

Ultrasound parameters and L/S ratio in prediction of perinatal outcome in term-growth restricted newborns

I. Babovic¹, Z. Radojicic², S. Plesinac³, S. Aksam¹

¹*Institute of Obstetrics and Gynecology, Clinical Center of Serbia, Belgrade*

²*School of Organizational Sciences, University of Belgrade, Institute of Statistics, Belgrade*

³*School of Medicine, University of Belgrade, Belgrade (Serbia)*

Summary

Aim: The relation between biophysical profile (BPP), cerebroplacental (C/P) ratio, and lecithin/sphingomyelin (L/S) ratio as a predictor perinatal outcome in term intrauterine growth restricted (IUGR) neonates was evaluated. **Materials and Methods:** A retrospective study of the perinatal outcome of 77 term monofetal pregnancies complicated with IUGR fetuses (< 10 percentile) who were terminated by cesarean section in 2010 was performed at the Institute of Gynecology and Obstetrics, Belgrade. **Results:** The most frequent early neonatal complication was asphyxia. The authors found a strong correlation between the L/S ratio and birth weight (BW) $r = 0.609$, as well as between BPP and Apgar score 5 $r = 0.583$. Significant negative correlation was found between asphyxia and BPP $r = -0.398$, as well as between asphyxia and C/P ratio $r = -0.379$. **Conclusion:** In serous IUGR neonates, low values of BPP and L/S ratios predicted asphyxia.

Key words: Growth restricted neonates; Biophysical profile; Cerebroplacental ratio; Lecithin/Sphingomyelin ratio; Asphyxia; Respiratory distress syndrome.

Introduction

Intrauterine growth restriction (IUGR) is a serious complication of pregnancies which is associated with an increase in fetal and neonatal morbidities and mortality rates [1]. IUGR fetuses are either low-growth potential, as result of genetic disease or environmental damage, or due to reduced placental perfusion and utero-placental insufficiency, and are at increased risk of perinatal morbidity and mortality and will require close fetomaternal monitoring and probably earlier intervention. IUGR occurs when gas exchange and nutrient delivery to the fetus are not sufficient to allow it to thrive in utero. Intrauterine fetal demise, asphyxia, meconium aspiration, neonatal hypoglycemia, and hypothermia are increased in both preterm and term IUGR neonates [1, 2]. Ultrasonographic evaluation of the fetus is based on multi-etiology of this disorder and includes fetal biometry and amniotic fluid index if less than eight cm, can present early sign of decrease in fetoplacental circulation. In pregnancies complicated by placental dysfunction, there may be a reduction in the number of functional villi and/or small blood vessels with resulting increased impedance, mainly reflected by a decrease in end-diastolic velocity. When the resistance further increases, there is no diastolic forward velocity (absent end-diastolic velocity - AEDV). Further increase in the resistance causes reversed end-diastolic velocity (REDV) and middle cerebral centralization, a late step in the cascade of events leading to poor perinatal outcome [3]. Changes or absence of diastolic flow in the umbilical artery can be observed well before the biophysical profile (BPP) demonstrates abnormalities.

The cerebroplacental ratio (C/P) may change subtly in response to shifts in circulation, representing the earliest stages of brain sparing.

Changes in C/P ratio may provide an early warning system to initiate more detailed fetal surveillance using BPP score [4, 5]. The relative proportion of lecithin (disaturated phosphatidylcholine) and sphingomyelin are stable until the middle of the third trimester, at which time the pulmonary active phospholipid lecithin, increases relative to the non-pulmonary sphingomyelin. A lecithin/sphingomyelin (L/S) ratio of at least 2:1 is considered indicative of fetal maturity. L/S ratio is very important in diagnosis of fetal lung maturity and is indirectly determined by influence of fetal hypoxia [6].

The aim of the study was to evaluate the predictive value of ultrasonographic parameters resistance indices in umbilical and middle cerebral arteries, C/P ratio, BPP, and L/S ratio on early neonatal morbidity in term-growth restricted newborns.

Materials and Methods

Retrospective study of 77 term (36 to 42 weeks) single-live born IUGR neonates who were delivered by elective or urgent cesarean section in 2010 in this Institute. IUGR neonates were defined as birth weight (BW) below the 10th percentile for gestational age. The authors analyzed: maternal age, parity, maternal morbidity, gestational age at delivery, BW, Apgar score at 5th minute, and early neonatal morbidity. Antepartum fetal assessment was performed using: fetal biometry, amniotic fluid index, BPP, resistance indices in umbilical and middle cerebral arteries, the C/P and L/S ratios. Fetal weight was estimated using Hadlock's method based on measurements of the fetal head, body, and femur. The fetal BPP was performed daily for 20 min. A combined real-time pulsed Doppler system fitted with 3.75 MHz curvilinear probe was used. The spatial peak

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Fig. 1

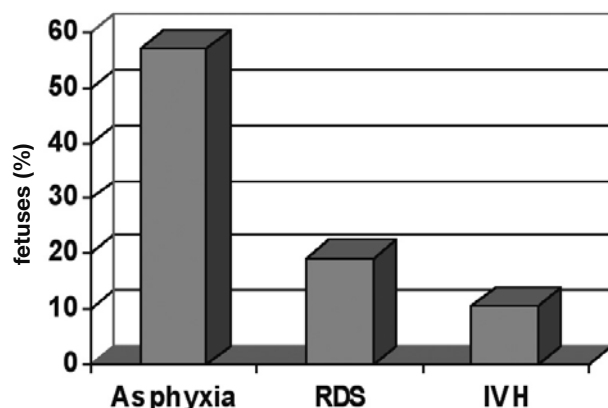


Figure 1. — Early neonatal morbidity.

temporal average power did not exceed 87 mW/cm. The Doppler angle of insonation was less than 30, the sweep speed was 2.5 cm/s, and the pulse repetition frequency ranged from 3.5 KHz to 5.0 KHz. The women rested in semi-recumbent position during Doppler examination. The same physician performed all measurements during fetal apnea. Blood velocity waveforms were obtained from both umbilical and fetal middle cerebral arteries. The umbilical artery was insonated close to its placental insertions and the middle cerebral artery about one cm distal to its origin from the internal carotid artery. The resistance index was calculated for each vessel by averaging the first two good quality resistance indices obtained from two consecutive waveforms. The C/P ratio less than one was considered abnormal. The last Doppler examination and the newborn evaluation were performed within five days of delivery. The specimens of amniotic fluid for estimate L/S was obtained by amniocentesis, 24 hrs before delivery. L/S ratio was estimated by Clemet's shake test.

Statistical analyses were performed using: Spearman's Rho-, and Student's t-test. Continuous variables were presented as mean (standard deviation as 95% confidence interval) assessed for normality or not. The Spearman's test of correlation was used to estimate significance of correlation between neonatal BW and L/S ratio, as well as the correlation between BPP/Apgar score 5, asphyxia/BPP, and asphyxia/C/P ratio.

Multifetal pregnancies, suspected fetal congenital malformations, and maternal Rh isoimmunization were excluded from the study.

Results

The mean maternal age participating in the study was 28.39 ± 5.2 years. Of the women, 21.8% were older than 35 years. Most of them were nulliparas (71%). Recurrent neonatal restricted growth was found in eight cases. The majority of women had an adequate prenatal care in their pregnancy (90.1%), but 10.9% were non-controlled. IUGR was diagnosed in 84.4% (65/77) fetuses.

BPP score was six in 35 (45.5%), while BPP score was four or less in 15 (19.50%) fetuses. Mean neonatal BW was $2,224 \pm 533$ grams (median 1,700; IQR 1,800). The most frequent early neonatal complications were asphyx-

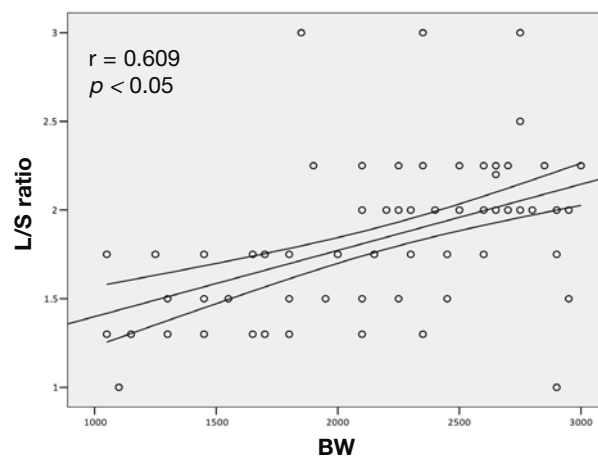


Fig. 2

Figure 2. — Neonatal BW significantly correlated with L/S ratio at delivery ($r = 0.609$; $p = 0.000$; Spearman's Rho test).

ia (57%), respiratory distress syndrome (RDS) (19.4%), and intraventricular hemorrhage (IVH) of different grade (10.5%) (Figure 1). There was a significant correlation between neonatal BW and L/S ratio ($p = 0.000$) (Figure 2).

C/R ratio less than one was diagnosed in 24.7% (19/77) fetuses. Apgar score at 5th min less than 7 occurred in 11 (14.3%) neonates. BPP showed significant correlation to low Apgar score 5 ($p < 0.05$). A significant negative correlation was found between frequency of asphyxia and BPP ($p = 0.000$), C/P ratio ($p < 0.05$), and L/S ratio ($p < 0.05$). Increasing incidence of RDS was in a statistically-negative correlation with L/S ratio ($p < 0.05$), BPP ($p = 0.003$), as well as with C/P ratio ($r < 0.05$). Elective cesarean sections were performed in 47/77 (61%) patients.

Discussion

The incidence of IUGR neonates increased more in nulliparous patients than in multiparous patients older than 30 years [7]. The growth restricted fetus can experience numerous complications in the neonatal period related to antepartal and intrapartal factors [4, 5]. Attempting to identify the cause of IUGR is important because it may have an influence on the estimate of recurrence and future pre-conceptional counseling, pregnancy management, prenatal diagnostic procedures, and neonatal management [7]. The majority of women (90.1%) had adequate prenatal care in pregnancy.

BPP scores were low in most of the high-risk pregnancies. Decrease in amniotic fluid index is long-term effect of chronic fetal hypoxia. Changes in the fetal heart rate are the first reactions to hypoxia regardless of the etiology [8]. BPP score less than four was diagnosed in 19.5% of IUGR fetuses in this study. Declining BPP scores strongly predicts increasing frequency of fetal distress and low five-minute Apgar score [5]. The authors found strong correlation between BPP and Apgar score 5 which was important for estimation of early and late complications among IUGR neonates.

The most frequent early neonatal complication was perinatal asphyxia in 57% but C/P ratio less than one was diagnosed in 24.7% fetuses. The combination of small abdominal circumference, normal anatomy, low BPP score values, and abnormal umbilical artery Doppler recording is strongly-suggestive of fetal IUGR due to placental insufficiency, i.e., in 24.7% of cases. Doppler may distinguish between small normal fetuses that will not manifest any abnormal placental vasculature, and fetuses affected by conditions causing restricted growth, secondary to placental condition and who are thus at higher risk of intrapartum difficulties and perinatal mortality [9]. The C/P ratio less than one provides identification of IUGR fetuses who are at higher risk for perinatal asphyxia. Changes in C/P ratio indicates the need for more intensive fetal monitoring using BPP which was also shown in this study [5]. Low BPP scores can also predict development of RDS as a result of prolonged intrauterine hypoxia.

Prolonged intrauterine hypoxia is inhibitor of synthesis components of surfactant and causes L/S ratio less than two, considered fetal immaturity and high-risk for neonatal asphyxia as in this study [6].

Conclusion

The risk of perinatal asphyxia and RDS were higher in IUGR neonates with lower BPP. Umbilical artery Doppler is a relative predictor of IUGR due to placental dysfunction, as well as the C/P ratio as relative predictor of neonatal asphyxia.

L/S ratio less than two as a result of chronic intrauterine hypoxia is associated with increased incidence of asphyxia and RDS in term IUGR neonates. It seems that neonatal BW is the best predictor of pulmonary maturity in high-risk pregnancies.

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Address reprint requests to:

I. BABOVIC, M.D.

63/27 Luke Vojvodica St. Belgrade

11000 Belgrade (Serbia)

e-mail: ivana.r.babovic@gmail.com