

**ROLE OF DOPPLER IN PREDICTION OF PERINATAL OUTCOME: A COMPARATIVE STUDY OF DOPPLER INDICES IN LOW RISK AND HIGH RISK PREGNANCIES**N. Uma<sup>1</sup>, D. Hemalatha Devi<sup>2</sup>, G. Rajyalakshmi<sup>3</sup>, D. Jotsna<sup>4</sup>**HOW TO CITE THIS ARTICLE:**

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**ABSTRACT: AIMS AND OBJECTIVES:** to evaluate Doppler abnormalities in low risk and high risk pregnancies and to determine their relation to the outcome of pregnancy. **METHODS:** A total of 60 no. of pregnant women without any known risk factors are included in the low risk group and 60 no. of pregnant women with pre-eclampsia or gestational hypertension or intra uterine growth restriction, are included in the high risk group. Doppler evaluation done at term and the outcome is noted in terms of mode of delivery and perinatal complications in both the groups. **RESULTS:** Forty percent of high risk pregnant women and 1.6 percent of low risk pregnant women are found to be associated with abnormal Doppler results. Abnormal UA-PI, in association with high risk pregnancy is significantly associated with abnormal mode of delivery (P-0.0005) and perinatal complications (P-0.0009). Abnormal MCA-PI and abnormal MCA-PI/UA-PI ratio of <1.1 are associated with perinatal complications with highest significance (P- <0.0001). High risk pregnancy with normal Doppler results, also had perinatal complications with slightly lower significance (0.0011). **CONCLUSION:** There is definite association of Doppler abnormalities with high risk pregnancy. Low risk pregnancy is almost never associated with Doppler abnormalities and it is not necessary to perform Doppler to all women. Of all the Doppler indices, the ratio of MCA-PI/ UA-PI appears to be the best predictor of poor outcome. Normal Doppler results in association with high risk pregnancy cannot ensure uncomplicated outcome. **KEYWORDS:** High risk pregnancy, Low risk pregnancy, Umbilical artery pulsatility index, Middle cerebral artery pulsatility index.

**INTRODUCTION:** Doppler study has become a part of routine investigation in the evaluation of high risk pregnancy. Detection of placental insufficiency is made possible through this non-invasive technique. Doppler ultrasound is a tool to identify an IUGR fetus in pre-acidotic state.

Doppler investigation of fetal arterial system provides an indirect assessment of placental resistance and Doppler evaluation of fetal venous system provides assessment of fetal cardiac function.<sup>[1]</sup> Maternal uterine artery evaluation can predict patients who are at risk for developing IUGR, preeclampsia and placental abruption.

**AIM:**

- To evaluate Doppler abnormalities in low risk and high risk pregnancies.
- To evaluate the outcome of pregnancy in relation to Doppler abnormalities in low risk and high risk pregnancies.

## A. Doppler Evaluation in Normal Pregnancy:

**Umbilical Artery Doppler [UA-Doppler]:** At term, the increasing demands of growing fetus are fulfilled by the increasing blood flow in the tertiary villi. As the gestation advances, placental resistance declines and the Doppler wave form changes, with increasing diastolic flow.<sup>[2]</sup> There is steady fall in the SD ratio from mid pregnancy to term. The pulsatility index [PI] and resistance index [RI] also fall with advancing pregnancy.

**Middle Cerebral Artery Doppler [MCA-Doppler]:** Fetal cerebral circulation is normally a high impedance circulation with continuous forward flow throughout the cardiac cycle.<sup>[3]</sup>

It is characterized by peak flows in systolic phase and minimal flow in diastolic phase.

## B. Doppler evaluation in high risk pregnancy [i.e., at Risk of Placental Insufficiency]

**Umbilical Artery Doppler:** Due to the inherent risks involved in conditions like pregnancy induced hypertension, pre-eclampsia and IUGR, many pathological events take place in placental circulation. Calcifications take place in placental villi. This leads to reduced blood flow in placental circulation. As a result the SD ratio, PI and RI are maintained high.

There can be reduced end diastolic flow, followed by absent end diastolic flow [AED] and later, reversal of end diastolic [RED] flow in diastolic phase. Reduced end diastolic flow can be seen when 30% of villous vessels are abnormal. With Absent ED and Reversed EDV, 70% of the villous vessels are blocked.<sup>[4]</sup>

**Doppler Indices:** The Doppler indices like SD ratio and resistance index cannot be measured further, when the diastolic flow becomes nil. Whereas the measurement of the pulsatility index is possible even when the diastolic flow becomes zero. Hence, measurement of UA blood flow is better monitored by performing Pulsatility index, rather than any other indices.

Umbilical artery Pulsatility index [UA-PI] is considered abnormal when it remains above the 95<sup>th</sup> percentile adjusted to the gestational age. Overall, UA Doppler results are considered abnormal in those fetuses with UA-PI above 95<sup>th</sup> percentile [In customized charts], with reduced end diastolic flow or absent End Diastolic Flow or Reversal of End Diastolic Flow.

**Middle Cerebral Artery Doppler:** In the presence of fetal hypoxemia, central redistribution of blood flow occurs, resulting in increasing blood flow to the brain, heart and adrenals and a reduction in flow to the peripheral and placental circulation. This is known as 'brain sparing effect' and plays major role in fetal adaptation to oxygen deprivation.<sup>[5]</sup>

In uteroplacental insufficiency the middle cerebral artery end diastolic flow is increased. Thus MCA Doppler is characterized by a lower S/D ratio than normal.<sup>[6]</sup> MCA-PI is considered as abnormal when it falls below 5<sup>th</sup> percentile in customized charts.

**The Ratio of MCAPI/ UAPI:** Normal ratio is above 1.08 and there are studies showing association of the ratio below 1.1 with adverse perinatal outcome.

In the present study the Doppler indices UA-PI, MCA-PI and ratio of MCA-PI/ UA-PI are evaluated in normal pregnancy and high risk pregnancy. The Doppler abnormalities are noted in both groups and the outcome studied.

**MATERIALS AND METHODS:** A total of 60 no. of pregnant women without any of known risk factors are included in to low risk group and a total of 60 no of pregnant women with known risk factors like intra uterine growth restriction, pre-eclampsia or gestational hypertension are included in high risk group.

**Selection Criteria for the ‘Low risk Group’:**

**Inclusion Criteria:** Normal pregnancy without any known risk factors at term.

**Exclusion Criteria:** Pregnancy with any of the risk factors like, Pre-eclampsia, Gestational hypertension, Intra-uterine growth restriction or Post-term pregnancy.

**Selection Criteria for the ‘High risk group’:**

**Inclusion Criteria:** Pregnancy associated with complications like gestational hypertention or pre-eclampsia or intra-uterine growth restriction in third trimester.

**Exclusion Criteria:** Normal pregnancy, Diabetes complicating pregnancy, Post term pregnancy and twin pregnancy.

**OBSERVATIONS:** In both the groups’ routine obstetric scan and Doppler indices are performed at term, and followed up till delivery and outcome is observed.

**1. Observations of Doppler results**

**2. Observations of the out come**

**1. Observations of Doppler Results:**

**A.** Abnormal Doppler results are considered whenever the

UA-PI is > 95<sup>th</sup> percentile.

MCA-PI < 5<sup>TH</sup> percentile.

MCA-PI/ UA-PI is <1.1.

**B.** Normal Doppler results are considered whenever

UA-PI is < 95<sup>th</sup> percentile.

MCA-PI > 5<sup>TH</sup> percentile.

MCA-PI/ UA-PI is >1.1.

**2. Observations of the Outcome:** The mode of delivery and presence or absence of perinatal complications are noted.

**A.** Mode of delivery is divided in to complicated and uncomplicated categories.

**Complicated mode of delivery:** Caesarean section or forceps delivery for fetal distress or meconium stained liquor.

**Uncomplicated mode delivery:** Either normal vaginal delivery or any operative intervention for indications other than fetal distress, is considered as uncomplicated delivery in the study aspect.

**B.** Perinatal outcome is divided in to complicated and uncomplicated categories.

**Complicated perinatal outcome:** Fetal distress evidenced by poor APGAR or meconium stained liquor or perinatal death **Uncomplicated outcome;** normal APGAR.

## ORIGINAL ARTICLE

### RESULTS:

The Results are tabulated as follows:

1. Doppler evaluation in normal and high risk pregnancy.
2. Umbilical artery Doppler abnormalities in low risk and high risk pregnancies and their relation to mode of delivery.
3. Umbilical artery Doppler abnormalities in low risk and high risk pregnancies and their relation to perinatal outcome.
4. Middle Cerebral Artery - PI abnormalities in low risk and high risk pregnancies and their relation to mode of delivery.
5. Middle cerebral artery - PI abnormalities in high risk and low risk pregnancies and their relation to perinatal outcome.
6. MCA-PI/UA-PI ratio in high risk and low risk pregnancies and their relation to mode of delivery.
7. MCA-PI/UA-PI ratio in high risk and low risk pregnancies and their relation to perinatal outcome.

Type of Risk Factor	Normal Umb. art. Doppler	Abnormal Umb. art. Doppler	Normal Midd.cer. art. Dopp	Abnormal Midd.cer. Doppler	Total Abnormal Doppler	Percentage of Abnormal Doppler
Normal pregnancy [60]	59	1	60	0	1	1.6%
High risk pregnancy [60]	57	3	36	24	24*	40%

**Table 1: Doppler evaluation in normal and high risk pregnancy**

Normal [Lowrisk] pregnancy is rarely associated with Doppler abnormalities.

\*All the 3 women with abnormal UA-PI are also associated with abnormal MCA-PI.

Umbilical artery -PI, with and without risk factors	Mode of Delivery		'p' value
	Abnormal	Normal	
Low risk pregnancy with normal UA-PI (59)	3(5.3%)	56 (94.9%)	
Low risk pregnancy with abnormal UA-PI (1)	0	1(100%)	0.99[not significant]
High risk pregnancy with normal UA-PI (57)	9[15.7%]	48[84.2%]	0.072[not significant]
High risk pregnancy with abnormal UA-PI (3)	[100%]	0	0.0005[highly significant]

**Table 2: Umbilical artery Doppler abnormalities in low risk and high risk pregnancies and their relation to mode of delivery**

High risk pregnancy in association with abnormal UA-PI is significantly associated with abnormal mode of delivery.

## ORIGINAL ARTICLE

Low risk pregnancy is not associated with Doppler abnormalities in most of the women. Only one woman presented with Doppler abnormality and it is not associated with abnormal mode of delivery

Umbilical artery- PI with and without risk factors	Perinatal outcome		'p' value
	Abnormal	Normal	
Low risk pregnancy with normal UA-PI (59)	4(6.7%)	55(93.3%)	
Low risk pregnancy with Abnormal UA-PI (1)	1(100%)	0	0.0833[not significant]
High risk pregnancy with normal UA-PI (57)	20(35%)	37(64.9%)	0.0002 [Significant]
High risk pregnancy with abnormal UA-PI (3)	3(100%)	0	0.0009 [significant]

**Table 3: Umbilical artery Doppler abnormalities in low risk and high risk pregnancies and their relation to perinatal outcome**

Low risk pregnancy is not significantly associated with either abnormal UA-PI or abnormal perinatal outcome.

High risk pregnancy is significantly associated with poor perinatal outcome, and the risk is further increased, when it is associated with UA-PI abnormalities.

Middle cerebral artery -PI with and without risk factors	Mode of Delivery		'p' value
	Abnormal	Normal	
Low risk pregnancy with normal MCA- PI (60)	3(4.9%)	57(94%)	
Low risk pregnancy with abnormal MCA- PI (0)	-	-	-
High risk pregnancy with normal MCA-PI(36)	4(11%)	32 (88%)	0.4192
High risk pregnancy with abnormal MCA-PI (24)	7(29.1%)	17(70.9%)	0.0048

**Table 4: Middle Cerebral Artery - PI abnormalities in low risk and High risk pregnancies and their relation to mode of delivery**

Low risk pregnancy is not found to be associated with MCA-PI abnormalities.

High risk pregnancy with normal MCA-PI is not significantly associated with abnormal mode of delivery.

High risk pregnancy with abnormal MCA-PI is significantly associated with abnormal mode of delivery

Middle cerebral artery -PI with and without risk factors	Perinatal outcome		P value
	Abnormal	Normal	
Low risk pregnancy with normal MCA-PI (60)	5(8.3%)	55(91.6%)	
Low risk pregnancy with abnormal MCA-PI (nil)	-	-	-
High risk pregnancy with normal MCA-PI(36)	13(36.1%)	23(63.8%)	0.0011
High risk pregnancy with abnormal MCA-PI(24)	12(50%)	12(50%)	<0.0001

**Table 5: Middle cerebral artery -PI abnormalities in high risk and Low risk pregnancies and their relation to perinatal out come**

## ORIGINAL ARTICLE

Low risk pregnancy is always associated with normal MCA Doppler.

High risk pregnancy with normal MCA-PI is associated with significant risk.

High risk pregnant women with abnormal MCA-PI are associated with adverse perinatal outcome with high significance.

MCA-PI/UA-PI in Association with High Risk or Low Risk Pregnancies	Mode of Delivery		P Value
	Abnormal	Normal	
Low risk pregnancy with normal MCA-PI/UA-PI (>1.1) (60)	3(4.9%)	57(94.99%)	
Low risk pregnancy with abnormal MCA-PI/UA-PI(<1.1) (0)	-	-	-
High risk pregnancy with normal MCA-PI/UA-PI(>1.1) (47)	7(14.8%)	40(85.1%)	0.0402
High risk pregnancy with abnormal MCA-PI/UA-PI(<1.1) (13)	6(46.1%)	7(53.8%)	0.0006

**Table 6: MCA-PI/UA-PI ratio in high risk and low risk pregnancies and their relation to mode of delivery**

Low risk pregnancy is not associated with abnormal MCA-PI/UA-PI.

Though high risk pregnancy with normal ratio had significant association with complications, those with abnormal ratio had highly significant complications.

MCA-PI/UA-PI in Association with high risk and low risk pregnancies	Perinatal outcome		P value
	Abnormal	Normal	
Low risk pregnancy with normal MCA-PI/UA-PI of >1.1(60)	5(8.3%)	55(91.6%)	
Low risk pregnancy with abnormal ratio MCA-PI/UA-PI<1.1(0)	-	-	-
High risk pregnancy with normal ratio MCA-PI/UA-PI of >1.1(47)	15(31.9%)	32(70.1%)	0.0025
High risk pregnancy with abnormal ratio MCA-PI/UA-PI of <1.1(13)	8(61.5%)	(31.5%)	<0.0001

**Table 7: MCA-PI/UA-PI ratio in high risk and low risk pregnancies and their relation to perinatal out come**

Low risk pregnancy is not associated with abnormal MCA-PI/UA-PI of <1.1.

Though High risk pregnancy is significantly associated with abnormal outcome even with normal Doppler, those with abnormal Doppler are associated with adverse outcome with highest significance.

## ORIGINAL ARTICLE

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**DISCUSSION:** Doppler abnormalities in association with high risk pregnancies and low risk pregnancies:

Out of 60 low risk pregnant women, only one woman had Doppler abnormality (elevated UA-PI) [1.6%] and rest of the women had normal Doppler results. Whereas, out of 60 high risk pregnant women, 24 [40%] women had abnormal Doppler results and rest of them had normal results. i.e., 1.6% vs. 40%.

The study conducted by U. Gupta & Qureshi, slightly higher No. of abnormal Doppler results are found in both low risk group and high risk group. i.e., 19% vs. 39%.

In the study of.<sup>[7]</sup> Savik K Das et al, out of 50 cases of Pregnancy with hypertension, 35[70%] cases had abnormal Doppler results, whereas all the 50 controls had normal results i.e., 0% vs. 70%.

### **High Risk Pregnancy in Association with Doppler Abnormalities and their Outcome.**

Three women had abnormal UA-PI results and 24 women had abnormal MCA-PI results.

All women with abnormal UA-PI had complicated outcome (100%).

In women with abnormal MCA-PI in high risk pregnancy, 30% of them had abnormal mode of delivery and 50% of them had perinatal complications (P-<0.0001).

### **The MCA-PI/UA-PI Ratio in High Risk Pregnancy and the Outcome.**

Of all the 60 high risk pregnant women, women who had abnormal MCA-PI / UA-PI of <1.1, there is significant association of abnormal mode of delivery, (P-0.0006) and perinatal complications (P-<0.0001)

The study of Rozeta Shahinag et al.<sup>[8]</sup> also the abnormal MCA-PI/UA-PI in pre-eclampsia and gestational hypertension had highly significant association with perinatal complications(P-<0.0001) Low risk pregnancy with Doppler abnormalities and the outcome.

In the present study, out of 60 low risk pregnant women, only one woman had abnormal Doppler result and it is not significantly associated with perinatal complications (P-0.99).

In the study conducted by Z. Alferevic.<sup>[9]</sup> 185 women with normal pregnancies were performed Doppler ultrasound, and no overall difference was found in the outcome. Hence there is no benefit in doing ultrasound Doppler in low risk pregnancy.

### **High risk Pregnancy without Doppler Abnormalities and the Outcome.**

In the present study the high risk pregnant women with normal Doppler results also, there is significant association of abnormal mode of delivery (P-0.042) and perinatal complications (P-0.0011). Hence there is inherent risk of perinatal complications, whether or not associated with abnormal Doppler results.

### **CONCLUSION:**

1. There is definite association of Doppler abnormalities in pregnancies complicated with hypertension, pre-eclampsia and IUGR.
2. Low risk pregnancy is almost never associated with Doppler abnormalities and it is unnecessary to perform routine Doppler in all pregnancies.

## ORIGINAL ARTICLE

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3. Of all the Doppler indices, the ratio of MCA-PI/UA-PI appears to be most reliable indicator. There is definite association of perinatal complications in those patients presenting with abnormal ratios of less than 1.1.
4. High risk pregnant women who do not show any Doppler abnormalities, also are associated with perinatal complications. Hence a normal Doppler in high risk pregnancy cannot ensure uncomplicated out come and one should carefully monitor the delivery in all high-risk pregnant women whether or not associated with Doppler abnormalities.

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