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ORIGINAL ARTICLE

Detecting color vision deficiency in patients presenting with ocular complaints.

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ABSTRACT… Objective: To detect color vision deficiency in patients presenting with ocular complaints. **Study Design:** Descriptive Cross Sectional study (Case Series). **Setting:** Department of Outpatient, THQ hospital, Daska, Sialkot. **Period:** 01 January 22 to 30 June 22. **Material & Methods:** Patients of all ages and both genders presenting to the outpatient department with ocular complaints. Patients who were uncooperative / non responsive, aware of their CVD, visually/ mentally handicapped or deaf, had a medical history of systemic disease, on CNS medications, had ocular pathology (corneal, retinal disease, cataract). Color vision defects were detected using Ishihara pseudo isochromatic colored plates (38). All the data was entered and analyzed using Microsoft excel spreadsheet software. Descriptive data was represented as range and mean ± SD whereas the qualitative variables were represented as frequencies and percentages. **Results:** Out of 687, 65.79 % (452) were males with a mean age of 36±12.62 years and 34.2% (235) were females with a mean age of 37±9.2 years. We found color vision deficiency in 4.22% of males and in 0.58% of females. **Conclusion:** We found CVD was present in a significant number of patients and none were aware of their Color vision deficiency and handicap.

Key words: Color Vision, Color Vision Defects, Female, Male, Outpatient.

INTRODUCTION

Color vision is defined as the ability to tell apart different stimuli on the basis of different hue and independent of at all added stimulus additives like luminance and polarization.[1] The human eye is unique in mammals which has a trichromatic vision property and has the ability to discriminate divergent light wavelengths.[2] This ability has been explained by the Trichromatic Theory, according to which the retina of the eye has three types of photoreceptors cones each one perceptive to a specific color namely green, red and blue.[3] The cones detect an appropriate mixture of red, green and blue lights which enables the eye to match any color which is visible to it. Color blindness is an art word in which there is no real blindness instead there is mal development of one or more sets of cones that interpret the color in the presence of light. Color vision deficiency is the lack of ability to visualize certain colors or to differentiate the difference in them.[4]

Color vision deficiency (CVD) can be congenital or acquired. Congenital CVD occurs due to the absence of one or more pigments. Inheritance pattern can be x linked recessive, autosomal dominant or very least autosomal recessive.[5] CVD may be partial (anomaly) or complete (anopia) and can be classified as protanopia / protanamoly (red color), deuteranopia/ deuteranomaly (green color) and tritanopia/ tritanomaly (blue color).[6] The red green deficiency is the most common CVD in the overall population which is determined genetically due to x linked recessive inheritance and is therefore common in males but is transferred by female carriers.[7] Acquired causes of CVD are diabetes mellitus, sickle cell anemia, optic neuritis, drugs like digoxin, chloroquine, anti tuberculosis and alcoholism but it can reverse with treatment of the underlying cause.[8]

Red green anomaly is the most common congenital CVD which has been reported to affect 8% of male and 0.5 % female population.[9]

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In Europe[10] CVD is reported as 6.0% in males and 0.25% in females whereas in Australia[11] it has been reported as high as 7.4% in males and 0.7% in females. Similarly reported prevalence in Turkey[12] was 7.3% and in India[13] was 2.8% to 8.2% due to ethnicity variations. CVD screening has become an essential part in pre job screening and most of the time patients are unaware of the disease and are detected during the screening process.[14] Chhipa SA et al[15] detected CVD in his patients who were applicants for being appointed as nurse and doctor. Similarly Y Iqbal et al[16] detected CVD in railways employees during annual screening. CVD can lead to problems in performing visual tasks in certain fields. Therefore individuals should be aware of the entity before selecting such professions. As limited data exists in Pakistan especially in Sialkot Punjab region regarding CVD, need for population based studies is increased tremendously. We intended to fill in the gap by determining CVD in patients presenting to the outpatient department of a government hospital with ocular complaints so that those who are affected become aware of their problem and a road map is laid for further studies.

MATERIAL & METHODS

It was a descriptive study conducted at the outpatient department of THQ hospital, Daska, Sialkot during a 6 month period from 01 January 22 to 30 June 22. The study was initiated after the approval of the hospital ethical committee and following the principles of declaration of Helsinki. The sample size was calculated using https://www.calculator.net/sample-size-calculator.html keeping the confidence interval 95%, population proportion 50% and margin of error 5%. We used simple convenient consecutive sampling technique for the collection of data. The patients were briefed about the research and a verbal consent was obtained from them to use the collected data for academic purposes. Those who refused, their data were not taken in account in the study. After a detailed history complete eye examination was done including visual acuity assessment with refraction, checking pupillary reflexes, intraocular pressure measurement, slit lamp examination and retinal examination.

Our inclusion criteria were patients of all ages and both genders presenting to the outpatient department with ocular complaints. Exclusion criteria was patients who were uncooperative / non responsive, aware of their CVD, visually/ mentally handicapped or deaf, had a medical history of systemic disease, on CNS medications, had ocular pathology (corneal, retinal disease, cataract), using topical medication and visual acuity less than 6/12 or near vision less than N8. Color vision defects were detected using Ishihara pseudo isochromatic colored plates (38), with addition any correction for near vision if required, while keeping them perpendicular to the sight and parallel to the face of the patient at a distance of 75 cm. The plates were exposed for 3 to 5 seconds to the patients and the numbers visible to them on the plates were inquired. The results were analyzed with the help of the key provided with chart. All the data was entered and analyzed using Microsoft excel spreadsheet software. Descriptive data was represented as range and mean ± SD where as the qualitative variables were represented as frequencies and percentages.

RESULTS

During the study period 24453 patients presented to the outpatient department out which 687 were selected for the study (sample size required was 386) who fulfilled our inclusion and exclusion criteria. Out of 687, 65.79 % (452) were males with a mean age of 36±12.62 years and 34.2% (235) were females with a mean age of 37±9.2 years. We found color vision deficiency in 4.22% of males and in 0.58% of females. The type of CVD is represented in Table-I.

Type of CVD	Males	Females
Protanamoly	4.22%	0.58%
Deuteranomaly	0.87%	Nil
Deuteranopia	0.87%	Nil

Table-I. Gender distribution of CVD prevalence (n = 687)

DISCUSSION

CVD is determined according to the type of pigment involved. Protans are red-green color vision deficient because red-sensitive cones are

involved and they have confusion between the spectrum of red, green, black, purple and grey color. Similarly Deutrans are also red-green color vision deficient due to green-sensitive cones involvement. They typically have confusion in yellow, green, grey and pink color. Tritans are blue-yellow color vision deficient due to blue-sensitive cones and they confuse between yellow, grey and blue. CVD is an X linked autosomal recessive disease. It is commonly inherited due to mutation on the mutation on the X chromosome and is more common in men compared to women. CVD is considered to be an occupational risk throughout the world and people with CVD face difficulty incident in their daily living. The troubles they encounter includes selection of career (33%), partial handicap in jobs (25%), difficulty in recognizing traffic control signals during driving (13%) and even decision making in everyday routine (75%) such as determining fruits freshness, clothes colors etc.[16] Occupations like telecommunications, electrical maintenances, air traffic control, railways industry all are involved in color coding and CVD can lead to unfortunate and risky functions.[17,18] Even as a medical professional, detecting true color is crucial to identify anemias and cyanosis to recognize and diagnose diseases.[19] Similarly while performing surgeries and laboratory tests the inability to detect true color becomes hazardous for diagnosis and treatment of the patients.[20] As it is a non fatal disease and their vision remains otherwise normal, most of the time CVD people remain unaware of the disease. Even in health occupational services people remain ignorant of their CVD because of lack of screening services.[21] The patients in our study were in the range of 24 to 48 years and yet they were unaware of their disability. This is the dilemma of the health care system and needs addressing.

The gold standard method of checking the color vision is by Nagel anomaloscope but it requires expensive equipment and is a difficult process for the patient to undergo. More convenient and cheap alternative is Farnsworth 100 hue test but it requires good cognition skills and time to complete the test.[22] Therefore in CVD screening ishihara test plates are routinely used which has a sensitivity of 96% and the specificity of 98.5%.[23]

In this study we found prevalence of CVD in males as 5.96%. Researchers from other parts of the world have reported the same. In India it was found as 8.73%, in United States of America as 8% and China as 6.5%.[16] Across the world CVD is prevalent more in males vs females due to the fact that it has an X linked recessive inheritance pattern and females are mostly carriers. In our study the prevalence of CVD was 0.58% in females. This is in accordance to the findings from Denmark who reported 0.54% and from Greenland and Ethiopia who have reported CVD in females as 0.4% and 0.2% respectively.[16] We detected protanamoly more than deuteranomaly and deuteranopia which is contrary to the findings of Abdul rehaman MA[24] who found it vice versa.

Even though CVD is not a visual disability but researchers have tried many treatment options to improve the condition. They tried applying warmth to the eye, stimulation by electric current, cobra venom extract injections but all was in vain and nothing could reverse or treat CVD.[16] Nowadays researchers are working on contact lenses and tinted glasses to facilitate patients with CVD in distinguishing colors and positive results are awaited.[25] Genetic technology is also being used to modify the retinal cone cells but human trials are yet to be conducted.

We are aware of the short comings of the study. It was hospital based study rather being a population based and does not determine the actual incidence or prevalence of the disease but it still provides ground to develop a screening policy for the population so that people become aware of their handicap before start of the career or any job selection.

CONCLUSION

We found CVD was present in a significant number of patients and none were aware of their Color vision deficiency and handicap which indicates that any early screening program should be initiated at nation level.

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