Original Research Article

Role of uterine and umbilical artery doppler assessment of the uteroplacental circulation in predicting pre-eclampsia: comparison between different doppler parameters

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ABSTRACT

Background: Hypertensive disorders are the common cause of maternal death which affecting nearly 5-10% of pregnancies all over the world. Pre-eclampsia develop from inadequate trophoblast invasion of the maternal spiral arteries and Doppler values permits non-invasive evaluation of uteroplacental circulation and is of great importance in the management of high risk pregnancies. The aim of the study was to assess the findings of Doppler data in predicting pre-eclampsia and comparison of the efficacy of uterine artery Doppler and umbilical artery Doppler.
Methods: The study comprises of 100 women with high risk pregnancy attending antenatal clinic at Geetanjali Medical College and Hospital, Udaipur were subjected to uterine and umbilical artery Doppler Study. Women with high risk pregnancy between 26-32 weeks of gestation were studied with colour Doppler. This was a prospective study over a period of 1 year from 2015-2016.
Results: The results of the study revealed that 5 out of 100 participants developed pre-eclampsia. Out of different parameters, notch is the best predictor of pre-eclampsia with high sensitivity and highest PPV for uterine artery Doppler and S/D ratio is considered to be best indicator for umbilical artery Doppler. Regarding efficacy, umbilical artery Doppler is more predictive than uterine Doppler.
Conclusions: Doppler study can be used for the prediction of pre-eclampsia to reduce maternal morbidity and mortality.

Keywords: Hypertension, Notch, S/D ratio, Pre-eclampsia, Uterine artery Doppler, Umbilical artery Doppler

INTRODUCTION

Despite of recent advances in antenatal care, pre-eclampsia remains the major cause of maternal morbidity and mortality. The persistence of high resistance of flow and diastolic notch after 24-26 weeks of gestation provides the rational to investigate the placental circulation of Doppler and to predict pre eclapmsia.[1] Pre-eclampsia is heterogenous disorder with variable maternal and fetal complications. The patients who are going to develop pre-eclampsia have progressive increase in systolic to diastolic ratio (S/D ratio), resistive index (RI) and appearance of diastolic notch.[2]

Pre-eclampsia is characterized by an imbalance between prostacycline and thromboxane production as well as failure of second wave trophoblastic invasion of the endomyometrial vasculature.[3]

Any organ may be involved by the disease, but the main organs are the placenta, kidney, brain and eyes. It may be associated with many other signs and symptoms such as

edema, visual disturbances, headache and epigastric pain.[4]

The result is abnormal utero placental blood flow and this had led to the use of Doppler assessment of uterine and umbilical arteries velocity waveforms as a method of screening for these antenatal complications. In order to avoid serious squeal screening of preeclampsia may allow antenatal surveillance and appropriate timing of foetal delivery and this led to the idea of using uterine and umbilical artery doppler assessment as a screening test for predicticting pre-eclampsia.[5]

The objective of this study was to assess the findings of Doppler data in predicting pre-eclampsia. And to compare the efficacy of uterine artery Doppler and umbilical artery Doppler.

METHODS

A total of 100 women with high risk pregnancy attending antenatal clinic at Geetanjali Medical College and Hospital, Udaipur were subjected to uterine and umbilical artery Doppler Study. Women with high risk pregnancy between 26-32 weeks of gestation were studied with colour Doppler. This was a prospective study over a period of 1 year from 2015-2016.

Study of umbilical and a uterine artery flow velocity form was done. In both uterine and umbilical artery, S/D ratio and RI (resistance index) were studied. In uterine artery presence and absence of early diastolic notch was noted. In umbilical artery, absent and reversed diastolic flows were studied. Informed consent was obtained from the women who underwent color Doppler study. The outcomes of the pregnancies were evaluated by review of the hospital records after delivery. This study was approved by institutional research committee of the institute.

The accurate gestational age (GA) was estimated by the last menstrual period (LMP) with 28-30 days regular cycles, otherwise, accurate expected date of delivery (EDD) was calculated by ultrasound examination.

These patients were followed up till delivery

Inclusion criteria

- History of preeclampsia or eclampsia in previous pregnancy
- Preeclampsia or pregnancy-induced hypertension (PIH) current.

Exclusion criteria

- Patient with congenital anomaly of fetus, multiple gestations

- Patients those who are not getting booked for delivery at Geetanjali Medical College and Hospital in Udaipur
- Patients with unreliable LMP details and not confirmed by early ultrasound.

All the data were entered in Microsoft excel sheet. Statistical analysis was done using diagnostic tests such as sensitivity, specificity and predictive values.

RESULTS

Out of total study subjects normal Doppler assessment was found in 78 out of 100 and rest of 22 women had abnormal Doppler assessment Table 1.

Table 1: Combination of uterine and umbilical Doppler values and pre-eclampsia.

Doppler values	Pre-eclampsia patients	Total patients
Both normal	1 (1.28%)	78 (100%)
Normal uterine and abnormal umbilical Doppler	0 (0%)	8 (100%)
Normal umbilical and abnormal uterine Doppler	2 (16.67%)	12 (100%)
Both abnormal	2 (100%)	2 (100%)
Total	5 (5%)	100 (100%)

Overall, out of total women, 12% had abnormal uterine artery Doppler, 8% had abnormal umbilical artery Doppler and only 2% had both abnormal Doppler indices Table 1.

Out of these 22 women with abnormal Doppler, 12 (54.54%) had abnormal uterine artery Doppler, 8 (36.36%) had abnormal umbilical artery Doppler and only 2 (9.09%) had both abnormal Doppler indices Table 1.

Out of total 100 patients, 5 were found to have pre-eclampsia. Out of these 5 patients with pre-eclampsia, only 1 (20%) had normal Doppler and remaining 4 (80%) had abnormal Doppler Table 1.

Out of these 4 patients with abnormal Doppler, 2 (50%) had both abnormal indices and 2 (50%) had abnormal uterine Doppler whereas no one had abnormal umbilical artery Doppler Table 1.

Thus, in Table 1, it was observed that when both uterine and umbilical Doppler was abnormal, 100% of patients developed pre-eclampsia. When both were normal, only 1.28% developed pre-eclampsia. But with abnormal uterine and normal umbilical Doppler, 16.67% developed pre-eclampsia and in case of abnormal umbilical Artery Doppler no one developed pre-eclampsia.

Table 2: Uterine artery Doppler parameters in predicting pre-eclampsia.

Indices	Sensitivity	Specificity	PPV	NPV
S/D ratio	60%	93.70%	33.30%	97.80%
RI	40%	94.70%	28.56%	96.77%
Notch	60%	94.74%	37.50%	97.82%
Combined	80%	89.47%	28.57%	98.83%

Table 2 reveals in the parameters of uterine artery Doppler in predicting pre-eclampsia, S/D ratio and Notch had sensitivity of 60% and positive predictive value (PPV) value to be 33.3% and 37.5%. Specificity of S/D ratio and Notch was 93.7% and 94.74% respectively. Thus, Notch as a single parameter is the best indicator with high sensitivity and highest PPV followed by S/D ratio. Since combination of parameter had highest sensitivity of 80% and PPV to be 28.57%, thus is considered to be good indicator. The sensitivity of RI was 40% and its PPV was 28.56%. The specificity of all the parameters was above 93% except combination of parameters (89.47%). Negative predictive value (NPV) of all the parameter was in range of 96-99%.

Table 3: Umbilical artery Doppler parameters in predicting pre-eclampsia.

Indices	Sensitivity	Specificity	PPV	NPV
S/D ratio	40%	96.84%	40%	96.84%
RI	40%	93.68%	25%	96.74%
Combined	40%	91.58%	20%	96.67%

Table 3 reveals that in umbilical artery Doppler sensitivity for all indices i.e. S/D ratio, RI and combined parameters were same i.e. 40%. S/D ratio had highest PPV value to be 40%, specificity to be 96.84%. In umbilical artery Doppler RI had specificity of 93.68% and PPV of 25% and combination of parameters had specificity of 91.58% and PPV of 20%. NPV of all the indices was found to be in range of 96-97%. Thus, out of parameters of umbilical artery Doppler S/D ratio is considered to be best indicator Table 3.
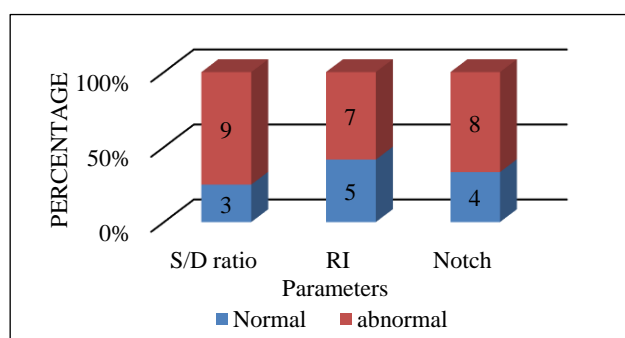

Figure 1: Parameter prediction in abnormal uterine artery Doppler (n=12).

Figure 1 shows that out of total of 22 women with abnormal Doppler, 12 women had found with abnormal uterine artery Doppler, 9 (75%) had abnormal and 3 (25%) had normal S/D ratio, 7 (58.33%) had abnormal and 5 (41.67%) had normal RI and 8 (66.67%) had abnormal and 4 (33.33%) had normal Notch.
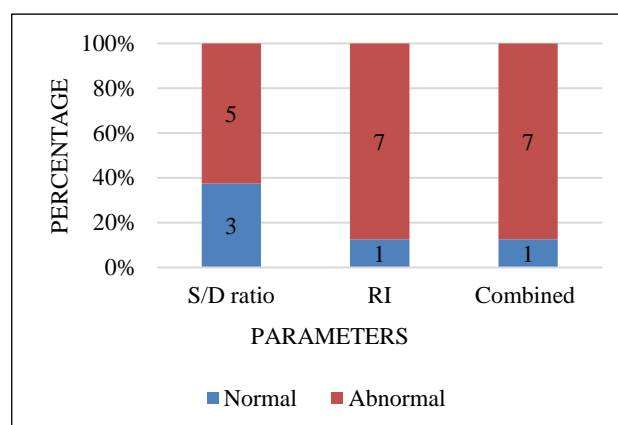

Figure 2: Parameter prediction in abnormal umbilical artery Doppler (n=8).

Figure 2 shows that out of 22 patients with abnormal Doppler, 8 women had found with abnormal umbilical artery Doppler, 5 (62.5%) had abnormal and 3 (37.5%) had normal S/D ratio, 7 (87.5%) had abnormal and 1 (12.5%) had normal RI and 7 (87.5%) had abnormal and 1 (12.5%) had normal combined parameters.

DISCUSSION

In this prospective study in a setup of Geetanjali Medical College and Hospital in Udaipur, which includes women from rural and urban sectors, the predictive values of various Doppler indices have been evaluated.

Out of total sample 0f 100 women, 78% found to have normal Doppler and 22% had abnormal Doppler.

Out of 22 patients with abnormal Doppler,12 (54.54%) had abnormal uterine artery Doppler, 8 (36.36%) had abnormal umbilical artery Doppler and only 2 (9.09%) had both abnormal Doppler indices.

In our study, the prevalence of pre-eclampsia was 5% which was similar to that quoted by Bewley et al, (4.6%) and Jasovic et al (4%).[6,7]

Out of 12 patients with abnormal uterine artery Doppler, 9 had abnormal S/D ratio and 7 had abnormal RI.[8] Patients had persistent early diastolic notch, among them, 4 had bilateral and 4 had unilateral.

Out of 8 patients with abnormal umbilical artery Doppler, 5 had abnormal S/D ratio and 7 had abnormal RI. 1 Patients had absent end diastolic flow.

Out of 22 patients, 5 developed pre-eclampsia with sensitivity of 60%, 40% and 60% for S/D ratio, RI and

Notch indices for uterine artery which is similar to results obtained by Kurdi et al.[8]

The specificity was between 93-96% for all indices and PPV was 33.3%, 28.6% and 37.5% for S/D ratio, RI and Notch respectively. This shows that notch is the best predictor of pre-eclampsia. This is similar to the findings of Bower et al, Divon et al and Antsaklis et al.[9-11]

Out of 8 patients with abnormal umbilical artery, 2 developed pre eclamsia with sensitivity of 40% for S/D ratio, RI and combined parameters. The specificity was between 93-97% for all indices and PPV was 40%, 25% and 20% for S/D ratio, RI and combined parameters respectively. This shows that notch is the best predictor of pre-eclampsia.

Mirza et al, did study in 268 women, and there were 57 cases with abnormal Doppler.[12] Of these, preeclampsia was diagnosed in 14% cases. Positive predictive values of S/D ratio, RI, and absent end diastolic flow were 40%, 25% and 100%, respectively. This indicates that umbilical artery Doppler is more predictive than uterine artery Doppler which is found similar to finding of this study.

Thus, it has been observed that umbilical artery Doppler is more predictive than uterine Doppler.

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