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FETAL EPICARDIAL FAT THICKNESS AS A MARKER FOR GESTATIONAL DIABETES MELLITUS

Radio-Diagnosis

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ABSTRACT

Aims: The study aimed to assess Fetal Epicardial fat thickness (EFT) and ascertain its role in diagnosis & effective prediction of Gestational Diabetes mellitus (GDM) with correlation to Oral Glucose tolerance test (OGTT). **Patients and Methods:** A case control study was conducted at J.J.M. Medical College in Davanagere, Karnataka, involving 80 pregnant women (40 GDM cases and 40 control). Patients underwent imaging procedures -ultrasonography after 75 g OGTT results were obtained between 24 weeks + 0/6 days to 28 weeks+ 0/6 days of gestation. **Results:** The study found that fetal epicardial fat thickness (EFT) was significantly higher in the group with gestational diabetes mellitus (GDM) compared to the control group without GDM. Additionally, the increased EFT showed a positive association with serum glucose levels from the 2-hour oral glucose tolerance test (OGTT), demonstrating high sensitivity and specificity. **Conclusion:** The study underscores the significance of the Fetal EFT as a useful marker for early prediction of GDM and identify early changes in fetal metabolism before accelerated fetal growth and polyhydramnios is apparent.

KEYWORDS

Fetal Epicardial fat thickness (EFT), Gestational Diabetes mellitus (GDM), Oral Glucose tolerance test (OGTT)

INTRODUCTION

Gestational diabetes mellitus (GDM) is defined as the new onset of varying degrees of glucose intolerance during pregnancy, irrespective of whether insulin or only diet modification is used for treatment and whether the condition persists/ resolves after pregnancy. It is diagnosed by routine antenatal screening for hyperglycemia in pregnant women rather than in symptomatic women[3,1]. As timing and severity of maternal diabetes play a critical role in determining the effects on fetal metabolic state and cardiovascular development, early detection plays a crucial role [3].

Compared to western population the prevalence rate of GDM is much higher in India i.e., 10–14.3% which is expected to increase to 20%. With this, the various complications associated with GDM include-maternal (postpartum hemorrhage, need for cesarean section, birth trauma, prolonged and obstructed labor, infection) as well as fetal (congenital anomalies, stillbirths, intrauterine death, birth injuries, neonatal hypoglycemia, respiratory distress) [3].

Epicardial fat is situated between the visceral pericardium and the myocardium, predominantly found near the right ventricle, and significantly contributes to myocardial energy production. It is an active and complex endocrine organ that secretes multiple anti-inflammatories and proinflammatory molecules [2]. In diabetes, the resistance to insulin precedes hyperglycemia. Many studies have shown the association of epicardial fat thickness measured on ultrasonography and insulin resistance in the adult population and has been found to be superior to waist circumference, however there are limited information about Fetal EFT and GDM [2,5].

The cardiac function evaluation of the fetus provides vital information on the hemodynamic status and the cardiovascular adaptation for associated perinatal adverse effects. Fetal electrocardiography and echocardiography help in evaluating the fetal cardiac structures and functions. The USG measurement of fetal EFT may serve as novel markers for altered fetal metabolism and its consequences on the fetal heart [3].

The present study aimed to estimate and compare the ultrasonographic measurement of fetal EFT in GDM and normal pregnancies at 24–28 weeks of gestation and evaluate the diagnostic efficacy in the prediction of GDM by correlating it with the results of OGTT.

Pathophysiology

Two mechanisms are proposed, that might be responsible for the increased EFT in GDM patients. Firstly, elevated levels of retinol-binding protein 4 and reduced levels of adiponectin, secreted by adipose tissue including epicardial adipose tissue, before 16 weeks of gestation, could lead to insulin resistance, which is the primary mechanism underlying GDM. Secondly, during the first-second trimester, epicardial adipose tissue releases higher levels of pro-inflammatory adipokines, and lower levels of anti-inflammatory adipokines (omentin-1 and adiponectin); these may participate in the chronic low-grade state of inflammation that has been confirmed to be associated with GDM. Further the association between increased Fetal EPT and postpartum cardiovascular diseases in mother as well as risk in fetus for development of Type 2 diabetes mellitus, obesity, metabolic and cardiovascular diseases in future needs to be addressed by follow up in these children.

MATERIALS AND METHODS

The analytical study was conducted at the Department of Radiodiagnosis, J.J.M Medical College in Davanagere, Karnataka. This study employed a case control design and included pregnant women between 24 weeks + 0/6 days to 28 weeks+ 0/6 days of gestation scheduled for a 75 g oral glucose tolerance test, after interpreting results using Diabetes in Pregnancy Study Group India (DIPSI) criteria of 2hr plasma glucose which is followed in our institute to interpret OGTT results,

- >200 mg/dL – Overt Diabetes
- 140-199mg/dL - GDM
- 120-139mg/dL-Gestational glucose intolerance, GGI
- <120mg/dL-Normal.

They were selected and assigned into two groups for study based on OGTT results Group I -cases of GDM (40 patients had raised 75 g OGTT results) and Group II- control (40 patients had normal 75 g OGTT results). The study spanned from November 2022 to October 2023, covering a 12-month period with a sample size of 80 pregnant women.

Inclusion Criteria:

Pregnant women with results of 75g OGTT either in range of GDM (case) or normal (control) were selected randomly from age group of 20-40 years. Primigravida with Singleton pregnancy and normal dating scan.

Exclusion Criteria:

- Pregnant women with OGTT results in range of diabetes or GGI (Gestational glucose intolerance)
- Cases of chromosomal and/or structural abnormalities
- Coexisting morbidities (preeclampsia, thyroid disorder, fetal growth restriction, multiple pregnancy).

The data collection methodology for the study involved a structured proforma to document pregnant women details, clinical history and

OGTT results followed by blinded antenatal ultrasonography, measuring Fetal EFT according to protocol of assessment.

Methodology

The study commenced after institutional ethical committee clearance, with all enrolled cases undergoing imaging procedures after securing written consent. The antenatal ultrasound examination of patients was performed after the results of OGTT. Antenatal ultrasonography in real-time using grey scale with Voluson E6 (GE Healthcare, Wauwatosa, WI) fitted with a 2–5 MHz curved abdominal probe.

For EFT measurement, a standardized method was used, the left ventricle outflow (LVOT) view was considered for visualizing the space between myocardium and epicardium, i.e., epicardial space, measured along the right ventricle. A reference line was drawn passing through the descending aorta and aortic annulus. Epicardial fat tissue was identified as the hypoechoic area between visceral pericardium and myocardium. In order to distinguish epicardial fat from pericardial fluid, Color Doppler study was used. EFT was measured from the area nearest to the reference line, with calipers measuring the inner-to-inner aspect.

A single observer blinded to the group the pregnant women was assigned based on OGTT results and then ultrasonography was performed. EFT was measured three times at different time intervals within the duration of performing complete obstetric scan and for the final analysis, mean of these measurements was used.

RESULTS

Among the cases (40) and controls (40) between the age group of 20-40 years, elevated OGTT was observed in 38 cases and 4 controls. The majority of pregnant women with elevated OGTT were aged between 28-36 years and showed increased EPT value.

Fig 1. 21-year-old female, G2P0L0A1 with single live intrauterine gestation corresponding to 24 weeks 6 days +/- 14days with normal OGTT results, demonstrated lower EPT value of 0.12 cm.

Fig 2. 28-year-old female, G3P2L2 with single live intrauterine gestation corresponding to 27 weeks 2 days +/- 14days with raised OGTT results, demonstrated raised EPT of 0.17 cm.

Fig 3. 31-year-old female, G2P1L1 with single live intrauterine gestation corresponding to 25 weeks 3 days +/- 14days with raised OGTT results, demonstrated raised EPT of 0.18 cm

The Ultrasonographic findings revealed the following distribution among the cases (elevated OGTT):

- Increased EPT was observed in 33 cases, constituting 82.5 % of the total cases.
- Normal EPT was observed in 7 cases, constituting 17.5% of the total cases.

The Ultrasonographic findings revealed the following distribution among the control (normal OGTT):

- Normal EPT was observed in 36 controls, constituting 90% of the total cases.
- Increased EPT was observed in 4 controls, constituting 10% of the total cases.

Table 1: Ultrasonographic findings among cases and controls

	Increased EPT	Normal EPT
Cases (elevated OGTT)	33	7
Control (normal OGTT)	36	4

The study shows high sensitivity (i.e., 82.5%) and low specificity (i.e., 10%). A positive predictive value (PPV) of 47.8 % and negative predictive value (NPV) of 36.4%. The diagnostic accuracy of the test was approximately 46.25%.

Table 2: Comparison of Mean EPT and OGTT results among cases and controls

	Group I - GDM	Group II - Control
EFT Mean ± SD	0.17+/- 0.05 cm	0.12 +/- 0.03 cm
OGTT results Mean ± SD	182.21 +/- 7.13 mg/dL	122.70 +/- 9.91 mg/dL

The mean fetal epicardial fat thickness (EFT) in mothers with GDM was significantly larger, i.e., 0.17+/- 0.05 cm than in mothers without GDM, i.e., 0.12 +/- 0.03 cm and increased EFT was positively associated with 2- hour OGTT serum glucose values.

DISCUSSION

The fetal EFT is indeed a useful tool in screening for GDM. Its high sensitivity suggests that it correctly identifies a significant proportion of GDM cases. However, its low specificity is limiting its reliability in "ruling out" the condition. The moderate PPV means that if the test indicates GDM, there's a moderate likelihood that GDM is actually present. Given the high rate of false positives and false negatives, individuals who test positive may need confirmatory tests to verify the diagnosis. Similarly, negative results should be interpreted with caution, especially if clinical symptoms suggest the presence of the condition. Patient Counseling is essential to inform about the potential need for additional testing to confirm the screening results.

The overall diagnostic accuracy of 46.25% suggests that fetal EFT, while providing utility in screening for GDM, should not be considered as diagnostic.

CONCLUSION:

The study results emphasize the use of USG measurement of fetal EFT at 24–28 weeks of gestation, only as a screening tool in combination with clinical and biochemical factors.

In conclusion, while the fetal EFT shows promise in identifying mothers with GDM early, its limitations in specificity and diagnostic accuracy suggest it should not be relied upon as the sole diagnostic tool. Clinicians should use it as part of a comprehensive screening approach, supplemented by more definitive diagnostic methods to ensure accurate diagnosis and appropriate management of GDM in mothers.

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