Original Article

J Babol Univ Med Sci
22; 2020. P: 169-174

Investigation of Ocular Changes in Patients with Thyroid Disease

S. Rahmani (PhD)[1], H. Azizi (MSc)[*2], A. Akbarzadeh Baghban (PhD)[3] , H. Kangari (PhD)[1], M. Ghassemi Broumand (MD)[1]

1.Department of Optometry, School of Rehabilitation, Shahid Beheshti University of Medical Sciences, Tehran, I.R.Iran

2.Student Research Committee, Shahid Beheshti University of Medical Sciences, Tehran, I.R.Iran

3.Proteomics Research Center, Shahid Beheshti University of Medical Sciences, Tehran, I.R.Iran

J Babol Univ Med Sci; 22; 2020; PP: 169-174

Received: Oct 26th 2019, Revised: Jan 14th 2020, Accepted: Feb 4th 2020.

ABSTRACT

BACKGROUND AND OBJECTIVE: Ocular thyroid disease is a common complication associated with Graves' disease and hyperthyroidism, which in severe cases there is a risk of irreversible loss of vision. The aim of this study was to compare the visual acuity, refractive errors, proptosis and ocular deviation of these patients with healthy individuals.

METHODS: In this historical cohort study, 65 patients with history of thyroid disease were compared with 65 healthy subjects. Patients in the age range of 24 to 60 years with a history of thyroid disease and healthy individuals were selected from those who referred to the eye clinic who did not have thyroid disease. The proptosis of the eyes was measured with Hertel exophthalmometer. Visual acuity of the patients was measured with Snellen chart and refractive error measurement was done with an auto-refractometer.

FINDINGS: Of the patients, 53 (81.5%) were males and 12 (18.5%) were females. Sphere refractive error in patients and healthy individuals was -0.85±2.44 diopters and -0.46±1.26 diopters, respectively. The mean visual acuity in the patient and healthy groups was 0.91±0.13 and 0.96±0.08 in Snellen unit ($p \leq 0.0001$), respectively. The mean proptosis in patient and healthy individuals was 17.7±2.55 mm and 16.05±1.86 mm ($p \leq 0.0001$), respectively. The mean of total eye astigmatism in patient and healthy individuals was -1.11±1.19 diopters and -0.6±0.66 diopters, respectively ($p \leq 0.0001$).

CONCLUSION: Higher astigmatism and proptosis and decreased visual acuity in the patients, indicating thyroid disease has affected on the involved eye.

KEY WORDS: *Thyroid Disease, Refractive Errors, Visual Acuity*.

Please cite this article as follows:

Rahmani S, Azizi H, Akbarzadeh Baghban A, Kangari H, Ghassemi Broumand M. Investigation of Ocular Changes in Patients with Thyroid Disease. J Babol Univ Med Sci. 2020; 22: 169-74.

[*]**Corresponding Author: H. Azizi (MSc)**
Address: Student Research Committee, Shahid Beheshti University of Medical Sciences, Tehran, I.R.Iran
Tel: +98 21 77548865
E-mail: Hajarazizi1374@gmail.com

[DOR: 20.1001.1.15614107.1399.22.1.22.4]
[DOI: 10.22088/jbums.22.1.169]

Introduction

Ocular thyroid disease is a common complication associated with Graves' disease and hyperthyroidism (1, 2). It occurs in 25-50% of patients with Graves' disease (3, 4), although it may also occur in people with hypothyroidism (5, 6). Although ocular thyroid disease is an autoimmune disorder, its pathogenesis is not fully understood (2, 5, 7). The disease is more common in women than men and its incidence is reported to be 2.9-16 cases per 100,000 people per year (1, 8).

Eyelid retraction, chemosis, proptosis, dry eye due to increased eyelid cleft, exposure to keratopathy and optic neuropathy are the most common presentation of ocular thyroid disease (1, 5, 9-12). Strabismus and diplopia are also possible due to involvement of the extraocular muscles (13). These complications have a negative impact on the quality of life of these patients (13, 14) and in severe cases there is a risk of irreversible vision loss (15). Orbital fibroblasts appear to be responsible for the increase in soft tissue volume in this disease and many of the above problems (16, 17).

So far, limited studies have been performed on the ocular problems of these patients in Iran and the world. Therefore, considering the importance of assessing visual acuity and refractive errors in patients with ocular thyroid disease, the aim of this study was to evaluate changes in ocular parameters (visual acuity, refractive errors, astigmatism and proptosis) in patients referred to Takab Hospital and compare it with healthy people.

Methods

This historical cohort study after approval by the Ethics Committee of Shahid Beheshti University of Medical Sciences with the number IR.SBMU.RETECH.REC.1397.714 was performed on 65 patients who referred to Takab city hospital with thyroid eye disease and 65 healthy individuals. Patients in the age range of 24 to 60 years with a history of thyroid disease were included in the study and excluded from the study in case of other eye diseases. Healthy individuals were selected from those who referred to an eye clinic who did not have thyroid disease. First, demographic information of patients including age and sex as well as ocular symptoms of patients were recorded. Eye protoptosis of patients was measured with a Holter type exophthalmometer (OCULUS, Germany) and their visual acuity was measured with a Snelln chart. Objective refractive error (sphere and cylinder) was evaluated with an autorefractometer (TOPCON, Japan) and recorded in diopter units. The best visual acuity of patients with maximum positive lenses was determined. To evaluate ocular aberration at near (40 cm) and far (6 m) distances by correcting distant vision, cover test was performed and two prism bars (horizontal and vertical) were used and the amount of aberration was recorded per diopter prism unit. The experiments were repeated 2, 4 and 6 months after the first examination for patients and healthy people, and finally the last examination (6 months later) was the basis for comparing patients and healthy people.

Data analysis was performed using SPSS software version 20. To compare the means in the two groups of patients and healthy, independent t-test was used and in the follow-up examinations of each group, paired t-test was used and $p < 0.05$ was considered significant.

Results

Out of the 65 patients, 53 individuals (81.5%) were male and 12 individuals (18.5%) were female. The age of the participating patients was 24-60 years with a mean age of 43.06±10.48 years and healthy individuals with a mean age of 42.44±9.86 years. Eyelid retraction (58.5%) and swelling around the eye (53.8%) were the most common ocular complications. The mean visual acuity of patients' right eye in the first examination was 0.93±0.11 and in the healthy group was 0.96±0.07, that the difference was not statistically significant, while in the last examination the mean visual acuity of patients' right eye was 0.13. ± 0.91 and in the healthy group was 0.96±0.08 which was statistically significant ($p \leq 0.02$). The mean visual acuity of patients' left eye in the first examination was 0.91±0.15 and in the healthy group was 0.96±0.07, that the difference was statistically significant ($p \leq 0.005$) and in the last examination the mean visual acuity of patients' left eye was 0.91±0.13 and in the healthy group was 0.97±0.07, which was also statistically significant ($p \leq 0.003$).

The mean sphere refractive error in the first examination in patients' right eye was -0.96±2.4 diopters and in the healthy eye was -0.48±1.18 diopters and in the last examination of patients' right eye the mean sphere refractive error was -0.92±2.52 diopters and in the healthy eye was -0.47±1.19 diopters, but these differences were not statistically significant.

[DOR: 20.1001.1.15614107.1399.22.1.22.4]
[DOI: 10.22088/jbums.22.1.169]

Also the mean sphere refractive error in first examination in patients' left eye was -0.87±2.37 diopters while in the left eye of healthy individuals was -0.41±1.33. In the fourth examination, the amount of sphere refractive error in patients' left eye was 0.78±2.36 diopters and in healthy individuals was -0.44 32 1.32 diopters, but these differences were not statistically significant. The mean of total patients' right eye astigmatism in the first examination was -1.04±0.1 diopter and in healthy individuals was -0.6±0.64 diopter, which was statistically significant (p≤0.003) and the mean of total patients' right eye astigmatism in the fourth examination was -0.97±0.1 diopter and in healthy individuals was -0.6±0.64 diopter, in which case the difference was statistically significant (p≤0.016). The mean of total patients' left eye astigmatism in the first examination was -1.14±1.14 diopter and in healthy individuals was -0.6±0.72 diopter, which was statistically significant (p≤0.007) and the mean of total patients' left eye astigmatism in the fourth examination was -1.25±1.34 diopter and in healthy individuals was -0.67±0.64 diopter, in which case the difference was statistically significant (p≤0.001). About 60% of patients with astigmatism accorded with norm.

Right eye proptosis of patients in the first examination was 17.2±2.50 mm and in the right eye of healthy individuals was 16.1±1.93 mm, which was statistically significant (p≤0.006). In the fourth examination, it reached 8.17±2.52 mm in the eyes of patients and 16.12±1.90 mm in healthy individuals, which was statistically significant (p≤0.0001). Left eye proptosis of patients in the first examination was 17.04 ± 2.59 mm and in healthy individuals was 15.89±1.91 mm, the difference was statistically significant (p≤0.005) and in the fourth examination was 17.61±2.59 mm in the eyes of patients and 15.98±1.81 mm in healthy individuals and this difference was statistically significant (p≤0.0001). In addition, only changes in proptosis in the right and left eyes of patients between the first and fourth examinations were statistically significant (p≤0.0001).

Figure 1 shows the mean visual acuity, astigmatism, and refractive errors of the right and left eyes of patients with healthy individuals. There were 6 cases in the group of patients with exotropia type of strabismus with a mean of 11.66±2.33 prism diopters, which was not present in the group of healthy individuals with strabismus.

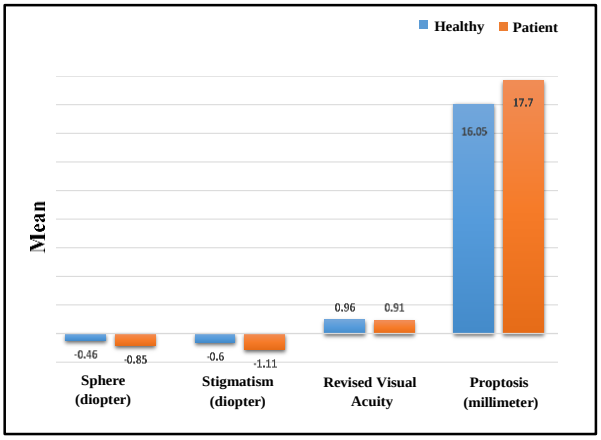


Figure 1. Comparison of mean refractive errors, visual acuity and proptosis in healthy and ocular thyroid disease

Discussion

The findings of the present study show that the proptosis of thyroid patients in a period of 6 months was higher than that of healthy individuals, which is slightly different from the study of Jankauskiene et al. (18) In this study, proptosis was measured cross-sectionally in different age groups, therefore, the measured values were significantly different from each other. Both studies used a device called a helter-type exophthalmometer to measure, which is a common and reliable method for measuring patients' proptosis (19). In a study by Migliori et al., the rate of proptosis in white men and women was 15.4 mm and 16.5 mm, respectively (20), which is consistent with the results of the present study. The amounts of proptosis vary in different races and ethnicities. For example, blacks have higher protoptosis than whites, and propetosis levels are higher in men than in women (21, 22).

Although limited and cross-sectional studies have been conducted in the world on the effects of thyroid ocular disease on refractive errors (18, 23, 24), it should be noted that the determination of refractive errors is an important part of eye examinations (25). The results of the present study are comparable to the study of Jankauskiene et al. about the refractive error of thyroid patients. They found in their study that patients with thyroid pathology are more defective than healthy individuals and their visual acuity is worse. In addition, patients with proptosis more than 17 mm had worse visual acuity than healthy individuals (24). Although both myopia and hyperopia changes have been mentioned in the sources (26) in the present study, the changes in the spherical part of the refractive errors were towards myopia, which should be noted that

[DOR: 20.1001.1.15614107.1399.22.1.22.4]
[DOI: 10.22088/jbums.22.1.169]

although not statistically significant compared to healthy individuals, but in terms of clinical is significant. Changes in refractive errors in patients with ocular thyroid can be due to the accumulation of immunological compounds in the side walls of the orbit as well as the bulking of the ocular muscles of the eye (18). In addition, changes in the axial length of the eye can also affect its refractive errors. In a study by Huismans et al. on two cases of thyroid ocular disease for the development of myopia, infiltration and ciliary body edema were considered as possible mechanisms for myopia (27). Eyelid retraction was one of the most common complications of this disease in the eye among other complications, which is consistent with the study of Medghalchi et al., which was performed to evaluate the complications of ocular thyroid patients living in northern Iran (2).

The presence of high prevalence of normal astigmatism in the patient group is consistent with the study of Mombaerts et al. (28), in the above study, it was shown that astigmatism according to the corneal base is more common in patients with Graves' ophthalmopathy and it seems that this issue is affected by soft tissue fibrosis in the upper outer part of the orbit (18). The results of the present study showed that thyroid ocular disease significantly reduces visual acuity, which is consistent with the results of the study by Jankauskiene et al. (24). However, in the present study, both patients and healthy groups had better visual acuity than that study, which may be due to the fact that the visual acuity was measured after refractive error correction. In both studies, changes in visual acuity could be related to myopia shift and optic nerve damage. Strabismus leads to limited eye movements due to thickening of the extraocular muscles and the type of deviation will vary depending on which muscle is involved. Although hypotropia and isotropia are more common due to involvement of the inner and lower right muscles, but it is possible for any deviation to occur (29) although in this study, people with deviation did not need surgery, but in case of severe ophthalmopathy, strabismus surgery may be needed to maintain binocular vision (5).

Finally, this study showed that proptosis, visual acuity and astigmatism of thyroid patients were different from healthy individuals and this showed the effect of the disease on the eyes of patients. Considering that this is the first study in the country to investigate the changes in refractive errors in thyroid patients, it is suggested that similar studies be performed on changes in other ocular features of these individuals.

Acknowledgment

Hereby, we would like to thank the Shahid Beheshti University of Medical Sciences and all the staff of Takab Hospital, especially Dr. Ali Naseri, for their support of this study.

[DOR: 20.1001.1.15614107.1399.22.1.22.4]
[DOI: 10.22088/jbums.22.1.169]

References

1.Briceno CA, Gupta S, Douglas RS. Advances in the management of thyroid eye disease. Int Ophthalmol Clin. 2013;53(3):93-101.

2.Medghalchi A, Akbari M, Alizadeh Y, Soltani Moghadam R. The epidemiological characteristics of patients with thyroid eye disease in a referral center in northern Iran. J Curr Ophthalmol. 2018;30(4):353-8.

3.Edmunds MR, Boelaert K. Knowledge of Thyroid Eye Disease in Graves' Disease Patients With and Without Orbitopathy. Thyroid. 2019;29(4):557-62.

4.Gharib S, Moazezi Z, Bayani MA. Prevalence and severity of ocular involvement in Graves' disease according to sex and age: A clinical study from Babol, Iran. Caspian J Intern Med. 2018;9(2):178-83.

5.Sahli E, Gunduz K. Thyroid-associated Ophthalmopathy. Turk J Ophthalmol. 2017;47(2):94-105.

6.Savku E, Gunduz K. Diagnosis, Follow-Up and Treatment Results in Thyroid Ophthalmopathy. Turk J Ophthalmol. 2015;45(4):156-63.

7.Huang Y, Fang S, Li D, Zhou H, Li B, Fan X. The involvement of T cell pathogenesis in thyroid-associated ophthalmopathy. Eye (Lond). 2019;33(2):176-82.

8.Perros P, Neoh C, Dickinson J. Thyroid eye disease. BMJ. 2009;338: b560.

9.Grisolia ABD, Couso RC, Matayoshi S, Douglas RS, Briceno CA. Non-surgical treatment for eyelid retraction in thyroid eye disease (TED). Br J Ophthalmol. 2018;102(2):158-163.

10.Pillar AJ, Richa DC. Treatment options for thyroid eye disease. Curr Treat Options Neurol. 2014;16(8):303.

11.Karabulut GO, Kaynak P, Altan C, Ozturker C, Aksoy EF, Demirok A, et al. Corneal biomechanical properties in thyroid eye disease. Kaohsiung J Med Sci. 2014;30(6):299-304.

12.Gholami A, Mousavie Anijdan SH. The high ratio of thyroiditis as a main cause of thyrotoxicosis in patients referred to the nuclear medicine department of Babol Shahid Beheshti Hospital. J Babol Univ Med Sci. 2018;20(12):33-8. [In Persian]

13.Lin TY, Li N, Yeh MW, Leung AM, Rootman DB. Prognostic indicators for the development of strabismus among patients with graves' ophthalmopathy. J Clin Transl Endocrinol. 2017;9:38-40.

14.Son BJ, Lee SY, Yoon JS. Evaluation of thyroid eye disease: quality-of-life questionnaire (TED-QOL) in Korean patients. Can J Ophthalmol. 2014;49(2):167-73.

15.Verity DH, Rose GE. Acute thyroid eye disease (TED): principles of medical and surgical management. Eye (Lond). 2013;27(3):308-19.

16.Shan SJ, Douglas RS. The pathophysiology of thyroid eye disease. J Neuro-Ophthalmol. 2014;34(2):177-85.

17.Eckstein A, Esser J. Endokrine Orbitopathie (Graves' ophthalmopathy). Der Internist. 2010;51(5):584-95. Available from: https://link.springer.com/article/10.1007/s00108-009-2497-5

18.Jankauskiene J, Jarusaitiene D. Assessment of visual acuity, refraction changes, and proptosis in different ages of patients with thyroid diseases. Int J Endocrinol. 2012;2012:643275.

19.Bahmani Kashkouli M, Beigi B, Noorani MM, Nojoomi M. Hertel exophthalmometry: reliability and interobserver variation. Orbit. 2003;22(4):239-45.

20. Migliori ME, Gladstone GJ. Determination of the normal range of exophthalmometric values for black and white adults. Am J Ophthalmol. 1984;98(4):438-42.

21.de Juan EJr, Hurley DP, Sapira JD. Racial differences in normal values of proptosis. Arch Intern Med. 1980;140(9):1230-1.

22.Sarinnapakorn V, Sridama V, Sunthornthepvarakul T. Proptosis in normal Thai samples and thyroid patients. J Med Assoc Thai. 2007;90(4):679-83.

23.Chandrasekaran S, Petsoglou C, Billson FA, Selva D, Ghabrial R. Refractive change in thyroid eye disease (a neglected clinical sign). Br J Ophthalmol. 2006;90(3):307-9.

24.Jankauskiene J, Jakstaite V, Smalinskas V. Changes of vision and refraction in patients with thyroid pathology. Medicina (Kaunas). 2009;45(5):378-81.

[DOR: 20.1001.1.15614107.1399.22.1.22.4]
[DOI: 10.22088/jbums.22.1.169]

25.Chu R-Y, Qu X-M. Refraction is important procedure in the diagnose and treatment of eye diseases. [Zhonghua yan ke za zhi] Chinese J Ophthalmol. 2010;46(11):961-3.
26.Kinori M, Godfrey KJ, Whipple KM, Kikkawa DO, Granet DB. Refractive changes following corrective surgery for thyroid-related orbitopathy. J AAPOS. 2017;21(1):67-8.
27.Huismans H. Conspicuous change of refraction in endocrine orbitopathy. Klin Monbl Augenheilkd. 1991;198(3):215-6.
28.Mombaerts I, Vandelanotte S, Koornneef L. Corneal astigmatism in Graves' ophthalmopathy. Eye (Lond). 2006;20(4):440-6.
29.Kim WJ, Moon JS, Kim M-M. Exotropia and hypotropia as the initial presentation sign of thyroid eye disease in an 18-year-old man. Journal of AAPOS. 2018;22(1):71-3.

[DOR: 20.1001.1.15614107.1399.22.1.22.4]
[DOI: 10.22088/jbums.22.1.169]