

A Prospective Study on the Effectiveness of Triple Vessel Wave Pattern During Pregnancy As A Predictor Of Adverse Maternal And Perinatal Outcome

Dr Arumugaselvi B. MD,DGO¹

Dr Krishna Parvathy S. MSOG²

Dr Muthu Prabha P. MDOG³

¹(Department of obstetrics & gynaecology , Thoothukudi Medical College/ Tamilnadu Dr MGR Medical University,India)

²(Department of obstetrics & gynaecology , Thoothukudi Medical College/ Tamilnadu Dr MGR Medical University,India)

³(Department of obstetrics & gynaecology , Thoothukudi Medical College/ Tamilnadu Dr MGR Medical University,India)

Abstract:

Background: With the advent of the Doppler study the assessment of maternal & fetoplacental circulation has reduced maternal and fetal morbidity and mortality. The information on the placental resistance was obtained from the uteroplacental and fetoplacental circulation and Doppler waveform analysis could assess the fetal circulation non-invasively using the fetal response to hypoxia. So it is possible to identify high risk fetuses that were at increased risk of morbidity and mortality due to impaired maternal and fetal circulations and implement corrective measures. This study determines the role of Umbilical artery, Uterine Artery and Middle cerebral artery Doppler ultrasound in predicting adverse perinatal outcomes in suspected high risk pregnancies and to focus on the role of Doppler velocimetry in clinical management of high-risk pregnancies.

Materials and Methods: A Prospective study of 100 Pregnant mothers was done after taking into account the inclusion & exclusion criteria. Doppler waveforms from the uterine, umbilical, middle cerebral arteries were obtained from all 100 pregnant mothers and were analysed. In this prospective controlled study, the study group included 50 pregnant women with high risk factors & control group included 50 pregnant women with no risk factors. All pregnant women included in the study were subjected to a Doppler waveform analysis following a detailed clinical history and ultrasonogram after getting written informed consent from the patient. Doppler assessment was again done at subsequent intervals such as at 28-30 weeks, 32-34 weeks and the pregnancy outcome was assessed.

Results: In the Uterine artery the increased impedance to blood flow & persistence of diastolic notching were of greater sensitivity. In the Umbilical artery, presence of Absent End Diastolic Flow & Reversed End Diastolic Flow Pattern were deemed perilous as it was associated with adverse perinatal outcome. The presence of increased diastolic flow in Middle cerebral artery was significantly associated with adverse neonatal outcome. Hence the Doppler analysis of waveforms of the triple vessels have a major role in the antepartum surveillance of normal and high risk pregnancies, thus aiding in the delivery of a healthy baby and healthy mother.

Conclusion: The waveform analysis of the uterine arteries, including the detection of early diastolic notch among high risk pregnancies, proves to be a diagnostic tool for patients with risk factors particularly GHTN or FGR which is on the high rise.

Doppler sonography has a significant impact on antenatal care. Therefore the knowledge about its application in obstetric practice is very crucial. It has also provided a vision about fetal circulation and the fetus in utero.

Key Word: Doppler waveform ; Uterine artery; Umbilical artery; Middle cerebral artery; Perinatal outcome .

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I. Introduction

All newborn infants have the potential credit & equal right to be born undamaged. In modern fetal maternal medicine fulfillment of this goal is very vital. The prime goal is that every pregnancy should terminate into a well baby and a well mother. The information on the placental resistance was obtained from the uteroplacental and fetoplacental circulation and Doppler ultrasound could non-invasively assess the fetal circulation using the fetal response to hypoxia.¹ So it is possible to identify high risk fetuses that were at increased risk of morbidity and mortality due to impaired maternal and fetal circulations. Objectives of this study were to evaluate and highlight the role of Doppler in the evaluation and management of a high risk pregnancy by analyzing the maternal circulation(which are the two maternal uterine arteries), fetoplacental circulation(Umbilical Artery middle cerebral artery) & to provide the beneficial role of uterine artery, umbilical artery and middle cerebral artery Doppler indices as predictors of poor perinatal outcome in suspected high risk pregnancies.

II. Material And Methods

This prospective comparative study was carried out on 100 antenatal mothers attending the outpatient Department of obstetrics and gynaecology & data was also collected from the department of Radio diagnosis. Inclusion criteria include documented pregnancy beyond 28 weeks gestation, antenatal women with Preeclampsia, Gestational Hypertension (GHTN), IUGR, GDM, BOH, Twin Pregnancies. Exclusion criteria include wrong dates, Renal disease, Chronic Hypertension, Pre gestational Diabetes, Heart disease complicating pregnancies.

All pregnant women included in this study were subjected to a Doppler analysis following a detailed clinical history and ultrasonogram after getting written informed consent. Doppler assessment was again done at subsequent intervals, such as at 28-30 weeks, 32-34 weeks. All patients were explained about the non invasive and atraumatic nature of the procedure. Doppler ultrasound with 2-5MHz frequency was used to localize the vessels. Doppler examinations were done when the fetus was in a quiescent state so as to avoid the influence of fetal respiration on the Doppler signals. Pregnancy was associated with a poor perinatal outcome if the following variables were present such as neonatal death, emergency cesarean section for fetal distress, APGAR score at 5 minutes is less than 7/10 and neonatal complications which require neonatal intensive care admission. Pregnancy outcome was termed as uneventful when the above complications were absent. Pulsatility index is defined as the difference between maximum and minimum blood velocity normalized to average velocity of the arteries under study. Resistance index is calculated by subtracting the end diastolic velocity from peak systolic velocity, divided by peak systolic velocity. The systolic/diastolic (S/D) ratio is the measure of peripheral resistance. Cerebroplacental ratio is calculated by dividing MCA P/I by Umbilical PI.

Statistical analysis

The subjects of both the groups were compared by non parametric tests like χ^2 (Chi-square) test, since the variables were categorical. The continuous variables were described by averages. The student independent 't' test was used for interpretation. The above statistical procedures were performed with the help of the statistical package named IBM SPSS statistics -20. The P-values less than or equal to 0.05 ($P \leq 0.05$) were considered statistically significant.

III. Result

Table-1: Comparison of Uterine Artery PI, RI and S/D of the study and control groups.

Variable	Study group mean	Control group mean	Difference	"t"	df	Significance
PI	0.6034	0.6026	0.0008	0.094	98	P = 0.925
RI	0.4352	0.4384	0.0032	0.876	98	P = 0.383
S/D	1.7444	1.6420	0.1024	6.157	98	P < 0.001

The above table compares the PI, RI and S/D of both the study and control groups. The mean PI of both the study and control groups were 0.6034 ± 0.03 and 0.6026 ± 0.05 respectively. The mean RI of study and control groups were 0.4352 ± 0.02 and 0.4384 ± 0.02 respectively. The difference of means between the two groups was not statistically significant ($P > 0.05$). The Means of S/D were 1.7444 ± 0.11 and 1.6420 ± 0.05 for study and control groups respectively. The difference between the means of both the study and control groups were statistically significant ($P < 0.001$).

Table-2: Comparison of Umbilical Artery PI, RI and S/D of the study and control groups.

Variable	Study group mean	Control group mean	Difference	"t"	df	Significance
PI	1.04	0.8	0.25	6.585	98	P < 0.001
RI	0.7	0.6	0.1	4.768	98	P < 0.001
S/D	3.5	2.6	0.9	8.411	98	P < 0.001

The differences between the means of both the groups were statistically significant (P<0.001).

Table-3: Comparison of MCA PI, RI and S/D of the two groups.

Variable	Study group mean	Control group mean	Difference	"t"	df	Significance
PI	1.2	1.4	0.2	6.330	98	P < 0.001
RI	0.7	0.8	0.1	6.246	98	P < 0.001
S/D	3.7	4.2	0.5	6.363	98	P < 0.001

The differences between the means of both the groups were statistically significant (P<0.001).

Table-4: Comparison of Fetal Maturity between the two groups.

Fetal maturity	Study group	Control group	Total	Results
Term	38 (76%)	45 (90%)	83	$\chi^2=3.473$ df = 1 P= 0.062
Preterm	12 (24%)	5 (10%)	17	
Total	50 (100%)	50 (100%)	100	

The difference between the two groups was not statistically j (P>0.05).

Table-5: Comparison of fetal condition at birth between the two groups:

Fetal condition at birth	Study group	Control group	Total	Results
IUD	2(4%)	1(2%)	3	$\chi^2=3.473$ df = 1 P= 0.035
Still birth	0	1 (2%)	1	
Live birth	48(96%)	48 (96%)	96	
Total	50 (100%)	50 (100%)	100	

The differences of the fetal condition at birth between the two groups were not statistically significant (P>0.05).

Table-6: Comparison of APGAR at 5 minute of birth between the groups:

APGAR at 5 min of birth	Study group	Control group	Total	Results
7 - 10	36 (72%)	47 (94%)	83	$\chi^2=10.766$

5 - 6	12 (24%)	1 (2%)	13	df =2 P= 0.005
< 5	2 (4%)	2 (4%)	4	
Total	50 (100%)	50 (100%)	100	

The APGAR score at 5 min of birth between the study and control groups was statistically significant (P<0.01).

Table-7: Comparison of Perinatal Outcome between the groups:

Perinatal outcome	Study group	Control group	Total	Results
Death	5 (10%)	1 (2%)	6	χ ² =15.000 df =2 P= 0.001
No complication	35 (70%)	49 (98%)	84	
complication	10 (20%)	0	10	
Total	50 (100%)	50 (100%)	100	

The perinatal outcome between the study and control groups was statistically significant (P<0.01).

IV. Discussion

This study showed that normal Doppler waveforms of the uterine, umbilical and middle cerebral artery were associated with good perinatal outcome. It was also found that Doppler indices are far more superior to ultrasound parameters in picking up high risk pregnancies especially fetal growth restriction and pre eclampsia. They were significant predictors of adverse neonatal outcome. Persistence of uterine artery diastolic notch, absent or reversal of diastolic flow in umbilical artery, increased diastolic notch in middle cerebral artery were observed to be sensitive parameters in assessing the perinatal outcome.² The following observations were made in this study. Abnormal uterine artery pattern, high resistance flow, persistent diastolic notching was noted in 24% among the study group & 0% among the control group and no statistical significance of PI & RI was observed among the study & control group. However the mean SD of uterine artery between both the groups was statistically significant. In our study the persistence of notching in the uterine artery waveform in the second trimester was the best predictor for the development of impaired utero placental circulation and thereby placental insufficiency.³ Umbilical artery was the main vessel used for monitoring the high risk pregnancies and it interprets the condition of the fetus in utero whether the fetus is compensated or decompensated in case of high risk pregnancy.⁴ Abnormal umbilical artery pattern - umbilical artery high resistance was seen in 60% ,AEDF in 68% and REDF was seen in 32% of study group whereas absent in the control group. Middle cerebral artery wave pattern was abnormal in 18% & normal in 82% among the study group. The waveforms were 100% normal in the control group. Increased diastolic flow was present in 18% of the control group whereas 100% it was absent in the control group. The presence of increased diastolic flow was associated with poor perinatal outcome. Among the study group 76% were term & 24% were preterm babies. In the control group 90% were term & 10% were preterm babies. There were 2 IUDs among the study group .Both these fetuses had abnormal umbilical artery pattern (REDF). The live birth rate (96%) was equal in both study & control group. The APGAR score at 5 minutes was analysed between study & control group. A score of >7/10 was considered normal. 72% in the study & 94% in the control group had >=7/10. A score of 5-6 was seen in 24% among the study group whereas it was found only in 2% among the control group. The IUD rate was 10% in the study & 2% in the control group. Perinatal complications in the babies were observed in 20% among the study group & was 0% in the control group which was statistically significant. So introduction of Doppler into routine obstetric practice has to be made in order to reduce perinatal mortality and morbidity.

V. Conclusion

The role of Doppler sonography has been continuously growing in the field of obstetrics. Doppler waveform analysis of the triple vessels has practically no adverse effects, contra indications, or disadvantages .cost effective, reproducible and takes less time for screening thus giving a very valuable practical information on the maternal and fetal status. Thereby timely prophylactic & therapeutic management result in a significant

reduction of maternal & fetal morbidity & mortality. The waveform analysis of the uterine arteries, including the detection of early diastolic notch among high risk pregnancies, proves to be a diagnostic tool for patients with risk factors particularly GHTN or FGR which is on the rise.⁵

Doppler sonography has a significant impact on antenatal care. Therefore the knowledge about its application in modern day obstetric practice is very crucial. It has also provided a vision about fetal circulation and the fetus in utero. It detects hypoxia even before the clinical manifestation of placental insufficiency as evidenced by poor growth rate, decreased liquor amnii. The purpose of the obstetrical Doppler measurement is the proper assessment of fetal condition independent of placental vascular impedance and the gestational age. Thus there is a general agreement about the clinical significance of Doppler in obstetrics.

References

- [1]. Urmila S, Beena B. Triple vessel wave pattern by Doppler studies in normal and high risk pregnancies and perinatal outcome. *J Obstet Gynaecol India* 2010;60(4):312-316.
- [2]. Zha C., Li J., Li X. Pulsatility indices of fetal middle cerebral artery and umbilical artery for predicting intrauterine fetal growth retardation. *Zhonghua Fu Chan Ke Za Zhi*. 1996;31:345–347.
- [3]. Sieroszewski P.,Guzowski G.,Sosnowski.,et al.The usefulness of uterine artery doppler velocimetry in high risk pregnancy diagnostic (PIH and/or IUGR) *Ginekol Pol*. 2005;76:342–347.
- [4]. Karsdorp V.H., Vugt J.M., Geijn H.P., et al. Clinical significance of absent or reversed end diastolic velocity waveforms in umbilical artery. *Lancet*. 1994;344:1664–1668. doi: 10.1016/S0140- 6736(94)90457-X.
- [5]. Pai MV. Uterine artery Doppler velocimetry in women with normal pregnancy, PIH and IUGR. *OGS and Gynec today* 2001;6(a):668- 670.

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