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Assessment of Doppler Velocimetry Parameters in Pregnancies Without Diabetes and Controlled Gestational Diabetes

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ABSTRACT

The fetal middle cerebral artery (MCA) and umbilical artery (UA) are two of the most often studied vessels for the diagnosis of prenatal disorders. In the third trimester of pregnancy, UA Doppler ultrasound examination is helpful in the diagnosis and management of fetal well-being. In previous studies the effect of doppler parameters of UA and MCA above pregnancy outcome was generally studied and it is not compared with normal antenatal mother's Doppler study. In this study, we aimed to compare the UA and MCA Doppler indices between controlled GDM and non-diabetic mother's. This is a comparative cross-sectional study conducted among GDM and non-GDM mothers coming for antenatal check-ups in the Tertiary care hospital, Kanyakumari. Around 50 GDM (cases) and 50 non-GDM mothers were selected by convenience sampling. The semi-structured questionnaire was used to collect data on age, parity and gestational age. Then all mothers were subjected to Doppler ultrasound by radiologists for various vessel indices. The Peak systolic velocity (PSV) of MCA and UA and Pulsality index of UA were studied. The data collected were entered in Excel and analyzed using Epi info version 7 software. The mean MCA-PI in the GDM group (1.81 ± 0.014) is significantly higher than the control group (1.70 ± 0.007). The mean MCA-PSV in the GDM group (47.19 ± 0.06) is significantly higher than the control group (47.07 ± 0.009). The mean UA-PI in the GDM group is 0.87 ± 0.11 whereas in the control group, it is 0.86 ± 0.047 and the results were not significant. Our study concludes a minimal change in physiology in GDM mothers can alter the Doppler indices in fetal brain vessels. Our study results in state MCA-PSV and MCA-PI values can be used as indicators to assess changes in GDM babies in the third trimester. Doppler USG, GDM, MCA-PSV, MCA-PI.

INTRODUCTION

In India, up to 5 million women experience Gestational diabetes each year, making it a global health concern[1]. Pregnant women can develop gestational diabetes (GD) which is characterized by its onset or discovery during pregnancy. Asymptomatic hyperglycemia to severe hyperglycemia can be the clinical manifestations of GD. Pregnancy hormones are hypothesized to cause insulin resistance, which the pancreatic beta-cells are unable to sufficiently offset by increasing their proliferation and release of insulin[2]. Recent research suggests that the prevalence of gestational diabetes has increased over the past ten years and that rates may be greater in particular racial or ethnic communities[2-3]. Obstetrical complications and poor fetal outcomes are risks that are heightened by this disease[2].

The fetal middle cerebral artery (MCA) and umbilical artery (UA) are two of the most often studied vessels for the diagnosis of prenatal disorders[3]. In the third trimester of pregnancy a UA Doppler ultrasound examination is helpful in the diagnosis and management of fetal well-being. An abnormal Doppler ultrasound result in UA indicates uteroplacental insufficiency, which leads to intrauterine growth restriction (IUGR) and possible preeclampsia. In GDM, the testing of UA with the Doppler study is also advised[4].

It has been investigated before how UA and MCA change in GDM. Prior research mainly focused on the association between Doppler ultrasound alterations and fetal outcomes in GDM patients. They have inconsistent findings, some said the UA and MCA examinations did not help predict adverse pregnancy outcomes in GDM[5]. While others claimed that UA and MCA vascular impedance changes were associated with pregnancy outcomes including birth weight in GDM-pregnant women[6-7].

In the aforementioned investigations, the effect of Doppler parameters of UA and MCA above pregnancy outcome was generally studied and it is not compared with normal antenatal mothers Doppler study. In this study, we aimed to compare the UA and MCA Doppler indices between GDM and non-diabetic mothers.

MATERIALS AND METHODS

This is a comparative cross-sectional study conducted among GDM and non-GDM mothers coming for antenatal check-ups in the Tertiary care hospital, Kanyakumari. The study was conducted from June 2022-2023. Around 50 GDM (cases) and 50 non-GDM mothers were selected by convenience sampling. The semi-structured questionnaire was used to collect data on age, parity and gestational age. Then all mothers were subjected to Doppler ultrasound by radiologists for various vessel indices.

Informed written consent was given before the start of the study by participants. The control group was selected by excluding mothers with Type 1-2 DM, Fetal abnormality, abnormal double or triple test, and multiple gestation. The cases were selected with mothers with controlled GDM blood reports as per American Diabetes Association guidelines[8].

The Peak systolic velocity (PSV) of MCA and UA and Pulsality index of UA were studied. For UA examination, the mother was examined in the left lateral position. Measurements were made near a cord loop that was free to float in one of the UAS. The patient was in the supine posture for the fetal MCA evaluation.

The data collected were entered in Excel and analyzed using Epi info version 7 software. The categorical variable is expressed in proportion and the continuous variables were expressed in mean with S.D. The Fisher's exact test and independent t-test were used to compare proportion and mean respectively. $p<0.05$ is considered significant.

RESULTS

The results of the comparative study show that the distribution of age, parity and gestational age in both groups was statistically non-significant suggesting both groups comparable (Table 1). The mean MCA-PI in the GDM group is 1.81 ± 0.014 whereas in the control

Table 1: Descriptive data of study participants

Variables	Cases (n %)	Control (n %)	p-value
Age in years			
20-25	08, 16	07, 14	0.941
25-30	17, 34	15, 30	
30-35	14, 28	15, 30	
≥35	11, 22	13, 26	
Gestational weeks			
34	12, 24	14, 28	0.924
35	17, 34	18, 36	
36	9, 18	07, 14	
37	12, 24	11, 22	
Parity			
primi	06, 12	08, 16	0.959
2	28, 56	27, 54	
3 or more	16, 32	17, 34	

Table 2: MCA-PI comparison between groups

MCA PI	Cases	Control	p-value
Mean	1.81	1.70	0.001
S.D	0.014	0.07	
Min	1.78	1.73	
Max	1.89	1.85	

Table 3: MCA-PSV comparison between groups

MCA PSV	Cases	Control	p-value
Mean	47.19	47.078	0.001
S.D	0.06	0.009	
Min	47.07	47.03	
Max	47.21	47.11	

Table 4: UA-PI comparison between groups

UA PI	Cases	Control	p-value
Mean	0.87	0.861	0.09
S.D	0.011	0.047	
Min	0.84	0.83	
Max	0.88	0.87	

group, it is 1.70±0.007 and the results were significant suggesting that the MCA PI value is higher in gestational diabetic mothers (Table 2).

The mean MCA-PSV in the GDM group is 47.19±0.06 whereas in the control group, it is 47.07±0.009 and the results were significant suggesting that the MCA-PSV value is higher in gestational diabetic mothers (Table 3). The mean UA-PI in the GDM group is 0.87±0.11 whereas in the control group, it is 0.86±0.047 and the results were not significant suggesting that the UA-PI value is similar in both groups (Table 4).

DISCUSSIONS

In obstetric imaging and fetal monitoring, doppler ultrasound was effectively introduced in[9]. The umbilical artery (UA) waveforms may be aberrant in fetuses with intrauterine growth restriction (IUGR), according to Fitzgerald *et al*. who was the first to provide a noninvasive demonstration of the umbilical cord (UC) blood flow pattern[10]. Several significant clinical applications were also produced by this ground-breaking waveform investigation idea. Antenatal surveillance practices now include UA Doppler testing as the standard of care[11]. Fetal anemia had also been extensively diagnosed via Doppler examination of the fetal middle cerebral artery (MCA)[12]. In addition to reflecting blood velocity, DU waveforms also reveal information on the presence and direction of flow, velocity profile, flow volume impedance. To prevent inter- and intraobserver fluctuation, angle-independent Doppler indices, such as those described below, were created for flow velocimetry[13].

The UA and MCA are reportedly more repeatable and generally simpler to access and evaluate among all the vessels tested in Doppler Ultrasound. A helpful tool for keeping track of fetal health is the cere-bro-placental ratio (CP ratio) which is calculated by combining the Doppler indices of the MCA and UA with the ratio of their pulsatility indices. Comparing the accuracy of predicting problems and negative outcomes to MCA or UA Doppler indices alone a low CP ratio implies a relative shift of blood flow to the cerebral circulation.

Before, it was assessed how patients with GDM changed the Doppler ultrasound features for UA and MCA. But inconsistent findings predominate in the literature. According to Pietryga *et al*.[13] Doppler ultrasound does not appear to have any clinical benefit for monitoring fetal condition in GDM patients. To predict an abnormal pregnancy result in GDM, Leung *et al*.[6] Claimed that the UA-PI, MCA-PI and MCA-Vmax tests were not useful. Shabani *et al*.[5] further highlighted the fact that patients with GDM had higher MCA PI values.

D'Ambrosi *et al*.[16] study included 217 non-diabetic participants and 35 Diabetic mothers. The GDM group had a substantially higher middle cerebral pulsatility index (PI) (mean MCA-PI = 1.82±0.27 vs. 1.71±0.26, p0.02)[15]. The results were similar to our study.

When Shabani *et al*. used a similar methodology to assess MCA characteristics in the third trimester, they discovered greater MCA PI levels in GDM patients. Additionally, they claimed that the PSV of the fetal MCA was higher in the GDM group[14]. Niromanesh *et al*.'s emphasis on the usefulness of UA and MCA Doppler ultrasound alterations in predicting poor newborn outcomes in GDM-pregnant women is further evidence of this[7]. The results were similar to ours.

PSV values were noticeably low in GDM patients among the MCA Doppler parameters investigated by Fatihoglu *et al*. At the second trimester exam, they discovered MCA PSV values in pregnant women with GDM were lower than those in controls[16]. The above results are contradictory to ours.

In our study, the mean UA-PI was not different between the two groups. Similar to ours, D'Ambrosi *et al*. reported UA-PI was higher in the non-GD group (mean of UA-PI = 0.88±0.14 vs. 0.86±0.15 p = 0.32) without statistical significance[15].

Our study shows the MCA-PSV and MCA-PI values were higher in GDM mothers when compared to non-GDM mothers at 34-38 weeks of gestational age. The UA-PI was not different between the two groups. There are some limitations in our study. This is conducted in a small sample size and also it is conducted in a single centre. A larger sample size may give even more consistent and valid results.

CONCLUSION

Our study concludes a minimal change in physiology in GDM mothers can alter the Doppler indices in fetal brain vessels. This recommends the need for Doppler USG in all GDM mothers during the third trimester to assess the abnormality early. And also our study results states MCA-PSV and MCA-PI values can be used as an indicator to assess changes in GDM babies in the third trimester.

Conflict of interest: The authors declare no conflict of interest

Ethical approval: The study was approved by the Institutional Ethical Committee.

Abbreviations:

- GD-gestational diabetes
- GDM-gestational diabetes mother
- MCA-middle cerebral artery
- UA- umbilical artery
- PI-pulsality index
- PSV-peak systolic velocity
- Vmax-velocity maximum

References

1. Morampudi, S., G. Balasubramanian, A. Gowda, B. Zomorodi and A.S. Patil, 2017. The challenges and recommendations for gestational diabetes mellitus care in India: A review. Front. Endocrinol., 8: 8-56.
2. Nelson, C., 2017. Canadian perinatal surveillance system. Maternal diabetes in canada. Paper presented at better Outcomes registry and network conference. Toronto, Ontario, Canada, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7653498/
3. Dabelea, D., J.K. Snell-Bergeon, C.L. Hartsfield, K.J. Bischoff, R.F. Hamman and R.S. McDuffie, 2005. Increasing prevalence of gestational diabetes mellitus (GDM) over time and by birth cohort. Diabetes. Care., 28: 579-584.
4. Moise, K.J., 2008. The usefulness of middle cerebral artery doppler assessment in the treatment of the fetus at risk for anemia. Am. J. Obstet. Gynecol., 198: 1610-161.
5. Leung, W.C., H. Lam, C.P. Lee and T.T. Lao, 2004. Doppler study of the umbilical and fetal middle cerebral arteries in women with gestational diabetes mellitus. Ultrasound. Obstet. Gynecol., 24: 534-537.
6. Pietryga, M., J. Brazert, E. Wender-Ozegowska, M. Dubiel and S. Gudmundsson, 2006. Placental doppler velocimetry in gestational diabetes mellitus. J. Perinatal. Med., 34: 108-110.
7. Niromanesh, S., M. shirazi, M. Eftekhariyazdi and F. Mortazavi, 2017. Comparison of umbilical artery doppler and non-stress test in assessment of fetal well-being in gestational diabetes mellitus: A prospective cohort study. Electron. Physician., 9: 6087-6093.
8. ADS., 2018. Classification and diagnosis of diabetes: Standards of medical care in diabetes-2018. Diabetes Care, 41:
9. Mari, G., 2009. Doppler ultrasonography in obstetrics: From the diagnosis of fetal anemia to the treatment of intrauterine growth-restricted fetuses. Am. J. Obstet. Gynecol., 200: 1-9.
10. FitzGerald, D.E. and J.E. Drumm, 1977. Non-invasive measurement of human fetal circulation using ultrasound: A new method. BMJ., 2: 1450-1451.
11. Maulik, D., D. Mundy, E. Heitmann and D. Maulik, 2011. Umbilical artery doppler in the assessment of fetal growth restriction. Clin. Perinatol., 38: 65-82.
12. Mari, G., 2005. Middle cerebral artery peak systolic velocity for the diagnosis of fetal anemia: The untold story. Ultrasound. Obstet. Gynecol., 25: 323-330.
13. Srikumar, S., J. Debnath, R. Ravikumar, H.C. Bandhu and V.K. Maurya, 2017. Doppler indices of the umbilical and fetal middle cerebral artery at 18-40 weeks of normal gestation: A pilot study. Med. J. Armed. Forces. India., 73: 232-241.
14. Zanjani, M.S., R. Nasirzadeh, S.M. Fereshtehnejad, L.Y. Asl, S.A.P. Alemzadeh and S. Askari, 2013. Fetal cerebral hemodynamic in gestational diabetic versus normal pregnancies: A doppler velocimetry of middle cerebral and umbilical arteries. Acta. Neurologica. Belgica., 114: 15-23.
15. D'Ambrosi, F., G. Rossi, M.D. Maso, C. Marino and C.M. Soldavini et al., 2022. Altered doppler velocimetry of fetal middle cerebral artery in singleton pregnancies complicated by mild well-controlled gestational diabetes. Fetal. Diagnosis. Ther., 49: 77-84.
16. Aydin, S., E. Fatihoglu, E. Karavas and M. Kantarci, 2021. Gestational diabetes mellitus and early hemodynamic changes in fetus. J. Med. Ultrasound., 29: 270-276.