Effects of Ramadan Fasting on Retinal Vascular and Anterior Chamber Parameters

Ramazan Orucunun Vasküler Retina ve Ön Kamara Parametrelerine Etkisi

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Abstract

Aim: In this study, we aimed to evaluate the effects of Ramadan fasting on retinal vascular and anterior chamber parameters.

Materials and Methods: The study included 60 healthy eyes of 30 volunteers (15 males, 15 females) who visited our clinic between May and July 2017. We performed measurements of intraocular pressure (IOP), anterior chamber volume (ACV), central corneal thickness (CCT), central macular thickness (CMT), optic disc retinal nerve fiber layer (OD-RNFL) and subfoveal choroidal thickness (SFCT) and retinal vascular analysis (the central retinal artery equivalent [CRAE], central retinal vein equivalent [CRVE], and artery-to-vein ratio [AVR]). The measurements were repeated in the 4th and 12th hours of the daily fasting period and 1st postprandial hour on the last 5 days of the Ramadan month, and one month after the Ramadan month.

Results: The mean participant age was 29.30±8.12 years. The twelfth-hour SFCT, CRAE, and CRVE measurements were statistically significantly lower than the values measured one month after Ramadan (p=0.033, p=0.020, p=0.025, respectively). However, no statistically significant difference was observed in the IOP, ACV, CCT, CMT, OD-RNFL, and AVR measurements.

Discussion and Conclusion: We found that fasting for 12 hours or longer caused changes in retinal vessel diameter and choroidal thickness.

Keywords: choroidal thickness; Ramadan fasting; reduced meal frequency; retinal vascular parameters; spectral domain optical coherence tomography

Öz

Amaç: Bu çalışmada Ramazan orucunun vasküler retina ve ön kamara parametreleri üzerindeki etkilerini değerlendirmek amaçlanmıştır

Gereç ve Yöntemler: Mayıs—Temmuz 2017 döneminde kliniğimize gelen 30 gönüllünün (15 erkek, 15 kadın) 60 sağlıklı gözü çalışmaya alındı. Göz içi basıncı (GİB), ön kamara hacmi (ÖKH), santral kornea kalınlığı (SSK), santral makula kalınlığı (SMK), optik disk retina sinir lifi tabakası (OD-RSLT) ve subfoveal koroit kalınlığı (SFKK) ölçümü ile retinal vasküler analiz (santral retinal arter damar değeri [SRAD], santral retinal ven damar değeri [SRVD] ve arter/ven oranı [AVO]) gerçekleştirildi. Ölçümler Ramazan ayının son 5 gününde orucun 4. ve 12. saatlerinde, iftardan 1 saat sonra ve Ramazan ayından 1 ay sonra tekrarlandı.

Bulgular: Katılımcı yaş ortalaması 29,30±8,12 yıl idi. Orucun 12. saatindeki SFKK, SRAD ve SRVD değerleri Ramazan ayından 1 ay sonra ölçülen değerlere kıyasla istatistiksel olarak anlamlı şekilde daha düşüktü (sırasıyla p=0,033; p=0,020; p=0,025). Fakat GİB, ÖKH, SSK, SMK, OD-RSLT ve AVO değerlerinde istatistiksel olarak anlamlı bir değişiklik gözlenmedi.

Tartışma ve Sonuç: On iki saat veya daha uzun süre oruç tutmanın retinal damar değerlerinde ve koroit kalınlığında değişiklere yol açtığı saptanmıştır.

Anahtar Sözcükler: azaltılmış beslenme sıklığı; koroit kalınlığı; Ramazan orucu; retinal vasküler parametreler; spektral alan optik koherens tomografisi

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INTRODUCTION

Voluntary hunger is a common choice around the world. Many people, regardless of nationality and religion, experience hunger for certain periods of time. Religious abstinence from food and drink during the daytime is referred to by various terms, such as fasting, Great Lent, and Yom Kippur (Day of Atonement), in Islam, Catholic and Orthodox Christianity, and Judaism.

Fasting can lead to various psychological and physiological changes in the body, including dehydration, energy deficiencies effective on the eye, decreased insulin levels, increased glucagon, norepinephrine and cortisol levels, and changes in the electrolyte and lipid profiles (1–11).

In this study, we aimed to investigate the short- and long-term effects of reduced meal frequency and fasting on anterior and posterior segment parameters of the eye, including intraocular pressure (IOP), anterior chamber volume (ACV), central corneal thickness (CCT), central macular thickness (CMT), optic disc retinal nerve fiber layer (OD-RNFL), subfoveal choroidal thickness (SFCT), central retinal artery equivalent (CRAE), central retinal vein equivalent (CRVE), and artery-to-vein ratio (AVR).

MATERIALS AND METHODS

This prospective observational cross-sectional study was conducted in our clinic in accordance with the principles of the Declaration of Helsinki. The study protocol was approved by the Afyon Kocatepe University Clinical Research Ethics Committee. Written informed consent was obtained from all participants.

The study included 60 healthy eyes of 30 volunteer participants (15 males, 15 females) who fasted during the month of Ramadan in May to June 2017. Full ophthalmological examination was performed. Individuals with a best-corrected visual acuity of 20/20 were included, and those with any ocular disease (cataract, glaucoma, dry eye, or corneal pathology including scarring, edema, dystrophy, and keratoconus), a history of contact lens use, systemic disease, ocular surgery, and refractive errors >±1 diopter (spherical and/or cylindrical values) were excluded.

We performed measurements of corneal topography (Sirius Scheimpflug-Placido Topographer, Costruzione Strumenti Oftalmici, Florence, Italy), intraocular pressure (Goldmann, Haag-Streit AG, Koeniz, Switzerland), post-pupillary-dilatation color fundus photography (Visucam 200; Carl Zeiss Meditec), and optical coherence tomography (SD-OCT, Heidelberg Engineering, Heidelberg, Germany). CCT and ACV were evaluated with the Sirius automatic Scheimpflug camera system. CMT and OD-RNFL were assessed with optical coherence tomography. SFCT was measured semiautomatically with enhanced deep imaging optical coherence tomography.

Images taken with fundus photography were calculated semiautomatically using the Interactive Vessel Analysis (IVAN) software (Knudtson, MD, University of Wisconsin, Madison, WI, USA). All images were separately calculated and objectivated by 2 different researchers (MCS and MD). Zone A and Zone B within a distance of 0.5 optical disc diameter around the optic disc were determined semiautomatically by the software, and the vessel diameters were calculated by Hubbard's formulation (12). The AVR was calculated as the ratio of the central retinal artery equivalent and central retinal vein equivalent (Figure 1).

The measurements were repeated in the 4th and 12th hours of the daily fasting period and 1st postprandial hour on the last 5 days of the Ramadan month, and one month after the Ramadan month.

The measurements and examinations performed one month later were evaluated as the normal control values.

Statistical analysis

All data were analyzed using the SPSS 20.0 (SPSS Inc., Chicago, IL, USA) software. The distribution was determined using the Kolmogorov–Smirnov test. The dependent sample t-test (paired t-test), which involves averaging the observed values of a variable in two different situations, was performed. $p<0.05$ was considered statistically significant.

RESULTS

The mean participant age was 29.30±8.12 years. The mean male and female participant age were 29.73±9.28 and 28.86±6.91 years, respectively.

The mean fourth-hour, twelfth-hour, first-postprandial-hour, and control IOPs were 13.73±2.16, 13.85±1.83, 13.78±2.06, and 13.58±2.18 mmHg, re-

Table 1. Comparison of the mean fourth-hour, twelfth-hour, first-postprandial-hour, and control values

Parameters	Fourth-hour values	Twelfth-hour values	Postprandial-hour values	Control values	p*		
					p1	p2	p3
IOP (mm-Hg)	13.73±2.16	13.85±1.83	13.78±2.06	13,58±2.18	0.443	0.654	0.149
ACV (mm^3)	160.55±43.57	160.98±43.21	160.70±43.82	160.31±44.04	0.466	0.449	0.189
CCT (μm)	540.11±33.22	530.48±55.17	540.35±33.16	530.35±54.80	0.266	0.168	0.803
CMT (μm)	225.76±39.64	225.63±40.03	225.75±39.65	226.45±39.90	0.892	0.823	0.098
OD-RNFL (μm)	96.53±7.40	96.50±7.32	96.61±7.35	97.00±7.03	0.096	0.507	0.072
SFCT (μm)	356.51±96.87	355.28±97.11	356.74±96.58	359.20±97.29	0.947	0.460	**0.033**
CRAE (μm)	129.32±15.05	127.65±15.11	131.09±15.13	134.59±10.13	0.258	**0.020**	**0.033**
CRVE (μm)	212.08±16.48	212.35±21.89	212.94±16.44	216.39±18.82	0.233	0.794	**0.025**
AVR	0.622±0.107	0.611±0.127	0.624±0.106	0.626±0.093	0.258	0.111	0.169

* The dependent sample t-test results. Statistically significant results in bold.
p1: Postprandial-hour and fourth-hour measurement comparison; p2: Postprandial-hour and twelfth-hour measurement comparison; p3: control and twelfth-hour measurement comparison

spectively. No statistically significant difference was found (p>0.05).

The mean fourth-hour, twelfth-hour, first-postprandial-hour, and control ACVs were 160.55±43.57, 160.98±43.21, 160.70±43.82, and 160.31±44.04 mm^3, respectively (p>0.05).

The mean fourth-hour, twelfth-hour, first-postprandial-hour, and control CCTs were 540.11±33.22, 530.48±55.17, 540.35±33.16, and 530.35±54.80 μm, respectively (p>0.05).

The mean fourth-hour, twelfth-hour, first-postprandial-hour, and control CMTs were 225.76±39.64, 225.63±40.03, 225.75±39.65, and 226.45±39.90 μm, respectively (p>0.05).

The mean fourth-hour, twelfth-hour, first-postprandial-hour, and control OD-RNFLs were 96.53±7.40, 96.50±7.32, 96.61±7.35, and 97.00±7.03 μm, respectively (p>0.05).

The mean fourth-hour, twelfth-hour, and first-postprandial-hour SFCTs were 356.51±96.87, 355.28±97.11, and 356.74±96.58 μm, respectively. No significant difference was found (p>0.05). The mean control SFCT was 359.20±97.29 μm and, compared to the twelfth-hour measurement, the difference was statistically significant (p=0.033).

The mean fourth-hour and twelfth-hour CRAEs were 129.32±15.05 and 127.65±15.11 μm, respectively. No significant difference was found (p>0.05). The mean post-prandial CRAE was 131.09±15.13 μm, which was statistically significant (p=0.020). The mean control CRAE was 134.59±10.13 μm and, compared to the twelfth-hour measurement, the difference was statistically significant (p=0.033).

The mean fourth-hour, twelfth-hour, and first-postprandial-hour CRVEs were 212.08±16.48, 212.35±21.89, and 212.94±16.44 μm, respectively. No significant difference was found (p>0.05). The mean control CRVE was 216.39±18.82 μm, which was statistically significant (p=0.025).

Finally, the mean fourth-hour, twelfth-hour, first-postprandial-hour, and control AVRs were 0.622±0.107, 0.611±0.127, 0.624±0.106, and 0.626±0.093, respectively (p>0.05).

In sum, we observed no significant fasting-related change in IOP, ACV, CCT, CMT, OD-RNFL, and AVR. The control SFCT, CRAE, and CRVE measurements were statistically significantly higher than the twelfth-hour measurements. The postprandial CRAE measurements were also significantly higher than the twelfth-hour values (Table 1).

DISCUSSION AND CONCLUSION

Biochemically, fasting for 12 hours or longer means surviving without food (13). During the Ramadan fasting, both physiological and pathological changes might be expected as the daily food intake occurs at night and sometimes after about 16 hours of diurnal hunger. Hunger and dehydration have been suggested to have various effects on the eye.

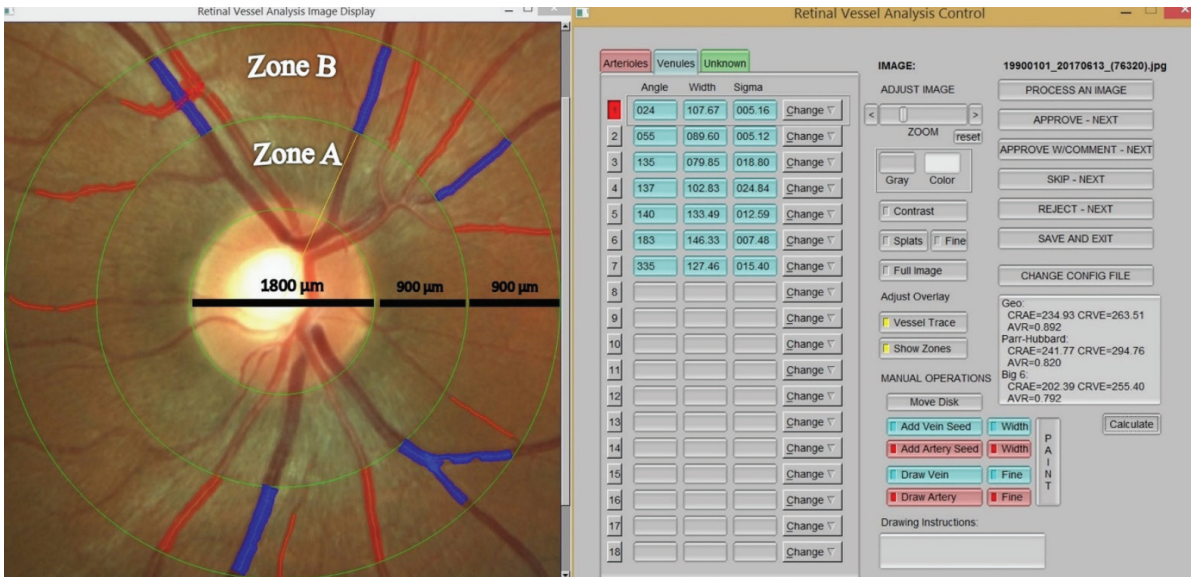

Figure 1. A color fundus photograph from the interactive vessel analysis software used. The appearance of Zone A and Zone B within a distance of 0.5 optic disc diameter. The retinal vessel diameters on Zone B were calculated semiautomatically.

However, Selver et al. (4) reported that fasting caused no significant change in central corneal thickness, anterior chamber angle, anterior chamber depth, pupil size, and visual acuity. Kerimoglu et al. (3) also found that central corneal thickness did not change with fasting. Similarly, we did not observe any significant difference between our central corneal thickness and anterior chamber volume measurements.

Brucculeri et al. (1) showed that drinking water could cause a sudden increase in the IOP, and Dadeya et al. (4) measured decreased levels of IOP due to fasting. Unlike these studies, Soleymani et al., Kayikcioglu et al., and Assadi et al. reported no significant difference between their measurements in fasters and nonfasters (14–16). In our study, we did not observe any significant change in the IOP. It has been suggested that the renin–angiotensin–aldosterone system and prostaglandin secretion during dehydration lead to a decrease in the IOP while the increased sympathetic activity provides an increase and thus stabilization (17).

The present study is a first study to investigate the effects of fasting with retinal vascular analysis. It was seen that dehydration and electrolyte imbalances were effective during the one-month Ramadan fasting. It was also found that the dehydration due to fasting for 12 hours or longer resulted in narrowed retinal arteries and veins and decreased choroidal thickness levels. However, the normalized values measured one month after the end of the fasting period show that the changes observed are reversible. Further extensive studies could help better understand the effects of fasting for >12 hours.

Finally, it should be noted that our study has several limitations. First, all participants were healthy volunteers and different effects are possible in patients with chronic diseases. Secondly, the month of Ramadan coincides with different seasons in different years and it coincided with the hot season (around June) during our study. In conclusion, our study showed that fasting and dehydration for >12 hours might lead to significant retinal and choroidal vascular (SFCT, CRAE, and CRVE) changes.

Conflict of Interest and Financial Disclosure

The authors declare that they have no conflict of interest to disclose. The authors also declare that they did not receive any financial support for the study.

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