Original Article

Association of amblyopia with ametropia and strabismus

Hadia Iqbal[1], Sehrish Akram[2], Saba Ghalib[3], Tehmina Waqar[4], Syeda Aal e Zahra Kazmi[5] , Duaa Waseem[6]

Abstract

Objective: To find out the association of amblyopia with ametropia and strabismus.
Study design: It is a descriptive cross sectional hospital based study.

Place and duration of study: A Nine-month study was carried out in Ophthalmology department of Holy Family Hospital, Rawalpindi. (from September 2022 to June 2023

Material and Methods: Fifty patients were studied during the research duration. Detailed history and examination of patients was done starting from Slit lamp examination followed by assessment of visual acuity, refraction and Fundus examination. Orthoptics assessment was done to the patients who were presented with complaint of deviation.

Results: Amblyopia is a condition of significant vision loss.I collected data of 50 patients of different age group depending on the time availability.Subjects of age group 11-20 years showed more prevalence of amblyopia (60%). 35 were females and 15 were male. Anisometropia was most common cause (60%).

Conclusion: This study showed that unequal refractive error in both eyes is termed as aniosometropia is the major leading cause of amblyopia.Crossed eyes or squint is the second most common cause of amblyopia. High prevalence of amblyopia in age group 10-20 is due to lack of screening causing late diagnosis,un awaremess in general public,the lack of counselling of parents. Late diagnosis makes it more difficult to revrese the condition.

Keywords: Amblyopia , ametropia, strabismus, visual acuity, refraction.

1. Introduction

Amblyopia is defined as the decrease in visual acuity that is caused by the deprivation of vision or by the unusual binocular interaction. There is no apparent cause can be seen on physical examination of eye. This condition is reversible by some therapeutic measure. Amblyopia can be unilateral and bilateral.[1] In other words amblyopia is basically neurodevelopmental disorder of visual cortex that happens when the binocular vision is disturbed in early childhood. This can be easily diagnosed on the basis of visual acuity.[2] Visual acuity is estimate of keenness of sight. The relationship between visual detection and size of the stimulus is known as visual acuity.[3] The mechanism to see one image by the both eyes simultaneously are called binocular single vision. There are certain areas in retina when they stimulated at the same time they produce the sensation of single vision. These areas are corresponding retinal areas. Normal retinal correspondence refers to phenomenon of cortex in which the corresponding points of both retinas lie in the same position with respect to fovea.[4,5] Visual confusion occurs when the corresponding points are stimulated with dissimilar images. When the non-corresponding points are stimulated with the same image it results in double vision and known as diplopia.[6,7] To avoid this visual confusion and diplopia there is a mechanism in cortex that ignores the one of images. This mechanism is known as Suppression.[8,9] If this suppression is monocular that it is non-alternating suppression, then this can lead to amblyopia.[10]

Student BSc. Optometry and Orthoptics, Rawalpindi Medical University, Rawalpindi, Pakistan,[1,6] Ophthalmology department, Holy Family Hospital, Rawalpindi,[2,3] Refractionist, Holy Family Hospital, Rawalpindi,[4,5]
Correspondence:, Duaa Waseem, Student BSc. Optometry and Orthoptics, Rawalpindi Medical University, Rawalpindi. **Email:** duaawaseem19@gmail.com

There are three types of amblyopia, strabismic amblyopia, anisometropic amblyopia, and deprivation amblyopia. These may occur at the same time in a single eye. There is no underlying pathology in the eye that affects the normal development of vision after birth, there are some other factors that influence the developmental process and cause amblyopia. These factors are strabismus that cause the disturbance in development of binocular vision refractive error especially anisometropia. If these factors are present earlier in postnatal period, there is more possible impact on vision development. If the time duration of affected vision is longer then the degree of amblyopia will be high.[11]

Anisometropic amblyopia may occur when there is a focusing difference between the two eyes. This may be caused by conditions such as astigmatism, hyperopia, or myopia. The brain only sees with the stronger eye, and as a consequence, the vision in the weaker eye does not develop. If there is a notable difference in the refractive errors of both the eyes, then this is anisometropia. It is spherical anisometropia if there is difference in spherical equivalent and it is astigmatic anisometropia if there is difference in the power of cylinder.[12,13] If there is a hyperopic difference of >1 diopters, myopic difference of >3 diopters and >1.5 astigmatic difference in refraction then this is anisometropic amblyopia.[14]

The misalignment of the eye in certain condition is known as strabismus. This condition can lead to diplopia and resulted in a visible squint. So in this case children can suppress the image formed by one eye to avoid diplopia.[15,16] The misalignment of eyes results in a binocular rivalry and the input of non-dominating eye is suppressed by the other eye. The neuro functional disorder occurring during first years of life provoke several monocular and binocular anomalies such as crowding, deficits in the accommodative response, contrast sensitivity, and ocular motility abilities. Congenital malformations affecting the pupil or retina such as congenital cataract, scars, etc., can cancel the vision of one eye, causing a loss of fixation. If it is not treated early the developed amblyopia will be profound and its reversibility will be more difficult. Early surgery can develop better visual acuity in both eyes but there is still affected stereopsis due to disturbed binocular vision in early age.[17]

Deprivation Amblyopia is reduced vision of one of the eyes, due to an obstacle in the anterior visual pathway such as cataract, ptosis and corneal opacities. In case of congenital media opacities and ptosis, the image formation on retina is distort or completely blocked. Occlusion amblyopia is a type of deprivation amblyopia that is a result of excessive patching for therapy purpose. In case of anisometropic amblyopia, the image in affected eye is not focused on retina due to the difference in the refractive errors of both eyes. In case of strabismus the images formed on retina are dissimilar. Amblyopia develops in the eye that is deviated all the time (it can be esotropia, exotropia, hypertropia and hypotropia). So in all these factors the development of perception of vision in visual cortex is hindered or disturbed that leads to amblyopia.[18,19]

Ametropia refers to any refractive condition that results in the image of the object in view, which does not allow for a properly focused image on the retina. As such, hyperopia, myopia, and astigmatism are all considered in these abnormal refractive disorders. Ametropia is commonly known as refractive error and is one the most common causes of visual impairment. vision screening is most commonly carried out on school children which is valuable method of identifying the refractive error and amblyopia. [20]

Three types of refractive error are: Myopia, Hyperopia and Astigmatism. If light converges on fovea, then eye is an emmetrope. These refractive errors are measured in diopters. Positive value for hypermetropia and negative value for myopia.[21] In myopia, usually close objects are clear and in hyperopia vice versa.

Treatment in adolescence can induce betterment in visual acuity. The level of visual loss and the rate at which vision is improving determines the duration of therapy. The treatment is basically to improve the image perception on retina by reducing the stimulation of good eye.

Occlusion therapy: It is a commonly used technique in which the good eye is covered with an adhesive patch for the stimulation of amblyopic eye. The duration of wearing patch is variable.

Atropine penalization: This technique works by paralyzing the accommodation and blurring the near vision so that amblyopic eye will be used. This is used to dilate the pupil of eye.[22] Both patching and atropine

therapies are effective but atropine therapy is more useful for patients who are not comfortable with occlusion therapy. The side effects of the atropine are headache, sensitivity of light and irritation but these don't result in discontinuation of therapy.

Surgery: It may be advised in strabismus to resolve the misalignment of eyes for the better binocular vision development. It is also done in ptosis and cataracts.

Refractive correction: Corrective lenses should be given for refractive error treatment so that the visual acuity will be maximized.

Additional techniques: These include cloth for patching of glasses, opaque contact lenses and to adjust the prescription for the blurring of vision in better eye.

A research done in Jaipuriya Hospital, Jaipur to detect the types of amblyopia in children of age group 5-15 years. Of the total 4020 children Amblyopia was diagnosed in 44 children. Types of amblyopia diagnosed were Anisometropic amblyopia (29.5%), strabismic amblyopia (25%), combined mechanism amblyopia (15.9%), meridional amblyopia (13.6%), ametropic amblyopia (11.6%), and the least was that of visual deprivation amblyopia being 4.5%. [22]

A study done at national level about clinical profile of amblyopia among children of age group 3-14 years was done at Khyber Institute of Ophthalmic Medical Sciences, Peshawar, Pakistan. This study included 316 children. Out of 316 children,120 children had strabismic amblyopia, 136 children had anisometropic amblyopia, while 60 children had combined mechanism amblyopia (strabismus and anisometropia both). [23]

A study was done in Department of Ophthalmology, College of Medicine, Sultan Qaboos University, Sultanate of Oman. From a randomly selected sample, including 49 primary schools, a total of 6292 children from Grade 1 and Grade 6 were examined. Amblyopia was present in 0.92%, and anisometropic amblyopia was present in 0.44%. Amblyopia with strabismus was present in 0.48% of the children. [24]

2. Materials & Methods

Descriptive cross-sectional hospital based study of 06 months duration was conducted from 01st of September 2022 to the of June 2023 at the ophthalmology department of Holy Family Hospital Rawalpindi. Out of 23761 patients from eye OPD of Holy Family Hospital Rawalpindi 8976 were referred to refraction room. I selected 50 patients in my sample according to the time and availability. The data of patients who were amblyopic and did not have any other pathology in refractive media and retina were obtained on specially designed proforma. Ophthalmic examination of amblyopic patients included vision assessment, objective refraction, subjective refraction, best corrected vision assessment with pin hole. Orthoptics assessment was done to the patients who were presented with complaint of deviation. Patients of both genders, Patients of all ages, Patients having complaint of decreased vision, Patients with anisometropia, Patients with strabismus were included in this study. I excluded patients with any other ocular pathology (media opacities and retinal abnormalities) and non-cooperative patients.

3. Results

I found that most commonly, anisometropia results in amblyopia. Out of 50 patients 30 patients were amblyopic (60%) due to anisometropia, there were 10(20%) out 50 with strabismus and 10 (20%) had both ametropia and strabismus.

Age wise distribution showed that amblyopia is common in age group 10-20(30 patients) out of 4 groups and then in 20-30 age group (15patients) and then in1-10 . 30-40age group (2 ,2 patients) and above 50 there was only 1 patient. This showed that amblyopia is most common in young people and children .

Gender wise distribution showed that amblyopia is more prevalent in females as compare to males. Out of 50 patients 35 patients were females and 15 patients were male.percentage of females was 70% and of males was30%.

Result of my research study showed that 7 patients out of 10 strabismic patients had esotropia and 3 patients had exotropia and 40 patients were orthophoric.in my research unilateral amblyopic cases were more frequent

than bilateral cases. Monocular vision loss disturbs the binocular vision and stereopsis and the quality of life also affected. Out of 50 patients 46 patients were unilateral amblyope and only 4 were bilateral amblyopes.

Amblyopia can be mild, moderate and severe depending on the vision deterioration level. This

data was gathered on the basis of best visual acuity. Frequency of moderate amblyopia was highest and of severe amblyopia is second highest.

Table. 1: Severity of Amblyopia

Severity of amblyopia		Frequency	Percent
	Mild-6/9-6/12	5	10.0
	Moderate-6/12-6/36	26	52.0
	Severity >6/36	19	38.0
	Total	50	100.0

4. Discussion

Amblyopia is a vision deterioation or impaired binocular vision due to stiummulus abnormality or deprivation in an eye.it can be due to high refractive errors or anisometropia, strabismus ,stumulus deprivation as in congenital cataract ,ptosis or congenital corneal opacity.in amblyopia binocular vision and stereopsis are affectedand it is difficult to reverse the loss specially after the age of plasticity that is between 10 -20 years .so it is a serious eye condition. The study was started from 01st of September 2022 to the of June 2023. Out of 23761 patients from eye OPD of Holy Family Hospital Rawalpindi 8976 were referred to refraction room. I selected 50 patients in my sample according to the time and availability. I have done this research to determine the association of amblyopia with ametropia and Strabismus. If I discuss the prevalence of amblyopia according to age my results show that it is more prevalent in age group from 11-20. Out of 50 patients 30 patients were amblyopic (60%) due to anisometropia, there were 10(20%) out 50 with strabismus and 10 (20%) had both ametropia and strabismus.

Age wise distribution showed that amblyopia is common in age group 10-20(30 patients) out of 4 groups and then in 20-30 age group (15patients) and then in1-10 . 30-40age group (2 ,2 patients) and above 50 there was only 1 patient. This showed that amblyopia is most common in young people and children .

Gender wise distribution showed that amblyopia is more prevalent in females as compare to males. Out of 50 patients 35 patients were females and 15 patients were male.percentage of females was 70% and of males was30%.

Result of my research study showed that 7 patients out of 10 strabismic patients had esotropia and 3 patients had exotropia and 40 patients were orthophoric.

According to my research anisometropia is most common cause of amblyopia and than strabismus and then mixed. These results support the results of Sir Hassan Hashemi who conducted study on prevalence of amblyopia and its determinants in underserved rural villages of Iran. According to his research anisometropia is most common cause of amblyopia and strabismus is the second most common cause of amblyopia.

In my research moderate amblyopia is most common and mild amblyopia is less comon.

Limitationsof my study are one hospital based study and small sample size.larger sample size with more hospital based study could give better results.

Conclusion:

Unequal refractive error in both eyes is termed as aniosometropia is the major leading cause of amblyopia.crossed eyes or squint is the second most common cause of amblyopia. High prevalence of amblyopia in age group 10-20 is due to lack of screening causing late diagnosis,un awaremess in general public,the lackof counselling of parents. Late diagnosis makes it more difficult torevrese the condition.

Acknowledgements/Authors contribution:

First author of this paper duely acknowledge this paper to the Holy Family Hospital, and its dedicated staff, for their tireless efforts and gartis services and support to achieve this milestone.

Disclosure/Conflict of interest:

Authors declared no conflict of interest.

References:

1. Von Noorden GK. Binocular vision and ocular motility. Theory and management of strabismus. 1990.

2.Holmes JM, Clarke MP. Amblyopia. The Lancet. 2006 Apr 22;367(9519):1343-51.

3. Kniestedt C, Stamper RL. Visual acuity and its measurement. Ophthalmology Clinics of North America. 2003 Jun 1;16(2):155-70.

4. Tsai J, Denniston A, Murray P. Oxford American handbook of ophthalmology. OUP USA; 2011 Jan 28.

5. Wick BR. Stability of retinal correspondence in normal binocular vision. Optometry and Vision Science: Official Publication of the American Academy of Optometry. 1991 Feb 1;68(2):146-58.

6. Flom MC. Corresponding and disparate retinal points in normal and anomalous correspondence. American Journal of Optometry and Physiological Optics. 1980 Sep 1;57(9):656-65.

7. Van Waveren M, Jägle H, Besch D. Management of strabismus with hemianopic visual field defects. Graefe's Archive for Clinical and Experimental Ophthalmology. 2013 Feb; 251:575-84.

8. Edelman PM. Functional benefits of adult strabismus surgery. American Orthoptic Journal. 2010 Jan 1;60(1):43-7.

9. Adams DL, Economides JR, Sincich LC, Horton JC. Cortical metabolic activity matches the pattern of visual suppression in strabismus. Journal of Neuroscience. 2013 Feb 27;33(9):3752-9.

10. Black JM, Hess RF, Cooperstock JR, To L, Thompson B. The measurement and treatment of suppression in amblyopia. JoVE (Journal of Visualized Experiments). 2012 Dec 14(70).

11. Sengpiel F, Blakemore C. The neural basis of suppression and amblyopia in strabismus. Eye. 1996 Mar;10(2):250-8.

12. Attebo K, Mitchell P, Cumming R, Smith W, Jolly N, Sparkes R. Prevalence and causes of amblyopia in an adult population. Ophthalmology. 1998 Jan 1;105(1):154-9.

13. Multi-ethnic Pediatric Eye Disease Study Group. Prevalence of amblyopia and strabismus in African American and Hispanic children ages 6 to 72 months: the Multi-ethnic Pediatric Eye Disease Study. Ophthalmology. 2008 Jul 1;115(7):1229-36.

14. Varma R, Deneen J, Cotter S, Paz SH, Azen SP, Tarczy-Hornoch K, Zhao P, Study Group TM. The multi-ethnic pediatric eye disease study: design and methods. Ophthalmic epidemiology. 2006 Jan 1;13(4):253-62.

15. Repka MX, Beck RW, Holmes JM, Birch EE, Chandler DL, Cotter SA, Hertle RW, Kraker RT, Moke PS, Quinn GE, Scheiman MM. A randomized trial of patching regimens for treatment of moderate amblyopia in children. Archives of ophthalmology (Chicago, Ill.: 1960). 2003 May 1;121(5):603-11.

16. Kanski JJ, Bowling B. Clinical ophthalmology: a systematic approach. Elsevier Health Sciences; 2011 Apr 28.

17. Tsai J, Denniston A, Murray P. Oxford American handbook of ophthalmology. OUP USA; 2011 Jan 28.

18. McKee SP, Levi DM, Movshon JA. The pattern of visual deficits in amblyopia. Journal of vision. 2003 Jun 1;3(5):5-.

19. Williams C, Northstone K, Harrad RA, Sparrow JM, Harvey I. Amblyopia treatment outcomes after screening before or at age 3 years: follow up from randomised trial. Bmj. 2002 Jun 29;324(7353):1549.

20. Eibschitz-Tsimhoni M, Friedman T, Naor J, Eibschitz N, Friedman Z. Early screening for amblyogenic risk factors lowers the prevalence and severity of amblyopia. Journal of American Association for Pediatric Ophthalmology and Strabismus. 2000 Aug 1;4(4):194-9.

21.Dandona R, Dandona L. Refractive error blindness. Bulletin of the World Health Organization. 2001:79:237-43

22.Jarwal PN, Singh R. Evaluation of amblyopia in school going children. DJO. 2020 Jan;30(3).

23.Shah M, Khan MT, Khan MD, Rehman H. Clinical profile of amblyopia in Pakistani children age 3 to 14 years. J Coll Physicians Surg Pak. 2005 Jun 1;15(6):353-7.

24.Lithander J. Prevalence of amblyopia with anisometropia or strabismus among schoolchildren in the Sultanate of Oman. Acta Ophthalmologica Scandinavica. 1998 Dec 1;76(6):658-62.