ORIGINALARTICLE

Colordoppler evaluation of cerebral-umbilical pulsatility ratio and its usefulness in the diagnosis of intrauterine growth retardation and prediction of adverse perinatal outcome

Saurabh Singla

Associate Professor, Department of Radio Diagnosis, Saraswathi Institute of Medical Sciences, Hapur, Uttar Pradesh, India

ABSTRACT:
Background: To evaluate the usefulness of the pulsatility index (PI) of the umbilical artery (UA) and that of the fetal middle cerebral artery (MCA), as well as the ratio of the MCA PI to the UA PI (C/U ratio), in the diagnosis of small-for-gestational-age (SGA) fetuses and in the prediction of adverse perinatal outcome. **Materials & methods:** A total of 50 pregnancies of 30-40 weeks gestation that had been diagnosed clinically as intrauterine growth retardation (IUGR) over a period of 1 year were enrolled. The UA PI and the MCA PI as well as the C/U ratio were calculated.$P < 0.05$ was considered significant. **Results:** A total of 50 pregnancies in the study were included. 15 showed abnormal UA PI. Among these, 13 were SGA and 12 had adverse perinatal outcome. In the cerebral-umbilical ratio, 20 (100%) fetuses were SGA and all had an adverse perinatal outcome. **Conclusion:** The C/U ratio is a better predictor of SGA fetuses and adverse perinatal outcome than the MCA PI or the UA PI used alone.
Keywords: pulsatility index, umbilical artery pulsatility index, middle cerebral artery pulsatility index.

Corresponding Author: Saurabh Singla, Associate Professor, Department of Radio Diagnosis, Saraswathi Institute of Medical Sciences, Hapur, Uttar Pradesh, India

INTRODUCTION

Intrauterine growth restriction (IUGR) is associated with increased perinatal mortality and morbidity, possibly extending also in adult life, as compared to fetuses and newborns presenting characteristics of normal growth. It is important to make a definite diagnosis based on the best criteria in order to decrease the perinatal mortality and morbidity associated with IUGR. Various studies all over the world have given different modalities to diagnose IUGR; the latest in the series to diagnosis IUGR antenatally is the analysis of Doppler blood flow velocity waveforms of fetal and maternal vessels. The clinical and ultrasound measurements diagnose IUGR at a very late stage when the fetus is already compromised, whereas Doppler waveform studies can detect IUGR at an early stage, so that the affected fetus can be delivered without significant compromise. The color Doppler ultrasound gives us information directly on vascular resistance and indirectly on blood flow. The present study had been planned to measure the pulsatility index (PI) and resistive index (RI) of the middle cerebral artery (MCA) and PI and RI of the umbilical artery (UA) in predicting fetal growth restriction.[1,2]
Doppler USG enables a better understanding of the hemodynamic changes and has therefore become one of the most important clinical tools for fetomaternal surveillance in high-risk pregnancies. It can be credited with causing a significant decrease in perinatal mortality and morbidity.[3]Umbilical arteries are the common vessels assessed by Doppler ultrasound, but recent studies confirm the efficacy of middle cerebral artery (MCA) Doppler assessment and advocate it.[4] MCA Doppler measurement is a well-known modality for detecting fetal compromise.[5] Some studies has showed that MCA blood flow abnormalities were associated with hypoxia and adverse perinatal outcome.[6,7] Relationship between fetal Doppler findings and perinatal risks have been defined in numerous cross-sectional studies. [8]Several studies have reported higher sensitivities and specificities for middle cerebral artery/umbilical artery (MCA/UA) Doppler ratio compared with umbilical artery velocimetry alone for the prediction of the fetal prognosis. [9,10] Hence, this study was conducted to evaluate the usefulness of the pulsatility index (PI) of the umbilical artery (UA) and that of the fetal middle cerebral artery (MCA), as well as the ratio of the MCA PI to the UA PI (C/U ratio), in the diagnosis of small-for-gestational-age (SGA) fetuses and in the prediction of adverse perinatal outcome.

MATERIALS & METHODS

A total of 50 pregnancies of 30-40 weeks gestation that had been diagnosed clinically as intrauterine growth retardation (IUGR) over a period of 1 year were enrolled. The UA PI and the MCA PI as well as the C/U ratio were calculated. Doppler velocimetry was considered as normal when the C/U ratio was above 1.08, and below that value, velocimetry was considered abnormal. The PI in the IUGR group was

compared with that in the normal study group using the chi square test and Fischer's exact test. P < 0.05 was considered significant.

Results

A TOTAL of 50 pregnancies in the study were included. 15 showed abnormal UA PI. Among these, 13 were SGA and 12 had adverse perinatal outcome. 5 of the 50 pregnancies showed abnormal MCA PI and all 5 (100%) fetuses were SGA and all (100%) had adverse perinatal outcome. Still birth was noted in one pregnancy, which showed a normal MCA PI. In the cerebral-umbilical ratio, 20 (100%) fetuses were SGA and all had an adverse perinatal outcome.

Table 1: Perinatal outcome according to the values of umbilical artery pulsatility index

Outcomes	Normal PI (n= 35)	Abnormal PI (n= 15)	P- value
Adverse perinatal outcome	3	12	0.001
Caesarean section for fetal distress	1	10	0.001
Stay in NICU>8 days	2	6	0.001
Still birth	-	1	0.01
Small-for-gestational age (birth weight less than 10th percentile for gestational age)	12	13	0.001

NICU - Neonatal intensive care unit; CS - Caesarian section

Table 2: Perinatal outcome of the study population according to the values of middle cerebral artery pulsatility index

Outcomes	Normal PI (n= 45)	Abnormal PI (n= 5)	P- value
Adverse perinatal outcome	10	5	0.001
Caesarean section for fetal distress	8	3	0.04
Stay in NICU>8 days	7	3	0.04
Still birth	1	1	0.001
Small-for-gestational age (birth weight less than 10th percentile for gestational age)	20	5	0.04

Table 3: Perinatal outcome of the study population according to the cerebral-umbilical ratio

Outcomes	Normal PI (n= 30)	Abnormal PI (n= 20)	P- value
Adverse perinatal outcome	2	20	0.001
Caesarean section for fetal distress	1	18	0.001
Stay in NICU>8 days	2	12	0.001
Still birth	-	1	0.01
Small-for-gestational age (birth weight less than 10th percentile for gestational age)	10	20	0.001

DISCUSSION

Advances in Doppler ultrasonography have improved access to the fetal circulation. There has been a great deal of interest in the fetal intracranial vessels. [11]Knowledge of Doppler flow velocimetry of the fetal MCA may assist in perinatal diagnosis and management of complicated pregnancies. A low index of pulsatility in the middle cerebral artery associated with fetal compromise has been described.[12,13] Because the MCA/UA ratio incorporates data not only on placental status but also on fetal response, it is potentially more advantageous in predicting perinatal outcome. Doppler data combining both umbilical and cerebral velocimetry provide additional information on fetal consequences of the placental abnormality. [14]Hence, this study was conducted to evaluate the usefulness of the pulsatility index (PI) of the umbilical artery (UA) and that of the fetal middle cerebral artery (MCA), as well as the ratio of the MCA PI to the UA PI (C/U ratio), in the diagnosis of small-for-gestational-age (SGA) fetuses and in the prediction of adverse perinatal outcome.

In the present study, a total of 50 pregnancies in the study were included. 15 showed abnormal UA PI. Among these, 13 were SGA and 12 had adverse perinatal outcome. 5 of the 50 pregnancies showed abnormal MCA PI and all 5 (100%) fetuses were SGA and all (100%) had adverse perinatal outcome. A study by Shahinaj R et al, the study population into two groups depending on normal or abnormal value of MCA/UA pulsatility index ratio. In 314 patients we found abnormal values of MCA/UA pulsatility index ratio. Neonates of mothers with abnormal values of MCA/UA pulsatility index ratio had significantly lower gestational age at delivery (34.8 versus 38.4, P<0.0001), lower birth weight (2174.6 g versus 3215.0g, P<0.001), significantly greater risk for perinatal death (30.8% versus 0.23%, P<0.0001)

significantly greater risk of admission to intensive care unit (77.8% versus 47.4%, P<0.0001), longer duration of treatment in NICU (10.6 days versus 6.5 days, P<0.0001), greater rate of cesarean delivery for fetal distress (76.7% versus 62.5%,P<0.0001), a great number of neonates with low Apgar score at 5 minute (61.9% versus 22.4%, P<0.0001) greater rate of cesarean delivery for fetal distress (71.9% versus 62.5%,P<0.0001), a great number of fetuses IUGR (7.18% versus 1.76%,P<0.0001). ACM/UA pulsatility index ratio is a very good predictor of adverse outcome in the fetuses of women with preeclampsia and gestational hypertension.[15]

In the present study, still birth was noted in one pregnancy, which showed a normal MCA PI. In the cerebral-umbilical ratio, 20 (100%) fetuses were SGA and all had an adverse perinatal outcome. Another study by Khanduri S et al, the umbilical artery PI had maximum sensitivity at the third visit (32–37 weeks) and maximum specificity also at the third visit (32–37 weeks). The umbilical artery resistive index had maximum sensitivity at the second visit (28–32 weeks) and maximum specificity at the third visit (32–37 weeks). The MCA PI had an overall diagnostic accuracy of 52.8 %. The PI of the umbilical artery was more sensitive than the PI of the middle cerebral artery. Umbilical artery PI has the maximum overall diagnostic accuracy of 75 %.[16]Shahina et al. [17]concluded that the C/U ratio is a better predictor of SGA fetuses and adverse perinatal outcome than the MCA PI or the UA PI used alone; the UA PI can be used to identify IUGR per se, and the MCA PI alone is not a reliable indicator for predicting fetal distress. Jurisic et al. [18] concluded that the reliability of C/U ratio in the estimation of fetal condition in preeclamptic patients is high. Very low C/U ratio values in patients with preeclampsia indicate that in these fetuses, fetal acidosis and fetal distress may be expected.Yushimura et al. [19] found a significant association between MCA/UA pulsatility index ratio and HC/AC ratio. They also found a close correlation between MCA/UA PI ratio and birth weight. Recently Banu[20] measured RI and PI in UA and MCA and also the RI & PI ratios between these arteries. The result of this study indicated that measurement of PI value in the UA is enough to detect IUGR per se, probably due to reflection of decrease placental vascular bed, but the ratio of indices between UA and MCA is more accurate than independent evaluations in identifying fetuses developing distress, reflecting a brain sparing effect as well as fetoplacental insufficiency.

CONCLUSION
The C/U ratio is a better predictor of SGA fetuses and adverse perinatal outcome than the MCA PI or the UA PI used alone.

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