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ORIGINAL ARTICLE

The association between oxygen saturation and cataract disease and related factors in Birjand Vali-asr Hospital

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Abstract

Introduction: Any opacity of lens is defined as cataract. This leads to reduced vision that is the most common cause of blindness in the world in among the elderly. There is no non-surgical treatment for cataract patients; thereby, patients have to spend a lot of money especially those residing in the undeveloped countries. It is thus necessary to be informed of predisposing factors in order to plan prevention strategies. Oxidative damage is a major cause or consequence of cortical and nuclear cataracts. This study planned to compare oxygen saturation levels in cataract and non-cataract persons so that a way can be found to reduce or delay cataract formation.

Methods: This study was performed on 135 cases and 136 age and sex-matching controls who referred to Vali-asr Hospital of Birjand. Information concerning oxygen saturation in the two groups was recorded in a checklist covering demographics, history of systemic diseases, drug consumption, ultraviolet exposure time, history of chronic eye diseases, and ocular trauma. The collected data were analyzed by T-test and ANOVA using SPSS software. P values lower than 0.05 were considered statistically significant.

Results: The mean Oxygen saturation level had a statistically significant relation between cases and control groups (P=0.041).This relation was also statistically significant between smoking (p=0.02), Ultraviolet exposure time (p=0.013) and ocular trauma (p=0.05) but it was insignificant in place of live p=0.22, (city or village), chronic systemic diseases p=0.08, chronic ocular diseases (p=0.69) and drug consumption (p=0.19).

Conclusions: This study showed that low oxygen saturation can be a risk factor for cataract disease. Therefore, we offer another study as a preventive strategy of cataract.

Key Words: Pulse Oximetry; Risk Factors; Cataract

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Introduction

Cataracts are the commonest cause of reversible loss of useful vision worldwide. In the second half of the 20th century, the surgical advancement in treating loss of vision from cataracts was unparalleled because virtually no progress has been made in identifying methods of preventing cataracts ever since. Due to accessibility, the outcome of cataract surgery in more developed countries is greatly different from that of the less developed countries (1). Although some possible risk factors for cataract development have been suggested and age is by far the biggest risk factor for cataract, there is no confirmed method to prevent cataract formation. Given the marked variability in the lenses of different species, there appears at present to be no ideal animal model system for studying human ARN cataract (1, 2). It is estimated that if the onset of cataract could be delayed by 10 years, the annual number of cataract operations performed would be reduced by 45%. This requires identifying risk factors for cataract (3). The pathogenesis of age-related cataracts is multifactorial and not completely understood (4). Clinical and experimental studies implicate increased exposure of the lens to oxygen as a major cause of nuclear cataracts (5, 6).

Additional support came from studies of patients undergoing vitrectomy. Many studies have documented very high rates of nuclear cataract formation within two years after vitrectomy surgery (60–95%) (7).

Any common exposure that increases the risk of cataract is therefore of great public health importance. Oxidative stress has been proposed to play a role in single cataract formation (8). Although cataracts are often considered to be an unavoidable consequence of aging, recent studies of the risk factors associated with human cataracts have identified interventions that may prevent cataracts or slow their progression. We undertook a matched case-control study to assess the arterial oxygen saturation in cataract patients.

Methods

A case-control study was designed to compare oxygen saturation in cataract and non cataract patient in the Birjand-based Vali-asr Hospital. Consecutive patients undergoing cataract surgery aged 40 years or more who had a diagnosis of cataract or patients with previous cataract surgery were eligible. Patients with inflammatory disease, corneal endothelial dysfunction, ischemic ocular disease, glaucoma, ocular neoplasia, and severe cardiopulmonary disease were excluded.

The control group members were all patients who were admitted in the Eye & ENT ward and who had no sign of cataract, inflammatory disease, corneal endothelial dysfunction, ischemic ocular disease, glaucoma, and ocular neoplasia. A complete general medical and ophthalmic history was obtained before surgery. Ophthalmology examination including visual acuity, slit lamp examination, red reflex, ophthalmoscopy, and tonometry was performed in all cases and controls. Its protocol was approved in the Ethics Committee of Birjand University of Medical Sciences with the code IR.BUMS.REC.353

Ethical standards were observed in this study. One of the ethical considerations of this study included observing the patients' rights. Accordingly, after passing this project in the Research Committee of the Faculty of Medicine, the protocol was sent to the Research Council of the university to be approved. After obtaining the oral and tacit consent of the subjects to participate in the study, written informed consent was obtained from the subjects. All processes of sampling were performed in sterile conditions by observing all safety precautions by an experienced person. A total of 271 (135 cataractous patients and 136 non-cataractous patients) were included in this study. Arterial blood oxygen saturation (ABOS) of all cataract patients was measured with Novametrix 520 a puls oxymeter 5 minutes prior to surgery for a cataract in the operation room and the mean of highest and lowest amount of ABOS in 1 minute before surgery was recorded.

Data on the following potential factors were extracted: age, sex, occupation, living place, sun exposure, history of drug consumption, history of systemic diseases, smoking habit, history of the chronic ocular disease, and ocular trauma. There was no selection of specific forms of cataract and all types (nuclear, cortical, posterior subcapsular and mature) of cataract were included in this study. Information on all cases was recorded in a questionnaire and the collected data were analyzed by T-test and ANOVA using SPSS software. The P values lower than 0.05 were considered statistically significant.

Results

A total of 271 subjects participated in this study (135 cataract cases and 136 non-cataract controls). The descriptive details of cases and controls are shown in Tables 1 and 2. In the case group, 51.1% and in the control group, 51.5% were female. The

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mean age for cataract patients was 70 years or more in 57.8%; this was 46.3% for the control group. In terms of the living place, 62.2% of the cases and 56.6% of the control group lived in rural areas. Sun exposure time about 4 hours or more amounted to 53.3% in the cases and 58.1% in the control group. History of chronic ocular disease was 3.7% in the cases and 0.7% in the control group. Previous ocular trauma was 3% in the cases and 0.7% in the control group. In 48.9% of the case group and in 43.4% of the control group, arterial blood oxygen saturation was equal or lower than 95%. The mean oxygen saturation in the case and control groups were significantly different (P = 0.04). These were also the statistically significant relations between sex, age, sun exposure with O2. However, associations were insignificant as for other factors such as living place (urban or rural), chronic systemic diseases, chronic eye disease, and drug consumption in the case group.

Table 1: Comparison of mean oxygen saturation in case and control groups

Group	N	Oxygen saturation (mean±SD)	P-value
Cases	135	95.38±1.45	0.041
Controls	136	95.6±1.21	

Table 2: Comparison of mean oxygen saturation in the case group

Variables		Case (mean± SD)	P-value
sex	male	95.33±1.54	0.042
	female	95.43±1.27	
age	<70	95.61	0.011
	≥70	95.21	
smoke	smoker	94.41±1.55	0.021
	non-smoker	95.59±1.48	
Exposure to sunlight	> 2 hours	95.18±1.38	0.013
	2-4 hours	96.15±1.30	
	< 4 hours	95.29±1.39	
Chronic systemic disease	Negative	95.55±1.34	0.081
	IHD*	96±1.41	
	COPD†	94.50±2.12	
	Diabetes	95.50±0.70	
	Hypertension (HTN)	95.50±1,39	
	IHD + HTN	93.50±57	
	Diabetes + HTN +HPL	94.50±1.58	
	Others	94±0	
Residence	Urban	95.94±1.41	0.22
	Rural	95.34±1.40	
Chronic eye disease	yes	95.43±1.39	0.69
	no	94±1	
Drug consumption	Do not take medication	95.55±1.35	0.19
	NSAID	95.25±0.95	
	Digestive medicine	95.50±1.58	
	Antihypertensive	95.50±1.39	
	Anti-diabetes medicine	96.0±0.0	
	Heart medicine	96.0±1.41	
	Anti-diabetes + anti-hypertensive + anti-fats	94.50±1.58	
	Antihypertensive+ Heart medicine	93.50±0.57	
	COPD	94.50±2.12	
	Other	95.50±0.70	

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Discussion

The results of this study raise a question regarding the development of sclerotic cataract in low levels of oxygen saturation. In contrast, Nancy et al. propose that brief exposure to very high levels of O2 can be responsible for cataract as it occurs during and after vitrectomy surgery or intraocular oxygen tension in eyes of diabetic and non-diabetic patients leading to the slightly elevated levels of O2 (8, 9).

It is not completely understood that the cataractogenic effect of molecular oxygen is the result of its inherent oxidative potential or its ability to give rise to oxygen free radicals. It is demonstrated that vitrectomy increases oxygen tension within the human eye during surgery in a significant manner. Therefore, in the vitreous surgery, presumably due to the loss of gel structure, normal oxygen gradients within the vitreous body are lost and oxygen tension remains significantly elevated for at least 10 months.

Thus, vitrectomy surgery exposes the crystalline lens to abnormally high levels of oxygen and may lead to nuclear sclerotic cataract. Thus it is suggested that protecting the lens from exposure to high levels of oxygen may prevent post-vitrectomy and age-related nuclear sclerotic cataract (8). Our findings concerning the higher prevalence of cataract in the presence of low levels of arterial blood oxygen saturation may be also due to other risk factors such as increased age, UV radiation, smoking and previous ocular trauma.

Our study indicated that low levels of O2 saturation can lead to greater cataract incidence. This may be associated with known factors such as increased age, sex, time of sun exposure, smoking and history of heart disease (10). Ying et al report that many factors such as the level of vitamin C and free iron are included in this process (11).

The possibility of a relationship between the state of the vitreous body and nuclear cataract formation is suggested by several observations. Laboratory studies have suggested that between ages 30 and 50 years, a barrier to the diffusion of small molecules occurs between the lens cortex and nucleus. Reduced glutathione, a metabolite that normally protects the proteins and lipids of the lens from oxidative damage, is produced in the lens cortex and reaches the lens nucleus by diffusion. The formation of a diffusion barrier in the lenses of older individuals would be expected to decrease the amount of reduced glutathione available to the lens nucleus, thereby increasing its susceptibility to oxidative damage. Consistent with this view, glutathione levels are low and an increased proportion of this glutathione is found in the oxidized state in nuclear cataract. Therefore, oxygen or other oxidants have greater potential to cause damage to the lens nucleus of older individuals (12).

However, this report is based on information that was conducted in animals in three groups of rabbits. Studies show that the amount of oxygen in rabbits in a state of hyper or hypotonic was different (13, 14).

These observations provide a possible explanation for the contribution of age to the risk of nuclear cataract (15). Therefore, the oxygen saturation of plasma was perhaps not a true estimate of it.

Since increased and decreased oxygen levels could be responsible for the cataract. It is therefore necessary to perform other investigations so as to confirm the accurate relation between cataract and oxygen saturation.

Cataract surgery and vitrectomy were associated with a significant increase in pO2 in the posterior chamber as well as increased oxygen levels in the anterior chamber angle and anterior to the lens. These data confirm the prediction that vitrectomy and cataract surgery increase exposure of the cells of the trabecular meshwork to oxygen and, possibly, metabolites of oxygen, such as hydrogen peroxide (16).

Conclusions

This study showed that low oxygen saturation can be a risk factor for cataract disease. Since increased and decreased oxygen levels could be responsible for the cataract, other investigations are thus needed in order to confirm the accurate relation between cataract and oxygen saturation.

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Conflict of interest

There is no any conflict of interest.

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