

## The Effect of Hyperthyroidism on Refractive Errors and Visual Acuity

Dr. Muna F. Abbas; MSc in Community Medicine, Dr. Saba D. Ahmed; MSc in Community Medicine, Dr. Ali Noaman Al-Ibadi; MB.CH.B. Resident ophthalmology

### Abstract

Hyperthyroidism is a condition in which there is over production of thyroid hormones, abnormal antibodies that attack the thyroid gland causes it to become over active. Abnormal antibodies may cause swelling and inflammation of the soft tissue around the eyes and the muscles that move the eyes and the eyelids.

**Aim of the study:** The aim of the study was to find the effect of hyperthyroidism on the vision and development of refractive errors in patient with hyperthyroidism

**Results:** It was found that the usual age of onset of hyperthyroidism was between 30 and 50 years with the females' preponderance. Myopia showed in high percentage within the age 40-50 and >50 years (61.1%), (68.0%) respectively. While hypermetropia was seen more in age <40 (28.9%) and hyperthyroidism has a bad effect on the visual acuity.

**Conclusion:** Myopia was seen more in older age group while hypermetropia seen in younger age group. Hyperthyroidism has a bad effect on the visual acuity.

### Introduction

Thyroid gland is located in the neck, produce thyroid hormone which helps to regulate body metabolism.

#### Thyroid eye disease (TED)

Thyroid eye disease also called thyroid ophthalmopathy' or 'thyroid associated ophthalmopathy explained by accumulation of tissue and fluid causing pressure on the orbit contents.<sup>(1)</sup>

is an autoimmune inflammatory disorder affecting the orbit around the eye, characterized by upper eyelid retraction, swelling (edema), redness (erythema), conjunctivitis, and bulging eyes (proptosis).

It is part of a systemic process with variable expression in the eyes, thyroid, and skin, caused by autoantibodies that bind to tissues in those organs, and, in general, occurs with hyperthyroidism.<sup>[1]</sup> The most common form of hyperthyroidism is Graves' disease. About 10% of cases do not have Graves' disease, but do have autoantibodies.

The autoantibodies target the fibroblasts in the eye muscles, and those fibroblasts can differentiate into fat cells (adipocytes). Fat cells and muscles expand and become inflamed. Veins become compressed, and are unable to drain fluid, causing edema

Swelling of the fatty tissue can cause the eyes to become red. This can also cause the eyes to be pushed forward (starey eyes, proptosis).<sup>(3)</sup>

In severe cases the damage at the back of the eye can cause swelling and stiffness of the muscles that move the eye causing double vision, especially when you look from side to as the muscles cannot keep the eyes exactly in line with each other.

Occasionally, the swelling behind the eyes is press on the nerve from the eyes to the brain affecting vision.<sup>(4)</sup>

Although less than five per cent of patients with thyroid disorder develop clinical thyroid eye disease, but examination may reveal up to 50 percent of patients being affected in a sub-clinical manner or with blood tests for antibodies.<sup>(5)</sup>

**Epidemiology of TED:**

- The incidence of TED is 2.9 to 16 cases/100,000/year.
- Thyroid eye disease affects an estimated 400 000 people in the United

Kingdom. This estimate is based on a UK population of 59 million. <sup>(6,7)</sup>

- The ophthalmic complications of Graves' disease or thyrotoxicosis affects between 25% and 50% of those with the disease.
- There is a female preponderance of 4:1; this reflects the higher incidence of thyrotoxicosis in women.
- The usual age of onset is between 30 and 50.
- TED can be more severe in men over the age of 60. <sup>(8)</sup>

**Symptoms of thyroid eye disease:**

- Protrusion of one or both eyeballs.
- Puffy, swollen eyelids.
- Gritty, burning, irritated eyes that frequently water.
- Diplopia (double vision).
- Decreased vision, often following reduced brightness of colors.
- Redness and swelling of the conjunctiva, the thin layer covering the white part of the eye.
- Difficulty in completely closing the eyelids, especially while sleeping.
- The most common eye sign in Graves' disease is proptosis, in which the eyes appear to bulge

outward. This finding is present in 70 – 90% of cases of thyroid eye disease. The swelling that causes proptosis is due to collections of fluid, fat, and inflammatory cells. <sup>(8),(9),(10)</sup>

The muscles that move the eyes may also become congested and stiff. This leads to double vision, since the muscles are unable to move the eyes together. As the disease gets worse, scarring of these muscles may occur, resulting in permanent limitation of eye movements. <sup>(10),(11)</sup>

**Methodology**

This retrospective study was conducted in Endocrine center at AL-Kindy Teaching Hospital in Baghdad during the period from 1<sup>st</sup> December 2008 till 1<sup>st</sup> July 2009

Sample included (50) males and (100) females having hyperthyroidism distributed in age group from (35) years and above.

Information was done by direct interview with the patients included demographic data followed by examination of refraction and visual acuity in the first visit, after one year and after two years. Statistical analysis was done using SPSS package program.

**Results and discussions****Table 1: Distribution of the sample according to their age and sex**

Age/years	Male		Female		Total	
	No	%	No	%	No	%
<40	16	57.1	12	42.9	28	18.7
40-50	26	36.1	46	63.9	72	48.0
>50	8	16.0	42	84.0	50	33.3
Total	50	33.3	100	66.7	150	100

In table (1) it was found that the higher percentage of the sample was between 40 -50 years (48%), followed by those of more than 50 years of age (33.3%). Also it was found that 2/3 of the

sample was females and 1/3 was males. this reflects the higher incidence of thyrotoxicosis in women which is coincide with (Perros P. et al) research <sup>(8)</sup> in which it was found that

the usual age of onset is between 30 and 50 and female preponderance of 4:1 male.

**Table 2: Distribution of the sample according to the age with the type of refractive errors**

Age/years	Emmetropia		myopia		hypermetropia		Total	
	No	%	No	%	No	%	No	%
<40	12	42.2	8	28.9	8	28.9	28	100
40-50	18	25	44	61.1	10	13.9	72	100
>50	10	20	34	68.0	6	12	50	100
Total	40	26.7	86	57.3	24	16	150	100

Table (2) reveals that myopia showed high percentage within the age 40-50 and >50 years (61.1%) and (68.0%) respectively. While hypermetropia was seen more in age <40 (28.9%) followed by 40-50 years of age (13.9%) and the least was seen at age >50 years (12.0%), This agree with a study done by (Jankauskiene J et al) in which they found that myopia was more in hyperthyroidism<sup>(12)</sup> but disagree with the study done by (S Chandrasekaran et al)<sup>(13)</sup> where they found that hypermetropia was more in hyperthyroidism, the proposed mechanism of hypermetropia relates to increased volume of orbital contents with flattening of the posterior globe.

The explanation of such findings is that the increase in extraocular muscles mass will lead to press on the sides of the eyeball at the equator level and this will cause elongation of antero-posterior (AP) axis and this will lead to

axial myopia while in the case of hypermetropia the pressure of extraocular muscles will be on the back of the eyeball and this will decrease the AP axis leading to axial hypermetropia.

Table 4 –A show the distribution of visual acuity grades along different periods of the studied times with causes correlation ship, which indicated that highly significant differences at  $P < 0.01$  between the sequential assorting visual acuity from (6/6 – 6/60) in reverse pointed by increasing frequency with bad grade of V.A and decreasing with

good grade compared by the initial period (predisposed up to final period (2 years))

In addition to that figure no. (A) Illustrated graphically the behavior of the sequential outcomes which were registered along the studied period.

**Table 3: Distribution of the sample according to sex and the type of refractive error.**

sex	Emmetropia		myopia		hypermetropia		Total	
	%	No	No	%	No	%	No	%
Male	14	28.0	28	56.0	8	16.0	50	100
Female	26	26.0	58	58.0	16	16.0	100	100
Total	40	26.7	86	57.3	24	16.0	150	100

Table 3 shows that the type of refractive errors looks to be the same in both sexes, the higher percentage was myopia and the least was hypermetropia.

**Table (4 - A): Distribution of Visual acuity grades along different Periods of times with correlation ship (Contingency coefficient – CC value)**

Periods		Visual Acuity							Total	C.S. P-value
		6/6	6/9	6/12	6/18	6/24	6/36	6/60		
Pre disease	Freq.'s	52	36	30	28	2	1	1	150	CC=0.479 P= 0.000 HS
	% Visual Acuity	47.3	51.4	55.6	60.9	2.7%	1.4%	4.3%	33.3%	
	% of Total	11.6%	8.0%	6.7%	6.2	0.4	0.2	0.2	33.3	
1 yrs. Post	Freq.'s	30	18	14	10	42	30	6	150	
	% Visual Acuity	27.3	25.7	25.9	21.7	56.8	41.1	26.1	33.3	
	% of Total	6.7%	4.0	3.1	2.2	9.3	6.7	1.3	33.3	
2 yrs. Post	Freq.'s	28	16	10	8	30	42	16	150	
	% Visual Acuity	25.5	22.9	18.5	17.4	40.5	57.5	69.6	33.3	
	% of Total	6.2	3.6	2.2	1.8	6.7	9.3	3.6	33.3	
Total	Freq.'s	110	70	54	46	74	73	23	450	
	% Visual Acuity	100	100	100	100	100	100	100	100	
	% of Total	24.4	15.6	12.0	10.2	16.4	16.2	5.1	100	

HS : Highly sig. at P<0.01

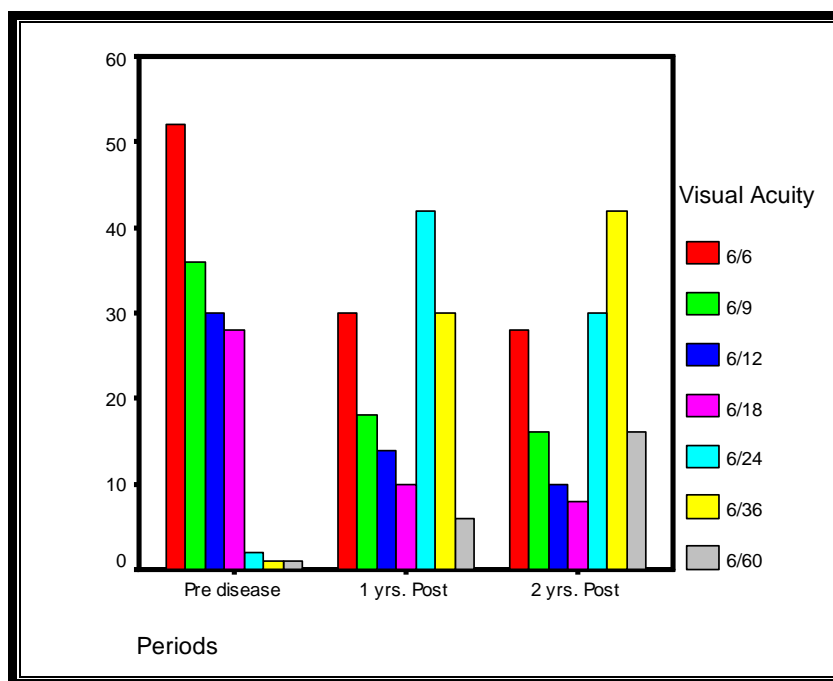


Figure (A): Cluster Bar chart for the distribution of Visual acuity grades along different Periods of times

Table (4- B) in order to explain the illustrated actual changeability in the visual acuity grade by the effectiveness of the disease, Sequentially testing were applied (Kruskal-Wallis Test) "non parametric statistical hypothesis" the results shows that within the 1<sup>st</sup> and 2<sup>nd</sup> visual acuity grade along the studied period by time a non-significant difference at p>0.05 was

obtained also followed by within the 1<sup>st</sup> three visual grade a non-significant differences at p >0.05 was obtained then followed by highly significant difference within the last two grades of visual acuity 6/24 and 6/36, this indicates that hyperthyroidism has a bad effect on the visual acuity. Same finding found by (Jankauskiene J et al).<sup>(12)</sup> The decrease in visual acuity (VA)

due to hyperthyroid ophthalmopathy is not only caused by compression of the optic nerve (due to increase intra-

orbital pressure) but also can be due to refraction errors in the form of myopia and hypermetropia.

**Table (4 - B): Effectiveness of durations of disease on the Visual acuity ( Sequentially testing )**

Visual Acuity	N	Total	Chi-Square	d.f.	Asymp. Sig.	C.S. <sup>(*)</sup>
6/6	110	180	0.3	1	0.584	NS
6/9	70					
6/6	110	234	1.266	2	0.531	NS
6/9	70					
6/12	54					
6/6	110	280	2.902	3	0.407	NS
6/9	70					
6/12	54					
6/18	46					
6/6	110	354	47.619	4	0.000	HS
6/9	70					
6/12	54					
6/18	46					
6/24	74					
6/6	110	427	91.923	5	0.000	HS
6/9	70					
6/12	54					
6/18	46					
6/24	74					
6/36	73					

(\*)Kruskal-Wallis Test ; HS : Highly sig. at  $P < 0.01$  ; NS : Non sig. at  $P > 0.05$

## Conclusion and Recommendations

The age of onset of thyrotoxicosis was between 30 and 50 years and females are more affected than males. Myopia was seen more in older age group while hypermetropia seen in younger age group. Hyperthyroidism has a bad effect on the visual acuity.

Based on above conclusion the researchers recommend changing the criteria of decompression surgery as decreasing in vision as appeared in this research not only due to compression of the optic nerve but also may be due to changes in refraction in the form of myopia or hypermetropia.

## References

1. Ghabrial, R .Thyroid Eye Disease, Mivision magazine. Issue 49. Reprinted with kind permission from Toma Publishing, the publishers of Mivision magazine.2010 August
2. Sergott , Robert C: Thyroid eye disease, Current Opinion in Ophthalmology: April 1990 - Volume 1 - Issue 2 - ppg 187-189
3. Lee , HBH ; Rodgers , IR; Woog , JJ. Evaluation and management of Graves' orbitopathy. Otolaryngol Clin N Am 2006; 39:923–942

4. Burch, H ; Wartofsky , L. Graves' ophthalmopathy: current concepts regarding pathogenesis and management. *Endocrine Reviews* 1993; 14:747–793.
5. De Carli , M ; D'Elisio , MM ; Mariotti ,S; Marocci ,C; Pinchera, A; Ricci , M ; Romagnani ,S ; del Prete, G. Cytolytic T cells with Th1-like cytokine profile predominate in retroorbital lymphocytic infiltrates of Graves' ophthalmopathy. *J Clin Endocrinol Metab* 1994; 77:1120-4
6. Besser, GM ; Thorner, MO; Weetman , AP. Hyperthyroidism and Graves' Disease. In: Besser GM, Thorner MO. *Comprehensive clinical endocrinology*. 3rd ed. Edinburgh: Mosby, 2002.
7. Tunbridge , WM; Evered, DC; Hall, R; Appleton, D; Brewis, M; Clark, F. The spectrum of thyroid disease in a community: the hickham survey. *Clin Endocrinol (Oxf)* 1977; 7:481–93.
8. Perros , P; Neoh , C; Dickinson, J. Thyroid eye disease. *BMJ*. 2009 Mar 6;338:b560. doi: 10.1136/bmj.b560.
9. Bahn, RS; Bartley , GB; Gorman, CA. Emergency treatment of Graves' ophthalmopathy. *Baillieres Clin Endocrinol Metab*. 1992 Jan;6(1):95-105.
10. Shomon , M. Thyroid Eye Disease/Graves' Ophthalmopathy symptoms and treatments . Updated December 14, 2003
11. Geoffrey, J; Gladstone, M.D; Frank, A; Nesi, M.D. Thyroid Eye Disease and the Role of the Thyroid Eye Specialist . National Graves' Disease Foundation, Inc., 1990–2000 *Br J Ophthalmol* 2006;90:307-309 doi:10.1136/bjo.2005.078295.
12. Jankauskiene , J; Jakstaite , V; Smalinskas ,V. Changes of vision and refraction in patients with thyroid pathology. *Medicina (Kaunas)*. 2009;45(5):378-81.
13. Chandrasekaran ,S ; Petsoglou, C ; Billson , F A; Selva, D; Ghabrial, R. Refractive change in thyroid eye disease (a neglected clinical sign) Correspondence to: Dr R Ghabrial Sydney Oculoplastic Surgery, Level 7, 229 Macquarie Street, Sydney, NSW 2000, Australia; [rafg@bigpond.com](mailto:rafg@bigpond.com).