Original Article

Electrooculographic and Electroretinographic Changes among Patients Undergoing Treatment with Amiodarone

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Abstract

Purpose: To evaluate the probable toxic effects of amiodarone on retina, using electrooculography (EOG) and electroretinography (ERG) testing methods.

Patients and Methods: Fifty participants in the present study included 25 patients with a history of amiodarone treatment as the case group and 25 age, sex and visual acuity matched healthy volunteers with healthy visual system as the control group. All the participants underwent EOG and ERG examinations on their both eyes. The results obtained in two groups were compared to look for possible changes among patients undergoing treatment with amiodarone compared to the control group.

Results: There was no statistically significant difference between the case and control groups regarding the age, sex, and visual acuity. Out of 50 eyes in the case group 9 eyes showed abnormal ERG including 7 eyes showing abnormal b-wave peak latency and 5 eyes showing abnormal b-wave peak amplitude. Three eyes had both abnormal latency and amplitude. In comparison, only one eye in the control group showed abnormal latency. The difference between the two groups in number of participants showing abnormal b-wave peak latency ($P = 0.022$) or amplitude ($P = 0.027$) were both statistically significant. Regarding the EOG testing 15 eyes among patients and 10 eyes from controls showed abnormal EOG Arden index indicating no statistically significant difference ($P = 0.248$).

Conclusion: Based on the results of the present study we can conclude that amiodarone has toxic effects on retina, which might be detected and followed using ERG b-wave latency and amplitude.

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Introduction

Amiodarone is used to treat and prevent a number of heart beat arrhythmias, congestive heart failure, and also in patients after acute myocardial infarction [1]. Ventricular tachycardia, ventricular fibrillation, wide complex tachycardia and atrial fibrillation are among the most common arrhythmias that can be treated using amiodarone [2].

Amiodarone may cause hepatotoxicity and symptomatic hepatic dysfunction, cirrhosis, peripheral neurotoxicity, nausea, vomiting and muscle weakness [3]. Amiodarone also has certain side effects on visual system mainly affecting the anterior segment including cornea and lens, as well as optic nerve and retinal side effects [4]. These side effects might cause visual loss, swelling of the optic disc and abnormal blue color vision [4,5]. After discontinuation of amiodarone either a visual stabilization, improvement, or a permanent deterioration may result [6-8].

As mentioned before retina and visual pathways may be affected by amiodarone. Shushtarian et al., [9] have reported a 39 year old patient with a history of amiodarone usage and chief complaint of seeing colored rings around the lights. The patient underwent different electrophysiological eye examinations such as visual evoked potential (VEP), ERG and EOG, which all showed abnormal results [9]. After the discontinuation of the drug the patient complains were subsided [9].

There are few previous studies reporting the effect of amiodarone retinal toxicity in ERG and EOG exams [10]. The aim of the present study was to further investigate the ERG and EOG findings among patients with a history of amiodarone usage.

Patients and Methods

Twenty five patients with a history of amiodarone usage with a dosage of at least 400 mg daily in the last six months entered the present study as the case group. The patients were selected from a large population of patients with a history of amiodarone prescription. The control group included 25 age, sex and visual acuity matched volunteers with healthy visual system and no history of amiodarone usage. The present study was approved by the ethics committee of Basir Eye Health Research Center, Tehran, Iran, and all participants gave written consent before entering the study.

All participants underwent electrooculography (EOG) and electroretinography (ERG) testing. Biomedical Mangoni instrument, which is capable of recording different electrophysiological tests, was used for testing the ERG and EOG in all participants. To perform EOG testing the patient's eye was pre-dark adapted for 15 minutes and the subject was asked to rotate his eyes simultaneously between the three bulbs fixed in front of his eyes for 10 minutes and the corresponding potential changes were measured. The mean of these readings was considered as the light adaptation potential (LAP). Then the subject was dark-adapted for 10 minutes. The same procedure was followed for measuring the dark adaptation potential (DAP). The ratio of LAP to DAP potential which is called Arden index (AI) was calculated for all participants.

For ERG examination three electrodes were used to connect the subjects to the machine. Active, reference and earth electrodes were attached to cornea, earlobe and forehead respectively. The active electrode was a hard contact lens. A thread shape cotton, soaked with saline, was placed on the lens to extract the electrical response of retina and transfer it to the electrode. For two other electrodes electrophysiological conductive paste was

used between electrodes and skin. Before placing the contact lens the patient's eyes were dilated with standard dilating eye drops. Also anesthetic drops were used to induce numbness of the eye. After placing the electrodes, the patient's eyes were stimulated using a standardized flash of light. The signal produced is an ERG wave consisting of two waves (a wave and b wave). In the present study the latency (msec) and amplitude (μv) of ERG b-wave peak were measured for each participant.

Table 1: Demographic findings of study participants

Variable	Group		P value
	Control	Case	
Age	45.24 ± 2.55	44.96 ± 3.03	0.726 *
Sex	Male : 17 Female: 8	Male : 17 Female: 8	1 **

* T Test

** Chi-Square Tests

Results

Fifty eyes of twenty five patients, (17 males and 8 females) were examined as the case group. The same number of normal population entered the study as the control group. The mean age of patients and the controls were 44.96 ± 3.03 years and 45.24 ± 2.55 years, respectively, indicating no statistically significant difference (Table 1).

Out of 50 eyes in the case group 9 eyes showed abnormal ERG including 7 eyes showing abnormal latency and 5 eyes showing abnormal amplitude. Three ayes had both abnormal latency and amplitude. In comparison, only one eye in the control group showed abnormal latency (Table 2). The difference between the two groups in number of participants showing abnormal b-wave peak latency (P = 0.022) or amplitude (P = 0.027) were both statistically significant. Regarding the EOG testing 15 eyes among patients and 10 eyes from controls showed abnormal Arden index indicating no statistically significant difference (P = 248) (Table 3).

Discussion

In the present study the patients in the case group showed significantly higher abnormal results in ERG b-wave peak amplitude and latency compared to the control group. There was no statistically significant difference between the case and the control group regarding the EOG Arden index. Schmidt et al., [5] examined six patients with the mean age of 71.7 years (five male, one female) who

Table 2: Compression of results regarding the amplitude and latency of b-wave peak in ERG in the case and control groups

Variable	Group				P value*
	Control		Case		
	Normal	Abnormal	Normal	Abnormal	
Latency (msec)	49	1	43	7	0.022
Amplitude (μv)	50	0	45	5	0.027

Chi-Square Tests

Table 3: Compression of results regarding the ERG Arden index in the case and control groups

Descriptive		Total	Normal	Abnormal	P value *
group	control	50	40	10	0.248
	case	50	35	15	

*Chi-Square Tests

were treated with amiodarone. They found that one patient developed abnormal blue color vision, five patients showed swelling of the optic disc, which completely disappeared after discontinuing the drug, one patient showed posterior ischemic optic neuropathy (PION), two patients showed a unilateral change of the optic disc, and finally three patients had a severe irreversible lesion of the optic nerve at follow-up examination [3]. Domingues et al., [11] studied 14 patients undergoing long term amiodarone therapy using pattern reversal visual evoked potential and found a significant prolongation in latency and reduction in amplitude of VEP, P_{100} peak in comparison with the same parameters in normal population. Shaikh et al.,[12] studied electrophysiological changes in patients undergoing amiodarone treatment using multifocal and full-field ERG. Their patients had received amiodarone at various dosages ranging from 100mg to 800mg daily for at least 15 months [12]. In contrast to our findings in their study multifocal and full-field ERG were mostly unremarkable, and the mildly subnormal findings in few patients showed no consistent pattern to suggest a toxic cause due to drug usage.

Conclusion

Based on the results of the present study we can conclude that amiodarone has toxic effects on retina, which might be detected and followed using ERG b-wave latency and amplitude.

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Footnotes and Financial Disclosures

Conflict of Interest:

The authors have no conflict of interest with the subject matter of the present study.