

## RENAL STIFFNESS ON PATIENTS WITH GESTATIONAL DIABETES

BIRNUR YILMAZ<sup>1</sup>, HALIME ÇEVİK<sup>1</sup>, TEVFIK BERK BILDACI<sup>2</sup>, SERDİNÇ ÖZDOĞAN<sup>2</sup>

<sup>1</sup>Okan University, Faculty of Medicine, Department of Radiology, Istanbul, Turkey - <sup>2</sup>Baskent University, Faculty of Medicine, Department of Gynecology and Obstetrics, Istanbul, Turkey

### ABSTRACT

**Introduction:** Gestational diabetes is defined as glucose intolerance first recognized in pregnancy. Oral glucose tolerance testing is the cornerstone in diagnosing gestational diabetes. In this study, we aimed to find a new method of diagnosis in addition to conventional diagnosed by 75 gr oral glucose tolerance testing.

**Material and methods:** 121 pregnant woman were included part in this study, forming two groups as gestational diabetic patients (51 patients) and control group (70 pregnant woman). Both kidneys are evaluated with B Mode Ultrasound and Colour Doppler Ultrasound mode by measuring resistive index for depiction of other renal pathologies. Stiffness of renal tissue determined by Acoustic Radiation Force Impulse (ARFI) technology utilized by two blinded radiology specialists.

**Results:** We were not able to find any correlation between gestational diabetes mellitus and resistivity index measurements ( $p > 0.05$ ). But a correlation between second hour glucose levels in oral glucose tolerance test and bilateral renal stiffness was found ( $p < 0.05$ ).

**Conclusion:** ARFI ultrasound may be a non-invasive technique in determining the course of the disease.

**Keywords:** Renal Stiffness, Gestational Diabetes, Acoustic Radiation Force Imaging, Ultrasound.

DOI: 10.19193/0393-6384\_2017\_4\_099

Received November 30, 2016; Accepted March 20, 2017

### 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 beginning during pregnancy with no known previous history<sup>(1)</sup>. Prevalence of GDM is around 5-10%, with an increase about 40% between 1989 and 2004<sup>(2)</sup>.

Oral glucose tolerance testing (OGTT) is one of the most recommended ways of testing insulin tolerance of pregnant patient, who has not been diagnosed as diabetic prior to pregnancy, by

American College of Obstetrics and Gynecology (ACOG) and other associations such as American Diabetes Association (ADA)<sup>(3,4)</sup>. Testing can be done either with one step testing approach as 75 gr OGTT testing or two step testing approach as initial 50 gr OGTT testing followed by a 100 gr OGTT if needed.

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 and with this technique we have more valuable information about the stiffness of tissue applied to.



0.06,  $0.66 \pm 0.05$  (right) and  $0.69 \pm 0.04$ ,  $0.67 \pm 0.05$  (left) respectively also with resistivity index there is no significant difference between these two values ( $p=.535$ ,  $p=.412$ ) at second hours.

When OGTT results are analyzed one by one for every hour and fasting values, there is found to be significant correlation between blood glucose level on second hour and bilateral kidney stiffness ( $p<0,05$ ) (Table 2).

	Study Group n: 51	Control Group n:70	p value
Age	$32.60 \pm 4.71$	$29.32 \pm 4.24$	.013
Birth Weight (gr)	$3350 \pm 317$	$3169 \pm 436$	.143
Gestational Weeks at Birth	$37.40 \pm .828$	$38.06 \pm 1.69$	.125
Gravidity	$1.38 \pm .64$	$1.47 \pm .60$	.632
Parity	$.27 \pm .46$	$.28 \pm .53$	.931
Gestational Weeks at ARFI measurement	$24.80 \pm .775$	$24.88 \pm 1.58$	.852

**Table 1:** Comparing means of pregnancy relevant information for patient groups.

	Study Group n: 51	Control Group n:70	p value
Right Kidney Stiffness (m/sn)	$3.43 \pm 0.88$	$2.86 \pm 0.72$	0.003
Left Kidney Stiffness (m/sn)	$3.52 \pm 1.11$	$2.45 \pm 0.92$	0.002
Right Kidney Resistivity Index (m/sn)	$0.65 \pm 0.06$	$0.66 \pm 0.05$	0.535
Left Kidney Resistivity Index (m/sn)	$0.69 \pm 0.04$	$0.67 \pm 0.05$	0.412

**Table 2:** Mean renal stiffness values of both kidneys and resistivity index for both groups (second hour).

## Discussion

The high prevalence of 24% for GDM is quite alarming considering the high risk for adverse pregnancy outcomes associated with diabetes in pregnancy<sup>(5,6)</sup>. A recent study from the geographically similar area found an incidence of 29.9% among pregnant population and they expressed the relation between higher prevalence of GDM with increasing age<sup>(7)</sup>. Our findings showed a significant age difference between patients with GDM and without, with an incidence of 23% in a relatively small population.

ARFI technology has been used for several years to evaluate the liver, thyroid, breast and renal tissues.

This technology has been proved to be safe for obstetric usage<sup>(8)</sup>. There are some reports presenting the use of ARFI in pregnant patient population with pre-eclampsia.

Abnormal glucose tolerance and collagen disorders are known causes of inflammatory changes in placenta<sup>(9,10)</sup>. Renal stiffness, which correlates well with renal fibrosis measured by ARFI elastography is a promising alternative imaging technology to biopsy<sup>(11-14)</sup>. To our knowledge, there is no such study in patients with GDM so far.

Major limitations of our study is not having histopathological examination done for renal tissues and the number of patients is less than of the control group. Although in our study a correlation between second hour glucose level in OGTT and renal elasticity is found, it is inadequate to make a general statement. The renal stiffness is increasing on diabetes. ARFI ultrasound may be a non-invasive technique in determining the course of the disease. Future studies with a more patients are needed to assess to usage of ARFI in GDM patients for renal stiffness evaluation.

## References

- 1) Metzger BE, Buchanan TA, Coustan DR, de Leiva A, Dunger DB, Hadden DR, Hod M, Kitzmiller JL, Kjos SL, Oats JN, Pettitt DJ, Sacks DA, Zouzas C. Summary and recommendations of the Fifth International Workshop-Conference on Gestational Diabetes Care. 2007 Jul; 30 Suppl 2: S251-60.
- 2) Getahun D, Nath C, Ananth CV, Chavez MR, Smulian JC. Gestational Diabetes in United States: temporal trends 1989 through 2004. Am J Obstet Gynecol. 2008 May; 198(5): 525.e1-5.
- 3) Practise Guidelines ACOG Releases Guideline on Gestational Diabetes Am Fam Physician. 2014 Sep 15; 90 (6): 416-417.
- 4) American Diabetes Association. Standards of medical care in diabetes, 2016. Diabetes Care. 2016; 39 (suppl 1): S1-S106.
- 5) Guariguata L., Linnenkamp U., Beagley J., Whiting D. R., Cho, N. H. "Global estimates of the prevalence of hyperglycaemia in pregnancy," Diabetes Research and Clinical Practice. 2014, vol. 103, no. 2, pp. 176-185.
- 6) Wahabi H. A., Esmaeil S. A., Fayed A., Al-Shaikh G., Alzeidan R. A. "Pre-existing diabetes mellitus and adverse pregnancy outcomes," BMC Research Notes, 2012, vol. 5, article no. 496.
- 7) Shahbaziana H, Noughjaha S, Shahbazian N, Jahanfar S, Latifia SM, Alealia A, Shahbaziana N, Saadatib N. Gestational diabetes mellitus in an Iranian pregnant population using IADPSG criteria: Incidence, contributing factors and outcomes. Diabetes & Metabolic Syndrome: Clinical Research & Reviews 10 (2016) ; 242-246.

- 8) Shiina T, Nightingale KR, Palmeri ML, Hall TJ, Bamber JC, Barr RG, Castera L, Choi BI, Chou YH, Cosgrove D, Dietrich CF, Ding H, Amy D, Farrokh A, Ferraioli G, Filice C, Friedrich-Rust M, Nakashima K, Schafer F, Sporea I, Suzuki S, Wilson S, Kudo M. WFUMB guidelines and recommendations for clinical use of ultrasound elastography: Part 1: basic principles and terminology. *Ultrasound Med Biol.* 2015 May, 41(5): 1126-47. doi: 10.1016/j.ultrasmed-bio.2015.03.009. Review.
- 9) Sugitani M, Fujita Y, Yumoto Y, Fukushima K, Takeuchi T, Shimokawa M, Kato K. A new method for measurement of placental elasticity: acoustic radiation force impulse imaging. *Placenta.* 2013 Nov; 34(11): 1009-13.
- 10) Cimsit C, Yoldemir T, Akpınar IN. Shear wave elastography in placental dysfunction: comparison of elasticity values in normal and preeclamptic pregnancies in the second trimester. *J Ultrasound Med.* 2015 Jan; 34(1): 151-9.
- 11) Syversveen T, Brabrand K, Midtvedt K et al. Assessment of renal allograft fibrosis by acoustic radiation force impulse quantification a pilot study. *Transpl Int.* 2011; 24: 100-105.
- 12) Stock KF, Klein BS, Vo Cong MT et al. ARFI-based tissue elasticity quantification in comparison to histology for the diagnosis of renal transplant fibrosis. *Clin Hemorheol Microcirc.* 2010; 46: 139-148.
- 13) Arndt R, Schmidt S, Loddenkemper C et al (2010) Noninvasive evaluation of renal allograft fibrosis by transient elastography a pilot study. *Transpl Int* 23: 871-877.
- 14) Syversveen T, Midtvedt K, E. Berstad A, Brabrand K, H. Strøm E, Andreas Abildgaard. Tissue elasticity estimated by acoustic radiation force impulse quantification depends on the applied transducer force: an experimental study in kidney transplant patients. *Europ. Radio.* October 2012, Volume 22, Issue 10, pp 2130-2137.

---

*Corresponding author*

BIRNUR YILMAZ MD

Okan University Medicine Hospital İçmeler, Aydınli Yolu Cad.

Aydemir Sk. No:2 Tuzla

İstanbul

(Turkey)