

**Colour Doppler Evaluation of Cerebro-Placental Ratio and it's outcome in Intra Uterine Growth Retardation**

Dr. Keerthi Shyam V, Dr. Anand SH, Dr. G. Gurushankar

Sri Siddhartha Medical College and Research Centre, Tumakuru, Karnataka, India.

**Corresponding Author:** Dr. Keerthi Shyam V, Sri Siddhartha Medical College and Research Centre, Tumakuru, Karnataka.

**Type of Publication:** Original Research Paper

**Conflicts of Interest:** Nil

**Abstract**

**Aim:** To determine and compare the diagnostic performance of Doppler sonography of maternal uterine arteries, umbilical artery and fetal middle cerebral artery for prediction of adverse perinatal outcome in clinically suspected Intrauterine growth restriction.

**Material and Methods:** Thirty singleton pregnancies beyond 28 weeks of gestation complicated by Intrauterine growth restriction were prospectively examined with Doppler ultrasound of uterine arteries, umbilical artery and middle cerebral artery.

**Results:** Nineteen patients of the thirty included in the study population had at least one adverse outcome, Adverse outcome criteria included perinatal deaths, emergency caesarean section for fetal distress, 5 min APGAR score of less than 7, admission to NICU for complications of low birth weight. Mean birth weight of neonate at delivery was  $2.18 \pm 0.26$  kg (2SD). 70% fetuses had birth weight of less than 2.5kg. There were 3 intrauterine deaths and 27 live births. Of the 3 IUDs two had absent diastolic flow and one had reversal of diastolic flow. The mortality in cases of reversal and absent end diastolic flow was 100% and 40% respectively, indicating grave prognosis. Of 27 live births 6 neonates were admitted to NICU, 7 neonates had 5min APGAR score of

less than 7 and 9 babies were born by emergency caesarian section.

**Conclusion:** PI ratio of MCA/Umb A is the most sensitive index in predicting perinatal outcome (89.5%). MCA pulsatility index is the most specific index (90.9%). Sensitivity of uterine artery Doppler to detect utero-placental insufficiency was 83%. Presence of absent or reversal of diastolic flow in umbilical artery is an ominous sign since it carries a grave prognosis and high mortality. The sensitivity of the Doppler studies can be significantly increased by studying multiple vessels. Hence we conclude that Doppler studies of multiple vessels the uteroplacental and fetoplacental circulation can help in monitoring of compromised fetus and can help us predicting neonatal morbidity. This may be helpful in determining the optimal time of delivery in complicated pregnancies.

**Keywords:** Doppler sonography, Uterine Artery (UA), Umbilical Artery(Umb A), Middle Cerebral Artery (MCA), Pulsatility index (PI).

**Introduction**

Intra uterine growth retardation (IUGR) due to fetoplacental vascular insufficiency is common in developing countries like India due to multiple factors. Intrauterine growth restriction (IUGR) is a term used to describe the condition of a fetus whose size or growth is

subnormal. The most common definition of intrauterine growth restriction is that “a fetus is growth restricted if its weight is less than the tenth percentile for its gestational age”.<sup>1</sup>

In India, according to recent UNICEF surveys, the incidence of IUGR is 25-30%.<sup>2</sup> The incidence of IUGR in a population where the mothers are generally healthy and well-nourished is estimated to be about 3-5%. In a population of women with hypertension or previous growth restricted fetus, the incidence increases to 15-20% or higher.<sup>3</sup> The incidence of IUGR varies from region to region and even in the same region, it varies in different sub populations.

This study focuses on establishing the role of Umbilical artery and Middle cerebral artery Doppler ultrasound in predicting adverse perinatal outcomes in clinically suspected IUGR pregnancies and to determine the role of Doppler velocimetry in clinical management of such pregnancies.

### Materials And Methods

Data for the study was collected from patients attending the department of Radio-diagnosis, referred by Department of Obstetrics and Gynecology at our college.

The study included 100 antenatal women who were diagnosed as having a fetus with intra uterine growth restriction based on grey scale ultrasound findings and referred for obstetric Doppler Ultrasound if the following inclusion criteria were met:

1. Singleton pregnancy with gestational age more than 28 weeks.
2. Women with reliable dating of pregnancy confirmed by an early first trimester ultrasound examination using CRL or BPD or with known LMP will be selected.

The exclusion criteria for the study included any pregnancy with

1. Antenatal women where IUGR was a clinical suspicion only and no grey scale ultrasound assessment was done.
2. All subjects with history of rupture of membranes, active labour, multiple pregnancies and fetuses with congenital anomalies.

**Outcome Criteria:** Doppler results were analyzed for prediction of perinatal

1 outcome.

Perinatal outcome variables included:

1. Mode of Delivery: Caesarian section/ Normal Vaginal Delivery.
2. Stillbirth or Perinatal death.
3. Low APGAR score (5 min APGAR score less than 7).
4. Admission to NICU for complications of Low Birth Weight.

Pregnancy was considered to have “Adverse outcome” when any of the following complications were present:

1. Perinatal death.
2. Emergency CS for fetal distress.
3. 5 minute APGAR score of less than 7.
4. Admission to NICU for complications of low birth weight.

The UmA Pulsatility index ratios were considered abnormal if the value was above the 95<sup>th</sup> percentile for the gestational age. The MCA pulsatility index was considered abnormal if the value was below the 5<sup>th</sup> percentile for the gestational age, according to reference values of D Gramellini et al.<sup>4</sup>

The MCA PI/ Umb A PI ratio was calculated. In our study a single cutoff value of 1.08 for MCA/Umb A PI ratio (cerebral-umbilical ratio) was used, above which velocimetry was considered normal and below which it

was considered abnormal, according to reference values of D Gramellini et al.

**Statistical Analysis**

The diagnostic statistics were used to find the diagnostic value of Umb A PI, MCA PI and MCA/Umb A PI in relation to perinatal outcome. The sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy were determined for all Doppler measurements. The statistical software namely SPSS 22.0 was used for the analysis of the data and Microsoft Word and Excel have been used to generate graphs, tables etc.

**Results and Discussion**

It is observed that the maximum number of pregnant women were in the age group of 18-25 years (50%). Among women where a cause for IUGR was identified. 22% had pregnancy induced hypertension (PIH) and 37% had anemia complicating pregnancy. 71 % (n=71) fetuses had at least one adverse outcome. Remaining 29% (n=29) fetuses had favorable outcome. There were 2 perinatal deaths, 6 stillbirths and 63 cases were admitted to NICU.

Of the 6 stillbirths, four had absent diastolic flow and two had reversal of diastolic flow. The mortality in cases of reversed and absent end diastolic flow was 100% and 40% respectively, indicating grave prognosis. By using Doppler ultrasound results for analysis, the MCA/Umb A pulsatility index ratio had a higher sensitivity and positive predictive value for predicting the adverse perinatal outcome than the MCA and the Umb A pulsatility indices. Our findings agree with the results of the studies that have shown Cerebroplacental ratio to be more useful than Uma PI or MCA PI in predicting the adverse outcome.

**Table 1: Results of Statistical Analysis**

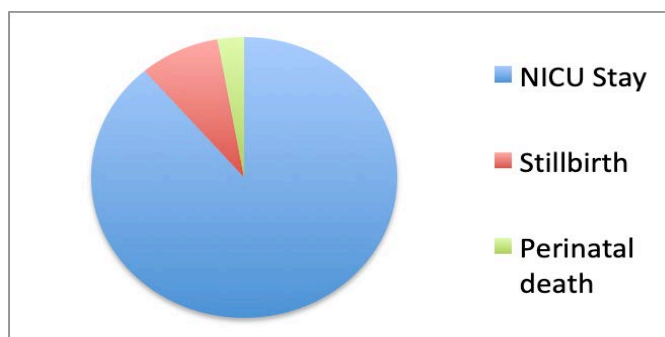
Sensitivity	Specificity	PPV	NPV	Diagnostic Accuracy
81.92%	82.35%	95.77%	48.28%	82%

**Table 2 : Analysis of Perinatal outcome**

Perinatal outcome	Number (n=100)	Percentage
Adverse	71	71%
Uneventful	29	29%

**Table 3 : Analysis of Adverse Perinatal outcome**

Adverse Perinatal Outcome	Number
NICU Stay	63
Stillbirth	6
Perinatal Death	2



**Table 4: Cerebroplacental ratio values in the study.**

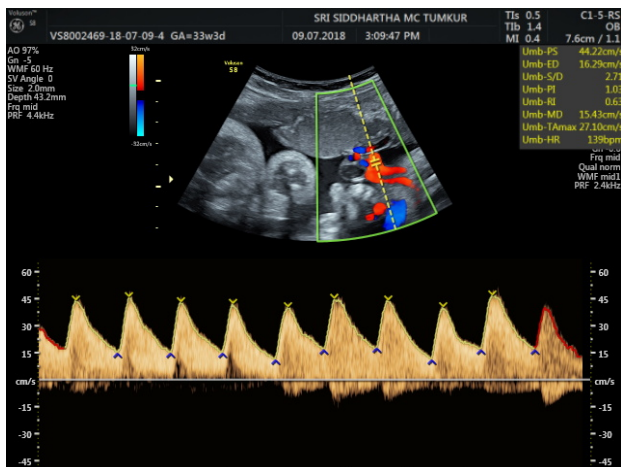
CPR	Number
CPR < 1.08	83
Normal	17

A bar chart showing the number of cases for different Cerebroplacental Ratio (CPR) values. The y-axis represents the number of cases, ranging from 0 to 100. The x-axis shows two categories: 'CPR < 1.08' with a bar height of 83, and 'Normal' with a bar height of 17.

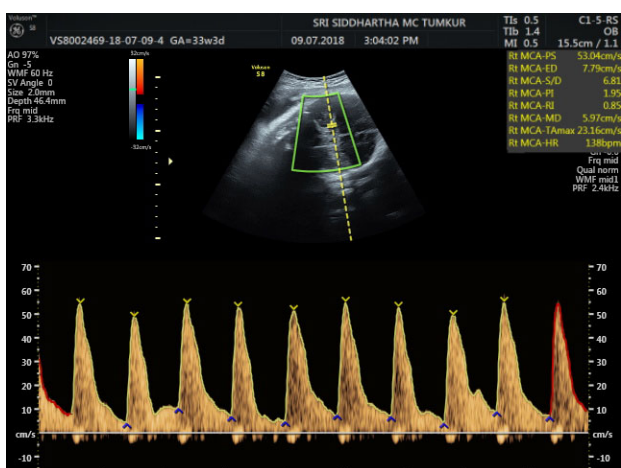
**Table 5: Comparison of Diagnostic accuracies**

Study	Diagnostic Accuracy
Gramellini et al	90%
Present Study	82%

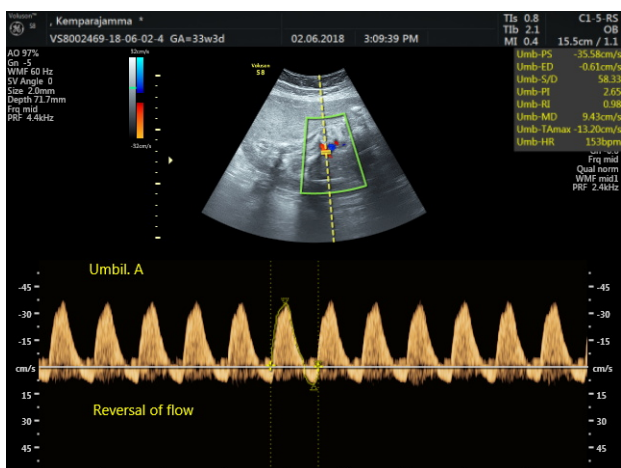
**Fig 1: Umbilical artery showing normal wave form**



**Fig 2: Middle Cerebral Artery showing normal wave form**



**Fig 3: Umbilical Artery showing reverse end diastolic flow.**



## Conclusion

The umbilical-placental and cerebral vascular beds are directly involved in the haemodynamic adjustments of fetal growth restriction. A Doppler index that reflects both of these areas can be useful for identifying fetuses with increased placental and/or decreased cerebral resistance. Assessment of both the uteroplacental circulation and the fetoplacental circulations together is more sensitive to predict to perinatal outcome, than assessment of each alone. In suspected IUGR, Cerebroplacental ratio (MCA/UA PI) is a better predictor of adverse perinatal outcome than an abnormal MCA PI or Umb A PI. Best results are obtained when we use MCA/UA PI Ratio, rather than PIs of middle cerebral artery and Umbilical artery separately. Presence of absent/reversal of diastolic flow in Umbilical artery is an ominous sign since it carries a grave prognosis and high mortality. Doppler imaging is of value for monitoring the pregnancy because it can provide indirect evidence of fetal compromise and is known to improve outcomes of high risk pregnancies with Intrauterine growth restriction. Hence Doppler evaluation is complementary to all other surveillance modalities.

## References

1. Lugo G.Cassady. Intrauterine growth retardation clinico pathological findings in 233 consecutive infants. Am J Obstet Gynecol 1971; 109: 615-122.
2. Devi PIC, Krishna menon MK, Bhaskar Rao K. Postgraduate obstetrics and gynecology. Orient long man; 3<sup>rd</sup> Edn 1986: 219
3. Galbraith RS, Kershmar EJ, Peirce WN, Low JA. The clinical prediction of intrauterine growth retardation. Am J Obstet Gynecol 1979; 133: 281-286.
4. Gramellini D, Folli MC, Raboni S, Vadora E, Meriardi A. Cerebral-umbilical Doppler ratio as a

- predictor of adverse perinatal outcome. *Obstet Gynecol* 1992; 79:416-420.
5. Seeds J.W. Impaired fetal growth: definition and clinical diagnosis *Obstet Gynecol* 1984; 64: 303-310.
  6. Sendhi Jain, Manju Puri. Diagnosis of intrauterine growth retardation – A review *Obstet and Gynec today* 2001; 11: 670-673.
  7. Kok JH, Devi Ouden AL, Verloove-Venhorick SP, Brand R. Outcome of very preterm small for gestational age infants : the first nine years of life. *Br J Obstet and Gynecol* 1989; 105: 162-168.
  8. Neilson JP, Alfirevic Z. Doppler Ultrasound in high risk pregnancies In : Neilson JP, Crowther CA, Hudnett CED, Hof meyr GJ, Keirse MJNC, eds *Pregnancy and child birth module of the cochrone database of systematic reviews*. Available in *Cochrone library [data base on disk and CD rom]*. Issue 3, Oxford, England: *Cochrane collaboration*, 1998.
  9. Ven den Wijngard JW, Groenenberg IL, Wladimiroff JW, et al. Cerebral Doppler ultrasound of the fetus. *Br J obstet Gynaecol* 1989; 86: 845-849.
  10. G V P, Jyothi J, Sarvottam S. ROLE OF DOPPLER STUDY IN THE EVALUATION OF INTRAUTERINE GROWTH RETARDATION. *Journal of Evidence Based Medicine and Healthcare*. 2015;2(42):7266-7275
  11. Gonzalez J, Stamilio D, Ural S, Macones G, Odibo A. Relationship between abnormal fetal testing and adverse perinatal outcomes in intrauterine growth restriction. *American Journal of Obstetrics and Gynecology*. 2007;196(5):e48-e51.
  12. Bano S, Chaudhary V, Pande S, Pande V, Sharma A. Color doppler evaluation of cerebral-umbilical pulsatility ratio and its usefulness in the diagnosis of intrauterine growth retardation and prediction of adverse perinatal outcome. *Indian Journal of Radiology and Imaging*. 2010;20(1):20.
  13. V GK M. COLOUR DOPPLER VERSES NST IN PREDICTING PERINATAL OUTCOME IN SEVERE PREECLAMPSIA AND FETAL GROWTH RESTRICTION. *Journal of Evolution of Medical and Dental Sciences*. 2015;4(39):6804-6810.
  14. Fleischer A, Schuman H, Farmakides G et al. Uterine artery Doppler velocimetry in pregnant women with hypertension. *Am j obstet Gynecol* 1986; 154: 806-813.
  15. Arduini. D, Rizzo G, Romenini C and Mancuso S. Fetal blood flow velocity wave form as predictors of growth retardation. *Obstet Gynecol* 1987; 70(1) : 7-10.
  16. Vanden Wijngaard JW, Groenenberg IL, Wladimiroff JW, et al. Cerebral Doppler ultrasound of the fetus. *Br J Obstet Gynaecol* 1989; 96:845-849.
  17. Arduini D, Rizzo G. Prediction of fetal outcome in small for gestational age fetus: comparison of Doppler measurements obtained from different fetal vessels. *J Perinat Med* 1992; 20:29-38.