Özgün Araştırma / Original Investigation

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The Impact of Fasting during the Month of Ramadan on Aortic Elasticity in Stable Cardiac Patients

Oruç Tutmanın Stabil Kardiyak Hastalarda Aort Elastisitesi Üzerine Olan Etkisi

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Abstract / Özet

Objective: The effects of fasting in the month of Ramadan on cardiac patients have been studied in previous studies. However, the association between ascending aortic elastic indexes measured echocardiographically (Aortic distensibility (AD) and aortic train (AS)) and fasting in patients with stable cardiac disease was not evaluated. The aim of this study is to investigate the association between elasticity indexes of aorta and fasting in patients with stable cardiac disease.

Methods: Twenty patients (10 female, 10 male and mean age of 52.1) with known stable cardiac disease who fasted for 30 days during the month of Ramadan were included. AS and AD as elasticity indexes of aorta were calculated from the aortic diameters using echocardiography three times; first before Ramadan (BR), second during Ramadan (DR) and finally after Ramadan (AR).

Results: No statistically significant difference in aortic elasticity measured three different times (AS: 8.7±3.94, AD: 0.32±0.18 vs 10.26±6.14, 0.39±0.27 vs 9.31±4.28, 0.37±0.22; respectively BR, DR, AR; p>0.05)was measured.

Conclusion: Findings of our study have shown that fasting during Ramadan do not have an adverse effect on aortic elasticity in stable cardiac patients.

Key Words: Aortic elasticity, fasting, cardiac disease, aortic distensibility, aortic strain

Amaç: Ramazan ayında oruç tutmanın kardiyak hastalardaki etkisi üzerine yapılmış bir çok çalışma bulunmaktadır. Ancak stabil kardiyak hastalarda ekokardiyografik olarak ölçülen asendan aorta elastikiyet parametrelerinin (aortik distensibilite (AD) ve aortik strain (AS) oruç tutunca etkilenip etkilenmediğine ilişkin yapılmış bir çalışma bulunmamaktadır. Bu nedenle biz bu çalışmada aortik elastikiyet parametreleri ile oruç tutmanın ilişkisini araştırmayı planladık.

Yöntemler: Bilinen kardiyak hastalığı olan ve Ramazan ayı boyunca oruç tutan 20 hasta (10 kadın, 10 erkek ve ortalama yaş 52,1) çalışmaya alındı. Aotik elastisite parametreleri olarak AS ve AD, ekokardiyografi ile asendan aorta çapları dikkate alınarak ölçüldü. Ölçümler 3 defa tekrarlandı: İlk ölçüm Ramazan başlamadan hemen önce (BR), ikinci ölçülm Ramazan ayı sırasında (DR) ve son ölçümde Ramazan ayından 2 hafta sonra (AR) yapıldı.

Bulgular: Her üç zamanda ölçülen aortik elastisite parametreleri arasında istatistiksel bir fark saptanamadı (AS: 8,71±3,94, AD: 0,32±0,18 ve 10,26±6,14, 0,39±0,27 ve 9,31±4,28, 0,37±0,22; sırasıyla BR, DR, AR; p>0,05).

Sonuç: Çalışma bulgularımız göstermektedir ki stabil kardiyak hastalarda Ramazan ayında oruç tutmanın aortik elastisite üzerine olumsuz etkisi bulunmamaktadır.

Anahtar Kelimeler: Aortik elastisite, oruç tutma, kardiyak hastalık, aortik distensibilite, aortik strain

Introduction

Over one billion Muslims fast in the holy month of Ramadan worldwide as fasting is an important ritual of Islam (1, 2). Not only eating, but also drinking, taking oral medications and intravenous fluids is banned from dawn till dusk (2). Ramadan is the 9th lunar month of the Islamic calendar, therefore the time of observance changes and fasting period varies from 13 to 18 hours per day, depending on the season and geographic site, since the lunar calendar is 11-12 days shorter than the solar year (2, 3). Eating is permitted after sunset. People who fast usually have 2 main meals; one just before sunrise (sahur), the other just after sunset (iftar) (2). Turkish people wake up early for sahur, eat a carbohydrate rich meal, pray, go back to sleep, wake-up for work or other daily activities and eat heavy foods at iftar in general. So, one's lifestyle seriously changes for a month (1, 2). People tend to sleep less and to eat more at night (2). For all these reasons, fasting may have a negative effect on Turkish cardiac patients.

Aortic stiffness reflects the mechanical tension and elasticity of the aortic wall. Aortic stiffness has been shown to increase in hypertension, diabetes, atherosclerosis, Marfan syndrome, smoking and aging and is associated with cardiovascular mortality (4-8). Aortic distensibility (AD) and aortic strain (AS) are indexes of aortic elasticity that reflect aortic stifness and can be measured with relatively simple, non-invasive methods (9, 10).

The effects of fasting in the month of Ramadan in cardiac patients were studied in previous studies. However, the association between ascending aorta elastic indexes measured echocardiographically (AD and AS) and fasting in patients with stable cardiac disease has not been evaluated. Hence, the purpose of this study was to investigate the association between elasticity indexes of the aorta and fasting in patients with stable cardiac disease.

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Methods

Patient selection

This study was based at the Mehmet Akif Ersoy Education and Research hospital, Istanbul. Twenty patients who fast in the month of Ramadan volunteered to participate. Each patient visited our hospital on three separate occasions: The first visit was 1 week before Ramadan (BR); to determine the patients' regular state, the second was during Ramadan (DR); at the 15th day; and the third was 1 month after the last day of Ramadan (AR). Written informed contest was taken from all patients.

Echocardiography

All the patients' echocardiographic asssessments were performed using general Electrics healthcares Vivid 3 cardiac ultrasound, the mean value of 3 consecutive cycle measurements was recorded. Routine echocardiographic assessment was performed according to related guidelines. The ascending aorta systolic and diastolic dimensions and the distance between the inner diameter of front and rear aortic walls were measured from 3 centimeters above the aortic valve in the supine position using the M-mode. The systolic aortic dimension (AoS) was measured while the aortic valve was fully opened, and the diastolic aortic dimension (AoD) was measured simultaneously with the electrocardiographic peak point of the QRS wave.

Blood pressure measurements

All the patients' blood pressure measurements were performed from the right arm in the supine position, simultaneously with echocardiographic evaluation using a standard cuff and sphigmomanometer.

The mean of 3 consecutive measurements was recorded. Korotkoff's first sound was considered as systolic, and the 5th sound as diastolic blood pressures.

Table 1. Clinical features and medications of the patients

	N	percent (%)
Heart failure	6	30
Valvular disease	2	10
Arrhythmia	1	5
CAD	11	55
Cardiomyopathy	1	5
Beta blocker	16	80
ACE-i	19	95
CCB	5	25
ASA	18	90
Clopidogrel	6	30
Digoxin	3	15
Warfarin	4	20
Diuretics	10	50

N: number of patients, CAD: coronary artery disease, ACE-i: angiotension converting enzyme inhibitor, CCB: calcium channel blocker, ASA: acetyl salicylic acid

Elastic properties of the aorta

Elastic properties of the aorta were accepted as the parameters of aortic function. The systolic and diastolic indices of the aorta were calculated by dividing the AoS and AoD by body mass index. The following aortic elasticity parameters were calculated using these indices:

Pulse pressure (mmHg) = Systolic pressure – diastolic pressure
Aortic strain (%) = 100. (AoS–AoD)/AoD
Distensibility ($cm^2.dyn^{-1}.10^{-3}$) = 2. (AoS-AoD)/pulse pressure. AoD

Statistical analysis

All the statistical analyses were performed using SPSS for the Windows 15.0 statistical package programme. Demographic features were analysed by arithmetic averages and standard deviations were measured (mea±SD). Categorical variables were evaluated with chi-square and student T tests. A p-value lower than 0.05 was considered statistically significant. The Oneway Anova test was used for analysis of more than two variables. Effects of related variables were evaluated by the linear regression test.

Results

We included 20 Muslim patients with stable cardiac disease who fast in the month of Ramadan. The mean age was 52.1±10.84 and 50% (n=10) of the patients were male. All the patients successfully completed the 30 day fasting period. 11 (55%) of the patients had coronary artery disease, 6 (30%) had heart failure, 2 (10%) had valvular heart disease, 1 (5%) had cardiomyopathy and 1 (5%) had arrhythmia (Table 1). Medications of the patients are also given in Table 1. Standard echocardiographic features of the patients are given in Table 2. There was no significant difference among the three periods with regard to clinical outcome. Table 3 shows the elacticity indexes measured BR, DR and AR. AS and AD measured BR, DR and AR were not significantly different (AS (%), AD($cm^2.dyn^{-1}.10^{-3}$); 7.43, 0.25 vs 11.32, 0.42 vs 0.23, 0.32; p>0.05 respectively) (Figure 1).

Discussion

In this population based study we found no significant difference in aortic stiffness during Ramadan when compared to before and after Ramadan values.

Fasting for a month is a heavy duty that especially changes eating and sleeping habits. Cardiac patients who intend to fast usually ask their cardiologist whether they can fast or there are any side effects of fasting. Therefore many investigators have studied the effects of fasting, but the results are conflicting (1-3, 11, 12). Fasting people eat two main heavy meals instead of three that could increase the body effort especially in cardiac patients whose drug schedule also changes. Therefore, it is not surprising to expect clinical, biochemical and hormonal changes. Recently published studies have shown changes in circadian secretion of glucose, calcium, magnesium, zinc, bilirubin, liver enzymes, gastrin, insulin and cortisone (2). Daytime glucose homeostasis is maintained by meals taken before sunrise and hepatic glycogen storage (3). Khafaji et al. (13) could not show differences in serum leptin and high sensitive C-reactive protein levels in stable cardiac patients who fast. Aybak et al. (14) showed prolongation of bleeding time and decrease in platelet response to some aggregant agents. El-Hazmi et al. (15) revealed a decrease in serum iron levels and the capacity

Table 2. Standard echocardiographic measurements of the patients

Echo parameter	Mean	SD (±)
Ived	4.99	0.47
Ives	3.17	0.36
Pw (cm)	1.08	0.19
Ivs (cm)	0.97	0.33
Ivs mass diastole	205.79	31.5
Ivs mass systole	171.66	61.74
EF (%)	45	14.91
edv	120.15	22.45
esv	42.15	9.98
mitral E	0.71	0.14
mitral A	0.75	0.16
E/A	0.98	0.28
dt	200.38	47.96
la vol	49.15	16.1

Ived: ıves: pw: posterior wall thickness, ıvs:interventricular septum thickness, ef: ejection fraction, edv:end-diastolic volume, esv:end-systolic volume, dt: la vol: left atrial volume

Table 3. Aortic elasticity and 24 hour blood pressure monitoring of the patients before, during and after Ramadan

Aortic elasticity parameters	Minimum	Maximum	Mean	Std. Deviation
AoS-BR	2,8	4,0	3,25	0,29
AoS-DR	2,5	4,0	3,24	0,37
AoS-AR	2,8	4,0	3,33	0,36
AoS-BR	2,5	3,7	2,98	0,32
AoS-DR	2,2	3,7	2,95	0,41
AoS-AR	2,6	3,8	3,06	0,35
AS-BR	3,03	16,0	8,71	3,94
beta index-BR	0,1	,058	0,24	0,15
AD-BR	0,04	0,71	0,32	0,18
AS-DR	2,78	23,08	10,26	6,14
beta index-DR	0,07	0,59	0,21	0,16
AD-DR	0,05	0,91	0,39	0,27
AS-AR	3,45	17,24	9,31	4,28
beta index-AR	0,08	0,45	0,22	0,11
AD-AR	0,14	0,81	0,37	0,22

AoS: systolic dimension of aorta, AoD: diastolic dimension of aorta, AD: aortic distensibility, AS: aortic strain, BR: before Ramadan, DR: during Ramadan, AR: after Ramadan

of binding iron. Scott et al. (16) showed a decrease in circulating erythrocyte numbers and increase in mean corpuscular and hemoglobin volume. While Gumaa et al. (12) found an increase in triglyceride levels and decrease in total cholesterol; Fedail et al. (17) showed the opposite: no change in triglyceride, increase in total cholesterol levels On the other hand, Maislos et al. (18)

Table 4. Comparison of aortic elasticity indexes and 24 hour blood pressure monitoring before, during, after Ramadan

	BR	DR	AR	p value
AoS	3.29	3.31	3.33	0.48
AoD				0.11
AS	7.43	11.32	9.3	0.23
beta index	0.28	0.19	0.23	0.95
AD	0.25	0.42	0.34	0.32

AoS: systolic dimension of aorta, AoD: diastolic dimension of aorta, AD: aortic distensibility, AS: aortic strain, BR: before Ramadan, DR: during Ramadan, AR: after Ramadan
p value 0.05: statistically significance

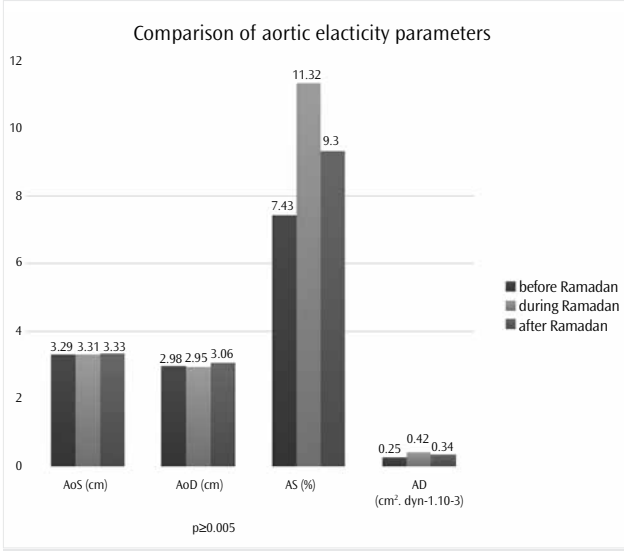

Figure 1. Comparison of aortic elacticity parameters

revealed an increase in high density lipoprotein (HDL) levels during Ramadan. However, Khafaji et al. (13) found a decrease in HDL levels, and an increase in low density lipoprotein levels in stable cardiac patients. Changes in serum lipid parameters are associated with the quantity and quality of the meals.

Although Suwaidi et al. (2) and Temizhan et al. (11) could not show an association between the incidence of acute coronary syndromes and Ramadan; Gumaa et al. (12) revealed an increase in anginal complaints during Ramadan. Suwaidi et al. (2) also studied whether hospitalisation for chronic heart failure increases during Ramadan or not in another study, and could not show a statistical difference between Ramadan and the remainder of the year.

Perk et al. (19) could not show any differences in blood pressure measurements. Recently published studies have shown more hypotension and bradycardia in Ramadan than the remainder of the year (3). Electrocardiogram changes are seen in Ramadan like QRS-T wave alterations, right axis (3). Fasting during daytime decreases venous return and symphatetic tonus and blood pressure, heart rate and cardiac output may decrease (13, 19). Similarly, Suawidi et al. (2) linked the decrease in heart rate with the inhibiton of catecholamine production during Ramadan. Khafaji et al. (13) found that cardiac events are seen higher during the first meal-just after

sunset and the second meal-just before sunrise in the month of Ramadan. However most of these studies could not show a worse cardiac outcome nor increase in the incidence of acute coronary syndromes and stroke in cardiac patients during Ramadan (3). Fasting may even be preventive against cardiovascular events because acute coronary syndromes are triggered by increased serum cathecolamines and hunger is associated with catecholamine inhibition (2). In support of this hypothesis; 71% of the patients with stable cardiac disease said that they felt better during Ramadan in another study by Khafaji et al. (13).

The reason for conflicting results between studies may be because of the retrospective design of most of them, leading to an unknown number of subjects who indeed fast. We only included patients who fasted and excluded patients who could not continue fasting. Another explanation may be the geographic and cultural differences among study populations that affect the eating hours and what is eaten; like salt consumption differences and fatty meal habits of the populations, and eating just 2 meals or eating all night long as is permitted as a cultural habit.

Arterial stiffness occurs by the interaction of changes in cellular and structural elements in the vessel wall. These vascular changes are affected by glucose regulation, salt intake, hormonal factors and hemodynamic alterations (20). Arterial stiffness increases as a result of smoking, hyperlipidemia, diabetes, hypertension and aging (5-8). Increased aortic stiffness and/or decreased distensibility is a marker of extensive atherosclerosis in the vascular system (21, 22). Besides being a marker of mortality, aortic stiffness is an indicator of vascular-related diseases such as myocardial infarction, stroke, heart failure, renal failure and dementia (8, 21-27). Safar et al. (27) not only revealed an association between aortic stiffness and energy consumption during resting and stress but also an association between aortic stiffness and orthostatic hypotension and shortness of breath. However we could not show an association between fasting; which is a stress factor that changes energy metabolism; and aortic stiffness. We could only speculate the possible reasons for this observation. First of all, aortic stiffness is a process that changes in the long term, therefore one month's fasting may have a minor effect on aortic stiffness that we are unable to show with today's technology. Secondly, all our patients were on medications for known cardiac diseases that might have helped aortic stiffness parameters not to change as expected.

Study Limitations

The main limitations of our study was its single-centered basis, non-randomized design and relatively small patient population size, thus limiting the impact of the study.

Conclusion

The results of this study showed that fasting during Ramadan does not have an adverse effect on aortic elasticity in stable cardiac patients. Further prospective, randomized trials on larger populations are warranted in the future.

Conflict of Interest

No conflict of interest was declared by the authors.

Peer-review: Externally peer-reviewed.

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Author Contributions

Concept - F.A.; Design - Ö.A., i.M.Ç.; Supervision - M.E.; Funding - A.A.Y.; Materials - F.U.; Data Collection and/or Processing - F.N.T.Ç.; Analysis and/or Interpretation - Ö.A.; Literature Review - F.N.T.Ç.; Writing - F.N.T.Ç.; Critical Review - F.U.

Çıkar Çatışması

Yazarlar herhangi bir çıkar çatışması bildirmemişlerdir.

Hakem değerlendirmesi: Dış bağımsız.

Hasta Onamı: Yazılı hasta onamı bu çalışmaya katılan hastalardan alınmıştır.

Yazar Katkıları

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