ORIGINAL ARTICLE

Pathophysiology Changes in Extraocular Muscles in Thyroid Eye Disease: Ophthalmic and Radiological Correlation in our Population

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ABSTRACT

Objective: To study the effect of thyroid eye disease on extra ocular muscles both clinically and radiologically.
Study Design: Descriptive study
Place and Duration of Study: Department of Ophthalmology, CMH Lahore from 1st January 2019 to 31st December 2019
Methodology: One hundred and ten confirmed cases of thyroid eye disease were included in the study. Visual acuity, intraocular pressure (IOP), extraocular motility, anterior and dilated posterior segment examination were carried out to determine the ophthalmic status. Computed tomography scan and magnetic resonance imaging were done to correlate radiological findings.
Results: Mean age of subject was 43 years. 42 (38.1%) were males and 68 (61.8%) were females. There was orbital fat involvement in 92% of patients and extraocular muscle involvement in up to 89% of patients. There was predominant involvement of inferior and medial rectus muscles.
Conclusion: Thyroid ophthalmopathy is associated with variable morbidity in terms of ocular motility problems and visual loss. Radiological finding correlate well with clinical findings
Key words: Thyroid eye disease, Ophthalmopathy, Exophthalmos, Magnetic resonance imaging, Extraocular muscles

INTRODUCTION

Thyroid eye disease (TED) is an autoimmune process featured by lymphocytic infiltration of the orbital tissues, involving the extra ocular muscles (EOMs). Fibrotic changes in post congestive and inflammatory phase results in considerable functional tissue loss especially extra ocular muscle functions. Thyroid associated orbitopathy is the most common cause of proptosis. On radiology, common features observed were bilateral and symmetrical enlargement of the extraocular muscle bellies with sparing of tendons as well as increase in orbital fat volume. High resolution magnetic resonance imaging reveal EOM enlargement in nearly two third of adult patients with TED.[1]

Thyroid eye disease is the most common disorder affecting the orbit and also the most common cause of bilateral proptosis. Registered incidence of TED is 16/100,000 females and 2.9/100,000 males. The prevalence reported is 0.25 percent with no ethnic predilection.[2] Higher preponderance in females is attributed to higher occurrence of hyperthyroidism in females. Incidence of TED in paediatric population (<18 years) with Graves' disease is variable and has been stated as 17% by Goldstein et al[3] and 63% by Chan et al.[4]

Magnetic resonance imaging is very sensitive and specific in detecting orbital fat and extra ocular muscles thickness.[5,6] Enlargement of the inferior rectus (IR) and medial rectus (MR) muscles frequently results in vertical ocular motility defects as these muscles are more prone to be affected in literature.[7] This leads to the clinical outcome of proptosis.[8] Magnetic resonance imaging also helps in distinguishing other causes of muscle enlargement like reduced venous outflow.[9]

PATIENTS AND METHODS

This descriptive study was carried out in the eye department CMH Lahore from 1st January 2019 to December 2019. A total of 110 confirmed cases from outpatient department that were clinically having features of thyroid eye disease were included in the study. Patients attending the eye OPD were examined on slit lamp after taking their visual acuity by snellen acuity charts and ocular motility assessment. Patients having diabetes, hypertension, cataract, any other preexisting disease, any other prophylaxis and extreme age 70 plus were excluded from the study. Then on slit lamp anterior segment examination was carried along with tonometry for baseline record. Posterior segment dilated examination was carried out with 90 D lens. A drop of pilocarpine was instilled at the end of examination. Thereafter patients were followed at 3 monthly intervals for 01 year .Same procedure was followed on each visit. Percentage was calculated for demographic status, visual and ocular motility status and effects on fundus.

Patients were also subjected to MRI scan in the Radiology Department. T1 and T2 weighted images were taken. On axial slices, thickness of medial and lateral rectus, and on sagital slices, thickness of superior and inferior rectus was taken for evaluation respectively. Thickness of the orbital fat was also measured. The data was entered and analyzed through SPSS-20.

RESULTS

There were 42 (38.1%) males and 68 (61.8%) females (Table 1). Correctable visual acuity ranges between 6/6 to 6/60. Intraocular pressure ranges between 10-28 mmHg. Cup disc ratio varied from 0.3 to 0.5. Patient age ranges from 20 to 65 years with mean value of 43 years. Visual symptoms were summarized in (Table 2). VF defects were noted in 04 patients. None had associated anterior or posterior segment changes.

The range of orbital fat thickness varied from 3.3 to

4.5 mm with a mean of 4.2 mm. This corresponded to an average increase of about 2 mm from normal measurements. There was extraocular muscle involvement in 89% of the patients. Bilateral muscles were involved in 82% of the patients with muscle involvement. 70% of the patients had symmetrically thickened muscles. in most patients there was a predominant involvement of inferior and medial rectus muscle (Table 3).

Table 1: Socio demographic profile of subjects

Sex	Frequency	Percentage
Male	42	38.1
Female	68	61.8

Table 2: Distribution of cases according to visual symptoms

Adverse effects	No.	%
Eye pain	42	38.1
Blur vision	37	33.6
Intraocular pressure	18	16.3
Motility defects	12	10.9
Proptosis	64	58.1

Table 3: Magnetic resonance imaging findings

Extraocular involvement	No.	%
Unilateral muscles	16	14.5
Bilateral muscles	82	74.5
Symmetrical muscles	70	63.6
Orbital fat	101	91.8

DISCUSSION

Thyroid eye disease is an autoimmune mediated patho-physiological process resulted in variable function loss in affected patients. Variable number of patient's manifest ophthalmic features in thyroid eye disease. Disease affects females more than males.[10] Evaluation with MRI is useful due to improved soft-tissue contrast and multiplanar function. The size of the muscles correlates with both the severity of disease and the risk of optic nerve compression. Most patients are clinically hyperthyroid, yet signs of thyroid ophthalmopathy can be present regardless of thyroid function. Although literature shows life threatening features in less than 5% of patients less serious features are observed in 30-50 percent of individuals. The natural course of thyroid eye disease consists of two stages: an active inflammatory stage and a static stage. Magnetic resonance imaging is more sensitive and specific in detecting extraocular muscle enlargement than US, especially when muscles are markedly enlarged. Nagy et al[11] found that T2 relaxation times on MRI provided more diagnostic and prognostic information than clinical and laboratory factors.

Sas et al[12], Xu et al[13] and Kirsch et al[14] showed similar results in correspondence to our study. The average increase in orbital fat thickness and bellies[12] of extra ocular muscles in our study is similar to the above mentioned studies. Vlainich et al[15] showed involvement of extraocular muscles in up to 79% of patients with thyroid eye disease. Our study indicated increased orbital fat thickness which correlated well with study done by Higashiyama et al.[16]

Mettu et al[17] recorded that 53 per cent of patients had proptosis of 19 thyroid eye disease. Vertical misalignment occurred in 58% of patients. Repeated imagery revealed a spacing of other extraocular muscles for 8 patients.

An increased orbital volume in TED can compensate for the effect of an increased soft tissue volume intraorbitally on increased intraorbital pressures, that is to say, it can be a form of spontaneous decompression. To support this, Chan et al[18] found that the osseous orbital angles were wider in the eyes without dysthyroid optic neuropathy (DON) and narrower in the eyes with DON, when controlled for the enlargement of extraocular muscles in TED patients' orbits.

In addition to thyroid associated orbitopathy (TAO) related morbidity, the quality of life is impaired significantly. Patients report difficulties in critical day-to-day tasks, including reading and driving.[19] Moreover, with the seriousness of the disease, the effect on quality of life increases.[20] Thyroid associated orbitopathy has been linked to increased anxiety and depression, due in part to a changed cosmetic appearance.

CONCLUSION

There is significant risk of visual loss and motility disorders in untreated and aggressive cases of thyroid eye disease 1 year.

REFERENCES

1. Enzmann DR, Donaldson SS, Kriss JP. Appearance of Graves' disease on orbital computed tomography. J Comput Assist Tomogr 1979;3: 815–9.
2. Lazarus JH. Epidemiology of Graves' orbitopathy (GO) and relationship with thyroid disease. Best Pract Res Clin Endocrinol Metab 2012;26:273-9.
3. Goldstein SM, Katowitz WR, Moshang T, Katowitz JA. Pediatric thyroid-associated orbitopathy: The children's hospital of Philadelphia experience and literature review. Thyroid 2008;18:997-9.
4. Chan W, Wong GW, Fan DS, Cheng AC, Lam DS, Ng JS. Ophthalmopathy in childhood Graves' disease. Br J Ophthalmol 2002;86:740-2
5. Rabinowitz MP, Carrasco JR. Update on advanced imaging options for thyroid-associated orbitopathy. Saudi J Ophthalmol 2012; 26(4):385–92.
6. Siakallis LC, Uddin JM, Miszkiel KA. Imaging investigation of thyroid eye disease. Ophthal Plast Reconstr Surg 2018; 34(4S Suppl 1):1.
7. Chotthoefer EO, Wallace DK. Strabismus associated with thyroid eye disease. Curr Opin Ophthalmol 2007;18: 361–5.
8. Thyroid eye disease - Radiology at St. Vincent's University Hospital [Internet] 2020.
9. Kawa MP, Machalińska A, Wilk G, Machaliński B. Graves' ophthalmopathy imaging evaluation. in: thyroid disorders - focus on hyperthyroidism. InTech; 2014.
10. Wiersinga WM, Bartalena L. Epidemiology and prevention of Graves' ophthalmopathy. Thyroid 2002;12:855–60.
11. Nagy EV, Toth J, Kaldi I, Damjanovich J, Mezosi E, Lenkey A, *et al.* Graves' ophthalmopathy: eye muscle involvement in patients with diplopia. Eur J Endocrinol 2000; 142(6): 591-7.
12. Sas TN, Camen GC, Stefanescu A, Gheonea IA. Imaging evaluation of the orbit in Graves ophthalmopathy. Curr Heal Sci J 2015; 41(3): 285–7.
13. Xu L, Li L, Xie C, Guan M, Xue Y. Thickness of extraocular muscle and orbital fat in mri predicts response to glucocorticoid therapy in Graves' ophthalmopathy. Int J Endocrinol. 2017;2017.
14. Kirsch E, Von Arx G. Graves' orbitopathy: current imaging procedures [Internet]. 2009.
15. Vlainich AR, Romaldini JH, Pedro AB, Farah CS, Sinisgalli CA. Ultrasonography compared to magnetic resonance imaging in thyroid-associated Graves' ophthalmopathy Comparação de ultrassonografia à ressonância magnética nuclear na oftalmopatia de Graves associada à tiroide. Arq Bras Endocrinol Metab. 2011;55.
16. Higashiyama T, Iwasa M, Ohji M. Quantitative Analysis of Inflammation in Orbital Fat of Thyroid-associated Ophthalmopathy Using MRI Signal Intensity. Sci Rep 2017 Dec 1;7(1).
17. Mettu YWP, Broadbent T, Radke P, Firl K, Shepherd JB, Couch SM, et al. Thyroid eye disease presenting with superior rectus/levator complex enlargement. Orbit 2020; 39(1): 5-12.
18. Chan LL, Tan HE, Fook-Chong S, Teo TH, Lim LH, Seah LL. Graves ophthalmopathy: the bony orbit in optic neuropathy, its apical angular capacity, and impact on prediction of risk. *Am J Neuroradiol*. 2009; 30: 597–602
19. Weiler DL. Thyroid eye disease: a review. Clin Exp Optom [Internet]. 2017; 100(1):20–5.
20. Manjandavida FP, Chahar S. An update on thyroid eye disease: Current knowledge, preferred practice patterns, and future therapies. Kerala J Ophthalmol 2020;32:10-26.