PIV and SII) were performed to avoid multicollinearity. Pairwise receiver operating characteristic (ROC) analysis was used to compare the two models [area under the curve (AUC), Youden index]. P-value <0.05 was considered statistically significant.

Results

The demographics of the study population are shown in Table 1. There were no statistical differences between the groups for age, sex, and laboratory parameters (p>0.05, for all).

The ultrasonographic findings of the thyroid and salivary glands of the patients and the control group are given in Table 2. While the volume of the thyroid gland was significantly higher in the patients than in the control group (p=0.030), there was no difference in the volume of the salivary glands. However, salivary gland parenchyma involvement and vascularity in the patient group were significantly different from those in the control group.

Multiple logistic regression analysis was used to evaluate the predictability of salivary gland involvement in patients with the disease. To avoid multicollinearity in the analysis, two models were performed (for model 1: SII, model: 2 for PIV). In the analysis, SII [odds ratio (OR): 1.002, p=0.046] value was found to be significant in predicting salivary gland involvement in model I, and PIV (OR: 1.002, p=0.040) value was also found to be an independent predictor of salivary gland involvement

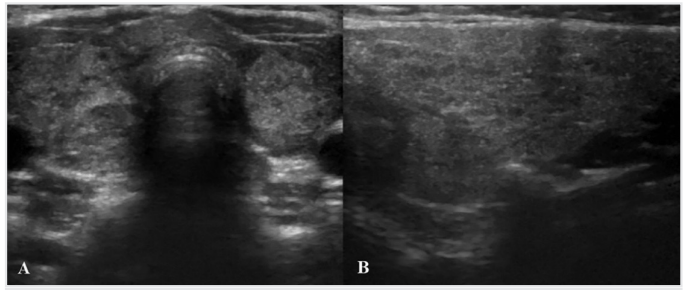

Figure 1. Heterogeneous nodular appearance of the thyroid parenchyma in a 9-year-old girl with autoimmune thyroiditis (A). Heterogeneous parenchyma accompanied by hypoechoic areas in the left parotid gland (B)

Table 1. Demographics and laboratory parameters of the study population

	The control group, (n=29)	Patients group, (n=37)	p-value
Age, months	14.2±2.1	14.6±2.3	0.489
Gender, female, (n, %)	17 (58.6%)	28 (75.7%)	0.140
WBC, 10^3/uL	9.4±5.7	7.6±2.3	0.087
Hemoglobin, g/dL	13.5±1.2	13.2±1.1	0.424
Platelet, 10^3/uL	334.7±69.0	312.0±61.1	0.162
Lymphocyte, 10^3/uL	2.7±0.7	2.4±0.7	0.060
Monocyte, 10^3/uL	0.7±0.3	0.6±0.2	0.244
Neutrophile, 10^3/uL	5.8±5.6	4.4±2.2	0.181
SII	608.8±455.7	587.6±510.2	0.861
PIV	406.1±402.9	406.0±672.8	0.999
TSH, mIU/L	-	6.0±10.0	-
fT4, ng/dL	-	3.9±16.6	-
Anti-TPO, IU/mL	-	835.3±430.7	-
ATG, IU/mL	-	622.4±857.7	-

ATG: Anti-thyroglobulin, TSH: Thyroid-stimulating hormone, fT4: Free thyroxine, WBC: White blood count, SII: Systemic immune-inflammation index, PIV: Pan-immune-inflammation value, TPO: Thyroid peroxidase

Table 2. Ultrasonographic measurements of the study population

	The control group, (n=29)	Patients group, (n=37)	p-value
Thyroid volume, mm^3	5.3±4.5	7.9±4.5	0.030
Parotid volume, mm^3	10.3±4.6	10.9±5.3	0.636
Submandibular volume, mm^3	8.6±4.6	9.0±4.1	0.705
Thyroid parenchyma	0 (0%)	30 (81.1%)	<0.001
Thyroid vascularity	0 (0%)	19 (51.4%)	<0.001
Parotid parenchyma	3 (10.3%)	16 (43.2%)	0.003
Parotid vascularity	2 (6.9%)	10 (27.0%)	0.036
Submandibular parenchyma	3 (10.3%)	20 (54.1%)	<0.001
Submandibular vascularity	4 (13.8%)	10 (27.0%)	0.099

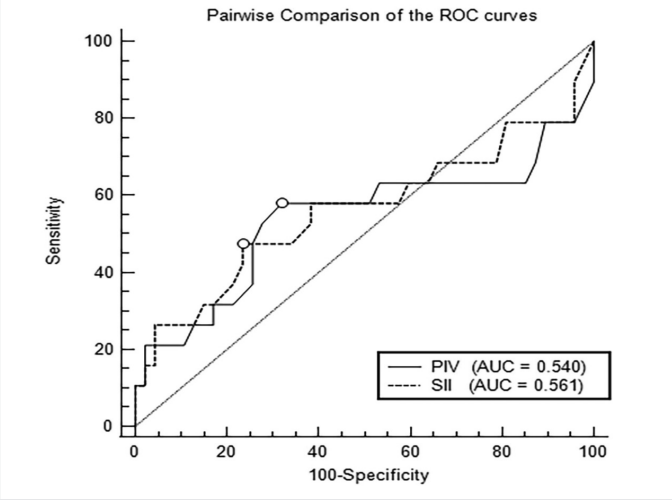

Figure 2. Pairwise comparison of the PIV and SII values in the prediction of salivary gland involvement in patients with thyroiditis (z-statistics: 0.143, differences between AUCs: 0.021, p=0.887)

SII: Systemic immune-inflammation index, PIV: Pan-immune-inflammation value, AUC: Area under the curve, ROC: Receiver operating characteristic

in model 2. Pairwise ROC analysis was performed to compare both parameters in predicting the salivary gland involvement. In the analysis, although SII gave a higher AUC value, there was no statistical difference in terms of both parameters (Figure 2).

Discussion

The main findings of our study were: (i) salivary gland parenchymal changes were significantly higher in patients with AT than in the control group, but there was no difference in salivary gland volumes; (ii) salivary gland involvement could be predicted by SII and PIV parameters in the regression analysis for salivary gland involvement; (iii) when comparing both parameters, there was no statistical difference in the pairwise ROC analysis. The disease, which is more common in women even before puberty, can result from defects in immune regulation or lymphocyte infiltration of the thyroid. In the majority of patients, antibodies (abs) can be detected against various thyroid-specific antigens. Whether antibody-mediated immune mechanisms contribute to the onset, progression, or pathogenesis of AT remains unclear. Anti-TPO and ATG are diagnostic markers of the underlying autoimmune destruction of the thyroid gland and are also found in the majority of patients (12).

The thyroid gland is histologically similar to the lacrimal and salivary glands. Studies of salivary gland involvement in people with AT have suggested that common mechanisms may be at work in the development of thyroiditis and salivary gland immune disease (5,13-15). It has been shown that an immunological imbalance in the salivary glands leads to secretory dysfunction not only in Sjögren's syndrome (SS) but also in other autoimmune diseases such as psoriasis (16), rheumatoid arthritis (17) and systemic sclerosis (18). Genetic and immunopathological similarity between SS and AT (19-21) has been reported. In previous studies, it was determined that the prevalence of AT in patients with primary SS increased compared with the normal population (5). In another study, it was confirmed that patients with euthyroid AT had increased oxidative modification of both the parotid and submandibular glands and that this was associated with autoimmunity (3).

Animal studies have shown that thyroid dysfunction can affect the secretory unit of the salivary gland (22). The secretory function of the submandibular glands is impaired in patients with AT, as shown by Agha-Hosseini et al (23). Syed et al. (24) showed that there may be significant involvement of the salivary glands in AT cases, that there is a significant decrease in sialometric values in AT patients, and that AT may be the cause of hyposalivation.

Rubaltelli et al. (25) and Nozaki et al. (26) stated that the hypoechoic area is a specific finding in chronic recurrent parotitis and patients with SS. Parenchymal heterogeneity was also noted as another finding. hypoechoic areas on sonograms correlate with findings on sialograms and that US may play an important role in diagnosis.

There is also evidence that hypoechoic areas are not only a sign of peripheral sialectasis but also of lymphocytic infiltration around the ducts (27), and argued that symographic changes could be verified more precisely than sialography. US is very sensitive in the detection of inflammatory changes in the salivary glands but has a lower degree of specificity. We observed that the parenchyma echo changes observed in the US evaluation of the submandibular and parotid glands, which were shown to be functionally affected in AT in previous studies, differed significantly compared with the control group. Although it is known that the echo structure of normal glands in children may vary according to the age and structure of the children, our data on a similar age range in the control group suggest that our findings are not related to the age of the children. In addition, patients with CBC and clinical signs of infection were not included to rule out infectious causes, which are common causes of parenchymal changes. We did not observe a significant difference in Doppler US between the patients and the control group. We believe that quantitative and advanced imaging techniques are required to assess glandular vascularity.

Systemic subclinical inflammation is the cause of comorbidities in children and adults (28,29). While there was no difference in NLR between patients with differentiated thyroid cancer and patients with benign thyroid nodules (30), higher values were associated with tumor size, invasion, and metastasis (31). In other studies, it has been shown that NLR and PLR values are higher in patients with Hashimoto's thyroiditis (32-34). Another study showed that obesity-induced thyroid dysfunction may be associated with inflammatory markers (NLR, PLR, and SII) (35). It has previously been shown that SII can be used in patients with subacute thyroiditis in the diagnosis and follow-up (36,37). In our study, we investigated SII and PIV values as parameters that can predict the salivary gland involvement in children with thyroiditis. We found that both were predictors of salivary gland involvement in children with thyroiditis. In addition, when both parameters were compared using pairwise ROC analysis although the AUC value of the SII parameter was higher, there was no statistical difference. We believe that salivary gland involvement in children with thyroiditis can be predicted from these parameters, which are used as indicators of acute inflammation.

Study Limitations

The main limitations of our study are its single-centre nature, a small number of patients, and cross-sectional design. One of the limitations of our study is that due to its routine use in our clinic, gray scale US and Doppler US were used and no quantitative evaluation was performed. Further studies with advanced US imaging methods are needed.

Conclusion

In our study, we observed that there may be salivary gland parenchymal changes in patients with AT, and SII and PIV inflammatory markers predict these changes, and at this point, the SII value may be more valuable than the PIV value. There is a need for large-scale studies to clarify this issue.

Ethics Committee Approval: The study was approved by the İnönü University Scientific Research and Publication Ethics Committee (approval number: 2020/491, date: 17.03.2020).

Informed Consent: It was obtained.

Peer-review: Externally peer-reviewed.

Authorship Contributions: Surgical and Medical Practices - S.D.T., A.S., N.Ç., A.C., G.M.D., A.A.; Concept - S.D.T., A.S., N.Ç., A.C., G.M.D., A.A.; Design - S.D.T., A.S., N.Ç., A.A.; Data Collection or Processing - S.D.T., A.S., N.Ç., A.C., G.M.D., A.A.; Analysis or Interpretation - S.D.T., A.S., A.C., G.M.D.; Literature Search - S.D.T., A.S., A.C., G.M.D.; Writing - S.D.T., A.S.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

References

1. Kahaly GJ, Frommer L. Polyglandular autoimmune syndromes. J Endocrinol Invest 2018; 41: 91-8.
2. Eisenbarth GS, Gottlieb PA. Autoimmune polyendocrine syndromes. N Engl J Med 2004; 350: 2068-79.
3. Morawska K, Maciejczyk M, Popławski Ł, Popławska-Kita A, Kretowski A, Zalewska A. Enhanced Salivary and General Oxidative Stress in Hashimoto's Thyroiditis Women in Euthyreosis. J Clin Med 2020; 9: 2102.
4. Changlai SP, Chen WK, Chung C, Chiou SM. Objective evidence of decreased salivary function in patients with autoimmune thyroiditis (chronic thyroiditis, Hashimoto's thyroiditis). Nucl Med Commun 2002; 23: 1029-33.
5. Warfvinge G, Larsson A, Henricsson V, Ericsson UB, Hansen B, Manthorpe R. Salivary gland involvement in autoimmune thyroiditis, with special reference

to the degree of association with Sjögren's syndrome. Oral Surg Oral Med Oral Pathol 1992; 74: 288-93.

6. Friedman E, Patiño MO, Udayasankar UK. Imaging of Pediatric Salivary Glands. Neuroimaging Clin N Am 2018; 28: 209-26.
7. Yang Z, Zhang Z, Lin F, Ren Y, Liu D, Zhong R, et al. Comparisons of neutrophil-, monocyte-, eosinophil-, and basophil- lymphocyte ratios among various systemic autoimmune rheumatic diseases. APMIS 2017; 125: 863-71.
8. Kim Y, Choi H, Jung SM, Song JJ, Park YB, Lee SW. Systemic immune-inflammation index could estimate the cross-sectional high activity and the poor outcomes in immunosuppressive drug-naïve patients with antineutrophil cytoplasmic antibody-associated vasculitis. Nephrology (Carlton) 2019; 24: 711-7.
9. Yang WM, Zhang WH, Ying HQ, Xu YM, Zhang J, Min QH, et al. Two new inflammatory markers associated with disease activity score-28 in patients with rheumatoid arthritis: Albumin to fibrinogen ratio and C-reactive protein to albumin ratio. Int Immunopharmacol 2018; 62: 293-8.
10. Kim JW, Jung JY, Suh CH, Kim HA. Systemic immune-inflammation index combined with ferritin can serve as a reliable assessment score for adult-onset Still's disease. Clin Rheumatol 2021; 40: 661-8.
11. Demiröz Taşolar S, Çiftçi N. Role of pan immune inflammatory value in the evaluation of hepatosteatosis in children and adolescents with obesity. J Pediatr Endocrinol Metab 2022; 35: 1481-6.
12. Brown RS. Autoimmune thyroiditis in childhood. J Clin Res Pediatr Endocrinol 2013; 5 Suppl 1(Suppl 1): 45-9.
13. Changlai SP, Chen WK, Chung C, Chiou SM. Objective evidence of decreased salivary function in patients with autoimmune thyroiditis (chronic thyroiditis, Hashimoto's thyroiditis). Nucl Med Commun 2002; 23: 1029-33.
14. Clark PG, Muhler JC, Shafer WG. The inhibition of hypophysectomy-induced changes in the rat submaxillary glands. Endocrinology 1956; 59: 516-21.
15. Akata D, Akhan O, Akyüz C, Ozmen MN, Yalcin B. Involvement of the thyroid and the salivary glands in childhood non-Hodgkin's lymphomas at initial diagnosis. Eur J Radiol 2002; 44: 228-31.
16. Skutnik-Radziszewska A, Maciejczyk M, Flisiak I, Kołodziej JKU, Kotowska-Rodziewicz A, Klimiuk A, et al. Enhanced Inflammation and Nitrosative Stress in the Saliva and Plasma of Patients with Plaque Psoriasis. J Clin Med 2020; 9: 745.
17. Zalewska A, Knaś M, Waszkiewicz N, Waszkiel D, Sierakowski S, Zwierz K. Rheumatoid arthritis patients with xerostomia have reduced production of key salivary constituents. Oral Surg Oral Med Oral Pathol Oral Radiol 2013; 115: 483-90.
18. Knaś M, Zalewska A, Waszkiewicz N, Szulimowska J, Dziezcioł J, Sierakowski S, et al. Salivary: flow and proteins of the innate and adaptive immunity in the limited and diffused systemic sclerosis. J Oral Pathol Med 2014; 43: 521-9.
19. Karsh J, Pavlidis N, Weintraub BD, Moutsopoulos HM. Thyroid disease in Sjögren's syndrome. Arthritis Rheum 1980; 23: 1326-9.
20. Scofield RH. Autoimmune thyroid disease in systemic lupus erythematosus and Sjögren's syndrome. Clin Exp Rheumatol 1996; 14: 321-30.
21. Moreno-Quispe LA, Serrano J, Virto L, Sanz M, Ramírez L, Fernández-Castro M, et al. Association of salivary inflammatory biomarkers with primary Sjögren's syndrome. J Oral Pathol Med 2020; 49: 940-7.
22. Bıxler D, Muhler JC. The relation of thyroid gland activity to the incidence of dental caries in the rat. II. A comparison of caries incidence under paired-feeding technics. J Dent Res 1957; 36: 880-2.
23. Agha-Hosseini F, Shirzad N, Moosavi MS. Evaluation of Xerostomia and salivary flow rate in Hashimoto's Thyroiditis. Med Oral Patol Oral Cir Bucal 2016; 21: e1-5.
24. Syed YA, Reddy BS, Ramamurthy TK, Rajendra K, Nerella NK, Krishnan M, et al. Estimation of Salivary Parameters among Autoimmune Thyroiditis Patients. J Clin Diagn Res 2017; 11: ZC01-4.
25. Rubaltelli L, Sponga T, Candiani F, Pittarello F, Andretta M. Infantile recurrent sialectatic parotitis: the role of sonography and sialography in diagnosis and follow-up. Br J Radiol 1987; 60: 1211-4.
26. Nozaki H, Harasawa A, Hara H, Kohno A, Shigeta A. Ultrasonographic features of recurrent parotitis in childhood. Pediatr Radiol 1994; 24: 98-100.
27. Shimizu M, Ussmüller J, Donath K, Yoshiura K, Ban S, Kanda S, et al. Sonographic analysis of recurrent parotitis in children: a comparative study with sialographic findings. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1998; 86: 606-15.
28. Chatzigeorgiou A, Karalis KP, Bornstein SR, Chavakis T. Lymphocytes in obesity-related adipose tissue inflammation. Diabetologia 2012; 55: 2583-92.
29. Nishimura S, Manabe I, Nagasaki M, Eto K, Yamashita H, Ohsugi M, et al. CD8+ effector T cells contribute to macrophage recruitment and adipose tissue inflammation in obesity. Nat Med 2009; 15: 914-20.
30. Liu JF, Ba L, Lv H, Lv D, Du JT, Jing XM, et al. Association between neutrophil-to-lymphocyte ratio and differentiated thyroid cancer: a meta-analysis. Sci Rep 2016; 6: 38551.
31. Feng J, Wang Y, Shan G, Gao L. Clinical and prognostic value of neutrophil-lymphocyte ratio for patients with thyroid cancer: A meta-analysis. Medicine (Baltimore) 2020; 99: e19686.
32. Onalan E, Aslan M. Could neutrophil to lymphocyte ratio be a marker in Hashimoto's thyroiditis? J Pak Med Assoc 2020; 70: 1381-3.
33. Aktas G, Sit M, Dikbas O, Erkol H, Altinordu R, Erkus E, et al. Elevated neutrophil-to-lymphocyte ratio in the diagnosis of Hashimoto's thyroiditis. Rev Assoc Med Bras (1992) 2017; 63: 1065-8.
34. Bilge M, Yesilova A, Adas M, Helvaci A. Neutrophil- and Platelet- to Lymphocyte Ratio in Patients with Euthyroid Hashimoto's Thyroiditis. Exp Clin Endocrinol Diabetes 2019; 127: 545-9.
35. Țaranu I, Lazea C, Creț V, Răcătăianu N, Iancu M, Bolboacă SD. Inflammation-Related Markers and Thyroid Function Measures in Pediatric Patients: Is the Grade of Obesity Relevant? Diagnostics (Basel) 2021; 11: 485.
36. Çiftel S, Tüzün Z. Could the Systemic Immune Inflammation Index Predict Diagnosis, Recovery Time, Hypothyroidism, and Recurrence Rates in Subacute Thyroiditis? Int J Gen Med 2023; 16: 1375-82.
37. Keskin Ç, Dilekçi EN, Üç ZA, Cengiz D, Duran C. Can the systemic immune-inflammation index be used as a novel diagnostic tool in the diagnosis of subacute thyroiditis? Biomark Med 2022; 16: 791-7.