ZKTB ORIGINAL RESEARCH

Does 75-g OGTT Influence Maternal and Fetal Doppler Parameters in Healthy Pregnancies? A Cross-Sectional Observational Study

75 gr Oral Glukoz Tolerans Testi Sağlıklı Gebelerde Maternal ve Fetal Doppler Parametrelerini Etkiler mi? Kesitsel-Gözlemsel Bir Çalışma

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ABSTRACT

Objective: *Oral glucose challenge test (OGTT) is widely used around the world screening for gestational diabetes mellitus (GDM). In our study, we aimed to evaluate the effect of 75 g OGTT on maternal and fetal Doppler parameters.*

Material and Methods: *Measurements of umbilical artery PI, RI, S/D, middle cerebral artery (MCA) PSV, PI, RI and mean PI, RI S/D of uterine arteries assessed 1 hour before OGTT and 1 hour following the test in 46 pregnancies between 24-28 weeks of gestation. The chi-square test was employed to compare variables. Statistical significance was established at p<0.05.*

Results: *The mean age of pregnant women was 24.6±5.4, the mean gravity status was 2.3±0.8, the mean BMI was 25.5±5.5 kg/m, and the mean gestational age was 26.5±1.6 Mean umbilical artery PI: 1.14±0.26, RI: 0.71±0.14, S/D ratio 2.24±0.73 calculated 1 hour before test and mean PI: 1.04±0.43, RI: 0.58±0.21, S/D ratio 2.01±0.44 and there was no significance (p: 0.64, 0,56, 0.71). Mean MCA PSV: 30.4±11.3 cm/sn, PI:1.89±0.36, RI: 0.81±0.19 measured 1 hour before test and 1 hour following test Mean MCA were PSV: 38.4±13.2 cm/sn, PI: 2.11±0.24, RI: 0.68± 0.21 and there was no difference (p: 0.83, 0.66, 0.82). Mean uterine arteries PI:1.13±0.21, RI: 0.69±0.11, S/D ratio 2.03±0.34 measured before the test and mean PI:1.24±0.11, RI: 0.74±0.16, S/D ratio 1.87±0.22 calculated after the test and these results were similar (p: 0.72, 0.79, 0.56).*

Conclusion: *There was no significant effect on maternal and fetal Doppler parameters of 75 g OGTT among healthy pregnancies.*

Keywords: *doppler, diabetes, fetus*

ÖZET

Amaç: *Oral glukoz tolerans testi (OGTT) gestasyonel diyabet (GDM) taramasında tüm dünyada yaygın olarak kullanılmaktadır. Bu çalışmada Van Bölge Eğitim ve Araştırma hastanesine başvuran ve 75 gr OGTT yapılan ve GDM saptanmayan gebelerde testin maternal ve fetal Doppler parametrelerine etkisini inceledik.*

Gereç ve Yöntemler: *Kliniğimizde takip edilen, 24-28 gebelik haftaları arasında 75 gr OGTT uygulanan ve GDM saptanmayan 46 sağlıklı gebede OGTT'den 1 saat önce ve testin tamamlanmasından 1 saat sonra umblikal arter PI, RI, ve S/D, MCA PSV, PI, RI ve her iki uterin arterin ortalama PI, RI,S/D değerleri kaydedildi. Veriler SPSS-16 programı ve Mann Whitney-U testi kullanılarak analiz edildi ve p değeri<0.05 anlamlı kabul edildi.*

Bulgular: *Olguların ortalama yaşı 24.6±5.4 yıl, ortalama gebelik sayısı 2.3±0.8, ortalama vücut kitle indeksi (VKİ) 25.5±5.1 kg/m2 ve ortalama gebelik haftası 26.5±1.5 bulundu. Testten 1 saat önce ortalama umblikal arter PI: 1.14±0.26, RI: 0.71±0.14 ve S/D oranı 2.24±0.73 saptandı. Testin tamamlanmasından 1 saat sonra ise ortalama umblikal arter PI: 1.04±0.43, RI: 0.58±0.21 ve S/D oranı 2.01±0.44 saptandı ve bu fark istatistiksel anlamlı değildi (p:0.64, 0,56, 0.71). Testten 1 saat önce ortalama MCA PSV 30.4±11.3 cm/sn, ortalama PI: 1.89±0.36 ve RI: 0.81±0.19 saptandı. Testin tamamlanmasından 1 saat sonra ise ortalama MCA PSV 38.4±13.2 cm/sn, ortalama PI: 2.11±0.24 ve RI: 0.68± 0.21 saptandı ve bu fark istatistiksel anlamlı değildi (p:0.83, 0.66, 0.82). Test öncesi her iki uterin arter ortalama PI:1.13±0.21, RI: 0.69±0.11 ve S/D oranı 2.03±0.34 bulundu. Test sonrası ise her iki uterin arter ortalama PI:1.24±0.11, RI: 0.74±0.16 ve S/D oranı 1.87±0.22 saptandı ve bu fark anlamlı bulunmadı (p:0.72, 0.79, 0.56).*

Sonuç: *75 gr OGTT normal saptanan sağlıklı kadınlarda OGTT maternal ve fetal kan akımı üzerine anlamlı etkisi bulunmamaktadır.*

Anahtar Kelimeler: *dopler, diyabet, fetus*

INTRODUCTION

Gestational diabetes mellitus (GDM) is one of the most frequent complications of pregnancy, which is as high as %15 in high-risk ethnic groups (1). GDM causes numerous fetal and maternal complications, including macrosomia, birth trauma, increased risk of cesarean delivery and hypertensive disorders, etc. (2). Around the World majority of national guidelines suggest universal screening of GDM with either one-step, two-step oral glucose tolerance test (OGTT). In Turkey, one-step 75-g OGTT is a generally accepted method to screen GDM. Glucose is the primary energy source of the fetus, and fetal glucose levels depend on maternal blood glucose levels and placental blood flow. Glucose across the placenta by facilitated diffusion via glucose transport proteins (GLUT) (3). Acute hyperglycemia enhances endothelium-dependent vasodilatation, increases insulin levels, and decreases catabolic hormones (4, 5). In recent years Doppler assessment of various vessels of the fetus was widely used to evaluate high-risk pregnancies. Also, fetal circulation hemodynamics were evaluated in diabetic pregnancies in literature. However, there is no robust evidence to show the effect of OGTT on placental and fetal hemodynamics. We, therefore, performed this study to evaluate the association between 75-g OGTT and Doppler parameters of the fetus in healthy low-risk pregnancies.

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MATERIAL AND METHOD

This cross-sectional study was performed in the departments of obstetrics and gynecology in Van Educational and Research Hospital and Van yüzüncüyıl University Hospital, Van, Turkey, between June-October 2019. 66 low risk, healthy pregnant women have recruited for the study. All of the participants were selected randomly, who had between 24-28 weeks of gestation with a singleton pregnancy. Women who had a history of gestational diabetes mellitus, preeclampsia, renal diseases, blood disorders were excluded. Furthermore, the mothers with any other condition affecting fetal blood Doppler parameters such as fetal anomaly, ıntrauterine growth restriction (IUGR), macrosomia, polyhydramnios or oligohydramnios were not accepted for the study.

Following the enrollment of appropriate cases, 66 low-risk women underwent 75-g OGTT. The cut of values was determined according to the International Association of Diabetes and Pregnancy Study Groups (IADPSG) threshold as fasting glucose value ≥92 and 1-hour postprandial glucose value ≥180 and 2-hour postprandial glucose value ≥153 (6). If one of these values were exceeded, GDM was diagnosed, and these patients were excluded. If all of the values under the threshold GDM were excluded and those pregnant women were recruited for our study. Maternal characteristics such as maternal age, number of gravity, a gestational week at OGTT was performed, and body mass index (BMI) also recorded. All ultrasound Doppler examinations were performed by one physician (G.T). The same equipment (Voluson E8-Expert, MW, USA) was used for all cases, and a curve-faced probe (4 MHz) was applied for Doppler evaluation. Doppler blood flow measurements were performed 1 hour before OGTT and 1-hour following completed OGTT (180 minutes after administration of 75-g glucose solution).

Doppler measurements were performed when pregnant women placed in a recumbent or semirecumbent position according to the ISUOG practice guideline (7). Both color and pulsed Doppler flow velocimetry of the various vessel was achieved. The pulsed Doppler gate was chosen according to the diameter of the vessel examined, and the position angle was below 30 in all the cases. Umbilical artery Doppler measurement was performed while a free-floating portion of the cord is identified and the Doppler sample volume is placed over an artery, and the vein and assessment were avoided during fetal breathing. Pulsatility index (PI), resistance index (RI) and Systolic/diastolic (S/D) ratio was calculated. The middle cerebral artery (MCA) was visualized using color flow mapping in a transverse view of the fetal brain. The Doppler beam was focused along the MCA, and the sample volıme was placed over the proximal section, where the MCA emerges from the circle of Willis. The measurement was performed in the absence of fetal breathing or fetal movements over at least three regular heart cycles acquired. Pulsatility index (PI), resistance index (RI) and Peak systolic velocity (PSV) were calculated. For the measurement of uterine arteries, the probe is placed longitudinally in the lower lateral quadrant of the abdomen and angled medially. Color flow mapping was applied to identify the uterine artery as it appears to cross the external iliac artery and sample volume is placed around 1 cm downstream from the crossover point. Both uterine arteries PI, RI, and S/D were calculated, and the mean values were recorded.

Data analysis was performed using the statistical software program SPSS version 18.0 (SPSS Inc. Chicago, IL, USA). The values were expressed as mean±SD. The data were analyzed with the ki-square test. A p-value of <0.05 was considered significant.

RESULTS

We enrolled 66 healthy patients fort his study. The mean age of patients was 24.6±5.4 (range, 19.3-33.2) years, and the mean gravity status was 2.3±0.8 (range, 1-4). The mean gestational age was 26.5±1.5 (range, 24-28)weeks when OGTT was performed and the mean BMI was 25.5±1.5 (range, 22-28.5). All the participants completed the study and 132 sonographic examinations were performed. The demographic features of the participants were shown in Table-1.

Table 1: Demographic features of 66 healthy pregnant women.

	n:66
Mean age	24.6±5.4
Mean gravity	2.3±0.8
Mean gestational weeks	26.5±1.6
BMI	25.5±5.5

75-g OGTT results were normal in all the pregnant women as defined by IADPSG consensus values: fasting<92, 1 hour<192, and 2 hours<153. Mean umbilical artery PI: 1.14±0.26, RI: 0.71±0.14, S/D ratio 2.24±0.73 were calculated 1 hour before the test and mean PI: 1.04±0.43, RI: 0.58±0.21, S/D ratio 2.01±0.44 following OGTT. All the parameters were in normal range either before and after OGTT; no statistically significant differences were found for umbilical artery Doppler values.

Mean MCA PSV: 30.4±11.3 cm/sn, PI:1.89±0.36, RI: 0.81±0.19 measured 1 hour before test and 1 hour following test Mean MCA were PSV: 38.4±13.2 cm/sn, PI: 2.11±0.24, RI: 0.68± 0.21. There was no significant difference before and after OGTT.

Mean uterine arteries PI:1.13±0.21, RI: 0.69±0.11, S/D ratio 2.03±0.34 measured before the test and mean PI:1.24±0.11, RI: 0.74±0.16, S/D ratio 1.87±0.22 calculated after the test. Similar to the umbilical artery and MCA doppler results mean uterine artery Doppler values were in normal ranges before and after OGTT, and we did not show a significant difference. Blood flow velocimetry results of women before and after 75-g OGTT weresummarized in Table-2.

Table 2: Blood flow velocimetry results of 66 healthy pregnant women before and after 75 gr OGTT (OGTT: oral glucose tolarance test).

	Variable	Before 75 gr OGTT	After 75 gr OGTT	p
Umblical artery	PI:	1.14±0.26	1.04±0.43	0.64
	RI:	0.71±0.14	0.58±0.21	0,56
	S/D	2.24±0.73	2.01±0.44	0.71
Middle cerebral artery	PSV:	30.4±11.3	38.4±13.2	0.83
	PI:	1.89±0.36	2.11±0.24	0.66
	RI:	0.81±0.19	0.68± 0.21	0.82
Mean uterin artery	PI:	1.13±0.21	1.24±0.11	0.72
	RI:	0.69±0.11	0.74±0.16	0.79
	S/D	2.03±0.34	1.87±0.22	0.56

DISCUSSION

Doppler velocimetry has considered very useful tool for investigating fetal complications such as intrauterine growth restriction or anemia, but its value in in association with other complications of pregnancy is still doubtful. Historically, its well known that fetal circulation can be affected by external stimuli, probably by altering blood flow. Patrick et al. showed that increased fetal breathing time after maternal meals is appreantly due to the elavated maternal glucose concentrations (8). Senoh et al. evaluated the effects of a 75-g OGTT in 15 women whose fetuses were of a size appropriate for gestational age (AGA) and 19 women whose fetuses were small for gestational age (SGA). They assesed MCA, splenic, renal, femoral and umbilical arteries. They showed reduced RI in middle cerebral artery in AGA fetuses but this alteration was not detected in SGA fetuses. Futhermore, they did not demonstrate any significant change in the other vessels either in AGA or SGA fetuses (9). Pardo et al. measured MCA and umbilical artery parameters before and after 50 g 0GTT in 21 pregnant women and showed significant decrease of MCA RI, but not in umbilical artery (10). Gillis et al. evaluated the affects of 50-g OGTT on fetal umbilical and cerebral arteries at 36-40 weeks of gestation and showed significant lower cerebral vessel RI following maternal glucose ingestion (11). Haugen et al. assesed umblical vein and fetal liver blood flow in 113 low-risk pregnancies at 30-32 weeks of gestation before and after 75-g OGTT. They revealed that changes in umbilical vein and fetal liver blood flow were positively corraleted to fetal abdominal circumfrence and they suggested that in the larger fetuses maternal glucose intake increases blood flow from placenta to the fetal liver (12). Furthermore, Haugen et al. evaluated umbilical and MCA blood flow following OGTT in 105 low risk pregnancies. They measured umbilical and MCAwafeforms before and after 75-g OGTT and found that MCA PI was significantly reduced following OGTT but umbilical artery values were not changed. Also, they revealed that the effect of OGTT was independent of fetal size (13). We showed that all Doppler waveforms were in normal range before and after OGTT and there was no significant difference.

Fetal hemodynamic changes in gestational diabetes studied widely in the literature. Zanjani et al. evaluated fetal cerebral hemodynamics in 33 gestational diabetic and 33 healthy pregnancies. They measured blood flow velocity in umbilical and MCA three times between 24-39 weeks. They showed that MCA PI was significantly higher in gestational diabetic group but cerebro-placental ratio (CPR) were not different. Also; umbilical artery values were similar between two groups (14). To et al. compared umbilical artery and umbilical vein wafeforms in 84 diabetic and 62 non-diabetic patients within 10 days before delivery. They found that the mean PI values for the umbilical artery and the mean total umbilical venous flow (TUVF) and TUVF per unit birth weight did not differ significantly between diabetic and nondiabetic pregnancies (15). Leung et al. investigated correlation between Doppler parameters in the umbilical and MCA and pregnancy outcome in women with (GDM). They evaluated 169 gestational diabetic pregnancies and measured umbilical and MCA Doppler parameters every 4 weeks until delivery and showed that neither MCA nor umbilical artery Doppler measurements were effective to predict abnormal pregnancy outcome in GDM (16). Wong et al. evaluated Ductus venousus (DV) Doppler in 82 diabetic pregnancies and showed that abnormal DV Doppler may be a useful tool do predict adverse perinatal outcome in diabetic pregnancies (17).

Pathophysological changes in vascular bed of placenta fundamentally functional in diabetes; not structural contrast to IUGR. Hyperglycemia could potentially increase thromboxane/prostocylclin ratio which may contribute to functional increase in placental vascular resistance in GDM (18). Thus, the abnormal umbilical and MCA Doppler waveforms may not occur which were observable in IUGR. Moreover, in pregnancies complicated by GDM, hyperglycemia may cause acute fetal acidosis and fetal death. Unfortunately, this acute consequence can not be identified routine fetal well-being tests such as non-stress test or biophyisical profile. Similar to diabetes acute hyperglycemia due to OGTT have no any affect on blood stream in fetus.

Our data revealed that 75-g OGTT have no affect on maternal or fetal Doppler parameters in whom test results were normal and this finding was compatible with previous studies. Our study had numerous limitations. Most importantly our patient number was small and we did not analyzed outcome of pregnancies. Also, we did not performed venous Doppler measurement additionall to arterial Doppler parameters. Nevertheless, our study is one of the few papers which compare fetal and maternal hemodynamics before and after OGTT in low-risk healthy pregnancies.

CONCLUSION

In summary, our findings indicate that 75-g OGTT is not associated with significant changes in blood flow in low risk healthy pregnancies.

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