



Original Article

Placental elasticity on patients with gestational diabetes: Single institution experience

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Received November 28, 2016; accepted January 26, 2017

Abstract

Background: Gestational diabetes is defined as glucose intolerance which is first recognized in pregnancy. Oral glucose tolerance test (OGTT) is the cornerstone in diagnosing gestational diabetes. Placental elasticity evaluation is relatively new concept and is principally used for research purposes. We aimed to find any relation between placental elasticity evaluation and patients of gestational diabetes diagnosed by 75 g OGTT.

Methods: There were 91 patients took part in study, forming two groups as gestational diabetic patients (21 patients) and control group (70 patients). Elasticity of placenta was determined by acoustic radiation force impulse technology utilized by two blinded radiology specialists.

Results: We were not able to find any correlation between 75 g OGTT values and placental elasticity measurements ($p > .05$). Also placental elasticity was not found to be significantly different in two groups ($p > .05$).

Conclusion: Placental elasticity measurement on the 24th–28th weeks does not seem to be a marker for identification of gestational diabetes. Copyright © 2017, the Chinese Medical Association. Published by Elsevier Taiwan LLC. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Keywords: Elasticity; Gestational diabetes; Placenta

1. Introduction

Diabetes is the most common complication of pregnancy. Depending on the time of diagnosis, women with diabetes can be classified as pre-gestational or gestational diabetes. Gestational diabetes mellitus (GDM) is defined as glucose intolerance with onset during pregnancy, with no known previous history.¹ Prevalence of GDM is around 5–10%, with an increase of about 40% between 1989 and 2004.²

OGTT is one of the most recommended ways of testing insulin tolerance of a pregnant patient who has not been diagnosed as diabetic prior to pregnancy, according to criteria of the American College of Obstetrics and Gynecology (ACOG) and other associations such as the American Diabetes Association (ADA).^{3,4} Testing can be done either with the one step testing approach such as 75 g OGTT testing, or the two step testing approach with initial 50 g OGTT testing followed by a 100 g OGTT if needed.

Acoustic radiation force imaging (ARFI) is an ultrasonography based technique of propagation of acoustic waves in attenuating tissues to establish values of elasticity. With increasing acoustic frequencies, the tissue does not respond fast enough to the transitions between positive and negative pressures. With this technique, however, we have more insightful

Conflicts of interest: The authors declare that they have no conflicts of interest related to the subject matter or materials discussed in this article.

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<http://dx.doi.org/10.1016/j.jcma.2017.02.007>

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information about the stiffness of tissue to which the technology is applied. The development of ARFI lead to some placental research performed on mostly pre-eclamptic patients; there even has been a recent study done on patients with GDM.^{5,6}

Our aim is to find any correlation between placental elasticity and GDM screening results from 75 g OGTT. To the best of our knowledge, this will be the first study done with 75 g testing, to identify a different approach to GDM testing.

2. Methods

This was a prospective single-blinded case–control study done on Baskent University Istanbul Education and Research Hospital between September 2015 and October 2016. During the 24th–28th week of pregnancy, patients were asked to have an ARFI testing performed on their placental tissues. Patients with multiple pregnancies, placenta located on the posterior side of the uterine wall, patients with other systematic disorders such as pre-gestational diabetes, hypertension, and rheumatological diseases are excluded from the study. A total of 91 patients agreed to participate, and provided appropriate consent.

GDM testing was done with 75 g oral glucose solution. A diagnosis of GDM was established when any of the following results were obtained: fasting ≥ 92 mg/dl (5.1 mmol/L), 1 h glucose level ≥ 180 mg/dl (10.0 mmol/L), or 2 h glucose level ≥ 153 mg/dl (8.5 mmol/L). Patients diagnosed with GDM were initially and if possible treated only with nutritional therapy. If nutritional therapy was not effective or inadequate for achieving the target glucose levels (fasting ≤ 95 mg/dl, 1 h ≤ 140 mg/dl, 2 h ≤ 120 mg/dl), then insulin therapy was initiated following consultation with an endocrinology specialist.

Two blinded radiologists with more than 10 years experience each in the field participated in this study by doing the ARFI examination on the day of GDM testing. The radiologists were completely unaware of patient glucose testing results as sonographic examinations were performed in the first hour interval of the OGTT process. We used an Acuson S2000 Ultrasound System (Siemens, Erlangen, Germany) with a C6-1Mhz convex probe for color Doppler ultrasonography (CDU), ARFI and resistivity index measurements. Placental measurements were obtained with patients lying on their backs. Following initial evaluation of placental maturation, resistivity index measurement was done from the arterial flow sample points on the peripheral part of the placenta using CDU. A region of interest (ROI) box was used to acquire standard 1 cm² areas for ARFI measurement, based on the umbilical cord insertion point and two other regions which were at least 2 cm away from the insertion point. Measurements were done on the sagittal plane from areas that are clearly seen by performer. Special attention was devoted to not having any vessel formation inside of the ROI during measurement. The mean of three measurements was calculated and used for statistical purposes. Pictures showing an example of how to measure elasticity and placental resistivity index have been presented below (Figs. 1 and 2).

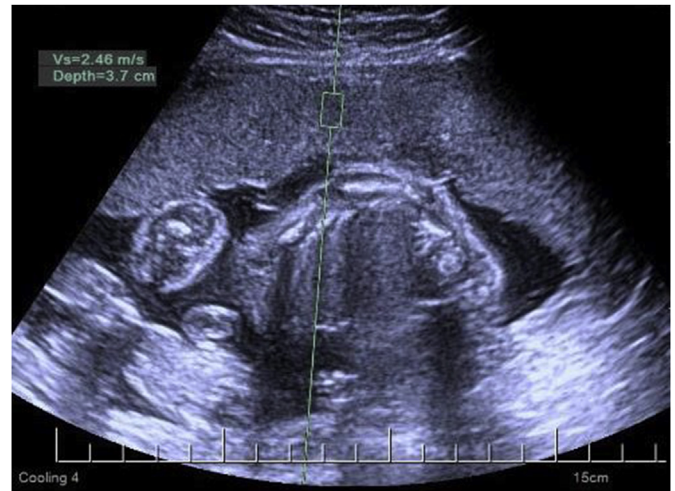


Fig. 1. Sample measurement for ARFI and placenta elasticity.

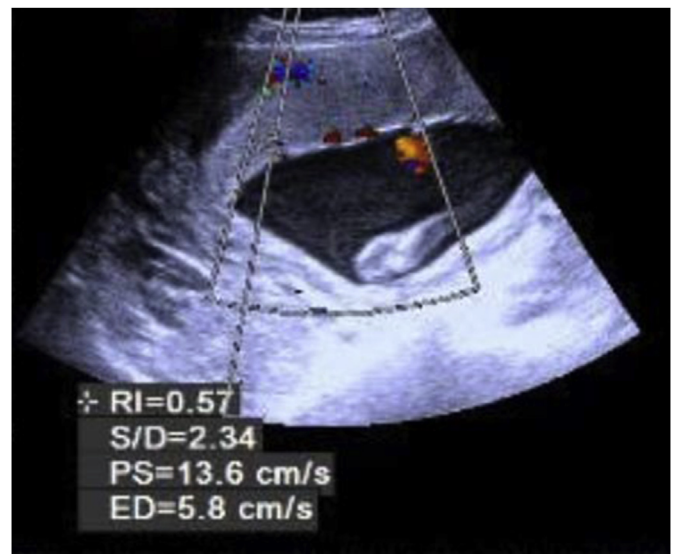


Fig. 2. Sample measurement on calculating resistivity index from placenta.

Statistical Package for the Social Sciences (SPSS) version 23.0 (IBM Co, Chicago IL, USA) was used for statistical analyses. Mann–Whitney U-test, independent sample t test and Pearson's correlation tests were used where appropriate. A p value $< .05$ was considered to be statistically significant. Baskent University IRB department provided approved this study, with id number of KA16/267.

3. Results

Patients were divided into two groups. Patients with GDM were referred to as the study group, with 21 patients enrolled whereas patients with normal OGTT values were referred to as the control group, with 70 patients enrolled. The incidence of GDM in the whole group was found to be 23%. The mean age of the study group was 32.60, and the mean age of the control group was 29.32 with a significant difference from study group

Table 1
Comparing means of relevant pregnancy and birth information for patient groups.

	Study group n = 21	Control group n = 70	<i>p</i>
Age	32.60 ± 4.71	29.32 ± 4.24	.013
Body Mass Index (BMI) of patients on evaluation day	29.25 ± 1.86	29.15 ± 2.28	.887
Gravidity	1.38 ± .64	1.47 ± .60	.632
Parity	.27 ± .46	.28 ± .53	.931
Gestational weeks at birth	37.40 ± .828	38.06 ± 1.69	.125
Birth weight (gr)	3350 ± 82	3169 ± 436	.143
Mean APGAR values on 1st minute	8.07 ± .961	8.18 ± 1.082	.717
Mean APGAR values on 5th minute	9.47 ± .743	9.40 ± .756	.765
Gestational weeks at ARFI measurement	24.80 ± .775	24.88 ± 1.58	.852

Significant values are given in bold.

($p < .05$). The mean of the characteristic properties were outlined in Table 1.

ARFI study results (placental elasticity) and placental resistivity index result of patients depending on their groups are listed in Table 2. Mean placental elasticity values for the study group and control group are $1.28 \pm .61$ and $1.17 \pm .57$, respectively. No significant difference found between these two values ($p = .549$). Mean placental resistivity index values for study group and control group are $.46 \pm .19$ and $.47 \pm .11$, respectively; additionally, also with resistivity index, there is no significant difference between these two values ($p = .941$).

4. Discussion

The prevalence of patients with GDM is on the rise, especially over the last decade. A recent study from a geographically similar area to our own found an incidence of 29.9% among the pregnant population and they expressed the relation between higher prevalence of GDM with increasing age.⁷ Our findings showed a significant age difference between those patients with GDM and those without, with an incidence of 23% in a relatively small population.

Although placental elasticity quantification is a recent development in obstetric issues, this technology had been used for some years in other organs such as the liver, thyroid and breast tissue. In addition, this technology has been proven safe to use for obstetrical purposes.⁸ There are some reports presenting the use of ARFI in pregnant patient populations such as patients with pre-eclampsia. It has been found that placental elasticity is significantly decreased (described as increase in placental stiffness) in patients with hypertensive disorder and intrauterine growth restriction both ex vivo and in vivo.^{9,10}

Table 2
Mean elasticity values of placenta and placental resistivity index for both groups.

	Study group n = 21	Control group n = 70	<i>p</i>
Placental elasticity (m/sn)	1.28 ± .61	1.17 ± .57	.549
Resistivity index (m/sn)	.46 ± .19	.47 ± .11	.941

Even though some authors reported the presence of focal necrosis and thickening of the villous trophoblastic basement membrane as a histopathological finding and elevated stiffness in patients with GDM, our findings suggest that there is no difference in elasticity between patients with GDM and those without.^{5,11} Also, there is no correlation between values of elasticity and glucose levels.

Takako et al. found no difference of placental elasticity for patients grouped under collagen diseases and diabetes mellitus, which includes both gestational and pre-gestational diabetic patients in their study, even though they expected to find placental stiffness more than control group because abnormal glucose tolerance and collagen disorders are known causes of inflammatory changes.¹² Our results showed similarity with the afore-mentioned study.

In their study Yüksel et al. found a significant difference of the mean placental elasticity between patients with GDM (established by a 50 g OGTT following a 100 g OGTT) and the control group ($p < .001$). It is understood that they used strain elastography where one needed to apply pressure to accomplish measurement; thus, it is more likely to have inter observer differences in that technique. We chose to use shear wave elastography for our study as difference. The reason of this discrepancy in results between our study and Yüksel et al.'s study could be because the lack of standardized measurement system in placental elasticity and also Yüksel et al. used a two-step approach on diagnosing GDM. The differences of our study from its predecessor studies are having radiologist team blinded and using a one-step approach on diagnosis of GDM.

There were several major limitations to our study, including not performing a histopathological examination for placental tissues and the number of patients in groups, especially the study group, could be more than what we have to make more precise predictions. Even though our patient population has similar BMI results for both groups, possible results from a future study can be adjusted depending on patients for different sized subcutaneous fatty tissues. Further larger studies needed to fulfill this hypothesis whether ARFI is useful in identifying elasticity to help diagnose GDM or not.

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