

Original Research Article

Doppler velocimetry of umbilical, and middle cerebral arteries in the prediction of fetal outcome

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Received: 02 October 2017

Accepted: 11 October 2017

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ABSTRACT

Background: Doppler ultrasound offers a unique non-invasive technology for investigating fetal, fetoplacental and uteroplacental circulation. Intrauterine growth restriction is associated with increased perinatal morbidity and mortality.

Methods: A hospital based descriptive study of Doppler velocimetry of umbilical Artery and Middle cerebral Artery was carried out in the Department of Obstetrics and Gynecology Pariyaram Medical College over a period of 1 year – April 2016 to March 2017. A total of 180 patients with clinically IUGR were selected for the study. Close monitoring done with daily NST and repeated Doppler study.

Results: The S/D ratio in Umbilical artery and RI ratio of MCA is valuable for monitoring growth retarded and small for gestational age fetuses and to take decision for early termination of pregnancy. In our study, perinatal outcome is very good, only 3 NND happened. i.e., due to extreme prematurity.

Conclusions: Colour Doppler helps in detection of compromised fetuses in high risk pregnancies like PIH, IUGR and other risk factors likely to cause placental insufficiency.

Keywords: Dopplerultrasound, Fetal, Fetoplacental, Uteroplacental circulation

INTRODUCTION

Doppler velocimetry is the best method of surveillance for fetal hypoxemia in high-risk pregnancy.¹ It is a non-invasive method for assessing fetal circulation. Its indices provide important information on the hemodynamics of the vascularity of fetal vessels. Umbilical and Middle cerebral arteries are commonly assessed. Middle cerebral artery doppler measurement is a well-known modality for detecting fetal compromise.² Studies have shown that MCA Doppler abnormalities were associated with hypoxia and adverse perinatal outcome.³ In high risk pregnancies like PIH and IUGR, MCA blood flow is increased by reducing the resistance index i.e., called brain sparing effect. Doppler study gives valuable information about hemodynamic situation of the fetus

and is an efficient diagnostic test of fetal jeopardy that helps in the management of high risk pregnancy.¹ Upto 16 weeks of gestation, an early diastolic notch is usually present in the uterine artery. Abnormalities in uterine artery Doppler are the presence of diastolic notch in the second trimester. It is a predictor of pre-eclampsia and IUGR.⁴

Abnormal wave form of the umbilical arteries occur in case of arteries of tertiary villi due to thrombosis and fibrinoid necrosis.⁵ Fetal cerebral flow is controlled by an autoregulatory mechanism which responds to oxygen saturation. Reduction in oxygen saturation causes dilatation of the intracerebral vessels which leads to an increased diastolic blood flow to the brain.^{6,7} Doppler study is carried out just beyond the origin of MCA at the circle of willis. Doppler study of the MCA is also useful

in fetal anemia which is reflected in the fetal MCA by increasing the Peak Systolic Velocity which is greater than 1.5 times MOM. The use of Doppler can be credited leading to significant decreasing in perinatal morbidity and mortality. The colour Doppler ultrasound gives information directly on vascular resistance and indirectly on blood flow. This study has been undertaken to detect the fetal compromise and early termination to improve the perinatal outcome.

METHODS

This hospital based descriptive study of Doppler velocimetry in umbilical artery and Middle cerebral artery were carried out in the Department of Obstetrics and Gynecology at Pariyaram Medical College, Kannur, Kerala over a period of 1 year (April 2016-March 2017). Out of 1906 deliveries, 180 high risk cases, like severe PIH, IUGR and oligohydramnios were selected. Counseled the patient and her husband regarding the necessity of repeated Doppler study and consent was taken. Doppler velocimetry of umbilical artery – S/D ratio and Middle cerebral artery RI (Resistance Index) were assessed; from 28 weeks onwards. Umbilical Artery S/D ratio >3, Middle cerebral Artery RI <0.7 are taken as abnormal. Fetal well-being is monitored by DFMC (Daily Fetal Movement Count), NST (Non-stress Test) and Doppler study. Steroid injection, given to augment lung maturity. Mode of delivery and fetal outcome were noted.

Perinatal outcome will be considered abnormal if anyone or combination of the following is present. i.e. perinatal death, APGAR<7 at first 5mts, respiratory complications within 72hrs of birth.⁸

Relationship between abnormal umbilical Artery S/D ratio and MCA resistance index and birth weight of the baby and the perinatal outcome were noted and the percentage calculated and compared with other studies.⁹ Emergency LSCS done in cases with Absent or Reversal of end diastolic flow.¹⁰

Table 1: Distribution of cases with high risk factors.

| | |
|--------------------------|-----|
| PIH | 110 |
| IUGR | 22 |
| Anemia | 10 |
| PIH with IUGR | 44 |
| Oligohydramnios | 28 |
| PIH with oligohydramnios | 32 |
| BOH | 10 |
| Total | 180 |

RESULTS

In our study of 180 patients with high risk factors were analysed. Doppler flow velocimetry of umbilical artery and Middle cerebral Artery were done and S/D ratio and Resistance indices and Pulsatility indices were calculated. All the women were followed until delivery. Mode of

delivery and outcome in terms of birth weight, APGAR score and NICU admission were recorded.

All indices (PI, RI, S/D ratio) showed progressive fall with advancing gestation in normal pregnancy suggestive of decrease in peripheral impedance and increase in diastolic flow with progression of gestation in both the umbilical artery and Middle cerebral artery.

In our study, analyzing the data, on the basis of age groups, 46.2% were under 30 years of age and 52% were nulliparous. While referring the increased umbilical artery S/D ratio, 97.8% cases belongs to PIH. Referring the fetal outcomes in case with abnormal umbilical arteries and MCA resistance, bad outcomes are more, in cases with reversal of flow. i.e. 4 cases.

Table 2: Fetal outcome.

| | |
|----------------|----|
| FSB | 4 |
| Birth asphyxia | 11 |
| NND | 3 |
| APGAR | 5 |
| IUD | 1 |
| Normal | 80 |
| IUGR | 42 |
| SGA | 34 |

With good NICU facilities, we got very good perinatal outcome, even with preterm babies.

Referring the abnormal resistance index in Middle Cerebral Artery and the weight of the baby 70.6% have < 2kg weight. Analyzing the mode of delivery in relation to Doppler findings, 16 cases with REDF delivered by LSCS.

Table 3: Mode of delivery in relation to doppler findings.

| Doppler findings | No. of cases | Vaginal | | Caesarian | |
|----------------------------------|--------------|---------|-----|-----------|------|
| | | No. | % | No. | % |
| Normal | 82 | 72 | 88% | 10 | 12% |
| Abnormal doppler | | | | | |
| Umbilical artery | | | | | |
| Raised S/D ratio | 52 | 32 | 61% | 20 | 38% |
| AEDF | 30 | 8 | 27% | 22 | 73% |
| REDF | 16 | 0 | | 16 | 100% |
| MCA | | | | | |
| Decreased S/D | 36 | 20 | 56% | 16 | 44% |
| Decreased cerebroplacental ratio | 16 | 6 | 37% | 10 | 63% |

In absent end diastolic flow (AEDF) and REDF patients, low APGAR score was seen in 5 cases and 4 cases respectively. Birth asphyxia was seen in 11 cases. Abnormal MCA/UA Doppler ratio is strongly correlated with worse fetal prognosis.

Table 4: Perinatal outcome in relation to doppler findings.

| | Abnormal UA S/D ↑ | Doppler AEDF | REDF | MCA S/D ↓ |
|---------------------------------|-------------------|--------------|------|-----------|
| IUGR | 36 | 6 | 3 | 22 |
| Poor Apgar Score | 16 | 6 | 3 | 8 |
| Hypoxic Ischemic Encephalopathy | 3 | 3 | 2 | 10 |
| Meconium aspiration | 14 | 6 | 3 | 5 |
| C. S for fetal distress | 16 | 22 | 16 | 16 |
| NICU admission | 36 | 6 | 16 | 16 |
| NND | 0 | 1 | 1 | 1 |

In our study, the fetal outcome is very good with early termination of pregnancy depending upon the abnormality in Doppler study and also good perinatal case available in our NICU. In babies with low birth weight and 28-30 weeks of gestation also good outcome is seen. Still birth and NND are only 7.

Table 5: Abnormal doppler findings in high risk patients.

| Risk factor | Normal Doppler findings | | Abnormal Doppler findings | | | |
|-----------------|-------------------------|----|---------------------------|----|-----|---|
| | No | % | Umbilical Artery | | MCA | |
| | | | No | % | No | % |
| PIH | 66 | 37 | 30 | 16 | 4 | 2 |
| IUGR | 6 | 3 | 36 | 20 | 8 | 4 |
| PIH with IUGR | 14 | 7 | 52 | 29 | 12 | 6 |
| Oligohydramnios | 8 | 4 | 16 | 8 | 4 | 2 |
| BOH | 2 | 1 | 8 | 4 | 2 | 1 |

DISCUSSION

The objective of fetal Doppler is to detect any hemodynamic changes at the earliest and to assess the placental dysfunction and the consequences of this on fetal growth and well-being.

In our study, the umbilical artery S/D ratio is abnormal in 96 cases. Low birth weight babies are 76 and 3 were NND due to extreme prematurity. Birth asphyxia is 11 cases.

This study shows that the Doppler study in 3rd trimester is very useful in predicting the fetal outcome in high risk pregnancy.

Abnormal MCA/UA Doppler ratio is strongly correlated with worse fetal prognosis. Fetuses with abnormal Doppler velocimetry had a significantly higher incidence of preterm birth, low birth weight, and admission to

NICU. Late onset SGA fetuses with normal Doppler velocimetry on diagnosis show progression from 37 weeks gestation with worsening uteroplacental ratio followed by a decrease in MCA pulsating index(PI).^{11,12}

There were more number of caesarian section and NICU admission in abnormal Doppler indices in various studies.¹³ Repetitive Doppler monitoring in pregnancy has been a great help to improve perinatal outcome in complicated pregnancies. The Doppler patterns follow a longitudinal trend with early changes in the umbilical artery followed by middle cerebral artery. Venous change follow the arterial pattern and occur in severely compromised fetus and predict poor perinatal outcome. Abnormal Doppler with a nonreactive NST is definitely associated with an adverse perinatal outcome. need immediate delivery. In our study caesarian section rate is more in cases with abnormal Doppler. In patients with umbilical artery S/D ratio alone, vaginal delivery occurred in 61% of cases. But in patient with absent end diastolic flow.73% cases ended in caesarian section. In patients with reversal of flow4-all delivered by caesarian section.

CONCLUSION

To improve the neonatal outcome we need to do caesarian section in cases with abnormal Doppler. Good NICU care is required for such babies. Close monitoring with NST and repeated Doppler studies are very effective in such case.

ACKNOWLEDGEMENTS

Authors would like to thank Dr. Mahesh and Dr. Sneha for their help in Doppler Ultra sound.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Malik R. Saxena A. Role of colour Doppler indices in the diagnosis of intrauterine growth retardation in high risk pregnancies. J Obstetr Gynecol. 2013;63(1);37.
2. Ebrashy A. Azmy O, Ibrahim M. Middle cerebral/umbilical artery resistance index ratio as sensitive parameter for fetal well-being and neonatal outcomes in patients with pre-eclampsia case control study. Croat Med. J. 2005;46(5):821-5.
3. Cruz Mertinez R. Figueras F, Andrade E. Fetal brain Doppler to predict caesarian delivery for nonreacts among fetal status in term small for gestational age fetuses. Obstetrics Gynecol. 2011;17:618-26.
4. Malik D. Basic principles of Doppler Ultrasound as applied in obstetrics. Clin Obstet Gyenaecol. 1989;32;628-44.

5. Giles WB, Trudinger BJ, Baird PJ. Fetal Umbilical artery flow velocity wave forms and placental resistance: Pathological correlation. *Br J Obstet Gynaecol.* 1985;92:31-8.
6. Vijas S, Nicolaides KH, Bower S. Middle cerebral artery flow velocity wave forms in fetal hypoxemia. *Br J Obstet Gynaecol.* 1990;97:797-803.
7. Burns PN. Doppler flow estimations in the fetal and maternal circulation; principles, techniques and some limitations. Ithaca Perinatol Press; 1987.p.43-78.
8. Lakhkar BN, Rajagopal K V, Gowrisankar P T. Doppler prediction of adverse perinatal outcome in PIH and IUGR. *Indian J Radiol Imaging.* 2006; 16(1):10-6.
9. Hernandez Andrade E, Stampal ija J, Figueras F. cerebral blood flow studies in the diagnosis and management of IUGR. *Curr opin obstetrics and Gynecol.* 2013;25(2):138-44.
10. Bamos, Chawdhary V, Pandes, Colour Doppler evaluation of cerebral, umbilical pulsatility ratio and its usefulness in the diagnosis of intrauterine growth retardation and prediction of adverse perinatal outcomes. *Indian J Radiol imaging.* 2010; 20(1):20-5.
11. Maged A M, Abdelhafz A Mostafa WAI. Fetal Middle cerebral and Umbilical artery Doppler after 40 weeks of gestational age. *I Matern fetal Neonatal Med.* 2014;27(18):1880-5.
12. Devore GR. The importance of the uteroplacental ratio in the evaluation of fetal wellbeing in SGA and AGA fetuses. *Am J Obstet Gynaecol.* 2015; 213(1):5-15.
13. Seal SL Ghosh D, Kamilya G. Does route of delivery affect maternal and perinatal outcome in woman with eclampsia?-A Randomised controlled pilot study. *Am J Obstet Gynaecol.* 2012;296:484 e1-7.

Cite this article as: Sumangali PK, Omana EK, Nambiar SS. Doppler velocimetry of umbilical, and middle cerebral arteries in the prediction of fetal outcome. *Int J Res Med Sci* 2017;5:4789-92.