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ORIGINAL ARTICLE

Prediction of Fetal Macrosomia Using Ultrasonographic Measurements of Placental Volume and Thickness, Umbilical Cord Thickness, Fetal Interventricular Septum Thickness in Pregnant Women With Gestational Diabetes

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Abstract

Background: **Fetal macrosomia is recognized to be at risk due to diabetes throughout pregnancy.**

Objective: **Evaluation of the impact of ultrasound measurements of placental volume and thickness, umbilical cord thickness, and fetal interventricular septum thickness in fetal macrosomia prediction in pregnant women with gestational diabetes.**

Patients and methods: **After receiving their consent, 70 gestational diabetes-positive pregnant women were enrolled in the study. They were then split into two equal groups: the study group, which included 35 patients with gestational diabetes was diagnosed, and the control group, which included 35 pregnant women in good health who were gathered from the obstetric inpatients and outpatient clinics of Al-Hussein and Al-Azhar University Hospitals and attended for routine antenatal care. At 27−28 weeks' gestation and again at 36−37 weeks' gestation, ultrasound exams were used to measure the volume and thickness of the placenta, the thickness of the umbilical cord, and the thickness of the fetal interventricular septum.**

Results: **The umbilical cord thickness (cm) 2.77 0.72 versus 2.06 0.44, the interventricular septum thickness (cm) 0.85 0.20 versus 0.53 0.08, and the placental volume (cm^3) were all statistically significantly higher in the GDM and macrosomic group compared with the controls; however, the placental thickness (cm) was statistically significantly lower in the GDM and macrosomic group compared with the controls.**

Conclusion: **In situations of pregnancy with gestational diabetes mellitus, sonographic evaluation of interventricular septum thickness was the most reliable indicator of fetal macrosomia.**

Keywords: Diabetes, Interventricular septum, Macrosomia, Placenta, Umbilical cord

1. Introduction

Egypt has a broad variation in the reported prevalence of GDM, similar to most other countries. It was shown that out of 250 pregnant women who visited a rural family health clinic in Egypt, 8% of them had GDM.[1]

It has a variety of effects on the mother and fetus. Children of diabetes mothers are more susceptible to macrosomia, a major cause of maternal and fetal morbidity.[2]

Regardless of the gestational age at which it was discovered, gestational diabetes mellitus is described as 'any degree of glucose intolerance with onset or first recognition during pregnancy'.[3]

A birth weight that exceeds the 90th percentile, two standard deviations above the gestational age, or 4000 g is referred to as macrosomia.[4]

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Diabetic pregnancy might be a factor. Human chorionic gonadotropin, oestrogen, progesterone, prolactin, and cortisol are among the high levels of maternal and placental hormones that are hypothesized to have an impact on the development of gestational insulin resistance. All things considered, these changes cause the mother's fasting blood sugar levels to drop but her postprandial glucose levels to climb steadily and for a longer time.[5]

Macrosomic fetuses are susceptible to a variety of delivery difficulties, including shoulder dystocia, labor issues, brachial plexus injuries, and fetal bone damage.[6]

Increased rates of surgical deliveries, third- and fourth-degree perineal abrasions, postpartum infections, and postpartum hemorrhages are all maternal complications.[7]

Predicting macrosomia antenatally is crucial so that efforts can be made to offer tailored intrapartum care, which is necessary to prevent the problems related to the delivery of macrosomic fetuses. The conventional method is called 'biometric estimation of fetal weight' (EFW), and it involves measuring a variety of measures, most frequently the femur length (FL), the biparietal diameter (BPD), and the abdominal circumference (AC).[8]

Particularly in cases with GDM, the formation of this subcutaneous fat in the macrosomic fetus is more pronounced.[9]

This research aims to explore the impact of ultrasonographic evaluations of placental volume and thickness, umbilical cord thickness, and fetal interventricular septum thickness in predicting fetal macrosomia in pregnant women with gestational diabetes.

2. Methods

Between December 2021 and April 2023, pregnant women who met the following criteria and received routine antenatal care at the Al-Hussein and Al-Azhar University Hospitals' Obstetrics and Gynecology Department, Obstetric Inpatients, and Outpatient Clinic were included in this case control research.

2.1. Inclusion criteria

Women who had singleton pregnancies at gestational ages of 27–28 weeks with gestational diabetes and normal umbilical cord morphology (two arteries and one vein) were enrolled.

2.2. Exclusion criteria

Women with a history of smoking or drinking alcohol were excluded, also, those who had multifetal pregnancy, fetal congenital abnormalities, chronic illnesses, placenta previa, oligohydramnios, preeclampsia, intrauterine growth restriction, preterm labor, or any of these conditions.

2.3. Study procedures

The study involved 70 pregnant women who were divided into two groups: the study group, which included patients with gestational diabetes, and the control group, which included healthy mothers who attended the antenatal care clinics of Al- Hussein and Al-Azhar University Hospitals as usual.

2.4. 2D TransAbdominal sonography

To assess placental volume and thickness, umbilical cord thickness, and fetal interventricular septum thickness, ultrasound exams were carried out using a Medison RS 3.7-mHz Convex transabdominal probe at 27–28 weeks of gestation and again at 36–37 weeks.

When the estimated fetal weight was over 4000 g, macrosomia was taken into account.

Also, age, BMI, parity, mode of delivery, estimated birth weight by ultrasonography, fetal sex, HbA1c, and umbilical cord thickness were recorded for all cases.

The primary outcome of the current study was to determine whether it was possible to predict fetal macrosomia using the thickness of the umbilical cord, the volume and thickness of the placenta, and the thickness of the interventricular septum. Gestational age at birth, fetal weight, NICU admission, and newborn hypoglycemia were secondary outcomes (Figs. 1-4).

Fig. 1. Placental volume.

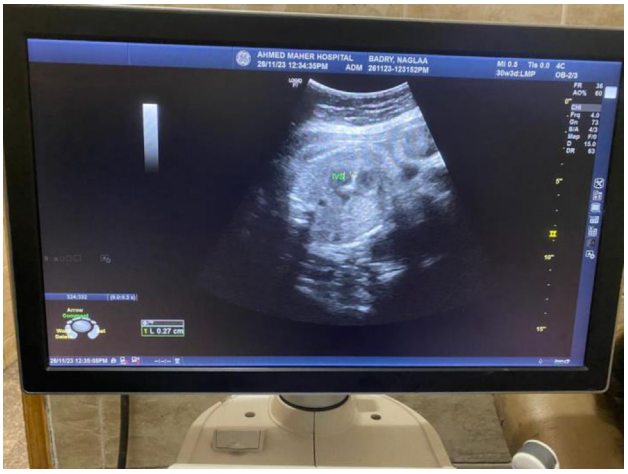

Fig. 2. Interventricular septum thickness.

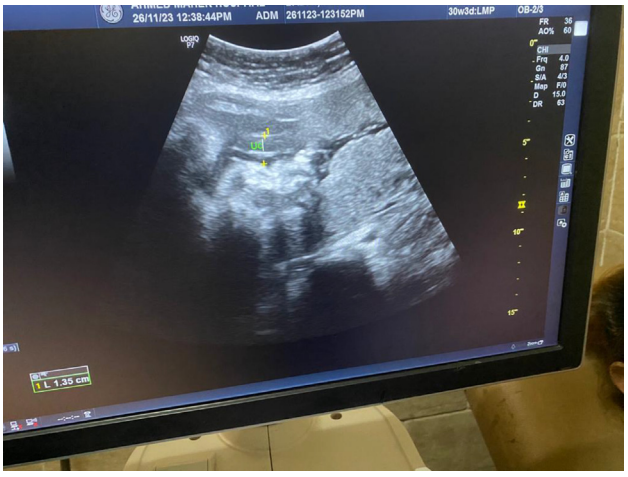

Fig. 3. Umbilical cord thickness.

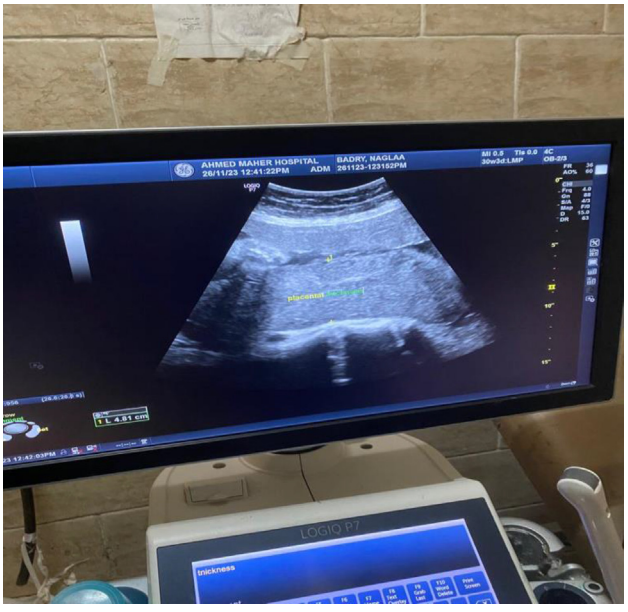

Fig. 4. Placental thickness.

2.5. Statistical analysis

The statistical software for social sciences, version 23.0 (SPSS Inc., Chicago, Illinois, USA), was used to evaluate the recorded data.

3. Results

Table 1.

This table shows:

The study included participants ranging in age from 19 to 38 (mean age, 27.96 6.24 years). The BMI ranged from 20 to 35, with a mean of 27.24 4.74; the parity ranged from 0 to 4 with a median of 2 (1–3); the GA 'wks.' at admission ranged from 27 to 28, with a mean of 27.51 0.42; the consanguinity rate was 19.1%; the proportion of rural patients was 24; and the proportion of regularity, 52; was 74.3% among all women. There was no statistically significant difference between study groups as regard demographic data (Fig. 5, Table 2).

This table shows:

A statistically significant difference in the mean placental volume between the GDM and control groups (P value = 0.004); moreover, a statistically significant difference in the mean placental thickness between the GDM and control groups (P value = 0.002); In addition, the GDM group's mean umbilical cord thickness was larger than that of the control group by a very statistically significant margin (P < 0.001) (Figs. 6 and 7, Table 3).

This table shows:

A statistically significant increase in CS was observed in the GDM group compared to the control group, with a P value of 0.047; additionally, there was a statistically significant higher mean value of fetal birth weight in the GDM group compared to the control group, with a P value of P < 0.001, and a statistically significant lower mean value of GA 'wks.' at delivery in the GDM group compared to the control group (Fig. 8, Table 4).

This table shows:

Receiver-operating characteristics (ROC) curve was performed for placental volume and demonstrated an area under the curve of 0.672 (0.549–0.779) with P value 0.008. The best cut-off value for prediction of fetal macrosomia was >418, with sensitivity 62.8% and specificity 60%; Also, placental thickness and demonstrated an area under the curve of 0.744 (0.626–0.841) with P value < 0.001, with sensitivity 65.7% and specificity 74.3%. While, umbilical cord thickness and demonstrated an area under the curve of 0.777 (0.661–0.868) with P value < 0.001, with sensitivity

Table 1. Comparison between groups according to demographic data.

Demographic data	GDM group ($n = 35$)	Control group ($n = 35$)	Test value	P value
Age (years)				
Mean ± SD	27.49 ± 6.20	28.43 ± 6.32	−0.630	0.531
Range	19–38	20–38		
BMI [wt/(ht)^2]				
Mean ± SD	27.20 ± 4.92	27.49 ± 4.62	−0.250	0.803
Range	20–34	20–35		
Parity				
Median (IQR)	2 (1–3)	2 (1–3)	0.384	0.702
Range	0–4	0–3		
GA 'wks.' at admission				
Mean ± SD	27.46 ± 0.51	27.57 ± 0.50	−0.949	0.346
Range	27–28	27–28		
Consanguinity				
No	24 (68.6%)	27 (77.1%)	0.650	0.420
Yes	11 (31.4%)	8 (22.9%)		
Residence				
Rural	11 (31.4%)	13 (37.1%)	0.254	0.615
Urban	24 (68.6%)	22 (62.9%)		
Regularity				
No	11 (31.4%)	7 (20.0%)	1.197	0.274
Yes	24 (68.6%)	28 (80.0%)		

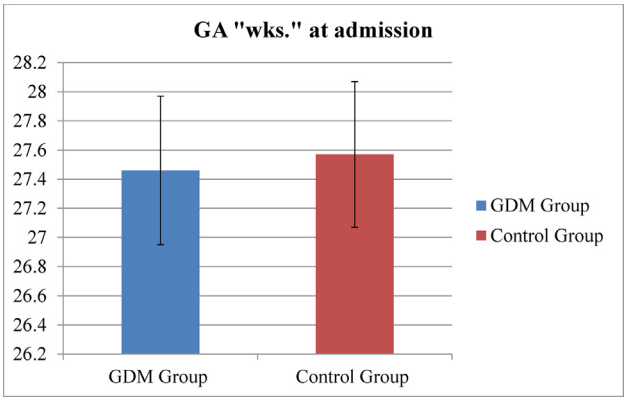

Fig. 5. Comparison between groups according to GA 'wks.' at admission.

60% and specificity 82.9%. As for the interventricular septum thickness and demonstrated an area under the curve of 0.927 (0.840–0.976) with P value < 0.001, with sensitivity 74.3% and specificity 88.6%; as well as HbA1c and demonstrated an area under the curve of 0.999 (0.946–1.000) with P value < 0.001, with sensitivity 83.3% and specificity 100%.

The area under the curve indicates that the Placental volume (cm^3), Umbilical cord thickness (cm), Interventricular Septum Thickness (cm) a good of Predictor of fetal macrosomia, with P value ($P < 0.05$) (Fig. 9).

Table 2. Comparison between groups according to placental volume (cm^3), placental thickness (cm), umbilical cord thickness (cm), interventricular septum thickness (cm) & HbA1c.

	GDM group ($n = 35$)	Control group ($n = 35$)	Test value	P value
Placental volume (cm^3)				
Mean ± SD	497.09 ± 157.64	400.86 ± 109.53	2.966	0.004*
Range	285–810	240–722		
Placental thickness (cm)				
Mean ± SD	3.50 ± 0.52	3.90 ± 0.41	−3.619	0.002*
Range	2.8–4.7	3–4.3		
Umbilical cord thickness (cm)				
Mean ± SD	2.77 ± 0.72	2.06 ± 0.44	4.953	<0.001**
Range	1.6–4	1.3–2.8		
Interventricular Septum Thickness (cm)				
Mean ± SD	0.85 ± 0.20	0.53 ± 0.08	8.905	<0.001**
Range	0.56–1.14	0.41–0.65		
HbA1c				
Mean ± SD	6.60 ± 0.62	5.16 ± 0.42	11.363	<0.001**
Range	5.6–7.6	4–5.5		

*P-value < 0.05 is significant.
**P-value < 0.001 is highly significant.

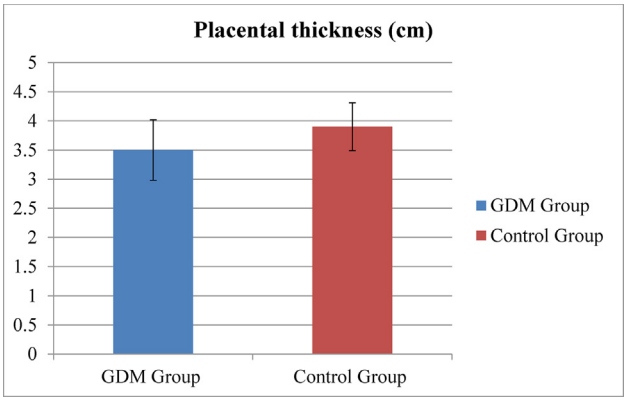

Fig. 6. Comparison between groups according to placental thickness 'cm'.

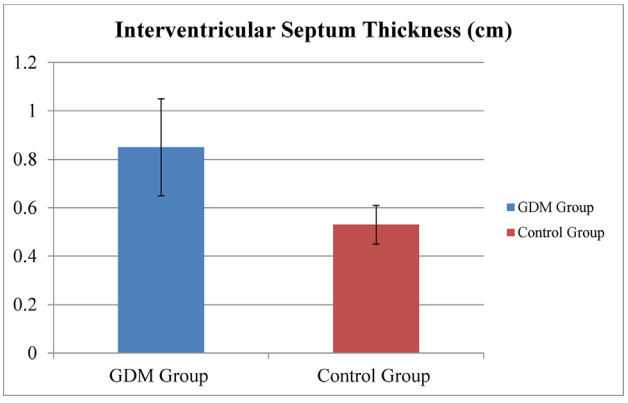

Fig. 7. Comparison between groups according to interventricular septum thickness 'cm'.

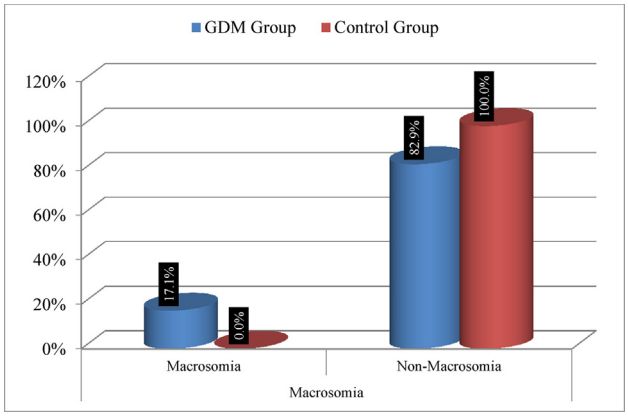

Fig. 8. Comparison between groups according to macrosomia.

4. Discussion

Shinde *et al.* (2021) concluded that placental thickness on ultrasonography gave a clear picture of the connection between the increase in prenatal and postpartum complications caused by a thin placenta and birth weight in the second and third trimesters.[10,11]

Momen Gharibvand *et al.* in 2020 concluded that placenta thickness and, therefore, cord area increase in mothers with gestational diabetes, independent of alterations caused by macrosomia and fetal weight.[12]

A 1995 research by Clampp *et al.* found a significant correlation between birth weight and placenta development in the second trimester.[13]

Table 3. Comparison between groups according to neonatal outcome.

Neonatal outcome	GDM group ($n = 35$)	Control group ($n = 35$)	Test value	*P* value
GA 'wks.' at delivery				
Mean ± SD	37.80 ± 1.08	39.34 ± 1.41	−5.134	<0.001**
Range	36–39	37–41		
Mode of delivery				
CS	22 (62.9%)	14 (40.0%)	3.621	0.047*
VD	13 (37.1%)	21 (60.0%)		
Sex				
Female	16 (45.7%)	14 (40.0%)	0.233	0.629
Male	19 (54.3%)	21 (60.0%)		
Fetal birth weight (gm)				
Mean ± SD	3727.03 ± 447.65	3271.14 ± 307.99	4.964	<0.001**
Range	3150–4570	2890–3995		
Macrosomia				
Macrosomia	6 (17.1%)	0 (0.0%)	8.258	^{FE} < 0.001**
Non-Macrosomia	29 (82.9%)	35 (100.0%)		
NICU admissions				
No	28 (80.0%)	33 (94.3%)	3.188	^{FE}0.074
Yes	7 (20.0%)	2 (5.7%)		
Neonatal hypoglycemia				
No	32 (91.4%)	35 (100.0%)	3.134	^{FE}0.077
Yes	3 (8.6%)	0 (0.0%)		

*P-value < 0.05 is significant.
**P-value < 0.001 is highly significant.

Table 4. Receiver-operating characteristic (ROC) curves employing placental volume (cm^3), placental thickness (cm), umbilical cord thickness (cm), interventricular septum thickness (cm), and HbA1c to distinguish individuals with or without fetal macrosomia.

Items	Cut-off	Sen.	Spe.	PPV	NPV	AUC (C.I.95%)	*P* value
Placental volume (cm^3)	>418	62.8%	60%	62%	61.8%	0.672 (0.549–0.779)	0.008
Placental thickness (cm)	<3.8	65.7%	74.3%	71.9%	68.4%	0.744 (0.626–0.841)	<0.001
Umbilical cord thickness (cm)	>2.4	60.0%	82.9%	77.8%	67.4%	0.777 (0.661–0.868)	<0.001
Interventricular Septum Thickness (cm)	>0.64	74.3%	88.6%	86.7%	77.5%	0.927 (0.840–0.976)	<0.001
HbA1c	>7.2	83.3%	100%	100%	98.5%	0.999 (0.946–1.000)	<0.001

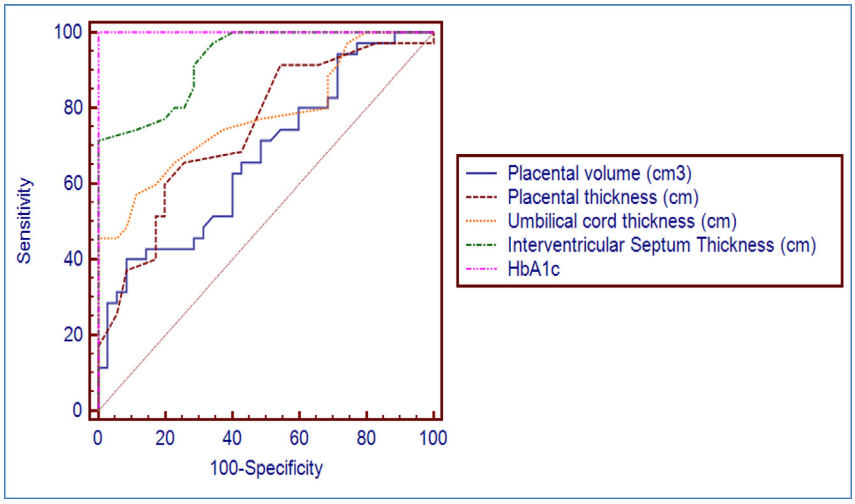

Fig. 9. Using placental volume (cm^3), placental thickness (cm), umbilical cord thickness (cm), interventricular septum thickness (cm), and HbA1c, receiver-operating characteristic (ROC) curves are used to distinguish between individuals with and without prenatal macrosomia.

Kartikayan *et al.* (2012) discovered a connection between placental thickness, gestational age, and fetal growth.[14]

In addition, a 2016 research by Halil *et al.* found that GDM patients had a larger placenta and thicker cords in both the diastolic and systolic stages of the disease. These results are consistent with what our research found. The criteria for fetal weight, placenta thickness, and cord diameter are greater in fetuses whose mothers have diabetes, even with normal results.[15]

Consistent with the results of this investigation, a study by Andrea *et al.* (2015) found that the placental weight and volume in diabetes mothers were greater than in normal pregnancies.[16]

In addition, our results are at odds with those of Taricco *et al.* (2006), who showed that the fetal weight was lower than the placental weight in pregnant women with GDM. The present study's findings showed that mothers with gestational diabetes had bigger cord diameters and placental thicknesses than women in the control group.[17]

Abdelrahman and Salama (2018) corroborated our results and showed how useful sonographic assessments of the thickness of the umbilical cord, the interventricular septum, and the hemoglobin A1c level are in predicting fetal macrosomia in women with gestational diabetes mellitus.[18]

According to studies conducted in 2013 by Proctor *et al.*, a thin umbilical cord during the second trimester may result in low birth weight and higher fetal discomfort during childbirth. They also showed a relationship between measures of the umbilical cord's diameter and area and elevated fetal macrosomia.[19]

Consistent with our most recent data, Kc *et al.* (2015) showed that moms with macrosomic pregnancies were more likely than mothers of non-macrosomic babies to deliver via cesarean section.[20,21]

4.1. Conclusion

In situations of pregnancy with gestational diabetes mellitus, sonographic evaluation of interventricular septum thickness was the most reliable indicator of fetal macrosomia. It is advised to utilize routine Hadlock's equation in conjunction with ultrasonographic measurements of the placental volume and thickness, the thickness of the umbilical cord, and the thickness of the fetal interventricular septum when these measurements are available to predict fetal macrosomia in pregnant women with gestational diabetes.

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Ethical approval

The study was approved by the Institutional Ethics Committee.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article.

Conflicts of interest

None declared.

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References

1. Khalil NA, Fathy WM, Mahmoud NS. Screening for gestational diabetes among pregnant women attending a rural family health center-Menoufia governorate-Egypt. *J Fam Med Health Care*. 2017;3:6–11.
2. Kallem VR, Pandita A, Pillai A. Infant of diabetic mother: what one needs to know? *J Matern Fetal Neonatal Med*. 2020;33: 482–492.
3. Moon JH, Jang HC. Gestational diabetes mellitus: diagnostic approaches and maternal-offspring complications. *Diabetes Metab J*. 2022;46:3–14.
4. Scifres CM. Short-and long-term outcomes associated with large for gestational age birth weight. *Obstet Gynecol Clin*. 2021;48:325–337.
5. Stern C, Schwarz S, Moser G, et al. Placental endocrine activity: adaptation and disruption of maternal glucose metabolism in pregnancy and the influence of fetal sex. *Int J Mol Sci*. 2021;22:12722.
6. Yusufkhanovna YD, Tolibovna UG. Improvement of methods for the prevention of obstetric complications in women with Fetus Macrosomia. *Euras Med Res Period*. 2023; 19:142–147.
7. Wilson AN, Homer CS. Third-and fourth-degree tears: a review of the current evidence for prevention and management. *Aust N Z J Obstet Gynaecol*. 2020;60:175–182.
8. Janani N, Vimala D, Gayathri N. Prospective study on sonographic measurement of umbilical cord thickness, foetal fat layer, interventricular septal thickness as predictors of macrosomia in fetus of women with gestational diabetes mellitus. *Int J Reprod, Contracept Obstet Gynecol*. 2018;7:1997–2002.
9. McIntyre HD, Catalano P, Zhang C, Desoye G, Mathiesen ER, Damm P. Gestational diabetes mellitus. *Nat Rev Dis Prim*. 2019;5:47.
10. Shinde GR, Kshirsagar N, Laddad M, Shivade V. Ultrasonographic placental thickness versus fetal outcome: a prospective study in Southern India. *Caspian J Intern Med*. 2021;12:562.
11. Fayez Mohamed Fathi M, Mohammed Moustafa T, Ramadan Alsawy Rady I. The role of umbilical cord thickness and glycated Hemoglobin (Hba1c) levels for prediction of fetal macrosomia in patients with gestational diabetes mellitus. *Al-Azhar Med J*. 2020;49:1741–1752.
12. Momen Gharibvand M, Hanafi MG, Fadaee MR. Ultrasonographic evaluation of placenta thickness and fetal cord cross section in gestational diabetes mothers compared to control group. *Int J Pediatr*. 2020;8:12001–12009.
13. Clapp IIIJF, Rizk KH, Appleby-Wineberg SK, Crass JR. Second-trimester placental volumes predict birth weight at term. *J Soc Gynecol Invest*. 1995;2:19–22.
14. Kinare AS, Natekar AS, Chinchwadkar MC, et al. Low midpregnancy placental volume in rural Indian women: a cause for low birth weight? *Am J Obstet Gynecol*. 2000;182: 443–448.
15. Halil G, Burcu A, Faik M, Yesim B. Three-dimensional ultrasonographic placental volume in gestional diabetes mellitus. *J Matern Fetal Neonatal Med*. 2016;29:610–614.
16. Andrea M, Gabor N. *Placental volume relative to fetal weight estimated by sonography in diabetic pregnancies*. 2015, Apr: 1229–1232.
17. Taricoo E, Radaelli T, Mooney EE, Bannigan J, McAuliffe FM. Stereology of placenta in type 1 diabeticpregnancies. *Placenta*. 2006;27:468–474.
18. Abdelrahman RM, Salama MM. The role of umbilical cord thickness, interventricular septum thickness and HbA1c levels in the prediction of fetal macrosomia in patients with gestational diabetes mellitus. *J Gynecol Res Obstet*. 2018;4:3.
19. Proctor LK, Fitzgerald B, Whittle WL, et al. Umbilical cord diameter percentile curves and their correlation to birth weight and placental pathology. *Placenta*. 2013;34:62–66.
20. Kc K, Shakya S, Zhang H. Gestational diabetes mellitus and macrosomia: a literature review. *Ann Nutr Metab*. 2015; 66(Suppl. 2):14–20.
21. Binbir B, Yeniel AO, Ergenoglu AM, Kazandi M, Akercan F, Sagol S. The role of umbilical cord thickness and HbA1c levels for the prediction of fetal macrosomia in patients with gestational diabetes mellitus. *Arch Gynecol Obstet*. 2012;285: 635–639.