Assessment of the Accuracy of Fetal Hemodynamic Indices in Prediction of Birth Weight at Term in Gestational Diabetic Mellitus Mothers

Thesis

Submitted for Partial Fulfillment of Master Degree in Obstetrics and Gynecology

Presented by

Noha Emad El Din Abd El Aziz

Resident at Manshyet El Bakry General Hospital M.B.B.,Ch (2012)

Supervisors

Prof. Magdy Mohamed Mahmoud Abd el Gawad

Professor of Gynecology and Obstetrics

Faculty of Medicine - Ain Shams University

Assistant Professor/ Mohamed Hussain Moustafa

Assistant Professor of Gynecology and Obstetrics

Faculty of Medicine - Ain Shams University

Assistant Professor /Laila Aly Farid

Assistant Professor of Gynecology and Obstetrics

Faculty of Medicine - Ain Shams University

Faculty of Medicine

Ain Shams University

2018

ACKNOWLEDGEMENT

First, thanks are all due to Allah the great for Blessing this work until it has reached its end.

My profound thanks and deep appreciation to Prof. Dr. Magdy Mohammed Mahmoud Abdel Gawad, Professor of Obstetrics and Gynaecology, Faculty of Medicine, Ain Shams University for his great support and advice, his valuable remarks that gave me the confidence and encouragement to fulfill this work.

My extreme thanks and gratefulness to Assistant Prof. Mohamed Hussain Moustafa and Assistant Professor Laila Aly Farid , Assistant Professors of Obstetrics and Gynaecology, Faculty of Medicine, Ain Shams University for there valuable supervision, co-operation and direction that extended throughout this work.

Finally, I am very grateful to dr. Ola El Sirgany and to all staff members of Fetal Care Unit-Ain Shams University and to all subjects who cooperated with us to finish this study.

List of Contents

AC: Abdominal Circumferance

AFI: Amniotic Fluid Index

AGA: Appropriate for Gestational Age

APAD: Anteroposterior Abdominal Diameter

BMI: Body Mass Index

BPD: Biparital Diameter

BW: Birth Weight

DIP: Diabetes In Pregnancy

DM: Diabetes Mellitus

EDF: End Diastolic Flow

EFW: Expected fetal weight

EPOCH: Exploring Perinatal Outcomes among Children

FL: Femur Length

FLW: Flow Velocity Wave

FPG: Fasting Plasma Glucose

FW: Fetal Weight

GAD: Glutamic Acid Decarboxylase

GDM: Gestational Diabetes Mellitus

HC: Head Circumferance

IDF: International Diabetes Fredration

IDF: International Diabetes Fredrdtion

IGT: Impaired Glucose Tolerance

LGA: Large For Gestational Age

MCA: Middle Cerebral Artery

List of Abbreviations

MODY: Maturity Onset Diabetes of the Young

NC: Normal Control

NCD: Non Communicable Diseases

NICU: Neonatal Intensive Care Unit

NS: Non Significant

NT: Nutrion Therapy

OFD: Occipitofrontal Diameter

OGTT: Oral Glucose Tolerance Test

PCOS: Polycystic Ovary Syndrome

PE: Pre-eclampsia

PI: Pulsatility Index

RA: Renal Artery

RI: Resistance Index

S: Systolic Peak

S/D: Systolic diastolic ratio

SPTD: Spontaneous Preterm Delivary

TAD: Transverse Abdominal Diameter

TNF: Tumor Necrosis Factor

TUVF: Total Umbilical Venous Flow

UA: Umbilical Artery

Vm: Mean Velocity

Table No. **Title** **Page**

Table No. **Title** **Page**

List of Figures

List of Figures

List of Figures

List of Figures

Abstract

Background: The offspring of women with gestational diabetes mellitus (GDM) are prone to macrosomia. However, birth weight is difficult to be correctly estimated by ultrasound because of fetal asymmetric growth characteristics. This study aimed at investigating the correlations between fetal hemodynamics, fetal growth indices in late pregnancy and birth weight in GDM.

Methods: A total of 180 women with GDM and 180 normal controls (NC) with singleton gestation and presented between 38-40 weeks gestation were enrolled in this study. Fetal hemodynamic indices, including the systolic/diastolic ratio (S/D), resistance index (RI), pulsatility index (PI) of umbilical artery (UA), middle cerebral artery (MCA), and renal artery (RA), were collected. Fetal growth indices, including biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL), were also measured by ultrasound. Birth weight, mode of delivery and need for Neonatal ICU admission data were collected.

Results: The independent samples *t*-test showed that BPD, HC, AC and FL were larger in GDM than in NC ($P < 0.05$). Birth weight was higher in GDM than in NC ($P < 0.001$). Among all included women, there was a highly statistically insignificant difference between GDM and NC groups as regard all ultrasound indices including UA_S/D, UA_RI, UA_PI, MCA_S/D, MCA_RI, MCA_PI, RA_S/D, RA_RI and RA_PI (P>0.05). Pearson's correlation analysis showed in GDM group that there was a highly statistically significant negative correlation between birth weight and the following ultrasound indices: (UA_RI, UA_S/D, UA_PI, MCA_RI and MCA_PI) and that there was a statistically significant positive correlation between birth weight & RA_RI (P<0.01) ($r = −0.273, −0.453, −0.537, −0.237, −0.265$ and 0.169 respectively, $P < 0.05$), but As regard NC group there was a highly statistically significant negative correlation between birth weight and the following ultrasound indices: (UA_S/D, UA_RI, UA_PI and MCA_PI) ($r = 0.148$, -0.360, -0.252 and -0.184 respectively, $P < 0.05$) but no correlation was found with any of renal artery indices ($P > 0.05$).

Conclusions: Fetal hemodynamic indices in late pregnancy might be helpful for estimating newborn birth weight in women with GDM.

Keywords: Fetus; Gestational Diabetes Mellitus; Infant; Middle Cerebral Artery; Renal Artery; Ultrasound; Umbilical Artery.

INTRODUCTION

Gestational diabetes mellitus, which is defined as glucose intolerance of variable degree with onset or first recognition during pregnancy accounts for 90% of cases of diabetes mellitus in pregnancy ***(Baptiste-Roberts et al., 2008).***

DM induced newborn and maternal complications include fetal death, fetal malformation, preeclampsia, intrauterine growth restriction, and fetal macrosomia. The incidence of fetal macrosomia ranges between 20% and 40% ***(Liu et al., 2014).***

Diabetic macrosomia increases the cesarean section rate and causes a long birth process, neonatal asphyxia, shoulder dystocia, clavicle fracture, and brachial plexus injury. Moreover, it raises the risk of subsequent type 2 diabetes. Diabetic macrosomia may also result in neonatal respiratory distress syndrome, hypoglycemia, hyperbilirubinemia, hypocalcemia, and hypomagnesemia ***(Hedderson et al., 2010).***

The size of the fetus is mainly assessed by measuring fetal growth indices using ultrasound including biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL). Fetal weight is automatically calculated by using Hadlock formula using BPD, HC, AC and FL by an ultrasonic instrument ***(Hadlock et al., 1985).***

However, birth weight is often inaccurately estimated using ultrasound in gestational diabetic mellitus mothers in late pregnancy because of fetal asymmetric growth characteristics ***(Ghi et al., 2010).***

The umbilical artery (UA) is the major vascular pathway connecting the fetus and placenta. The fetus obtains nutrients and oxygen through the umbilical circulation. The systolic/diastolic ratio (S/D), pulsatility index (PI), and resistance index (RI) are the hemodynamic indices of the fetoplacental circulation. The fetal middle cerebral artery (MCA) can directly reflect blood circulation of the fetal brain, and the S/D, PI, and RI are the hemodynamic indices of brain circulation ***(Fu and Olofsson, 2011).***

The fetal renal artery (RA) also tends to directly reflect blood perfusion of the fetal kidney. The RA is one of the organs sensitive to hypoxia and one of the first organs to have endothelial dysfunction ***(Surányi et al., 2013)***.

A previous study of 146 women with GDM showed a strong correlation between uterine artery doppler and birth weight than did that of the umbilical artery ***(Pietryga et al., 2006).***

Another study of 169 women with GDM showed that the PI of the umbilical artery of fetuses in pregnant women with GDM was negatively correlated with birth weight. This finding suggested that the UA was crucial for fetal growth ***(Quintero et al., 2016).***

A recent study of 226 women with GDM showed that the umbilical artery hemodynamic indices (S/D, PI, and RI) in late pregnancy were strongly negatively correlated with birth weight, but they did not correlate with fetal growth indices ***(Li et al., 2014).***

Research question:

Can hemodynamic indices predict birth weight accurately in pregnant diabetic women at term?

Research hypothesis:

Hemodynamic indices predict birth weight accurately in pregnant diabetic women at term.