

STUDY OF RELATIONSHIP OF DOPPLER INDICES TO THE PERINATAL OUTCOME IN HIGH RISK PREGNANCIES

N. Uma¹, D. Hemalata Devi², P. Usha³, D. Jyotsna⁴, A. Bhagya Lakshmi⁵

HOW TO CITE THIS ARTICLE:

N. Uma, D. Hemalata Devi, P. Usha, D. Jyotsna, A. Bhagya Lakshmi. "Study of Relation Ship of Doppler Indices to the Perinatal Outcome in high Risk Pregnancies". Journal of Evidence based Medicine and Healthcare; Volume 2, Issue 06, February 09, 2015; Page: 705-713.

ABSTRACT: BACKGROUND: The Doppler velocimetry has become an important tool in the evaluation and management of high-risk pregnancies. The umbilical and uterine artery Doppler abnormalities can detect abnormal feto-placental circulation. Recently MCA to Umbilical Artery (UA) pulsatility index (PI) ratio have been described to be good predictors of neonatal outcome in high risk pregnancies in the third trimester and have been proposed to identify fetuses at risk of morbidity and mortality. **AIM:** To know the relationship of MCA-PI (Middle cerebral artery- Pulsatility Index), UA-PI (Umbilical artery- Pulsatility Index) and ratio of MCA-PI/UA-PI on the outcome of pregnancy in high risk cases. **METHOD OF STUDY:** Analytical study at tertiary care centre on 60 pregnant women in third trimester of pregnancy with associated risk factors of intrauterine growth retardation, pregnancy induced hypertension or preeclampsia were included in the study. Doppler evaluations were performed from diagnosis to delivery with weekly follow up. MCA-PI (Middle cerebral artery- Pulsatility Index), UA-PI (Uterine artery- Pulsatility Index) were recorded. The perinatal out-come were noted and calculated for level of significance. **RESULTS:** Abnormal UA- PI is significantly associated with operative intervention and poor perinatal outcome. But UA-PI is not sensitive. Abnormal MCA - PI though, moderately significant in association with operative intervention; association with perinatal complications is not significant. The ratio of MCA-PI/UA-PI; those with ratio of <1 and <1.1 , are associated with operative intervention and also poor perinatal outcome with high significance. **CONCLUSIONS:** High risk pregnancy requires close follow up . Fetal doppler provides more accurate assessment of fetal wellbeing .Of all the tests, ratio of MCA-PI/UA-PI is a more dependable index; ratio of <1 and <1.1 is associated with operative intervention and perinatal complications with high significance, good specificity and moderate sensitivity.

KEYWORDS: High risk pregnancy, MCA –PI, UA-PI, Perinatal outcome.

INTRODUCTION: In a pregnancy that is complicated with pre-eclampsia, pregnancy induced hypertension or intra uterine growth retardation, the Doppler abnormalities are observed in various vessels like, umbilical artery, middle cerebral artery, descending aorta, umbilical vein, ductus venosus etc. The events noted in umbilical artery and middle cerebral artery precedes the abnormalities noted in ductus venosus and umbilical vein. The abnormalities observed in ductus venosus mark end stage of the disease and indicate cardiac decompensation. The changes that take place in middle cerebral artery (MCA) & umbilical artery (UA) can predict the prognosis few days to few weeks before the onset of terminal events in the fetus. It is important to identify the fetus that is vulnerable and plan for timing of delivery before it reaches terminal stages. There are many studies showing consistant relationship of abnormal UA-PI & abnormal MCA-PI to poor

ORIGINAL ARTICLE

perinatal outcome. The present study is done to evaluate the relation of the cut off ratios of <1 , between 1 and 1.1, and > 1.1 of MCA-PI/UA-PI to the outcome of pregnancy.

MATERIALS AND METHODS: Analytical study conducted in the department of Obstetrics and Gynecology at tertiary care centre from June 2014 to December 2014. Study population included sixty pregnant women coming from surrounding areas of the hospital both urban and rural with poor socioeconomic status. Only those women, who came for regular follow-up and got delivered in this hospital, were included in the study.

INCLUSION CRITERIA:

1. Pregnancy induced hypertension (PIH): Pregnant women, who were identified with new onset of hypertension of 140/90, mmHg or above, after 20 wks of gestation.
2. Pre eclampsia (PA): Pregnant women with new onset of hypertension after 20 weeks of gestation along with albuminuria of one + or more.
3. Intra uterine growth restriction (IUGR): pregnant women with known dates and regular follow-up, with suspected growth lag were offered obstetric scan. Those with abdominal circumference of less than 5th percentile for the gestational age, confirmed as growth restricted and included in the study. The standardized charts are used for this purpose.
4. Pregnant women with any of the above combinations.

EXCLUSION CRITERIA:

1. Normal pregnancy.
2. Pregestational or gestational diabetes mellitus.
3. Congenital anomalies.
4. Hydramnios.
5. Twin gestation.
6. Placenta previa & APH.
7. Uterine anomalies, fibroid uterus.
8. Post term pregnancy.

The ultrasound machine of high quality, with the Doppler facility was used for study. GE WIPRO LOGIC 5 PRO, 2008 MODEL was used for study. Measurement of Umbilical artery pulsatility index (UA- PI): Normal UA-PI is considered when it is below 95th percentile & abnormal-PI is considered, when it is above 95th percentile. The percentiles are obtained by referring to standardized charts adjusted to gestational age. Measurement of middle cerebral artery pulsatility index (MCA- PI): Normal MCA-PI is considered, when the MCA-PI is above 5th percentile & abnormal MCA-PI is considered when it is below 5th percentile. The percentiles are obtained by referring to the standardized charts and adjusted to gestational age. The following data was noted on Color Doppler blood flow; UA-PI, MCA-PI and ratio of MCA-PI/ UA-PI.(Fig 1 & Fig 2) The above values were recorded weekly and continued till delivery. The fetal outcome was recorded under the headings of;

1. Mode of delivery:

- a. Complicated mode of delivery for.
 - i. Caesarean sections done for fetal distress.
 - ii. Forceps delivery conducted for fetal distress.
- b. Uncomplicated delivery for.
 - i. Normal vaginal delivery.
 - ii. Operative delivery for indications other than fetal distress.

2. Perinatal outcome:

- a. Uncomplicated as with,
 - i. Normal APGAR
 - ii. Healthy neonate at the end of a week
- b. Complicated as with,
 - i. Minor complications.
 1. Fetal distress, fetal bradycardia:
 2. Meconium stained liquor.
 3. Poor APGAR of 6 or less at 5min after birth.
 - ii. Major complications.
 1. Perinatal death.
 2. Irreversible damage to organs.

STATISTICAL ANALYSIS USED: Level of significance is calculated by obtaining P value by Fisher exact test. Sensitivity and specificity were calculated by measuring true positive, true negative, false positive and false negative values in relation to each test.

RESULTS: A total of 60 women with high risk pregnancy were included in the study. More no of pregnant women with IUGR (78.3%) were recruited in the study.(Table 1). Caesarean sections for fetal distress and forceps delivery for fetal distress are considered as increased operative intervention due to placental insufficiency. Abnormal UA-PI is associated with operative intervention for fetal distress by 100% and normal UA-PI is associated with operative intervention by 15.7% (10.5%+5.2%). (Table 2) Abnormal UA-PI is associated with increased operative intervention, (P value -0.0064) shows that is significant. Sensitivity is only 25%, indicating that normal UA-PI is also associated with operative intervention. Specifity is 100% indicating abnormal UA-PI is always associated with operative intervention

Poor APGAR, meconeum stained liquor and perinatal deaths are considered as complicated perinatal outcome. Abnormal UA-PI is associated with perinatal complications by 100% (66.6%+33.3%) and normal UA-PI is associated by 31.5% (28%+3.5%). (Table 3). Abnormal UA-PI is associated with increased perinatal complications, (P value -0.0389) shows that it is significant. Sensitivity is only 14.3 % indicating that normal UA-PI is also associated with significant perinatal complications. Specificity is 100%, highly specific, indicating that abnormal UA-PI is always associated with perinatal complications.

ORIGINAL ARTICLE

Abnormal MCA-PI is associated with operative intervention by 33% (29.1%+4.1%) and normal MCA-PI is associated with operative intervention by 10%(5%+5%) (Table 4).Abnormal MCA- PI is associated with increased operative intervention, (P value 0.0498), indicating that it is significant. Sensitivity is 66.6 %(more sensitive than UA-PI) and Specificity is 66.6 % (less specific than UA-PI).

Abnormal MCA-PI is associated with perinatal complications by50 %(45%+ 4.1%) and normal MCA-PI is associated with perinatal complications by 35.5% (30%+5.5%). (Table 5)

Abnormal MCA-PI is not associated with significant perinatal complications (P value 0.3013) showing that it is not significant. Sensitivity is 48%, (more sensitive than UA-PI) and specificity is 65% (less specific than UA-PI).

Those with MCA-PI ratio of <1 , 66.6% (50% +16.6%) of them are associated with operative intervention for fetal distress. (Table 6). Ratio of <1 is significantly associated with operative intervention compared to ratios of 1 or more (P value 0.0167), sensitivity 30.7% and specificity 97.82%. Of all those with ratios of <1.1 (6+7=13), operative intervention for fetal distress is seen with 6 women (46.15%). Hence those with ratio <1.1 also, there is increased operative intervention (P value -0.0249) showing that it is also significant. Sensitivity 46% and specificity 85%.

Of those (n=6) with MCA-PI of <1 , 88.3% (n=5) are associated with perinatal complication

Those with MCA-PI Ratios of <1 (n=6), there is increased risk of perinatal complications (P value of 0.033).Sensitivity 20.9% and specificity 97.2% (Table 7).All those with ratios of <1.1 (n=13) also, there is 61.5% (n=8) incidence of perinatal complications(P value 0.0498) showing that it is also significant. Sensitivity 33% and specificity -88.8%.Hence all the women with either <1 or <1.1 , there is increased incidence of operative intervention and perinatal complications.

DISCUSSION: UMBILICAL ARTERY DOPPLER: In a normal pregnancy, the umbilical artery blood flow steadily increases with advancing gestational age with increasing flow in diastolic phase. It helps to meet the nutritional demands and oxygenation of the growing fetus. The increased diastolic flow through a vessel lowers the pulsatility index [PI] of the vessel, that is being studied. Hence the PI value of UA steadily falls with advancing gestation in a normal pregnancy. In a situation where the pregnancy is complicated with placental insufficiency (PE, PIH or IUGR) the placental villi are narrowed & calcified leading to reduced blood flow in the diastolic phase. It gives rise to increasing PI values. With ongoing pathological events, the blood flow in diastolic phase becomes zero. This is followed by reversal of blood flow in the end diastolic phase. The absent end diastolic flow [AEDF] & reversal of end diastolic flow [REDF] indicate poor fetal prognosis.

Umbilical artery Doppler abnormalities are seen only in 5% of the high risk pregnancies. The results are similar to the study of H J Odendal et al^[1] and Divon MJ et al^[2] in which 5.5% of high risk pregnant women presented with abnormal UA Doppler. Study by P Komuhangi et al^[3] and Byun, Y et al^[4] show that 10% of high risk pregnancies are associated with abnormal UA Doppler. But the study by Malik Rajesh et al^[5] and Shivani Singh et al^[6] had higher incidence of (60%) of abnormal UA Doppler in association with high risk pregnancy. The variation in the incidence of UA -PI abnormalities is due to the variation of subjects included in the present study.

The present study contained more no of IUGR pregnancies than hypertension complicating pregnancy.

In the present study, those women presenting with abnormal UA-PI, are significantly associated with more operative interventions (P value 0.0064) as well as perinatal complications (P value 0.0389) with highest specificity (100%) and highest positive predictive value (100% positive predictive value). Our study is consistent with the study of Malik Rajesh et al^[5] which shows 80% specificity 96% positive predictive value in association with poor perinatal outcome. But the sensitivity is very poor in our study, i.e., 25% for operative intervention and 15% for poor perinatal outcome. But review by Francesc Fiqueras et al^[7] is giving the results that abnormal UA Doppler is associated with adverse perinatal outcome with sensitivity of 60% and specificity of 60%. But according to present study and the study by HJ Odendal et al,^[1] one cannot depend on the UA Doppler alone, because it has far lower sensitivity (25%). Those with normal UA Doppler, surveillance by other tests like MCA-PI, Non stress test and biophysical profile is important to identify those women at risk of perinatal complications

MIDDLE CEREBRAL ARTERY DOPPLER: In a normal pregnancy the blood flow pattern in the MCA is characterized by increased peak systolic flow with minimal flow in diastolic phase. This results in high PI values. Where there is placental insufficiency, the blood flow is reduced in the mesentery and umbilical arteries. There is cerebral vasodilatation with redirection of blood flow to cerebral blood vessels. There is dilatation of MCA with resultant falling PI values in these vessels. This is called 'brain sparing effect', which is an indirect evidence of placental insufficiency.

Middle cerebral artery Doppler abnormalities are more commonly observed than umbilical artery abnormalities, in high risk pregnancy. In the present study, 40 % of them show abnormal flow patterns in association with high risk pregnancy. The study by Malik Rajesh et al^[5] shows lower incidence (8%) of abnormal MCA-PI in association with high risk pregnancy. The difference could be due to the fact that our study group contained more no of IUGR (75%) pregnancies than others. In the present study, MCA Doppler abnormalities are associated with more operative interventions (33%) (P -value 0.049) with a sensitivity of 66% and specificity of 66%. But it is not in association with significant poor perinatal outcome (P value is 0.3013). It is not a reliable predictor for poor perinatal outcome. Study by Malik Rajesh et al [5] shows sensitivity as 7.7% and specificity as 90%. This could be due to the difference in the type of risk factors in association with the studies.

Ratio of MCA- PI & UA- PI: Both MCA- PI & UA- PI values are taken into consideration. The falling ratio indicates changing pattern of blood flow in both MCA & UA .If blood flow of both vessels is taken in to consideration, i.e., the study of the ratio of MCA-PI/UA-PI, the results could be of more significance. Many studies proved that the ratios of MCA-PI/UA-PI are in correlation with the perinatal outcome.

Alaa Ebrashy et al^[8] showed that MCAPI/UAPI <1.0 carried increased risk of neonatal morbidity with 64.1% sensitivity; 72.7% specificity; 89.2 positive predictive value; 36.3 negative predictive value. A study by Obido Ao et al^[9] shows that MCA-PI/UA-PI of <1.08 predicts poor perinatal outcome with sensitivity of 72%; specificity of 62%; positive predictive value of 68%;

ORIGINAL ARTICLE

negative predictive value of 67%. Tongta Nanthakomon et al^[10] observed in his study that the MCA- PI/ UA- PI ratio could not be used as the predictor of the severe fetal growth retardation from mild fetal growth retardation.

Present study is showing that the MCA-PI/UA-PI of <1.1 carried increased risk of operative intervention for fetal distress with P value of 0.0249; sensitivity of 46.15% and specificity of 85.11%. So also ratio of <1.1 is in association with poor perinatal outcome with P value of 0.0498; sensitivity of 33.3% and specificity of 88.88%. If the cut off for the ratio is taken as <1 , the risk of adverse perinatal out-come increases. The P value 0.033; sensitivity 20.9% and specificity is 97.2%. Hence if the ratio is falling below 1.1, one can predict significant adverse perinatal outcome. If the cut off is <1 it is highly significant and one can be sure of the outcome. By providing this information to the parents, one may avoid legal implications.

Of all the three parameters studied in the high risk pregnancy; Abnormal UA-PI is significantly associated with more operative interventions and adverse perinatal outcome. But it is least sensitive and there is every chance of missing abnormal outcome and it is essential to depend on the other parameters to rule out adverse outcome. Abnormal MCA-PI alone is not a reliable indicator for poor perinatal outcome. But it appears to be more sensitive in suspecting adverse outcome than UA-PI. The MCA-PI/UA-PI Ratio when it falls below 1.1, there is increased risk of operative intervention as well as adverse perinatal outcome. The significance further increases if it is falling <1 .

CONCLUSION: While performing Doppler study in high risk pregnancies, it is necessary to perform both the umbilical artery and middle cerebral artery Doppler. Though abnormal UA- PI is highly specific & one can be sure of poor outcome, it is not sensitive and cannot detect all pregnancies at risk. Abnormal MCA-PI is not significantly associated with adverse outcome but is more sensitive in identifying many pregnancies at risk of having poor outcome. Present study indicates that MCA-PI/ UA-PI ratio is a more dependable parameter to pick-up those pregnancies at risk as it can predict adverse outcome. It is significant if it is <1.1 and highly significant if it is <1 . However other tests like Non stress test and Biophysical profile are important in identifying the fetus at risk. Each test is complementary to the other. More studies with good quality and expertise are essential to prove the significance of these tests. Those with high significance should guide the obstetrician in planning the timing of delivery.

REFERENCES:

1. Odendal H. J, Theron A M, Carstens M H, de Jagaret M, Grove D. Intra uterine deaths in high risk pregnancies with normal and border line umbilical artery Doppler velocity wave forms. SAJOG 2008; 14: 1.
2. Divon MJ. Umbilical artery Doppler Revisited: Clinical utility in high risk pregnancies. Am J Obstet Gynecol 1966; 174: 10-14.
3. Komuhangi P, Byanyima R. K, Kigule E, Malwadde, Nakisige C. Umbilical artery Doppler flow patterns in high-risk pregnancy and fetal outcome in Mulago hospital .CRCM 2013; 2: 554-561.

ORIGINAL ARTICLE

4. Byun, Y.J, Kim, H, Yang, J, Kim, J.H, Kim, H.Y. and Chang, S.J. Umbilical Artery Doppler study as a predictive marker of perinatal outcome in preterm small for gestational age infants. *Yongei Medical Journal* .2009; 50: 39-44.
5. Rajesh M. Saxena A et al.Role of color Doppler indices in the diagnosis of Intra uterine growth retardation in High risk pregnancies. *J Obstet Gynaecol India*. 2013; 63 (1): 37-34.
6. Singh S, Verma U, Shrivastava K, Khanduri S, Goel N, Zahra F, Shirivastava K. L. Role of color Doppler in the diagnosis of intra uterine growth restriction (IUGR). *Int J Reprod Contracept Obstet Gynecol*. 2013; 2(4): 566-572.
7. Fiqueras F, Gardosi J. Intrauterine Growth restriction: new concepts in antenatal surveillance, diagnosis and management. 2011; 204 (4): 288-300.
8. Ebrashy A, Azmy O, Ibrahim M, Waly M, Edris A. Middle cerebral/umbilical artery resistance Index ratio as sensitive parameter for fetal well-being and Neonatal outcome in patients with preeclampsia: Case control study. *Croat Med J* 2005; 46(5): 821-825.
9. Odibo AO, Riddick C, Pare E, Stamilio DM, Macones GA. Cerebroplacental Doppler ratio and adverse perinatal outcomes in intrauterine growth restriction: evaluating the impact of using gestational age-specific reference values. *J Ultrasound Med*. 2005 Sep; 24 (9): 1223-8.
10. Nanthakomon T, Somprasit C. The value of middle cerebral artery-umbilical artery pulsatility index ratio in prediction of severe fetal growth restriction. *Thammasat Medical Journal* 2010; 10: 3.

Risk factor noted	Number of cases(N)	Percentage
Hypertension	20	33%
IUGR	47	78.3%
IUGR + Hypertension	7	11.6% [overlap]
Total	60	

Table 1: High risk factors in pregnancy-60

UA-PI	Total No 60	Caesarean section for fetal distress	Forceps for fetal distress	Caesarean section for other indications	Normal vaginal deliveries
Normal PI	57 (95%)	6 (10.5%)	3 (5.2%)	17 (29.8%)	31 (54.3%)
Abnormal PI	3 (5%)	3 (100%)	0	0	0

Table 2: UA- PI (umbilical artery pulsatility index) and Mode of delivery

ORIGINAL ARTICLE

UA-PI	Total No 60	Normal APGAR	Poor APGAR + meconeum stained liquor	Perinatal deaths
Normal UA- PI	57(95%)	39(68.4%)	16 (28%)	2(3.5%)
Abnormal UA- PI	3(5%)	0	2 (66.6%)	1(33.3%)

Table 3: UA-PI (umbilical artery pulsatility index) and Perinatal outcome

MCA-PI	Total No 60	Caesarean section for fetal distress	Forceps for fetal distress	Caesarean section for other indications	Normal Vaginal deliveries
Normal MCA-PI	36 (60%)	2 (5%)	2 (5%)	10 (27.7%)	22 (61.1%)
Abnormal MCA- PI	24 (40%)	7 (29.1%)	1 (4.1%)	7 (29.1%)	9 (37.5%)

Table 4: MCA-PI (middle cerebral artery pulsatility index) and Mode of delivery

MCA-PI	Total No 60	Normal APGAR	Poor APGAR + meconeum stained liquor	Perinatal deaths
Normal MCA-PI	36 (60%)	23 (63.8%)	11 (30%)	2 (5.5%)
Abnormal MCA-PI	24 (40%)	12 (50%)	11 (45%)	1 (4.1%)

Table 5: MCA-PI (middle cerebral artery pulsatility index) and Perinatal outcome

MCA-PI /UA-PI	Total No 60	Caesarean section for Fetal distress	Forceps for fetal distress	Caesarean section for other indications	Normal deliveries
<1	6 (10%)	3 (50%)	1(16.6%)	2 (33.3%)	0
1 to 1.1	7(11.6%)	1 (14.2%)	1(14.2%)	0	5 (71.4%)
>1.1	47 (78.3%)	5(10.6%)	2 (4.2%)	14 (29.7%)	26 (55.3%)

Table 6: Ratio of MCA-PI/UA-PI and Mode of delivery

ORIGINAL ARTICLE

MCA-PI/UA-PI	Total No 60	Normal APGAR	Poor APGAR + meconeum stained liquor	Perinatal deaths
<1	6(10%)	1(16.6%)	3(50%)	2(33.3%)
1 to 1.1	7(11.6%)	4(57.1%)	3(42.8%)	0
>1.1	47(78.3%)	31(65.9%)	14(29.7%)	2(4.25%)

Table 7: Ratio of MCA-PI/UA-PI and Perinatal outcome

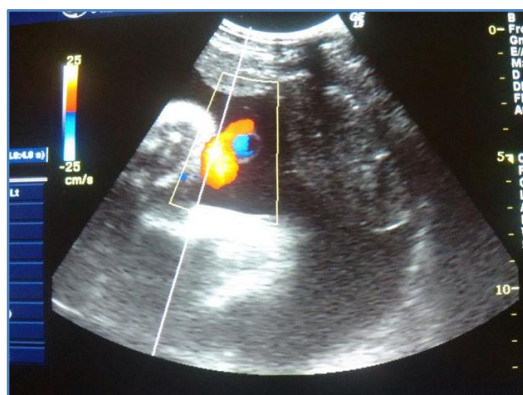


Fig. 1: Colour Doppler of Umbilical artery

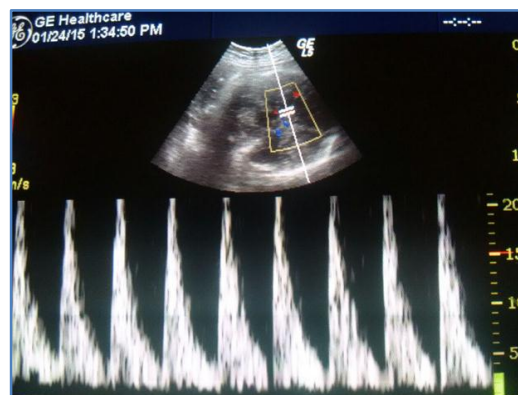


Fig. 2: Colour Doppler of Middle cerebral artery

AUTHORS:

1. N. Uma
2. D. Hemalata Devi
3. P. Usha
4. D. Jyotsna
5. A. Bhagya Lakshmi

PARTICULARS OF CONTRIBUTORS:

1. IC Professor, Department of Obstetrics & Gynaecology, Andhra Medical College / GVH.
2. Associate Professor, Department of Obstetrics & Gynaecology, Andhra Medical College / GVH.
3. Assistant Professor, Department of Obstetrics & Gynaecology, Andhra Medical College / GVH.

4. Post Graduate, Department of Obstetrics & Gynaecology, Andhra Medical College / GVH.
5. Professor & HOD, Department of Pathology, Andhra Medical College / GVH.

NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:

Dr. A. Bhagyalakshmi,
Professor & HOD,
Department of Pathology,
Andhra Medical College /
Government Victoria Hospital, Visakhapatnam.
E-mail: dr.a.bhagyalaxmi@gmail.com

Date of Submission: 27/01/2015.

Date of Peer Review: 28/01/2015.

Date of Acceptance: 03/02/2015.

Date of Publishing: 05/02/2015.