COLOR DOPPLER EVALUATION OF CEREBRAL-UMBILICAL PULSATILITY INDICES AND RATIO AND ITS USEFULNESS IN THE DIAGNOSIS OF INTRAUTERINE GROWTH RETARDATION.

THESIS
Submitted For Partial Fulfillment Of M.Sc. Degree In Radiodiagnosis

By
Mohamed ElSayed Kamel AbdElAziz ElSayed
(M.B.B.CH)
Faculty Of Medicine
Cairo University

Supervisors

Prof. SohaTalaat Hamed
Prof. Of Radiodiagnosis
Faculty Of Medicine
Cairo University

Dr. Olfat Nouh Riad Ali
Assistant professor of gynecology and obstetrics
Faculty Of Medicine
Cairo University

Dr. Rasha Wessam AbdElRahman
Lecturer Of Radiodiagnosis
Faculty Of Medicine
Cairo University

Cairo University
2013

ACKNOWLEDGMENT

First, I would like to thank God who enables us to think, to search, and to conclude. No one can count the favors of God.

I wish to express my profound gratitude and deep appreciation to **Professor Dr. Soha Talaat Hamed**, Professor of radiodiagnosis, Faculty of Medicine, Cairo University, for giving me the advantage of working under her supervision, for her faithful guidance and for giving me great help for completing this work.

I am deeply indebted to **Professor Dr. Olfat Nouh Riad Ali,** Assistant Professor of obstetrics and gynecology, Faculty of Medicine, Cairo University, and **Dr. Rasha Wessam Abd ElRahman**, Lecturer of radiodiagnosis, Faculty of medicine, Cairo University for their close continuous encouragement, meticulous scientific supervision, all of them left their marks on each aspect of this work.

Many thanks to all staff members of radiology department and to my colleagues for their valuable support and help.

I would like to deeply thank my father and mother and all my family members who encouraged me and exerted all their effort in helping me to complete this work.

I'm grateful to my wife who helped me every second to finish this work and I appreciate this role.

LIST OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

AC	Abdominal Circumference
AEDF	Absent End Diastolic Flow
AFI	Amniotic Fluid Index
AFV	Amniotic Fluid Volume
BPD	Bi-Parietal Diameter
BPM	Beats Per Minute
BPP	Biophysical Profile
CNS	Central Nervous System
CRL	Crown Rump Length
CS	Cesarean Section
CST	Contraction Stress Test
CTG	Cardiotocography
C/U Ratio	Cerebro-Umbilical Ratio
CVS	Cardiovascular System
DV	Ductus Venosus
ECG	Electrocardiograph
EFW	Estimated Fetal Weight
FGR	Fetal Growth Restriction.
FHR	Fetal Heart Rate
FL	Femur Length
FN	False Negative
FP	False Positive
FVW	Flow Velocity Waveform
HC	Head Circumference
IUFD	Intra-Uterine Fetal Death
IUGR	Intra-Uterine Growth Restriction
LBW	Low Birth Weight
LMP	Last Menstrual Period
MCA	Middle Cerebral Artery
NICU	Neonatal Intensive Care Unit
NPV	Negative Predictive Value
NST	Non-Stress Test
PI	Pulsatility Index
PIH	Pregnancy Induced Hypertension
PPV	Positive Predictive Value
RDS	Respiratory Distress Syndrome
REDF	Reversed End Diastolic Flow
RI	Resistive Index
S/D	Systolic/Diastolic Ratio
SD	Standard Deviation
SFH	Symphyseal Fundal Height
SGA	Small For Gestational Age.
TN	True Negative

TP	True Positive
UA	Umbilical Artery
UPI	Utero-placental insufficiency
U/S	Ultra-Sound
VD	Vaginal Delivery
WHO	World Health Organization

ABSTRACT

BACKGROUND:

Multi-vessel Doppler ultrasonography 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:

To determine and compare the sensitivity, specificity and diagnostic accuracy of the fetal umbilical artery, middle cerebral artery pulsatility indices and their ratio for the prediction of adverse perinatal outcome in intrauterine growth restricted fetuses.

DESIGN:

Prospective cohort study.

PATIENTS and METHODS:

Thirty patients were studied that had been diagnosed clinically and ultrasonographically as intra-uterine growth restriction (IUGR). All patients in the study underwent uniform antenatal assessment protocol that includes a four component biophysical profile score, umbilical artery (UA) and middle cerebral artery (MCA) Doppler ultrasound studies. These were conducted either twice weekly or daily according to the severity of the condition. Thirty normal pregnancies were also studied as a control group. Patients were delivered by caesarean section or vaginally.

OUTCOME:

Predictive value of UA and MCA pulsatility indices and ratio in diagnosing and following IUGR as well as their ability to predict adverse perinatal outcome.

RESULTS:

Abnormal UA PI was found in 18 cases, 17 cases (56.7%) of the IUGR group and only 1 case (3.3%) of the control group.

Abnormal MCA PI was found in 24 cases, 18 cases (60%) of the IUGR group and 6 cases (20%) of the control group.

Abnormal C/U Ratio was found in 21 cases, 20 cases (66.7%) of the IUGR group and only 1 case (3.3%) of the control group.

Sensitivity, specificity, PPV, NPV and diagnostic accuracy were 56.6%, 96.6%, 94.4%, 90.6% and 76.6% for the UA PI, 60%, 80%, 75%, 66.6% and 66.6% for the MCA PI and 66.6%, 96.6%, 95.2%, 74.3% and 81.6% for the C/U Ratio.

UA PI and C/U Ratio were well correlated with adverse fetal perinatal outcome.

CONCLUSION:

Among the Doppler indices, the C/U ratio is a better predictor of IUGR fetuses and adverse perinatal outcome than either the UAPI or the MCA PI alone, with a high specificity and PPV. However, measurement of the UAPI (among all the Doppler indices) is enough to detect IUGR per se, probably because UAPI is a direct reflection of the resistance in the placental vascular bed. The MCA PI alone is not a reliable indicator.

We also concluded that multi-vessel Doppler ultrasonography and BPP scoring combined use is likely to be complementary in determining the optimum time of delivery and predicting adverse fetal perinatal outcome.

Keywords:

Doppler ultrasonography - middle cerebral artery - umbilical artery - pulsatility index - Biophysical profile - intra-uterine growth retardation - Fetal growth restriction.

INTRODUCTION

Intrauterine growth restriction (IUGR) is a syndrome, characterized by failure of the fetus to attain its normal growth potential ***(Malhotra etal., 2006).***Intrauterine growth restriction (IUGR) occurs in 3-10% of all pregnancies ***(Turan etal., 2007).***

IUGR is challenging because of the difficulties in reaching a definitive diagnosis of the cause and planning management. IUGR is associated not only with a marked increased risk in perinatal mortality and morbidity but also with long-term outcome risks. Combinations of fetal biometry, amniotic fluid volume, heart rate patterns, arterial and venous Doppler, and biophysical variables allow a comprehensive fetal evaluation of IUGR ***(Dikshit, 2011).***

The best screening tests have to be accessible, available and relatively inexpensive. They must also provide reproducible results and be acceptable to patients. ***(Mc Leod, 2008).***

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 & Harman, 2011).***

An adequate placental perfusion is crucial for the normal growth and well being of the fetus and newborn. The blood flow through the placenta can be compromised in a variety of clinical situations, always causing important damage to the gestation. Placental insufficiency promotes compensatory hemodynamic

fetal changes including blood flow redistribution towards essential fetal organs, at the expense of others. The fetal compensatory response results in increased blood flow to the brain, also called the "brain sparing effect". On the other hand, there is reduction in fetal growth, of liver size, and a reduction or absence of fat deposit. ***(Da Silva et al., 2007).***

Doppler usage has guided obstetric decision-making, particularly in growth-restricted fetuses. Controversy continues as to which is the best fetal vessel for deciding pregnancy continuation, vis-à-vis termination. Evidence from authorities recommend umbilical artery (UA) Doppler to be good, but supplementation of other vessels such as middle cerebral artery (MCA) or ductus venosus, may add value to decision-making ***(Malhotra et al., 2006).***

The challenge in monitoring pregnancies complicated by placental insufficiency remains today, as no method of diagnosis or follow-up is complete. The dilemma involves essentially premature babies since the effects of prematurity need to be highly considered. Research is still needed to help finding the best time of delivery, when the effects of fetal hypoxia become worse than those of the low gestational age and weight ***(Da Silva et al., 2007).***