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Research Article

Role of Doppler indices of umbilical and middle cerebral artery in prediction of perinatal outcome in preeclampsia

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ABSTRACT

Background: Hypertension which develops de novo in pregnancy appears to be unique to human and continue to be a major cause of reported perinatal mortality. The aim and objectives of the study was to evaluate the diagnostic value of Umbilical and Middle cerebral artery Doppler in predicting the perinatal outcome in preeclampsia.
Methods: A prospective study at Sri Siddhartha Medical College and Hospital between October2013-September2015 on 80pregnant women with preeclampsia at >30weeks gestation. Studies of fetal vessels were performed using a pulsed Doppler ultrasound. Resistance Index (RI), Pulsatility Index (PI) and systolic/diastolic ratio (S/D) were measured in umbilical artery (UA) and Middle cerebral artery (MCA) and perinatal outcomes were monitored and statistically analyzed.
Results: Out of 80 cases studied, 25 cases showed adverse perinatal outcome, among which 6 cases with perinatal death, 13 cases had low APGAR at 5minutes. 6 cases had NICU admission.
Conclusions: Color Doppler has an important role in antepartum fetal surveillance in preeclampsia which can detect fetal compromise at an early stage. In our study pulsatility index of umbilical artery and ratio of MCA/UA PI was more sensitive than other parameters with PPV 78%.

Keywords: Preeclampsia, IUGR, Doppler, UA, MCA

INTRODUCTION

Hypertensive disorders are the commonest medical disorder in pregnancy. It is a major cause of perinatal morbidity and mortality worldwide, with reported incidence of 5-10%.[1,2] Preeclampsia can result in placental abruption, intrauterine fetal death, Intra uterine growth restriction. Doppler Velocimetry of Umbilical artery (UmA) and Middle cerebral artery (MCA) can detect fetal compromise much before than other antepartum test.

Doppler ultrasound is used as a part of clinical protocol in surveillance of high risk pregnancies.[3] It gives direct information of feto-placental circulation and identifies placental circulatory failure.[4] The advantage of Doppler ultrasound is that the technique is fast, reproducible and can be performed on a daily basis.[3]

The blood flow characteristics can be quantified by Doppler indices by Systolic/Diastolic ratio (S/D ratio= peak systolic velocity/ end diastolic velocity), Resistance Index (RI= peak systolic velocity-end diastolic velocity/ peak systolic velocity), Cerebro placental index (CPI= MCA resistance/UmA resistance), Pulsatility Index (peak systolic velocity-end diastolic velocity/ mean velocity). Preeclampsia is associated with 22% of all perinatal death[4]. It presents an increased risk of complications for the fetus, prematurity, low birth weight, neonatal intensive care and fetal death.[5-7]

The challenge of clinician is to deliver at the optimum time so as to minimize the damage to the baby. The aim of the present study is to detect early fetal compromise in utero by Doppler velocimetry findings in umbilical artery and middle cerebral artery for favourable perinatal outcome and fetus may be delivered before the occurrence of irreversible change.

METHODS

It is a prospective study conducted in Department of Obstetrics and Gynaecology in time span of two years on 80subjects in a teaching hospital in Karnataka. The study got ethical clearance from the institution and informed consent was taken from all the patients.

Inclusion criteria

- All ANC patients with BP ≥140/90mmHg with proteinuria or edema or both.
- Gestational age ≥30weeks.
- Singleton pregnancy.

Exclusion criteria

- Patients having h/o chronic hypertension.
- H/o Gestational diabetes.
- H/o Patients with cardiac diseases.
- Pregnancies with multiple gestation and congenital anomalies.

A detailed history and thorough examination was done. Laboratory investigations were done according to the need.

All the patients were subjected to routine ultrasound followed by Doppler waveform analysis on color Doppler using GE voluson 730pro with 3.5 MHz probe, of Umbilical artery (UmA) and Middle cerebral artery (MCA) with respect to S/D ratio, Pulsatility index (PI), and Resistance Index (RI).

Doppler study repeated at 2-4weeks interval depending on severity of hypertension and abnormalities of waveform. Cases were followed till delivery and perinatal outcome noted. All the measurements were performed in semi-recumbent position. The umbilical artery color Doppler waveform was collected from free floating parts of the umbilical cord during minimal fetal activity and the absence of fetal breathing. For measurement of MCA, an axial view of fetal head was obtained at the level of cerebral peduncles, then the color Doppler was used to visualize the Circle of Willis and Doppler sample volume was placed within 1cm of the origin of MCA that was easily identified on a major branch running antero-lateral from the Circle of Willis toward the lateral edge of the orbit.

The Umbilical artery Pulsatility index was considered abnormal when values were <5th percentile. MCA/UA PI <1 was considered abnormal. The statistical analysis included the x^2 test, Sensitivity, specificity, positive and negative predictive values. P value less than 0.05 were considered statistically significant.

RESULTS

Table 1: Age distribution.

Age in years	No. of cases	%
15-20yrs	20	25
21-25yrs	45	56.2
26-30yrs	12	15
31-35yrs	3	3.75

Doppler ultrasonography has given an improved access to fetal circulation.[8]

In the present study out of 80 cases studied, 56% cases were between 21-25years. The mean age found was 23.73±4.57. Out of 80 cases, 41 were mild preeclampsia of which 12 cases has adverse outcome (28%). 39 were severe preeclampsia of which 19cases with adverse outcome (45%).

Table 2: Incidence of outcome in relation to severity of preeclampsia.

Severity of preeclampsia	No. of cases	Adverse outcome
Mild preeclampsia	41	12 (28%)
Severe preeclampsia	39	19 (45%)

In the present study out of 80 cases studied, 56% cases were between 21-25years. The mean age in mild and severe preeclampsia was 23.73±4.57 and 23.80±3.09 years respectively. Out of 80 cases, 41 were mild preeclampsia of which 12 cases has adverse outcome (28%). 39 were severe preeclampsia of which 19cases with adverse outcome (45%) (Table 2).

Table 3: Distribution of gestational age.

Gestational age	No. of cases
>37weeks	52.9%
33-37weeks	40%
28-32weeks	7.1%

52.9% showed gestational age >37weeks (term gestation), 40% were between 33-37weeks gestation, and 7.1% were between 28-32weeks of gestation (Table 3).

Out of 80cases studied 41% were primigravida, 33% were second gravida, 18% were third gravida and 5% were fourth gravida (Table 4).

Table 4: Parity distribution.

Gravida	No. of cases	%
Primigravida	33	41
Second gravida	27	33
Third gravida	15	18
Fourth gravida	4	5

Table 5: Correlation of umbilical artery velocimetry and perinatal outcome.

No. of patients	Adverse outcome	Normal outcome
Increased PI Normal PI	15 (18.7%) 5 (6.25%)	1 (1.25%) 59 (73.7%)
Abnormal RI Normal RI	20 (25%) 1 (1.25%)	12 (15%) 47 (58%)
Abnormal S/D ratio Normal S/D ratio	20 (25%) 3 (3.75%)	13 (16%) 44 (55%)

Abnormal Umbilical PI value is increased in 93% of cases and Umbilical RI value increased in 62.5% of cases which showed adverse perinatal outcome. In our study umbilical artery PI was more sensitive (Table 5).

Table 6: Umbilical artery S/D ratio.

S/D ratio	No. of cases	%
<2	17	21.5
2-3	25	31.2
3-4	15	18.7
>4	9	11.2
Absent diastolic flow	10	12.5
Reversed diastolic flow	4	5

S/D ratio >3 had a positive predictive value of 60.6% in detection of adverse perinatal outcome. Also Absent and reversal end diastolic flow in umbilical artery results were more sensitive in predicting perinatal outcome (Table 6).

Table 7: Correlation of MCA PI and adverse perinatal outcome.

	No. of patients	Adverse perinatal outcome	PPV
Abnormal MCA PI <1	18	5	23
Normal MCA PI >1	4	53	57

Middle cerebral artery PI was decreased in 78% of cases with 78% positive predictive value and 92% of negative predictive value (Table 7).

Out of 80cases studied 25 showed adverse perinatal outcome. 6 were perinatal death and 13 had low Apgar score at 5 minutes and 6 were admitted to NICU (Table 8).

Table 8: Adverse perinatal outcome.

Perinatal outcome	No. of cases
IUD	4
Still birth	2
Low APGAR score	13
NICU admission	6
Total	25

Table 9: Statistical analysis of results.

	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Um PI	75	98.3	93.3	92.19
Um RI	95.24	79.66	62.5	97.91
MCA - PI	80	91	78	92

DISCUSSION

In the present study out of 80 cases 50.5% had mild preeclampsia and 49.4% had severe preeclampsia.

The highest number of cases in our study is between 21-30yrs and the incidence of preeclampsia was more in Primgravida. Preeclampsia is a disease of young primigravidae Andersch B et al, also observed that primiparity was almost twice as common in preeclampsia groups compared with randomly selected controls.[9,10]

Table 10: Comparison of our study of Um.A doppler velocimetry with study done by B.N. Lakkhar, K.V. Rajgopal, Hazra et al, Shah Nehal S et al.

	B.N. Lakkhar	K.V. Rajgopal	Hazra et al	Present study
Sensitivity	58.8%	64%	25%	75%
Specificity	81.8%	90.7%	92.6%	98.3%
PPV	22.2%	72.7%	12.5%	93.3%
NPV	95.7%	86.7%	95.6%	92.2%

In present study Abnormal Umbilical PI value is increased in 93.3% of cases and Umbilical RI value increased in 62.5% of cases which showed adverse perinatal outcome. In our study umbilical artery PI was found more sensitive. S/D ratio >3 had a positive predictive value of 60.6% in detection of adverse perinatal outcome. In studies of Bhatt et al 56% had abnormal S/D ratio in umbilical artery (Table 10).[11]

Also Absent and reversal end diastolic flow in umbilical artery results were more sensitive in predicting perinatal outcome. In studies of Hazra et al with absent and end diastolic velocity, perinatal mortality was 50% and 50% had IUGR babies(Table 11).[12]

Table 11: Comparison of absent/reversed diastolic flow with other studies.

	Kurkinen Ratty	Hazra et al	Karsador P	Present study
Absent end diastolic	8.1%	50%	41%	75%
Reversed end diastolic	35.7%	50%	75%	100%

Table 12: Comparison of absent/reversed diastolic flow with other studies.

	B.N. Lakkhar	K.V. Rajgopal	Present study
Sensitivity	91.7%	24%	75%
Specificity	53.9%	100%	75.4%
PPV	15.1%	100%	50%
NPV	98.6%	77.3%	92%

In the present study Middle cerebral artery PI was decreased in 78% cases showing adverse perinatal outcome, comparable to Bhushan N. Lakkhar, Gramenilli et al (Table 12).[13]

Abnormal MCA/PI Doppler ratio correlates with fetal prognosis. In present study ratio of PI of Middle cerebral artery/ umbilical artery shows 78% positive predictive value. According to Gramellini et al and Arduini et al, assessment of MCA/UA PI index provide information in predicting perinatal outcome when compared with umbilical or middle cerebral artery Doppler indices alone.[15,16]

In the present study out of 80cases studied 25 showed adverse perinatal outcome. 6were perinatal death and 13 had low Apgar score at 5minutes and 6 were admitted to NICU. 68.4% showed low birth weight and 10.59% showed very low birth weight. Gramenilli et al found neonatal complications in 33.3% newborns of the mothers with abnormal MCA/UA ratio as compared to 1.38% new-borns with normal MCA/UA ratio. Kassanos et al also found similar results.[17]

Table 13: Comparison of our study of MCA/UA- PI doppler velocimetry with study of Gramellini, B.N Lakkhar, K.V. Rajgopal, Rozeta.

	Parameter	Gramellini et al	B.N Lakkhar K.V. Rajgopal	Rozeta et al	Present study
MCA/UA- PI	Sensitivity	68%	66.6%	98%	88%
	Specificity	98.4%	73.9%	66%	91%
	PPV	94.4%	40%	30.8%	78%
	NPV	88.8%	89.4%	99.7%	73%

CONCLUSIONS

Doppler study in pregnancy hypertension is a non-invasive hemodynamic study; abnormal waveforms are associated with the adverse perinatal outcome in our study. It is useful guide to plan timely intervention so as to reduce perinatal mortality and morbidity.

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