The role of fetal echo in assessment of ventricular and inter ventricular thickness in diabetic and non-diabetic mothers

Thesis

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بسم الله الرحمن الرحيم

قالوا

سبحانك لا علم لنا
إلا ما علمتنا إنك أنت
العليم الحكيم

صدق الله العظيم

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ABSTRACT

Background: Maternal diabetes mellitus is a common medical disorder that can significantly affect the fetal heart in both structure and function. Studies have demonstrated impaired development of cardiac and venous flow patterns in fetuses of diabetic mothers as early as 12 weeks of gestation. **Aim the work:** to highlight the role of fetal echo in assessment of inter ventricular thickness in diabetic and non-diabetic mothers. **Patients and Methods:** This study was conducted on fifty pregnant women which divided into two groups: 25 pregnant women with gestational diabetes and 25 pregnant non-diabetic women referred from obstetricians to the radiology department, Ain Shams University Hospitals. **Results:** mean age of diabetic pregnant mothers was significantly higher than non-diabetic women while mean gestational age in diabetic pregnant mothers was significantly higher than non-diabetic women. The mean fetal weight, amniotic fluid index (AFI), fetal heart rate were significantly higher in pregnant diabetic women. Also, GA, BPD, HC, AC, FL, Fetal weight, AFI and FHR showed significant moderate positive correlation with IVS thickness in diabetic group only. To the best of the knowledge, our study shows a define cut-off point for IVST in diabetic mothers as we found that IVS thickness which concluded that it is perfect predictor for fetal assessment in diabetic pregnant women. **Conclusion:** fetuses of women with diabetes have higher AFI, AC, HR, BPD, FL and thicker IVS.

Key words: fetal echo, ventricle, inter ventricular thickness diabetic, non-diabetic mothers

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List of Abbreviations

Abb.		Full Term
BMI	:	Body mass index
CHD	:	Congenital Heart Disease
CHD	:	Congenital Heart Disease
CTAR	:	Leiden theoretic are ration
DKA	:	Diabetic ketoacidosis
FOAD	:	Fetal Origins of Adult Disease
GDM	:	Gestational Diabetes Mellitus
GDM	:	Gestational diabetic mellitus
HAPO	:	Hyperglycemia and Adverse Pregnancy Outcomes
IADPSG	:	International Association for Diabetes and Pregnancy Study Groups.
IDDM	:	Insulin dependent diabetic mellitus
IUGR	:	Intrauterine growth retardation
IUGR	:	Intra uterine growth retardation
LGA	:	Large for gestational age
LGA	:	Large gestational age
OGTT	:	Oral glucose tolerance test
OGTT	:	Oral glucose tolerance test
SGA	:	Small for gestational age
T1DM	:	Type 1 diabetes mellitus
T2DM	:	Type 2 diabetes mellitus
TGA	:	Transposition of the great arteries
TLD	:	Total loudial dimension
TOF	:	Tetrology of Fallot
WHO	:	World Health Organization

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INTRODUCTION

Maternal diabetes mellitus (DM) affects the structure and function of the fetal heart and alters the fetal placental circulation from embryonic development in the first trimester until the perinatal period through the second and third trimesters ***(Bolognesi, 2015).***

Hyperglycemia may influence all stages of cardiac development, including cardiac morphogenesis, placental development, and fetal circulation ***(Nashaat, 2010).***

Fetal hyperinsulinemia and increased expression or affinity of insulin receptors, followed by changes in the metabolism of diabetic mothers, lead to alterations in cardiomyocyte gene expression and subsequent structural and functional malformation in the fetal heart ***(Tabib,2013).***

Insulin-dependent DM (IDDM) occurs in nearly 0.1% of the pregnant population. Maternal diabetes is associated with increased teratogenic effects on fetuses. Cardiomegaly is an extremely common malformation in fetuses of diabetic mothers (30%), and heart failure occurs in 5% - 10% of these cases ***(Moses,2010).***

The incidence of asymmetric septal hypertrophy is 30% - 38% of cases, specifically, 50% in fetuses of mothers with IDDM

and 25% in fetuses of mothers with insulin-independent DM (IIDM).

Fetal echocardiography for assessment of ventricular and inter venricular thickness in diabetic and non diabetic mothers ***(Allen,2013).***

Although several articles have demonstrated cardiac malformation and defects in fetuses of diabetic mothers, there is little information about their systolic and diastolic cardiac function ***(Liu,2012).***

Fetal echocardiography shows the timing of development of the myocardial changes in the fetus of the diabetic mother with documentation of increased ventricular and inter ventricular thickness ***(Simpson,2011).***

Aim of the work

The aim of this work was:

To highlight the role of fetal echo in assessment of inter ventricular thickness in diabetic and non-diabetic mothers.

Chapter (1):
Effects of hyperglycemia in pregnancy

Gestational diabetes mellitus is defined as carbohydrate intolerance resulting in hyperglycaemia, with first onset or detection during pregnancy. It increases the risk of complications for both mother and child during pregnancy, childbirth and beyond. ***(Wendland et al., 2012).***

In 1999, WHO clarified that GDM encompassed impaired glucose tolerance and diabetes (fasting ≥ 7 mmol/l or ≥ 126 mg/dl; 2 h plasma glucose ≥ 7.8 mmol/l or 140 mg/dl) and, over the years has maintained their recommendations. ***World Health Organization. (1999)***

Current evidence suggests early detection and management of gestational diabetes improves outcomes for both mother and child ***(Metzger et al., 2008).***

Gestational diabetes mellitus occurs in 2 to 9 percent of all pregnancies and is associated with substantial rates of maternal complications (as perinatal mortality) and perinatal complications (as fetal macrosomia). Other perinatal risks include shoulder dystocia, birth injuries such as bone fractures and nerve palsies, and hypoglycemia. ***(Buchanan et al., 2007); (American Diabetes Association; 2011)***

Long-term adverse health outcomes reported among infants born to mothers with gestational diabetes include sustained impairment of glucose tolerance, subsequent obesity (although not when adjusted for size), and impaired intellectual achievement.

For women, gestational diabetes is a strong risk factor for diabetes. ***(Sacks et al., 2012).***

Why is gestational diabetes important?

Antepartum and Perinatal Considerations

Overt maternal diabetes mellitus can adversely influence intrauterine development. Spontaneous abortions and major congenital anomalies may be induced in the first trimester. Excessive fetal growth, neonatal hypoglycaemia, jaundice, polycythaemia and stillbirth may be induced during the second and third trimesters(***Ryan, 2011)***.

Excess birth defects are generally limited to cases of gestationally diagnosed hyperglycaemia that meets criteria for overt diabetes mellitus. The frequency of the other adverse outcomes across the full range of maternal glycaemia that defines true GDM is difficult to determine. The reason is simple women in the upper part of that range almost always receive some form of treatment. ***(Long,2011).***

Results from the Hyperglycemia and Adverse Pregnancy Outcomes (HAPO) study provide useful insight into the frequency

of perinatal complications in women with relatively mild GDM in the absence of treatment. In the HAPO study, women found to have fasting plasma glucose levels of >5.8 mmol/l or a glucose level of >11.1 mmol/l on the 75 g, 2 h Oral glucose tolerance test (OGTT) were referred for treatment of GDM. Women with lower glucose levels than these thresholds received no diagnosis or care related to their glycaemic control. ***(Black et al., 2010).***

Retrospective application of the new International Association for Diabetes and Pregnancy Study Groups (IADPSG) criteria for GDM to these untreated women revealed statistically significant increases in ten different adverse perinatal outcomes in women with GDM compared with those who were not **(Table 1).**

Although the relative increase in risk ranges from 17-20% across the ten complications, the absolute risk (the difference in complication rates between the GDM and control groups) was not more than 11% for any complication. Similar patterns have been observed in many smaller studies; for example, 10% absolute risk of caesarean delivery and 14% absolute risk of macrosomia in women with untreated, borderline GDM in the Toronto Tri-Hospital GDM project. ***International Association of Diabetes and Pregnancy Study Groups Consensus Panel. (2010); (Buchanan et al., 2012).***

Table (1): Perinatal outcomes in the HAPOstudy when the criteria of IADPSG for GDM, are applied *(American Diabetes Association; 2014)*

Outcome	Frequency in GDM (%)	Frequency in non-GDM (%)	Frequency difference (%)
Pre-eclampsia	9.1	4.5	4.6
Delivery at <37 weeks	9.4	6.4	3
Primary caesarean delivery	24.4	16.8	7.6
Shoulder dystocia or birth injury	1.8	1.3	0.5
Intensive neonatal care	9.1	7.8	1.3
Clinical neonatal hypoglycaemia	2.7	1.9	0.8
Neonatal hyperbilirubinaemia	10	8	2
Birthweight >90th percentile	16.2	8.3	7.9
Cord C-peptide >90th percentile	17.5	6.7	10.8
Percent body adipose tissue content >90th percentile	16.6	8.5	8.1
Cardiac malformation	8.8	1,17	7.63

The main message is that the diagnosis of GDM imparts some excess risk of perinatal complications. However, only a minority of pregnancies have an adverse outcome that could be attributed to GDM. This fact will become important when approaches to antepartum management are discussed below.

Long-Term Health of the Mother:

Women who are diagnosed with GDM are at high risk of developing diabetes mellitus later in life. An estimated ~10% of