

Photostress Recovery Time in Males: Alcoholics vs Non Alcoholics

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ABSTRACT

Introduction: The photostress recovery test (PSRT), depends on resynthesis of visual pigments and measures the time to recover after bleaching due to light exposure. Abnormal recovery times in retinal diseases or toxicity suggests that the pathology in these conditions involves the outer layer of the retina or the pigment epithelium. Aim: 1) To measure photostress recovery time in chronic alcoholics males; (2) To measure photostress recovery time in apparently healthy males; (3) To compare photostress recovery time in apparently healthy males and chronic healthy males

Material and methods: Photostress recovery time was recorded using Photostress Recovery Tester (GT – 991 Medicaid: Chandigarh). The subject was presented with a high beam of light focused on the eyes of subjects for short and fixed period of time. As soon as light stimulation was over, a word was displayed on screen for subject to read and automatically the clock started counting in seconds. When the subject recognized the word displayed he pressed the stop button on the remote control and read it out aloud, the clock stopped counting and word disappeared.

Result: The p-value was statistically significant with a value of 0.003 showing a comparable difference of PSRT in group I and group II.

Conclusion: Alcohol predisposes nervous tissue to injury via multiple mechanisms, including the development of oxidative stress. Retina is another among the vulnerable area for redox changes caused due alcohol intoxication, with lower threshold levels of ethanol tolerance.

Keywords: photostress Recovery Time, Alcoholics, Retina, Oxidative Stress

INTRODUCTION

The photostress recovery test (PSRT), depends on resynthesis of visual pigments and measures the time to recover after bleaching due to light exposure.^{1,2} This test has been used to evaluate macular function. Previous reports demonstrated prolonged photo-stress recovery times in patients with idiopathic central serous chorioretinopathy (ICSC), age related macular degeneration, diabetic retinopathy, or digitalis toxicity. Abnormal recovery times in retinal diseases or toxicity suggests that the pathology in these conditions involves the outer layer of the retina or the pigment epithelium.³ Optic nerve diseases can be differentiated from retinal diseases with the PSRT, because optic nerve dysfunction does not affect the PSRT. However, a pro-longed recovery time, or delayed dark adaptation, was reported in glaucoma, which mainly affects ganglion cells. This suggests that a ganglion cell abnormality may delay recovery or that glaucoma may cause visual pigment

abnormality.^{4,5}

The photostress recovery depends upon the rate at which the photopigment is resynthesised as well as on the functioning of the photoreceptors and retinal pigment epithelium (RPE). In earlier studies, they used a penlight to dazzle the eye to determine the PSRT of the subjects; the results corresponded with that of another study, who used an elaborate high intensity light flash system. PSRT has been found to increase slightly with age. The implication of an age-dependent reduction in PSRT is that there is a non-pathologic deterioration of macular function with age. A wide range of variation in photostress recovery time has been shown in various studies.^{6,7} Chilaris reported 10-50secs, Glaser 27±11secs and Sherman 41.97±17.34secs. The lack of standardization with respect to the intensity and duration of the bleaching light, the method used to measure visual acuity, the chosen end point of the test and the population studied could undoubtedly account for this wide variation in PSRTs. A study investigated the source of variability in the photostress test. They evaluated the effect of age, ametropia, pupil size, and acuity on PSRT in normal subjects using a reference technique designed to bleach a consistent amount of photopigment. Analysis of data obtained with the reference and best clinical technique showed that age was the only factor that had a significant effect on PSRT. However patients with different pathologies ranging from maculopathies, glaucoma, retinitis pigmentosa, multiple sclerosis, optic neuritis and optic atrophy, showed an abnormal (longer) response after photostress with respect to age-matched controls.^{8,9,10}

Toxic optic neuropathy is a group of medical disorders characterized by visual impairment because of optic nerve damage as a result of exposure to a toxin chronically. For the pathogenesis of toxic optic neuropathy resulting from tobacco and alcohol exact cause is not established and is probably multifactorial, but cyanide in tobacco smoke and malnutrition due to alcohol intake appear to be the most important causative factors. Toxic optic neuropathy is usually an underdiagnosed disease entity and a large proportion of patients present at a stage when recovery of

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vision is not possible. The underlying mechanism is the injury to mitochondria that disrupts the process of oxidative phosphorylation resulting in axonal loss, which particularly affects the parvocellular neurons in the papillomacular bundle, causing thinning of RNFL.^{11,12}

The purpose of this study is to investigate the difference in abnormality of photostress recovery between apparently non-alcoholic males with those having chronic intake of alcohol. The chronic alcohol intake leads to retinal damage because of oxidative stress. Therefore, we tested the subjects with chronic alcohol intake for any damage to retina with the help of photostress recovery time.

MATERIAL AND METHODS

The study was conducted on 60 subjects recruited from a tertiary Hospital. They were divided into two groups of 30 subjects each.

Diagnosis of alcoholism was based on:

1. Detailed history including information of daily intake, frequency and duration of alcohol intake.
2. Complete clinical examination.
3. Alcohol Use Disorder Screening Test (AUDIT), a standardized questionnaire as a screening test for clinical diagnosis of alcohol abuse or dependence.

Inclusion criteria

1. Subjects diagnosed as chronic alcoholics on basis of Alcohol Use Disorder Screening Test (AUDIT).
2. Subjects showing alcohol dependent withdrawal symptoms or physical signs and symptoms that were useful in identifying alcoholism i.e. mild and fluctuating hypertension, repeated infections etc.

Exclusion criteria

1. Subjects suffering from any clinical disease likely to affect retina, auditory or visual pathway i.e. abnormal hearing or abnormal vision.
2. Subjects having any other addiction i.e. opium, phensedyl, morphine, poppyhusk, benzodiazepines and barbiturates.
3. Had covert evidence of hepatic encephalopathy or head injury.
4. Patients on drugs known to produce adverse effect on auditory and visual system e.g. streptomycin, gentamycin, tobramycin, furosemide, quinine, chloroquine, salicylates, indomethacin, digitalis, thiazides, amiodarone, phenytoin, diazepam, chlorpromide, phenothiazines, levodopa, lithium, OCP's.

A written informed consent was taken from all the subjects. All the subjects were thoroughly acquainted with the apparatus and three practice sessions were given to every subject before taking the reading. Photostress recovery time was recorded using Photostress Recovery Tester (GT – 991 Medicaid: Chandigarh). The subject was presented with a high beam of light focused on the eyes of subjects for short and fixed period of time. As soon as light stimulation was over, a word was displayed on screen for subject to read and

automatically the clock started counting in seconds. When the subject recognized the word displayed he pressed the stop button on the remote control and read it out aloud, the clock stopped counting and word disappeared. Measured photostress recovery time was displayed on digital display and was noted.

RESULT

Shows the comparison of PSRT in milliseconds of subjects in alcoholic group and non-alcoholic group. The mean of alcoholics in group I subjects was 283.68 and that of non-alcoholics in group II subjects was 145.07 with a SD of 238.18 and 71.51 respectively. The t-value was 3.05. The p-value was statistically significant with a value of 0.003 showing a comparable difference of PSRT in group I and group II.

Group	Mean	SD
I Alcoholics	283.68	238.18
II Non alcoholics	145.07	71.51
t-value	3.05	
p-value	0.003	

Table-1: Photostress in alcoholics and non alcoholics

DISCUSSION

Alcohol also prolongs time course of glare recovery. Photostress is the description of vision due to veiling luminance (such as the light from the headlight of oncoming traffic at night) being superimposed on the visual image (such as the outline of the car ahead). Photostress recovery is the rapidity with which a person's vision functioning returns to what it was before the light was encountered. Alcohol has a direct effect on human retina. When the integrity of retina is disturbed by drug or disease, the adaptation process is retarded and recovery of contrast sensitivity is prolonged. Further it is shown that alcohol slows dark adaptation and resynthesis of photo pigment in albino rats, that this is due to inhibition of a catalyst thought to be required for oxidative resynthesis of retinaldehyde from retinol.

Deficiencies of Zinc and Vitamin D may play a role in the night blindness of some chronic alcoholics. The period of recovery is a period of relative blindness for the individual and as such is potentially hazardous.

The impact of direct demonstration and sharing of information of this simple procedure improves positive thinking and psyche of alcoholics. This enables the person's ability and power to heal him or herself. A simple procedure like PSRT can enhance the effectiveness of counseling and increase the effectiveness in prevention of relapse counseling and motivational counseling. Counseling plays an important role in helping the alcoholics to understand their addictive illness. The heart of any effective counseling process is a relationship characterized by warmth, genuineness, acceptance, caring and trust. This quality of relatedness is often described in psychological medicine as "therapeutic". Incorporation of a "physical component" in psychological counseling could probably help the alcoholics to understand the harmful effects

of alcohol and this could have a significant positive impact in giving up their drinking habits. The effects of reduced processing time and reaction time could be explained to the patients of rehabilitation ward. Successful merging of a simple physiological technique with psychological skilled counseling techniques could be a potent factor in enhancing the healing –growth process.

Alcohol predisposes nervous tissue to injury via multiple mechanisms, including the development of oxidative stress.¹³ Several studies reported that the ROS formed from these systems are important in causing oxidative stress in the central nervous system^{14,15}, which renders a significant decrease of antioxidant enzymes and an altered GSH homeostasis in brain.^{16,17} The results herein from the study revealed that eyes of ethanol-treated rats show an increase in lipid peroxidation-derived products (MDA), as well as a decrease in the level of endogenous antioxidants (GSH).¹⁸ These findings agree with previous studies that reported an alteration of oxidative stress metabolites after long term administration of ethanol in liver^{19,20} and brain²¹⁻²⁴ and also with our previous publications that reported an alcohol induced GSH decrease and MDA increase in peripheral nerve, optic nerve²⁵, and hippocampus, suggesting a direct toxic effect of ethanol related to oxidative stress. Retina is another among the vulnerable area for redox changes caused due alcohol intoxication, with lower threshold levels of ethanol tolerance. In fact, rod outer segment membranes contain a high amount of long-chain polyunsaturated fatty acids²⁶, which make them particularly susceptible to oxidative stress.

One early proposal concerning the effects of alcohol on vision was that it induced a state in the retina that was functionally equivalent to dark adaptation and that the retinal neural organization changes to become rod dominated.^{27,28} In each of these studies electroretinogram (ERG) recordings were made under light adapted conditions before and after alcohol consumption. Those recordings were then compared with existing data on the dark adapted retina. In the humans ERG, reported that the b-wave increased in amplitude with slowing of the rise and recovery time after a single flash of the stimulus. She observed that alcohol increased responsiveness to light and reduced the ability to follow a flashing target. These are also characteristics of the dark adapted retina. Based on these similarities, it is concluded that alcohol acts to change the neural organization of the retina, allowing it to become rod dominated in the same way it would if it were dark adapted.

Zinc deficiency in alcoholic liver disease was first documented by studies.²⁹ The level of serum zinc appeared to correlate inversely with the severity of hepatic dysfunction. In man, several zinc deficiency syndromes have been described including hypogonadic dwarfism, hypogeusia, impaired wound healing and acrodermatitis.³⁰⁻³⁴ Among the specific zinc metalloenzymes is alcohol dehydrogenase of both liver and retinal origin.^{35,36} The enzymatic interconversion of vitamin A alcohol (retinol) to the photochemically active vitamin aldehyde (retinaldehyde) in the eye was first demonstrated by Wald.³⁷ Retinaldehyde must be supplied

constantly to the rods for the formation of visual pigment (rhodopsin) and the prevention of night blindness.³⁸ Illumination of the retina bleaches rhodopsin causing a release in retinaldehyde which is then reduced to retinol. To resynthesize rhodopsin, retinol must be reoxidized to retinaldehyde by alcohol dehydrogenase. Using the rat model, Huber and Gershoff were able to show that zinc deficient animals had significant reductions in the enzymatic activity of retina alcohol dehydrogenase.

CONCLUSION

It can be concluded from the study that the individuals who have chronic intake of alcohol suffer from various cellular level injuries that grows with the increase in the years of consumption. The results of a simple test like photostress recovery time showed that there was an obvious harmful effect of chronic alcohol intake on retina as well as on central nervous system. This test can also be used as a motivation and for maintenance of abstinence in the alcoholics.

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