



CLINICAL ARTICLE

# Prognostic value of umbilical-middle cerebral artery pulsatility index ratio in fetuses with growth restriction

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## KEYWORDS

Intrauterine growth restriction;  
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## Abstract

**Objective:** To study the utility of Doppler velocimetry and computerized cardiotocography in the management of intrauterine growth restriction and prediction of neonatal outcome. **Patients and methods:** Seventy-two pregnant women with fetuses showing growth restriction and delivered within 48 h of their last Doppler velocimetry evaluation. The last computerized cardiotocographic trace from these fetuses was used for statistical analysis, and the last trace from the healthy fetuses of 93 consecutive women undergoing cesarean section was used as control. Umbilical artery pulsatility index (UA PI), middle cerebral artery pulsatility index (MCA PI), UA PI/MCA PI ratio, and uterine artery resistance index (Ut RI) were assessed. **Results:** Among women with growth-restricted fetuses, all parameters were significantly higher in those who had hypertension; and in those who had diabetes, only the UA PI/MCA ratio was significantly higher. Umbilical artery PI values and the UA PI/MCA ratio were higher in those who had a nonreassuring result to computerized nonstress test immediately before delivery. A multiple logistic analysis showed that the UA PI/MCA ratio was the only Doppler velocimetry parameter predicting cardiotocographic nonreactivity; furthermore, the predictivity of extended newborn hospitalization (longer than 15 days) was verified, with a sensitivity of 56% and a specificity of 92% when the ratio was higher than 1.26. **Conclusion:** The MCA PI of fetuses with growth restriction should be assessed. The UA PI/MCA ratio is predictive of a nonreactive computerized cardiotocography trace and of prolonged neonatal hospitalization. © 2005 International Federation of Gynecology and Obstetrics. Published by Elsevier Ireland Ltd. All rights reserved.

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## 1. Introduction

Fetuses that do not reach their growth potential (based on growth curves whose inferior limit is the 10th percentile) according to gestational age are considered to be affected by intrauterine growth restriction (IUGR). It has been estimated that 3% to 10% of all newborns had fetal growth restriction [1].

Not all newborns with a birth weight lower than the 10th percentile are affected by a pathological growth restriction, however. Jacobson and colleagues and Gardosi and colleagues have shown that 25% to 60% of newborns considered small for their gestational age were of normal size when such factors as ethnicity and maternal weight, height, and parity were considered [2,3]. Growth potential is genetically determined, but the fetus needs an adequate intrauterine environment to reach its proper size [4].

The risk of perinatal mortality is approximately 4 to 8 times higher for fetuses with than for fetuses without growth restriction [5], and 50% of those with growth restriction who survive birth have high short- and long-term morbidity, including intrapartum respiratory distress, hypoglycemia, hypocalcemia, and meconium aspiration syndrome [6], as well as an increased incidence of abnormal neurological development [7].

This study was conducted to determine which ultrasonographic, cardiotocographic, and/or velocimetric parameters may identify growth-restricted fetuses at risk for neonatal complications.

## 2. Patients and methods

The participants, all of whom were white, were hospitalized in the third trimester of pregnancy at the Perinatology and Child Health Department of the Institute of Gynecological Sciences, Rome, Italy, between January 2000 and April 2004. They were continually monitored and deliveries, all by cesarean section, occurred before the 37th week of gestation.

Admission criteria were the following: (1) singleton pregnancy; (2) estimated fetal weight less than the 10th percentile; (3) follow-up visits always at this institute; (4) steroid therapy for induction of fetal lung maturity received more than 3 days before the Doppler velocimetry evaluation to avoid possible effects on fetal blood flow [8]; and (5) delivery at this institute and, when required, newborn transfer to the neonatal intensive care unit. The study group consisted of 72 pregnant

women, and 93 women with similar pregnancy durations were selected as controls. The controls were hospitalized for premature rupture of membranes, previous cesarean delivery, and/or fetal cardiotocographic alterations.

For all participants, anamnestic and clinical data were recorded regarding obstetric history and the presence of risk factors for IUGR such as diabetes, hypertension, smoking, and the use of alcohol and medications.

Gestational age was determined on the basis of the last menstrual period and results of the first-trimester ultrasonographic examination (crown-rump-length and biparietal diameter measurements). All underwent ultrasonographic, velocimetric, and cardiotocographic evaluations during hospitalization.

Ultrasonographic evaluations were performed using the Aloka SSD-2000 device (Aloka, Tokyo, Japan) and a convex 3.5 MHz probe. The biometric parameters considered were fetal biparietal diameter, head circumference, abdominal circumference, femur length, and estimated weight according to the Shepard and Hadlock formulas. Furthermore, amniotic fluid volume and placental grade were evaluated.

The Doppler velocimetric evaluation was performed 48 h before delivery for study participants and controls. The investigated parameters were umbilical artery pulsatility index (UA PI), middle cerebral artery pulsatility index (MCA PI), their numeric ratio (UA PI/MCA PI), and the resistance index of both uterine arteries (Ut RI). From the Doppler velocimetry study to delivery, no complications (e.g., placenta abruptio) were observed. Pulse wave velocity waveforms were obtained in real time, with the woman in supine position in the absence of gross fetal movements or fetal respiratory cycles [9,10], and by 1 only operator (J.P.) to avoid interobserver variation. Furthermore, the mean value of 2 measurements was recorded to avoid intraobserver variation.

Doppler velocimetry results were considered abnormal when, adjusted for gestational age, (1) UA PI was higher than the 95th percentile; (2) MCA PI was less than the 5th percentile; and (3) UA/MCA was greater than the 95th percentile. The presence or absence of the protodiastolic notch in the uterine artery waveforms and an absent or reverse end-diastolic flow in the umbilical arteries were also noted [11,12].

In the absence of rhythmic contractile uterine activity, computerized cardiotocography was performed a mean of twice daily using Sonicaid equipment (Oxford Instruments Plc, Eynsham, Witney, UK); the computerized analysis was done using

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