

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

**THESIS**

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# LIST OF ABBREVIATIONS

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

<b>TP</b>	True Positive
<b>UA</b>	Umbilical Artery
<b>UPI</b>	Utero-placental insufficiency
<b>U/S</b>	Ultra-Sound
<b>VD</b>	Vaginal Delivery
<b>WHO</b>	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 et al., 2006*). Intrauterine growth restriction (IUGR) occurs in 3-10% of all pregnancies (*Turan et al., 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*).