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The effect of Ramaddan fasting on fetal/obstetric B-mode and Doppler ultrasound findings

Oruç tutmanın fetal obstetrik B-mod ve Doppler ultrasonografi bulgularına etkisi

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Abstract

Aim: Ramaddan is a month of religious fasting within a year in which eating and drinking are prohibited during the time between sunrise and sunset. We investigated whether there is an effect by prolonged periods with no fluid or food ingestion during long and hot days of Ramaddan in 2014 on obstetric B-mod and Doppler ultrasound parameters.

Material and Method: Our study included a total of 187 pregnant women admitted to our department with the request for obstetric ultrasound between June 28 and July 27, 2014. Ninety-five pregnant were recorded as the fasting group and 92 were recorded as the non-fasting control group. The fasting group was divided into two sub-groups based on the time of ultrasound examination during the day of fasting (between 0-8 hours and 9-16 hours) and three sub-groups according to the number of fasting days (1-10 days, 11-20 days and 21-30 days). We compared ultrasonographic parameters of two main and the subgroups.

Results: B-mode and Doppler ultrasound findings did not differ between the two main groups ($p > 0.05$). In the comparison made according to the number of fasting days, the resistive index (RI) of the umbilical artery (UMA) was lower in the sub-group of 1-10 days than the others ($p=0.019$).

Conclusion: In pregnant women who had sahur and iftar meals regularly, Ramaddan fasting during long and hot days did not significantly alter obstetric B mod and Doppler ultrasound parameters, but fasting decreased the resistive index of the umbilical artery in the early days.

Keywords: Pregnancy, Ramaddan, ultrasonography.

Öz

Amaç: Ramazan ayı, yıl içerisinde bir ay süren ve gün doğumu ile gün batımı arasındaki sürede yemek ve içmenin yasak olduğu oruç tutulan aydır. Çalışmamızda 2014 yılı Ramazan ayının sıcak ve uzun günlerinde açlık ve susuzluğun, obstetrik B-mod ve Doppler ultrasonografi (US) parametrelerine etkisi olup olmadığını araştırdık.

Gereç ve Yöntem: 28 Haziran-27 Temmuz 2014 tarihleri arasında obstetrik US istemiyle bölümümüze başvuran toplam 187 gebe çalışmamıza dahil edildi. Doksan beş gebe oruç tutan grubu oluştururken, 92 gebe de oruç tutmayan kontrol grubunu oluşturdu. Oruç tutan grup US inceleme esnasındaki, açlık süresine göre iki alt gruba (0-8 saat ve 9-16 saat) ve tutulan oruç gün sayısına göre de üç alt gruba (1-10 gün, 11-20 gün ve 21-30 gün) ayrıldı. İki ana ve alt grupların ultrasonografik parametreleri karşılaştırıldı.

Bulgular: İki ana grup arasında B-mod ve Doppler US bulguları bakımından fark yoktu ($p>0.05$). Oruç gün sayısına göre yapılan karşılaştırmada ise, 1-10 gün alt grubunda umbilikal arter resitif indeks (UMA Rİ) değerleri, diğer alt gruplardan düşük çıktı ($p=0.019$).

Sonuç: Düzenli sahur ve iftar yapan gebelerde uzun ve sıcak günlerde oruç tutma, B- mod ve Doppler US parametrelerini anlamlı olarak değiştirmemekte, ancak oruç tutulan ilk günlerde UMA Rİ azalmaktadır.

Anahtar Kelimeler: Gebelik, Ramazan, ultrasonografi.

Introduction

Ramaddan is a lunar month (29-30 days) of fasting for Muslims, when eating and drinking are prohibited from sunrise to sunset. On average, this month gets 11 days earlier each solar year. This means that the season it falls in changes over the years. Pregnant and lactating women are permitted not to fast, as long as they make up the days later. Nonetheless, some persevere, as they do not wish to miss this religious activity at the special time. For pregnant women, fasting raises concern about their health as well as the health of their babies and this concern is higher when Ramaddan falls in the summer, as the day, and therefore fasting, time is longer and the weather is hotter than in other seasons.

The uteroplacental blood flow must be sufficient for a normal fetal growth and development [1]. B-mode and Doppler ultrasonography (US) are valuable for evaluating fetal growth and fetomaternal circulation [2,3]. There is no sufficient number of studies investigating the effects of fasting in these days on B-mode and Doppler ultrasound parameters. Moreover, some of these studies were conducted in the autumn months which have a shorter period of fasting and dehydration and lower temperature values [2,4,5].

The average daytime temperature in the shade during long and hot days of Ramaddan in Konya in July 2014 was approximately 310 [6]. The total daily fasting duration was about 17 hours. Therefore, we planned this study to evaluate fetal development and fetomaternal circulation in pregnant women who fast in long and hot days. In this study, we evaluated amniotic fluid index (AFI), fetal biometric measurements, fetal bladder volume (FBV) and Doppler ultrasound indices in pregnant women fasting during Ramaddan and investigated whether there is an effect of fasting on these parameters.

Material and Method

The present study included a total of 187 pregnant women admitted to our department for the request of obstetric ultrasound, a kind of routine follow up method in our department, in the second and third trimesters in Dr. Faruk Sükan Maternity and Children's Hospital. For this study, the approval of ethics committee was obtained from Necmettin Erbakan University and informed consent forms were filled for every pregnant woman. All pregnant women are healthy individuals who make their normal daily activities and have a singleton pregnancy. The study excluded pregnant women with a proven oligohydramnios and with growth retardation in their fetus on B-mode ultrasound examination. Ninety-five pregnant were accepted as the fasting group (group 1) and 92 pregnant women were accepted as the non-fasting control group (group 2). For both groups, we paid attention to create a

balanced allocation according to the gestational week. In addition, the fasting group was divided into two sub-groups 1a and 1b based on the time of ultrasound examination during the day of fasting (between 0-8 hours and 9-16 hours) and three sub-groups 1x, 1y and 1z according to the number of fasting days (1-10 days, 11-20 days and 21-30 days). For all participants, we recorded demographic characteristics including age, weight, gravidity, parity, last menstrual period and average gestational age according to fetal biometric measurements. B-mode and Doppler ultrasound examinations were performed by a single experienced radiologist using Siemens Acuson Antares and Toshiba Famio 8 devices. Using B-mode ultrasound examination, we recorded fetal biometric measurements including biparietal diameter (BPD), femoral length (FL), abdominal circumference (AC) and estimated fetal weight (EFW), and amniotic fluid index (AFI) as measured by the total of four quadrant measurement and FBV. The gestational age that was associated with fetal biometric measurements was calculated using Hadlock's formula (Benson, 2004). Doppler ultrasound examination included the resistive index (RI), pulsatility index (PI) and systolic/diastolic ratio (S/D) of umbilical artery (UmA), middle cerebral artery (MCA) and uterine artery (UA), and the value of umbilical vein flow (UVf). Of these, MCA and UA were unilaterally measured. The measurements of UA and UmA were performed from the side of placental localization and free part of the umbilical cord, respectively. The results were compared between group 1 and group 2 and the subgroups of group 1. Moreover, we investigated the correlation between FBV and AFI and the relationship of FBV and AFI with the number of fasting days.

Statistical Analysis

Student's t test and Mann-Whitney U test were used for the comparison of B-mode and Doppler ultrasound findings of groups 1 and 2 and of subgroups 1a and 1b, whereas ANOVA and Kruskal-Wallis tests were used for the comparison of the subgroups 1x, 1y and 1z. Tukey's HSD multiple comparison test was used to determine the groups with statistically significant differences according to the ANOVA test. The relationship of fasting days and FBV and AFI was examined with Spearman's Rho correlation coefficient. The Kolmogorov–Smirnov test was used to confirm the normality of variables. The power calculation was 81.9%. Statistical analyses were performed using IBM SPSS for Windows 13.0, and $P < 0.05$ was considered statistically significant.

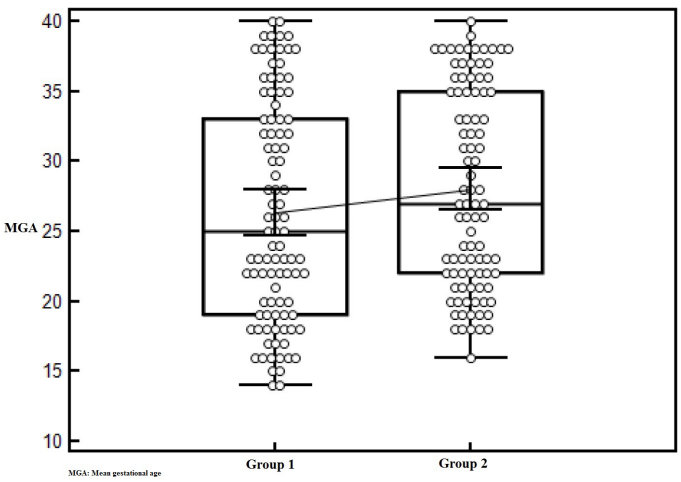
Results

The study was conducted between June 28 and July 27, 2014 on 187 pregnant women. In spite of the fact that all of them underwent B-mode ultrasound examination, due to not to tolerate prolonged supine of some pregnant women, Doppler ultrasound examination could be performed in 107 pregnant women. Because of improper position of the fetus, FBV could be measured in 108 fetuses. The mean age was 26.9 years in the fasting group, whereas 26.1 in the control group. Demographic characteristics including age, weight, gravidity, parity, and mean gestational age were similar between the groups (Table 1). The distribution characteristics according to gestational week were similar between two groups (Figure 1).

Table 1. Descriptive characteristics

	Fasting (n=95)		Non-fasting (n=92)		
	Mean±SD	IQR	Mean±SD	IQR	*p*
Age	26.93±6.46	10	26.12±5.93	10	0.399
Weight	68.88±11.77	15	71.84±12.95	16	0.072
Gravidity	2.83±1.91	3	2.46±1.60	2	0.200
Parity	1.47±1.37	2	1.15±1.35	2	0.071
MGA	26.33±7.89	14	28.02±7.15	13	0.109

MGA: The mean gestational age, IQR: Interquartile Range



Subtitle of Figure 1: The distribution of groups 1 and 2 by MGA.

PI, RI and S/D ratio of UmA, MCA, UA, and UVf, FBV, AFI and EFW were compared between the two groups. No statistically significant difference was found between the two groups (p> 0.05) (Table 2). According to the comparison according to the time of ultrasound examination during the day of fasting, there was no statistically significant difference between all parameters of the subgroups 1a and 1b (p>0.05) (Table 3). In the comparison between the subgroups 1x, 1y and 1z, UmA RI was lower in the subgroup 1x than subgroups 1y and 1z and this difference was statistically significant (p =0.019). There was no statistically significant difference in the other parameters between the groups (p >0.05) (Table 4).

In addition, there was no correlation between the number of fasting days and FBV and AFI. There was a negative correlation between FBV and AFI (Spearman's rho=-0.532, p <0.001) (Table 5).

Table 2. A comparison of B-mode and Doppler ultrasound findings between Groups

	Fasting			Non-fasting			Test	*p*
	n	Mean±SD	IQR	n	Mean±SD	IQR		
UmA PI	47	0.97±0.21	0.32	60	1.03±0.20	0.28	-1.539	0.127
UmA RI	47	0.61±0.10	0.15	60	0.64±0.08	0.10	-1.720	0.088
UmA S/D	45	2.82±0.72	1.05	50	3.02±0.71	0.44	-1.369	0.174
OSA PI	47	1.61±0.39	0.46	59	1.50±0.35	0.39	1.580	0.117
MCA RI*	47	0.78±0.09	0.14	59	0.79±0.22	0.09	-1.003	0.316
MCA S/D*	45	5.52±2.67	4.05	49	4.88±2.58	1.48	-1.007	0.284
UA PI*	46	0.82±0.37	0.36	53	0.86±0.44	0.43	-0.260	0.795
UA RI	46	0.53±0.17	0.16	53	0.52±0.14	0.17	0.547	0.586
UA S/D	46	2.25±1	0.65	53	2.34±1.09	0.77	-0.207	0.836
UVf*	47	197.70±159.77	213	58	202.17±147.03	190.2	-0.477	0.633
FBV*	50	6.18±8.34	8	58	8.67±9.42	10.50	-1.399	0.162
AFI*	95	13.11±1.91	3	91	12.60±3.23	3	-1.769	0.077
EFW*	88	1372.32±1210.61	2064	86	1500.14±1189.02	2252	-1.201	0.230

*: Mann-Whitney U test was used for non-normally distributed groups, IQR: Interquartile Range

UmA: Umbilical artery PI: Pulsatility index RI: Resistive index S/D: Systolic and diastolic velocity ratio

MCA: Middle cerebral artery UA: Uterine artery UVf: Umbilical vein flow FBV: Fetal bladder volume

AFI: Amniotic fluid index EFW: Estimate fetal weight

Table 3. A comparison of B-mode and Doppler ultrasound findings according to the time of ultrasound examination

	0-8 hours (Group 1a)			9-16 hours (Group 1b)			Test	p
	n	Mean±SD	IQR	n	Mean±SD	IQR		
UmA PI	25	0.98±0.22	0.41	22	0.96±0.18	0.29	0.319	0.752
UmA RI	25	0.63±0.09	0.15	22	0.60±0.11	0.14	0.982	0.331
UmA S/D	24	2.88±0.81	1.08	21	2.76±0.62	1.07	0.573	0.570
MCA PI	25	1.67±0.37	0.49	22	1.54±0.40	0.48	1.205	0.235
MCA RI*	25	0.79±0.08	0.13	22	0.77±0.11	0.15	-0.502	0.616
MCA S/D*	24	5.70±2.76	4.34	21	5.32±2.61	4.35	-0.853	0.394
UA PI*	25	0.80±0.31	0.36	21	0.84±0.43	0.41	-0.210	0.834
UA RI	25	0.51±0.10	0.14	21	0.56±0.22	0.21	-1.067	0.292
UA S/D	25	2.15±0.61	0.55	21	2.36±1.33	0.89	-0.099	0.921
UVf*	25	219.24±190.02	247.5	22	173.23±116.05	230	-0.544	0.587
FBV*	30	8.03±10.21	9.25	20	3.40±2.58	5	-1.507	0.132
AFI*	59	12.88±2.01	2	36	13.47±1.70	2	-1.479	0.139

*: Mann-Whitney U test was used for non-normally distributed groups, IQR: Interquartile Range

UmA: Umbilical artery PI: Pulsatility index MCA: Middle cerebral artery RI: Resistive index AFI: Amniotic fluid index

UA: Uterine artery S/D: Systolic and diastolic velocity ratio UVf: Umbilical vein flow FBV: Fetal bladder volume

Table 4. A comparison of B-mode and Doppler ultrasound findings according the number of fasting days

	0-10 days (Group 1x)			11-20 days (Group 1y)			11-20 days (Group 1z)			Test	p
	n	Mean±SD	IQR	n	Mean±SD	IQR	n	Mean±SD	IQR		
UmA PI	7	0.91±0.18	0.24	20	1.02±0.22	0.39	20	0.94±0.18	0.20	1.004	0.375
UmA RI	7	0.52±0.13a	0.13	20	0.64±0.97b	0.14	20	0.62±0.67ab	0.10	4.325	0.019
UmA S/D	7	2.53±0.62	0.72	19	3±0.79	1.11	19	2.75±0.67	0.74	1.269	0.292
MCA PI	7	1.69±0.35	0.55	20	1.48±0.29	0.21	20	1.72±0.45	0.77	2.185	0.124
MCA RI*	7	0.81±0.08	0.15	20	0.75±0.08	0.05	20	0.80±0.09	0.16	4.330	0.115
MCA S/D*	7	6.15±2.85	4.38	19	4.49±1.68	0.65	19	6.33±3.15	5.76	3.182	0.204
UA PI*	7	0.62±0.17	0.28	19	0.93±0.49	0.66	20	0.78±0.22	0.36	3.287	0.193
UA RI	7	0.58±0.33	0.18	19	0.54±0.15	0.23	20	0.51±0.09	0.15	0.528	0.594
UA S/D	7	1.81±0.29	0.51	19	2.56±1.43	1.09	20	2.10±0.43	0.63	3.338	0.188
UVf*	7	175.86±122.8	167	20	153.1±137.7	199	20	249.95±181.4	207.5	4.430	0.109
FBV*	2	2±1.41	-	24	5.33±9.70	5.75	24	7.38±7.08	7	5.719	0.057
AFI*	35	13.46±1.82	2	36	13.14±1.84	3	24	12.54±2.06	2.75	2.695	0.260

a,b : There are significant differences between different letters.There is no significant difference between the same letters.
*: Kruskal-Wallis test was used for non-normally distributed groups. Tukey HSD multiple-comparison test was used to determine the differences between the groups.
IQR: Interquartile Range UmA: Umbilical artery PI: Pulsatility index MCA: Middle cerebral artery
RI: Resistive index UA: Uterine artery S/D: Systolic and diastolic velocity ratio UVf: Umbilical vein flow
FBV: Fetal bladder volume AFI: Amniotic fluid index

Table 5. Correlation between fetal bladder volume - amniotic fluid index – the number of fasting days

	n	r (Rho)	p	95% confidence interval for r (Rho)
FBV-AFI	108	-0.532	<0.001*	-0.655 to -0.382
FBV-Days	50	0.099	0.493	-0.184 to 0.367
AFI-Days	95	-0.084	0.415	-0.281 to 0.119

*: $p<0.05$ indicates statistical significance
FBV: Fetal bladder volume AFI: Amniotic fluid index

Discussion

In our study, we investigated whether there is an effect by prolonged periods with no fluid or food ingestion despite normal physical activity during long and hot days of Ramaddan. Therefore, we examined the effect of Ramaddan fasting on B-mode and Doppler ultrasound findings and no statistically significant difference was observed between the fasting group and non-fasting control group. In previous studies conducted in September and November that have lower temperatures and a shorter period of fasting, there was no significant difference in AFI between the fasting and non-fasting groups [2,4]. In another study investigating the effects of fasting on UA flow there was no significant difference in UA RI, PI and S/D ratio between the fasting and non-fasting groups and thus it was indicated that the fasting has no significant effect of UA flow [8]. In another study investigating the effects of fasting in September and October on fetal development, it was determined that the fasting does not affect fetal growth, AFI and UmA flow [5].

We believe that our study has different characteristics from similar studies conducted so far in terms of its period and analysis parameters. Our study also was conducted in June and July that have a long fasting period of 17 hours and average temperature of 310 in the shade [6]. Therefore, we believe that the studies conducted during these months are more significant to assess the effects that may be caused by hunger and thirst due to Ramaddan fasting. We observed no significant differences between the two groups in terms of the effects of long-term hunger and thirst on B-mode and Doppler ultrasound findings. In a similar study conducted by Moradi [9], in which the month of Ramaddan had coincided with August and September, it was noted that Ramaddan fasting had no effect on UA and UmA RI, PI and S/D ratio and AFI. Another study that was conducted during the summer season assessed both AFI and MCA and UmA S/D ratios and showed that fasting has no effect on these parameters [10]. In one of the other two studies conducted during the summer season, Sakar et al. [11] showed an increase in AFI in non-fasting group and Seckin et al. [12] showed in the latter study that there was no alteration in Doppler ultrasound indexes but a decrease in AFI.

In this study, we have also compared the flow in the umbilical vein which carries oxygen and nutrient rich blood from mother to fetus and showed no significant difference between the groups. In the relevant literature, we have found no studies evaluating UVf. As it is known, the value f UVf directly reflect placental function [13]. There is also a correlation between fetal growth and the value of UVf [14,15]. In some studies, it was shown that a decrease in the value of UVf was occurred before the changes in the flow of UmA in fetuses with intrauterine growth retardation [16]. Furthermore, in a study conducted in term fetuses, it was reported that the measurement of the amount of UVf is important for risk stratification before delivery and the risks during delivery increase in fetuses with low flow values [17]. In the light of these results, we believe it is important and valuable to evaluate the effects of fasting on UVf.

As known, fetal urine is one of the most important sources of amniotic fluid especially in the 3rd trimester [18]. In our study, we also measured FBV to increase objectivity in quantitative evaluation of AFI. Indeed, we believe that the negative correlation that was found between FBV and AFI in our study is an indicator of the contribution of fetal urine to the amniotic fluid. Our results showed no significant difference in both AFI and FBV between the two groups. Furthermore, there was no correlation between the number of fasting days and FBV and AFI. Mirghani et al. [19] in their study conducted in autumn season evaluated the FBV and determined that fasting does not cause a difference in bladder volume. In this study, we have determined that long-term hunger and thirst in the hot weather has no effect on AFI and FBV.

Considered studies related to fasting during pregnancy, we noticed that Ramaddan fasting has no effect on Doppler USG indices both in the summer and autumn. However, there are different results in AFI values in the studies conducted in the summer. We must emphasize that all the pregnant women in our study are healthy individuals who have sahur and iftar meals regularly and pay attention to fluid intake. In our study, we think that the absence of a change in AFI values despite hunger and thirst in long and hot days can be explained by an optimal food and fluid intake during iftar and sahur meals. Along with this, the lack of significant difference should have been interpreted with caution because of possible lack of power calculation.

In addition, the present study showed that, in the sub-group comparisons made according to the number of fasting days, UmA RI values in the sub-group 1x (1-10 days) were observed to be lower than the other subgroups. In the study conducted by Moradi et al. [9], there was a decrease in UmA RI values in fasting and non-fasting groups at the beginning and end of the Ramaddan month. Therefore, they reported that this change was not statistically significant as it was detected in both groups and accept as a normal change that can be seen during the month. In our study, the decrease in UmA RI was attributed a compansation that occurred in order to increase fetomaternal blood flow in the early days of Ramaddan fasting. However, not affected of UmA PI and S/D ratios and the low number of cases give our thesis a speculative nature.

Our study has some limitations. First, the number of fasting pregnant included to study was not enough to draw power statistic. Second, Doppler ultrasound examination could not be performed to all pregnant in view of not tolerating prolonged supine position. However, having made of the study in the long and hot Ramaddan days, its strength side is. It should be mentioned that there are needs large and new researchs so that these data can be used in the clinical practice.

In conclusion, in pregnant women who have sahur and iftar meals regularly, Ramaddan fasting during long and hot days does not significantly alter AFI, FBV and UVf value, and indices of UMA, MCA and UA, but fasting decreases UMA RI in the early days of fasting in the small sized study.

Declaration of conflicting interests

The author declared no conflicts of interest with respect to the authorship and/or publication of this article.

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