

## Middle Cerebral to Umbilical Artery Resistancy in High Risk Pregnancies in the Prediction of Perinatal Outcome

<sup>1</sup>M.K. Tarzami, <sup>1</sup>Fatemeh Ghatresamani, <sup>2</sup>Simin Tagavi, <sup>1</sup>Isa Adibfar and <sup>1</sup>Sara Farhang

<sup>1</sup>Department of Radiology, <sup>2</sup>Department of Gynaecology and Obstetrics, Tabriz University of Medical Sciences, Tabriz, Iran

**Abstract:** Antenatal fetal surveillance tests have led to a significant decrease in perinatal mortality and morbidity rates especially in high risk pregnancies. There is no concurrence on the best and accurate modality yet. The aim of this study is to evaluate, accuracy of antenatal assessment with biophysical profile and Doppler sonography (cerebral and umbilical artery) regarding fetal acidosis and asphyxia. This is a cross-sectional study on fetus of 70 women with 28-42 weeks singleton pregnancy, which had hypertension, diabetes mellitus or intra uterine growth retardation and were admitted as high risk pregnancies. Study population routinely underwent sonographic evaluation of cerebral and umbilical arteries and biophysical profile twice a week. Infants who had a lower score of biophysical profile, had a lower umbilical Ph and negative base deficit. Fetuses with a lower C/U RI Index had higher base deficit and acidosis (measured from umbilical blood) after birth. Apgar on 5 min was higher in infants with a history of higher profile score, as well as a higher C/U RI Index ratio. On the other hand, there was no significant correlation between MCA RI index or UA RI and Ph or base deficit of umbilical Ph, neither with apgar on 5 min. Biophysical profile and assessment of umbilical and cerebral arteries are valuable modalities for predicting fetus condition and outcome in high risk pregnancies. C/U RI Index ratio is a better indicator compared to its components.

**Key words:** Middle cerebral artery, umbilical artery, antenatal surveillance, modified biophysical profile, doppler ultrasonography

### INTRODUCTION

Antenatal screening gives valuable information about status of the fetus and whether there is a need to intervention in high risk conditions. Many studies suggest antenatal fetal surveillance tests for significant reduction in perinatal mortality and morbidity (Ott *et al.*, 1998; Porto, 1987). The modalities of ante-partum test are selected according to underlying pathophysiology and there is no ideal test for high risk fetuses yet. Biophysical Profile (BPP) scoring is one of the most regularly utilized devices to assess pregnancies in higher risk but its efficacy or wastefulness compared to other ante-partum tests is not proven yet (Lalor *et al.*, 2008).

Another, widely used modality to follow up pregnancies complicated by hypertension, diabetes or intrauterine growth retardation is Doppler ultrasound imaging (Fleischer *et al.*, 1985; Trudiger *et al.*, 1985; Bracero *et al.*, 1986). An index reflecting circulatory insufficiency of the umbilical artery as well as adaptive changes/modifications of cerebral artery (i.e., middle cerebral to umbilical artery resistance (C/U) ratio) is

reported to be sensitive and specific for prediction of fetal outcome.

The objective of the present study was to evaluate the usefulness of well known biophysical profile scoring and the middle cerebral artery to umbilical artery resistance index ratio as predictors of adverse perinatal outcome in high-risk pregnancies. Doppler results of the fetal circulation were compared with well-established routine parameters of fetal assessment such as the biophysical profile score.

### PATIENTS AND METHODS

Singleton pregnancies (24-42 weeks of gestation) complicated with hypertension, diabetes or intrauterine growth restriction were included in this prospective study, at Saint Zahra Hospital, Tabriz, Iran. The duration of pregnancy was determined from the last normal menstrual period and confirmed by ultrasonographic biometry at 20 weeks. A total of 70 patients with either diastolic pressure >90 mmHg/proteinuria >300 mg, fetal weight below the tenth percentile for gestational age by

sonographic biometry, blood sugar (BS) >200, Fasting BS >200 mg dL<sup>-1</sup> or 2 h post prandial BS >95 mg dL<sup>-1</sup> who underwent a caesarean delivery were enrolled in this study. The decision to deliver was made on the basis of a non-stress test, biophysical profile and maternal condition by the obstetrician who had access to the C/U ratio as well.

We used a blood sample from umbilical artery of neonates after a caesarean delivery to achieve the closest result to fetal status. Blood Ph and base deficit were then recorded. Apgar score at 5 min was collected as pregnancy outcome.

BPP and ultrasonographic evaluations were performed twice a week and at least one scan was performed. The colour Doppler Aloka 3500 Pro Ultrasonography (Convex 3.5 MHz probe) was used to visualize the circle of Willis and Doppler sample volume was placed within 1 cm of the origin of the MCA that was easily identified as a major branch running anterolateral from the circle of Willis toward the lateral edge of the orbit. Umbilical artery Doppler resistance index was estimated on a free loop of cord in the absence of fetal breathing schedule.

The SPSS statistical package (ver. 13) was used to analyze the data. Correlation for continuous variables was determined by the simple pearson correlation. A value of  $p < 0.05$  was considered to be significant.

## RESULTS AND DISCUSSION

Score for the last biophysical profile was correlated with observed C/U ratio ( $p < 0.005$ ,  $r = 0.468$ ). C/U ratio was positively correlated with blood Ph ( $p = 0.036$ ,  $R = 0.251$ , Fig. 1) and base deficit ( $p = 0.024$ ,  $R = 0.279$ , Fig. 2). Lower fetal C/U was followed by lower blood Ph and more base deficit. C/U ratio was correlated with 5 min apgar as well ( $p = 0.006$ ,  $R = 0.323$ , Fig. 3).

Significant results were observed for BPP. Fetuses with a lower BPP score had a lower umbilical blood Ph ( $p = 0.024$ ,  $R = 0.269$ , Fig. 1) and more base deficit ( $p = 0.043$ ,  $R = 0.243$ , Fig. 2). BPP score was correlated with apgar on 5 min ( $p = 0.012$ ,  $R = 0.299$ , Fig. 3) as well.

Neither middle cerebral artery nor umbilical artery resistance indices were significantly correlated with blood Ph, base deficit of apgar on 5 min.

We found that both BPP score and C/U ratio satisfactorily facilitate appraising fetal status and neonate outcome in pregnancies complicated by hypertension, diabetes or IUGR.

The search for better surveillance techniques in IUGR fetuses is still progressing. Significantly, improvement of outcome (Platt *et al.*, 1983) and reduction in perinatal

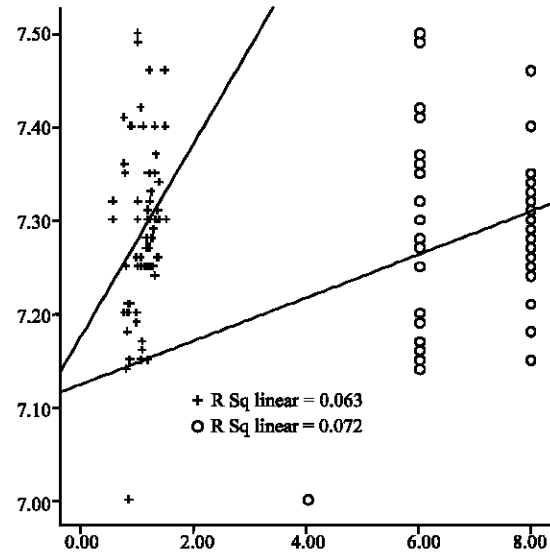


Fig. 1: Correlation between umbilical artery Ph of neonates with last C/U ratio and score of last biophysical profile in high risk pregnancies

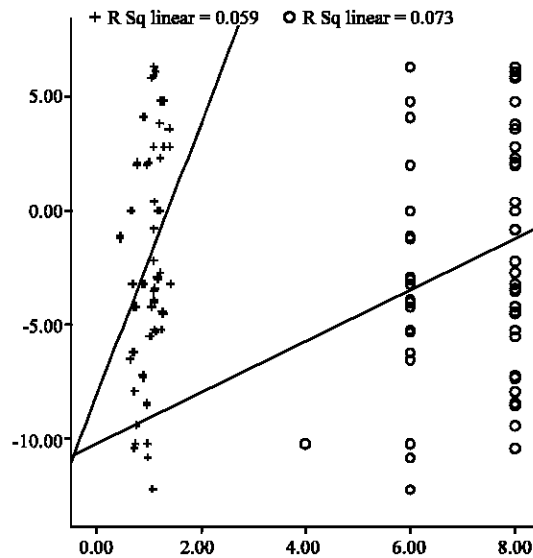


Fig. 2: Correlation between base deficit in neonates with last C/U ratio and score of last biophysical profile in high risk pregnancies

mortality (Maning *et al.*, 1991) is reported by using BPP for management of high risk pregnancies despite its limitations. Detailed study of cardiovascular system is available by examination of blood flow dynamics with doppler ultrasonography. Advances in Doppler ultrasonography had facilitated the possibility of using fetal cranial circulation together with umbilical wave forms as a fetal surveillance test (Alfirevic and Neilson,

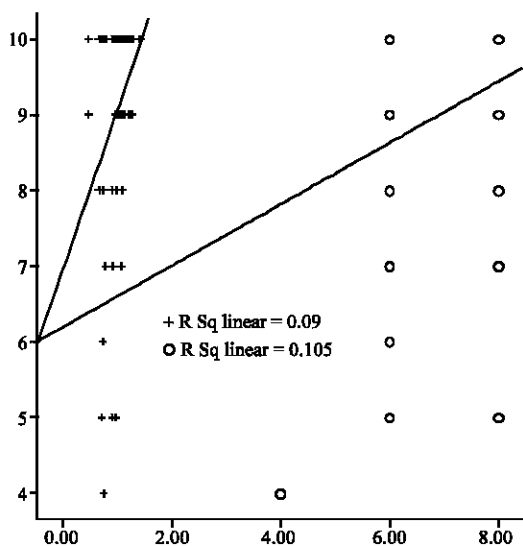


Fig. 3: Correlation between apgar of neonate in 5 min with last C/U ratio and score of last biophysical profile in high risk pregnancies

1995; Divon, 1996). This will represent adaptive to acidosis and hypoxemia changes in fetal circulation. Blood-flow dynamics in IUGR fetuses are related to several factors including vascular resistance and differential organ autoregulation (Baschat, 2001). Identified as brain sparing phenomenon; vascular resistance is increased in the umbilical arteries and decreased in the intracranial arteries in growth restricted fetuses. So, that the cerebral blood flow is preserved.

Doppler and biophysical variables are endpoints reflecting altered methods of fetal compromise in IUGR. Studies support comparison of these 2 tests. Application of biophysical profile scoring to a population of IUGR fetuses that has been selected by Doppler examination yields good results (Divon, 1989; Gramellini *et al.*, 1992). We observed a significant correlation between BPP score and C/U ratio, which is compatible with previous reports (Arduini and Rizzo, 1992). This supports independently usefulness of these 2 tests in antenatal surveillance. Future well designed researches may detect efficacy of using a combination of them.

Our study also, showed that C/U RI had a better value than either middle cerebral or umbilical artery resistance indices as measured by Doppler in predicting poor neonatal outcome. Some others authors have previously reported that C/U RI was more accurate than each of its components in the diagnosis of fetal morbidity and compromise (McCowan and Duggan, 1992; Ebrashy *et al.*, 2005).

## CONCLUSION

Both Doppler Ultrasonography and BPS can effectively demonstrate vascular insufficiency in high risk fetuses with a favourable correlation, yielding an opportunity to improve fetal outcome.

## REFERENCES

- Alfirevic, Z. and J.P. Neilson, 1995. Doppler ultrasonography in high-risk pregnancies: Systematic review with metaanalysis. *Am. J. Obstet. Gynecol.*, 172: 1379-1387. DOI: 3053,35400005092037.0030. PMID: 7755042. <http://cat.inist.fr/?aModele=afficheN&cpsid=3566026>.
- Arduini, D. and G. Rizzo, 1992. Prediction of fetal outcome in small for gestational age fetuses: Comparison of Doppler measurements obtained from different fetal vessels. *J. Perinat. Med.*, 20: 29-38. PMID: 1608021.
- Baschat, A.A., U. Gembruch and C.R. Harman, 2001. The sequence of changes in Doppler and biophysical parameters as severe fetal growth restriction worsens. *Ultrasound Obstet. Gynecol.*, 18: 571-577. DOI:10.1046/j.0960-7692.2001.00591.PMID: 11844191. <http://www3.interscience.wiley.com/cgi-bin/fulltext/101525380/PDFSTART>.
- Bracero, L., H. Schulman, A. Fleischer, G. Farmakides and B. Rochelson, 1986. Umbilical artery velocimetry in diabetes and pregnancy. *Obstet. Gynecol.*, 78: 654-658. PMID: 3763078. <http://lib.bioinfo.pl/pmid:3763078>.
- Divon, M.Y., 1996. Umbilical artery doppler velocimetry: Clinical utility in high-risk pregnancies. *Am. J. Obstet. Gynecol.*, 174 (1 Pt 1): 10-14. DOI: 3053,35400005515094.0010. PMID: 8571990. <http://cat.inist.fr/?aModele=afficheN&cpsid=2970939>.
- Divon, M.Y., B.A. Girz, R. Lieblich and O. Langer, 1989. Clinical management of the fetus with markedly diminished umbilical artery end diastolic flow. *Am. J. Obstet. Gynecol.*, 161: 1523-1527. PMID: 2690628. <http://international.inist.fr/article39.html>.
- Ebrashy, A., O. Azmy, M. Ibrahim, M. Waly and A. Edris, 2005. Middle cerebral/umbilical artery resistance index ratio as sensitive parameter for fetal well-being and neonatal outcome in patients with preeclampsia: Case-control study. *Croat. Med. J.*, 46 (5): 821-825. PMID: 16158478. <http://www.cmj.hr/2005/46/5/16158478.pdf>.
- Fleischer, A., H. Schulman, G. Farmakides, L. Bracero, P. Blattner and G. Randolph, 1985. Umbilical artery velocity waveforms and intrauterine growth retardation. *Am. J. Obstet. Gynecol.*, 151: 502-506. PMID: 3976751.

- Gramellini, D., M.C. Folli, S. Raboni, E. Vadora and A. Meriardi, 1992. Cerebral-umbilical Doppler ratio as a predictor of adverse perinatal outcome. *Obstet. Gynecol.*, 79: 416-420. PMID: 1738525.
- Lalor, J.G., B. Fawole, Z. Alfirovic and D. Devane, 2008. Biophysical profile for fetal assessment in high risk pregnancies (Cochrane review). *Cochrane Database Syst. Rev.*, 23 (1): CD000038. DOI: 10.1002/14651858. PMID: 18253968. <http://mrw.interscience.wiley.com/cochrane/clsystrev/articles/CD000038/frame.html>.
- Maning, F.A., C.R. Harman, S. Menticoglou and I. Morrison, 1991. Assessment of fetal well-being with ultrasound. *Obstet. Gynecol. Clin. North Am.*, 18 (4): 891-905. PMID: 1803308.
- Mc Cowan, L.M. and P.M. Duggan, 1992. Abnormal internal carotid and umbilical artery doppler in the small for gestational age fetus predicts an adverse outcome. *Early Hum. Dev.*, 30: 249-259. DOI: 17562,35400003202844.0070. PMID: 1468387. <http://cat.inist.fr/?aModele=afficheN&cpsidt=4392295>.
- Ott, W.J., G. Mora, F. Arias, S. Sunderji and G. Sheldon, 1998. Comparison of the modified biophysical profile to a new biophysical profile incorporating the middle cerebral artery to umbilical artery velocity flow systolic/diastolic ratio. *Am. J. Obstet. Gynecol.*, 178: 1346-1353. DOI: 10.1177/875647939801400619. PMID: 9662321. <http://cat.inist.fr/?aModele=afficheN&cpsidt=2312966>.
- Platt, L.D., G.S. Eglinton, L. Sipos, P.M. Broussard and R.H. Paul, 1983. Further experience with the fetal biophysical profile. *Obstet. Gynecol.*, 61 (4): 480-485. PMID: 6681892. <http://www.greenjournal.org/cgi/reprint/61/4/480>.
- Porto, M., 1987. Comparing and contrasting methods of antenatal surveillance. *Clin. Obstet. Gynecol.*, 30: 956-967. PMID: 3319326.
- Trudinger, B.J., W.B. Giles and C.M. Cook, 1985. Uteroplacental blood flow velocity-time waveforms in normal and complicated pregnancy. *Am. J. Obstet. Gynecol.*, 152: 155-163. DOI: 10.1111/j.1471-0528.1985.tb01046. PMID: 3890544. <http://www3.interscience.wiley.com/journal/119516310/abstract>.