

DOPPLER STUDY, CARDIOTOCOGRAPHY AND BIOPHYSICAL PROFILE IN GROWTH RESTRICTED FETUSES

THESIS

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و القياسات البيوفيزيائية
في الأجنة المحدودة النمو

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INTRODUCTION

Intrauterine growth restriction (IUGR) is a syndrome, characterized by failure of the fetus to attain its normal growth potentials; fetuses with IUGR, therefore represent a subset of fetuses designated small for gestational age (SGA). The term SGA describes a group of neonates with a birth weight below the 10th percentile. (*Karsdorp et al., 1994*).

This term doesn't distinguish between constitutionally small infants and growth delay due to underlying pathology. Underlying pathologies for IUGR include aneuploidy, non aneuploid syndromes, viral infections and associated fetal anomalies where outcomes are not altered by intervention. In contrast, placental dysfunction causes growth restriction in otherwise normal fetuses. These fetuses are at risk of progressive metabolic deterioration, with manifestations in almost any organ system, leading to adverse fetal and neonatal outcome. (*Baschat et al., 2000 and Bilardo et al., 2004*).

Because no therapy at present has been shown to significantly improve placental function, the goal of prenatal testing in such cases is to optimize the timing of delivery, late enough to avoid the sequel of iatrogenic severe prematurity, yet early enough to avoid fetal death. (*Cohn et al., 1974*).

Doppler ultrasonography, CTG and biophysical profile scoring (BPP) are the principal surveillance tools in pregnancies complicated by placental vascular insufficiency and fetal growth restriction (IUGR). These antenatal testing modalities aim to detect fetal compromise by evaluating fetal manifestations of altered oxygenation and metabolic status. Fetal cardiovascular responses are a prominent feature of this form of growth restriction and their assessment reflects disease severity. As placental blood flow resistance worsens, changes in descending aortic and cerebral blood flow resistance are observed in the compensated state. Finally deteriorations in venous Doppler parameters are observed and reflect alterations in cardiac

forward function in response to advanced placental insufficiency. (*Ferrazzi et al., 2002*).

Multi-vessel Doppler examination is able to accurately depict this progression in IUGR fetuses. Dynamic fetal variables (movement, tone, breathing and amniotic fluid volume) utilized for BPP and heart rate reactivity remain normal longer in the progression of IUGR Fetuses. (*Baschat et al., 2001*).

With progressive fetal compromise reduction of global fetal activity is followed by a decline in fetal heart rate reactivity, fetal breathing movement and amniotic fluid volume. (*Ribbert et al., 1993*).

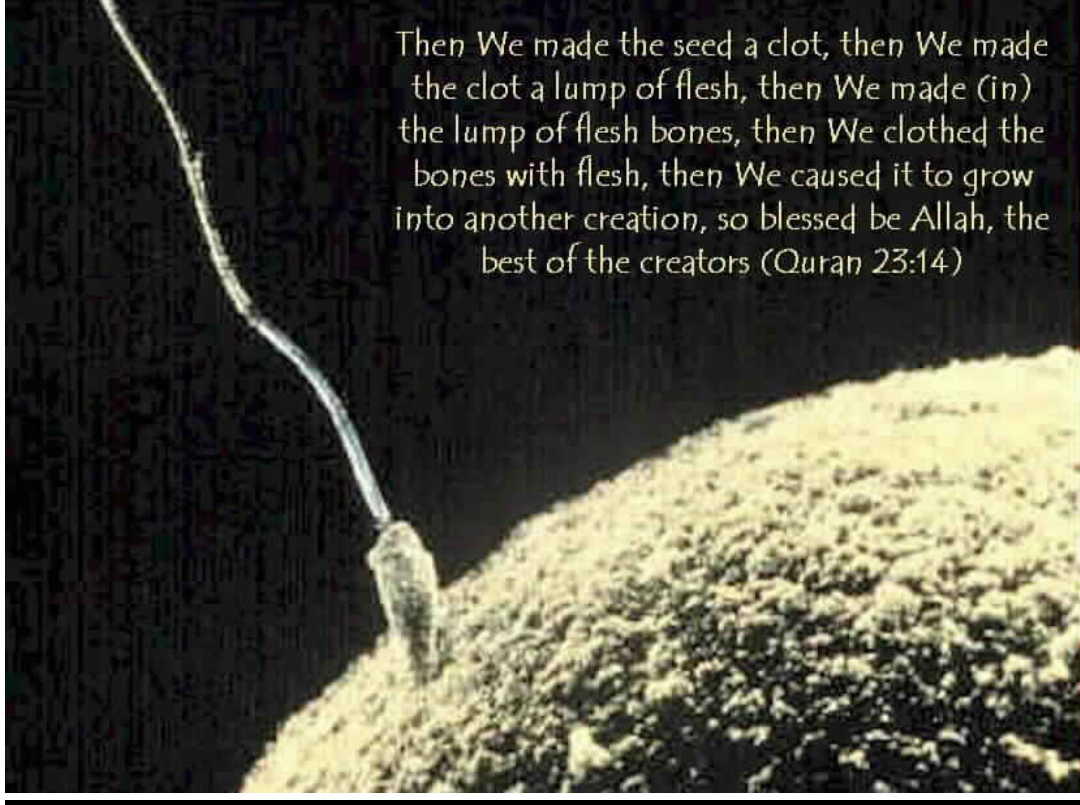
Finally, fetal tone and movements are lost in response to worsening acidemia. The BPP provides a good correlation with fetal acid-base status throughout the second half of pregnancy. (*Manning et al., 1993*).

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Aim of the Work

The aim of the work was to determine the distribution and relationship of arterial and venous Doppler, BPP and CTG test results in a population of IUGR fetuses with placental insufficiency and to correlate these results with umbilical artery PH at birth in IUGR fetuses to guide timing of delivery in these fetuses.

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Then We made the seed a clot, then We made the clot a lump of flesh, then We made (in) the lump of flesh bones, then We clothed the bones with flesh, then We caused it to grow into another creation, so blessed be Allah, the best of the creators (Quran 23:14)

"ثم جعلنا النطفة علقة فخلقنا العلقة
مضغة فخلقنا المضغة عظاما فكسونا
العظام لحما ثم أنشأناه خلقا آخر فتبارك
الله أحسن الخالقين"

سورة المؤمنون آية ١٤

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Before and above all, thanks to ALLAH who helped me to finish this work

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LIST OF ABBREVIATIONS

AC	Abdominal Circumference
AEDF	Absent End Diastolic Flow
AFV	Amniotic Fluid Volume
BMI	Body Mass Index
BPD	Bi-Parietal Diameter
BPM	Beats Per Minute
BPP	Biophysical Profile
CNS	Central Nervous System
CRL	Crown Rump Length
CST	Contraction Stress Test
CTG	Cardiotocography
CVS	Cardiovascular System
DV	Ductus Venosus
ECG	Electrocardiograph
EFW	Estimated Fetal Weight
FAA	Fetal Abdominal Area
FGR	Fetal Growth Restriction.
FHR	Fetal Heart Rate
FL	Femur Length
FWV	Flow Velocity Waveform
GIT	Gastrointestinal Tract
GTT	Glucose Tolerance Test
GUT	Genitourinary Tract
HC	Head Circumference
IUGR	Intrauterine Growth Restriction
L/S	Lecithin Sphingomyelin Ratio
LBW	Low Birth Weight
MCA	Middle Cerebral Artery
NST	Non-Stress Test
PI	Ponderal Index
PI	Pulsatility Index
REDF	Reversed End Diastolic Flow
RI	Resistance Index
SFH	Symphyseal Fundal Height
SGA	Small For Gestational Age.
UA	Umbilical Artery
UPI	Utero-placental insufficiency
WHO	World Health Organization

ABSTRACT

BACKGROUND:

Multi-vessel Doppler ultrasonograph, cardiotocography and biophysical profile scoring are the principal surveillance tools in pregnancies complicated by fetal growth restriction. The interpretation of these tests done concurrently may be complex.

OBJECTIVE:

This study examines the relationship between arterial and venous Doppler, BPP and CTG results in IUGR fetuses and correlates their abnormalities with umbilical artery PH at birth to guide timing of delivery of these fetuses.

DESIGN:

Prospective observational study.

SETTING:

Fetal Medicine Unit, Department of Obstetrics and Gynecology-Cairo University Hospitals-Kasr El Aini.

PATIENTS and METHODS:

50 patients diagnosed with intrauterine growth restriction (IUGR); all patients underwent uniform antenatal assessment protocol that includes a four component biophysical profile score, cardiotocography and umbilical artery (UA), middle cerebral artery (MCA) and ductus venosus (DV) Doppler ultrasound studies.

All patient were delivered by caesarean section. Samples were obtained from the umbilical cord for cord artery PH. Apgar scores at 1 and 5 minutes were recorded.

OUTCOME:

Correlation of Doppler results, BPP, CTG and cord blood PH were analyzed.

RESULTS:

There was no significant decrease in GA at time of termination in cases of IUGR with abnormal DV-PIV compared to those with only abnormal UA-PI and MCA PI. Abnormal UA-Doppler was found in 19 patients (38%); 16 of them showed high PI (32%), 2 showed absent end

diastolic flow (4%) and 1 showed reversed diastolic flow (2%). Abnormal MCA Doppler was found in 8 patients (16%) and abnormal DV Doppler was found in 9 patients (18%). The Abnormal DV Doppler was significantly related to poor outcome parameter; $pH < 7.20$, low Apgar at 5-min and perinatal mortality; when compared with either Abnormal MCA or UA Doppler ($p < 0.05$). While there was no significant difference between MCA and UA Doppler abnormalities in detecting poor outcome ($p > 0.05$). BPP was normal in 33 patients (66%), equivalent in 9 patients (18%) and abnormal in 8 patient (16%). The Abnormal and equivalent BPP were significantly related to poor outcome parameter; $pH < 7.20$, low Apgar at 5-min and perinatal mortality; when compared with normal BPP. ($p < 0.05$). CTG was reactive in 31 patients (62%), non reactive in 10 patients (20%) and showed loss of variability in 9 patients (18%). Loss of variability and non reactive CTG were significantly related to early GA at delivery, poor Apgar score at 1 and 5 min when compared with reactive CTG ($p < 0.05$). But these were of no significance in detecting $PH < 7.2$ ($p > 0.05$).

CONCLUSION:

The conclusion of our study is that there is an important association between DV abnormalities and adverse neonatal outcomes suggesting that the assessment of this vessel is important to determine the timing of delivery especially premature as once DV-PIV is elevated 2 SD above the mean delivery is indicated provided that the fetus has a good chance of postnatal survival. We concluded also that multi-vessel Doppler ultrasonography, CTG and BPP can effectively stratify IUGR fetuses with placental vascular insufficiency into risk categories. When applied together, the pattern of results is not perfectly consistent. Fetal deterioration appears to be independently reflected in these testing modalities: their combined use is likely to be complementary.

Keywords:

Doppler ultrasonography – Cardiotococraphy - Biophysical profile
- Fetal growth restriction.