

Assessment of echocardiographic parameters in infants of diabetic mothers

Thesis submitted for fulfillment of
Master Degree in Pediatrics

Investigated by:

Suzy Samir Swedan

M.B., B.Ch. (2006)

Supervised by:

Prof. Mohamed Ahmed Aboulhassan

Professor of Pediatrics,
Faculty of Medicine - Cairo University

Prof. May Ahmed khairy

Ass. Professor of Pediatrics,
Faculty of Medicine - Cairo University

Dr. Alaa El-Din Adel Sobeih

lecturer of Pediatrics,
Faculty of Medicine - Cairo University

**Faculty of Medicine
Cairo University**

٢٠١٥

List of content

Title	Page
Introduction	1
Aim of the work	4
Review of literature	5
➤ Diabetes in pregnancy & infant of diabetic mother (IDM)	5
• Types of diabetes in pregnancy	7
• Maternal /fetal metabolism in normal pregnancy	11
• Maternal /fetal metabolism in diabetic pregnancy	12
• Perinatal complications of diabetes in pregnancy	13
- Perinatal asphyxia	15
- Prematurity	16
- Birth injury	16
- Intrauterine growth restriction (IUGR)	17
• Neonatal morbidity and mortality	17
- Macrosomia	17
- Congenital anomalies	21
- Neonatal hypoglycemia	26
- Polycythemia and hyperviscosity	28
- Hyperbilirubinemia	30
- Hypertrophic and congestive cardiomyopathy	30
- Respiratory distress syndrome (RDS)	30
- Metabolic disturbances	32
- Central nervous system	33
• Long term complications	34
➤ Cardiac problems in IDM	36
• Cardiovascular Anomalies	37
• Patent Ductus Arteriosus and Patent Foramen Ovale	39
• Pathological Ventricular Hypertrophy / Hypertrophic Cardiomyopathy	41
• Diastolic myocardial function	47
• Systolic myocardial function	49

• Troponin	50
Patients & Methods	52
Results	59
Discussion	97
Conclusion & Recommendations	105
Summary	106
Reference	108
Arabic Summary	

List of tables

Table no.	Title	page
Table 1:	Demographic data in the four studied groups.	Error! Bookmark not defined.
Table 2:	Sex distribution in the four studied groups.	Error! Bookmark not defined.
Table 3:	Comparison among the studied groups regarding mode of delivery	Error! Bookmark not defined.
Table 4:	APGAR score in the four studied groups.	Error! Bookmark not defined.
Table 5:	Comparison between AGA-IDM and LGA-IDM as regards type of diabetes Mellitus (DM).	Error! Bookmark not defined.
Table 6:	Comparison between AGA-IDM and LGA-IDM regarding management of diabetes.	Error! Bookmark not defined.
Table 7:	Comparison between AGA and LGA regarding the control of DM (HbA1C)	Error! Bookmark not defined.
Table 8:	Comparison among the four studied groups regarding vital signs.	Error! Bookmark not defined.
Table 9:	Cardiac examination in the four studied groups	Error! Bookmark not defined.
Table 10:	Comparison among the four studied groups as regards important laboratory results on admission.	Error! Bookmark not defined.
Table 11:	Comparison between AGA-IDM and LGA-IDM regarding random blood sugar (RBS).	Error! Bookmark not defined.
Table 12:	Comparison among the four studied groups regarding chest x-ray findings.	Error! Bookmark not defined.
Table 13:	Comparison between AGA-IDM, LGA-IDM and LGA-IDM regarding respiratory support.	Error! Bookmark not defined.
Table 14:	PDA in the four studied groups.	Error! Bookmark not defined.
Table 15:	Comparison among the four studied groups regarding the echo-cardiographic parameters.	Error! Bookmark not defined.
Table 16:	Comparison between control and AGA-IDM regarding the echo-cardiographic parameters.	Error! Bookmark not defined.
Table 17:	Comparison between control and LGA-IDM regarding the echo-cardiographic parameters.	Error! Bookmark not defined.
Table 18:	PDA in control and IDM groups.	Error! Bookmark not defined.
Table 19:	Comparison between control and IDM regarding the echo-cardiographic parameters.	Error! Bookmark not defined.

Table 20: PDA in AGA-IDM and LGA- IDM groups:Error! Bookmark not defined.
Table 21: Comparison between AGA-IDM and LGA-IDM regarding the echo-
cardiographic parameters..... Error! Bookmark not defined.
Table 22: PDA in LGA-IDM and LGA-INDM groupsError! Bookmark not defined.
Table 23: .Comparison between LGA-IDM and LGA-INDM regarding the echo-
cardiographic parameters..... Error! Bookmark not defined.
Table 24: Comparison between poor control LGA-IDM and good control LGA-IDM
regarding the echo-cardiographic parameter.Error! Bookmark not defined.
Table 25: comparison between GD and PGD as regards echo-cardiographic parameters
..... Error! Bookmark not defined.
Table 26: Correlation between HbA1c and echocardiographic parameter in LGA-IDM.
..... Error! Bookmark not defined.
Table 27: Correlation between birth weight and HbA1c in IDMErrors! Bookmark not
defined.

List of figures

Figure no.	Title	page
Figure 1:	Comparison between AGA-IDM and LGA-IDM regarding control of DM	Error! Bookmark not defined.
Figure 2:	Comparison among the four studied groups as regards the presence of PDA.	Error! Bookmark not defined.
Figure 3:	Comparison among the four studied groups regarding PFO and PDA size.	Error! Bookmark not defined.
Figure 4:	Comparison between the four studied groups regarding ESPAP.	Error! Bookmark not defined.
Figure 5:	Comparison between the four studied groups regarding LVEDD and RV.	Error! Bookmark not defined.
Figure 6:	Comparison between the four studied groups regarding IVS	Error! Bookmark not defined.
Figure 7:	Comparison between the four studied groups regarding Mitral E, Mitral A, Tricuspid E and Tricuspid A.	Error! Bookmark not defined.
Figure 8:	Comparison among the four studied groups regarding Tricuspid E/A ratio and Mitral E/A ratio.	Error! Bookmark not defined.
Figure 9:	Comparison between control and AGA-IDM as regards ESPAP	Error! Bookmark not defined.
Figure 10:	Comparison between control and AGA-IDM as regards Mitral E, Mitral A, Tricuspid E and Tricuspid A	Error! Bookmark not defined.
Figure 11:	Comparison between control and AGA-IDM as regards Tricuspid E/A ratio and Mitral E/A ratio.	Error! Bookmark not defined.
Figure 12:	Comparison between control and LGA-IDM regarding ESPAP	Error! Bookmark not defined.
Figure 13:	Comparison between control and LGA-IDM regarding LVEDD and RV.	Error! Bookmark not defined.
Figure 14:	Comparison between control and LGA-IDM regarding IVS.	Error! Bookmark not defined.
Figure 15:	Comparison between control and LGA-IDM regarding Mitral E, Mitral A, Tricuspid E and Tricuspid A	Error! Bookmark not defined.

Figure 16: Comparison between control and LGA-IDM regarding, Tricuspid E/A ratio and Mitral E/A ratio

..... Error! Bookmark not defined.

Figure 17: comparison between control group and IDM as regards the presence of P

..... Error! Bookmark not defined.

Figure 18: Comparison between control and IDM regarding ESPAP.....

..... Error! Bookmark not defined.

Figure 19: Comparison between control and IDM regarding IVS.

..... Error! Bookmark not defined.

Figure 20: Comparison between control and IDM regarding Mitral E, Mitral A, Tricuspid E and Tricuspid A

..... Error! Bookmark not defined.

Figure 21: Comparison between control and IDM regarding, Tricuspid E/A ratio and Mitral E/A ratio

..... Error! Bookmark not defined.

Figure 22: Comparison between AGA-IDA and LGA-IDM as regards the presence of PDA

..... Error! Bookmark not defined.

Figure 23: Comparison between AGA-IDM and LGA-IDM regarding ESPA.... P

..... Error! Bookmark not defined.

Figure 24: Comparison between AGA-IDM and LGA-IDM regarding LVEDD and RV

..... Error! Bookmark not defined.

Figure 25: Comparison between AGA-IDM and LGA-IDM regarding IVS.....

..... Error! Bookmark not defined.

Figure 26: Comparison between AGA-IDM and LGA-IDM regarding Mitral E, Mitral A, Tricuspid E and Tricuspid A

..... Error! Bookmark not defined.

Figure 27: Comparison between AGA-IDM and LGA-IDM regarding Tricuspid E/A ratio and Mitral E/A ratio

..... Error! Bookmark not defined.

Figure 28: Comparison between poor control LGA-IDM and good control LGA-IDM regarding IVS.....

..... Error! Bookmark not defined.

Figure 29: Correlation between HbA1c and IVS in LGA-IDM.....

..... Error! Bookmark not defined.

List of Abbreviations

Abb.	Full term
ADA	American diabetes association
AGA	Appropriate for gestational age
ASH	Asymmetrical septal hypertrophy
BSA	Body surface area
BWIS	Baltimore– Washington study
CHD	Congenital heart disease
DM	Diabetes mellitus
FS	Fractional shortening
GDM	Gestational diabetes mellitus
GTT	Glucose tolerance test
HAPO	Hyperglycemia and adverse pregnancy outcome
HCM	Hypertrophic cardiomyopathy
IDDM	Insulin dependent diabetes mellitus
IDM	Infant of diabetic mothers
IGF-1	Insulin-like growth factor-1
IGFBP-1	Insulin growth factor binding protein-1
IGT	Impaired glucose tolerance
INDM	Infant of non diabetic mother
IUGR	Intrauterine growth restriction
IVS	Interventricular septum
LGA	Large for gestational age
LV	Left ventricle
LVEDD	Left ventricular end diastolic dimension
LVESD	Left ventricular end systolic dimension
LVPW	Left ventricular posterior wall
PAP	Pulmonary artery pressure
PDA	Patent ductus arterioisus
PFO	Patent foramen ovale
PG	Phosphatidyl-glycerol
PGDM	Pregestational diabetes mellitus
PVH	Pathologic ventricular hypertrophy
RDS	Respiratory distress syndrome

RV	Right ventricle
SGA	Small for gestational age
TnI	Troponin I
WHO	World health organization

ACKNOWLEDGMENT

*First and foremost, thanks to **ALLAH**, the most beneficent and merciful.*

*I wish to express my sincere appreciations to **Professor Dr. Mohamed Ahmed Abo El - Hassan**, Professor of Pediatrics Faculty of Medicine Cairo University for his supervision, valuable guidance and advices throughout this work,*

*I am also deeply grateful to **Professor Dr. May Ahmed Khairy**, Professor of Pediatrics Faculty of Medicine Cairo University for her continuous supervision, effort, support, knowledge and assistance she offered me throughout the performance of this work,*

*Also, I am profoundly grateful and would like to express my deepest thanks and sincere appretiations to **Dr. Alaa El -Din Adel Sobeih**, Lecturer of Pediatrics Faculty of Medicine Cairo University for his continuous guidance support, assistance and great help through the whole work,*

Finally, I convey my thanks to my family especially my parents for their continuous help, support and love, I owe to them a lot, Without their help I won't finish this work,

ABSTRACT

The present study was a Descriptive cross-sectional comparative one that includes Infant of diabetic mothers and Large for gestational age infants of non-diabetic mothers admitted in NICU. Healthy full-term neonates were also included as a control

Infants of diabetic mothers are frequently suffered from several cardiac complications

Our study assessed the echocardiographic parameters in infant of diabetic mothers and reported that they are more likely to develop increased pulmonary pressure, hypertrophy in the interventricular septum systolic and diastolic dysfunction than infant of non diabetic mothers.

Macrosomic infant of diabetic mothers are more likely to cardiac complication than AGA infant of diabetic mothers.

Key words:

(Echocardiography, infant of diabetic mothers)

INTRODUCTION

Diabetes mellitus is increasing in incidence in the general population leading to growing number of pregnancies complicated by this condition (**Katheria & Leone, 2012**).

Diabetes in pregnant women could be either pregestational or gestational. Gestational diabetes accounts for about 80% of cases and could represent a predisposition to type 2 diabetes mellitus or an extreme manifestation of metabolic changes during pregnancy (**Opara et al, 2010**). Gestational diabetes is defined as glucose intolerance with onset or first recognized during pregnancy (**Lindsay, 2002**).

Infants of insulin dependent diabetes mellitus (IDDM) and noninsulin dependent diabetes mellitus (NIDDM), and also gestational diabetic (GDM) women have more perinatal problems than those of normal mothers. These complications have usually been attributed to poor control of hyperglycemia and iatrogenic or emergency preterm delivery (**Nili & Mahdavian, 2004**).

Neonatal respiratory distress, jaundice, hypoglycemia, hypocalcemia, polycythemia, macrosomia, perinatal asphyxia, prematurity, congenital malformation, hyperbilirubinemia, large and small for gestational age, and renal vein thrombosis are seen more in these infants. Certain congenital anomalies are reported with higher frequencies, such as cardiovascular, skeletal, and genitourinary defects (**Roodpeyma et al, 2013**).

Infants of diabetic mothers (IDMs) frequently suffer from macrosomia and alterations in postnatal cardiac function, thought to be secondary to fetal hyperglycemia and hyperinsulinemia (**Zahka & Patel, 2002**). Fats, amino acids, maternal anti-insulin antibodies and an increased number of insulin receptors may have some role in the pathophysiology of large for gestational age (LGA) (**Vela-Huerta et al, 2000**).

Echocardiography allows a direct assessment of the direction of blood flow across fetal channels, namely the foramen ovale (FO) and the patent ductus arteriosus (PDA), which is an indicator of the degree to which the pulmonary resistance has fallen after birth (**Katheria & Leone, 2012**).

Cardiac malformations in IDMs are five times higher than in normal pregnancies. Ventricular or atrial septal defect, transposition of great vessels, truncus arteriosus, double outlet right ventricle, and coarctation of aorta are most common (**Wren et al, 2003**).

Meta-analysis by **Lisowski et al (2010)** showed that approximately half of the congenital heart diseases (CHD) in infants of type 1 diabetic mothers were conotruncal anomalies.

It is believed that anabolic results of fetal hyperinsulinemia triggered by maternal hyperglycemia during the third trimester can cause hypertrophic cardiomyopathy (HCM) with asymmetric septum enlargement in 30% of IDMs (**Potter & Kicklighter, 2006**).

Fetal hyperinsulinism may trigger hyperplasia and hypertrophy of myocardial cells by increasing fat and protein synthesis (**Mehta & Hussain, 2003**).

Highly significant positive relationships were detected between birth weight of the studied IDMs and all the echocardiographic measurements (*El-Ganzoury et al, 2012*).

In the HCM of the IDM, thickening of the septum may result in a transient hypertrophic subaortic stenosis with left ventricular (LV) outflow obstruction and a congestive heart failure. Moreover, left ventricular diastolic function was significantly impaired in the IDM (*Barany et al, 2004*).

AIM OF WORK

The purpose of this study was to assess the echocardiographic parameters in infants of diabetic mothers (IDM) either appropriate for gestational age (AGA) or large for gestational age (LGA) compared to large for gestational age (LGA) neonates of non-diabetic mothers and healthy full-term neonates