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Correlation between abnormal Doppler indices and pregnancy outcome

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Abstract

Abnormal placentation occurs long before clinical appearance of obstetrical complications like FGR (Fetal Growth Restriction), preeclampsia, SGA (Small for Gestational Age, preterm labour, premature rupture of membranes (PROM) and fetal death. Assessment of the maternal vasculature evaluates "up-stream" blood flow or the maternal side of placental resistance. Doppler wave form analysis was done anywhere in between 10 weeks 6 days to 14 weeks of gestation along with nuchal translucency (NT) scan, again UtA doppler was done at any time between 19 to 24 weeks as a part of fetal anomaly scan. Sample size was 247 pregnancies out of which we obtained 217 cases. From the 217 cases, 20 cases were lost to follow up and 4 resulted in first trimester abortions. So finally after tending to the inclusion criteria we had a total of 193 pregnant followed up throughout their pregnancy into the Women. Early diastolic notch in the first trimester was significant for GH, preeclampsia and the complications of hypertensive diseases of pregnancy being FGR, oligoaminos and preterm deliver. Significance with outcome and high risk pregnancy was also observed.

Keywords: Doppler indices, pregnancy, FGR

Introduction

The advent of Doppler flow studies has changed the practice of obstetrics by providing a window to the womb through which the maternal and fetal vessels can be evaluated. The use of Doppler ultrasound has become common in the evaluation and management of high risk pregnancies as it provides a non-invasive method for the study of the utero placental circulation. Preeclampsia is of considerable public health threat particularly in developing countries globally, affecting approximately 8% of all pregnancies and is the second leading cause of direct maternal and fetal death. The prevalence of fetal growth restriction (FGR) in developing countries is as high as 35%. The incidence of LBW is about 30% in India and a large percentage; approximately 70% of LBW are small for gestational age (SGA). The global burden of the above mentioned outcomes is the highest in developing countries ^[1,2].

Abnormal placentation occurs long before clinical appearance of obstetrical complications like FGR (Fetal Growth Restriction), preeclampsia, SGA (Small for Gestational Age, preterm labour, premature rupture of membranes (PROM) and fetal death. Assessment of the maternal vasculature evaluates "up-stream" blood flow or the maternal side of placental resistance. This has generated a great interest in the possibility of using UtA Doppler as a screening test for abnormal pregnancy outcomes. There is extensive evidence that UtA Doppler ultrasound is useful in second trimester to assess the uteroplacental perfusion and to predict further development of preeclapmsia, FGR, abruption and still birth. However, scientific interest is now focused on early pregnancy. To date, very limited data about UtA Doppler evaluation in the late first trimester or pregnancy are available. High risk pregnancies have higher impedance. UtA Doppler than normal pregnancies, suggesting that the lack of a normal uteroplacental circulation occurring at an early stage of pregnancy may partly predict the later development of some pregnancy complications. Pregnancies with an increased risk of developing hypertensive disorders and related complications already have an abnormally increased UtA Doppler in early pregnancy so the potential advantages of early screening of hypertensive disorders and their associated complications is the use of prophylactic interventions before 20 weeks gestation ^[3,4]. High impedance of UtA Doppler velocimetry in early pregnancy will identify pregnancies with an increased risk of developing preeclampsia, GH, FGR oligoaminos, preterm delivery, placental abruption and LBW.

Methodology**Study design:** Prospective observational study**Study setup:** Out patient and inpatient departments of Obstetrics and Gynaecology**The sample size:** 247 patients**Inclusion criteria**

- Gestational age between 10 weeks 6 days to 14 weeks.
- Any gravida with singleton pregnancy.
- Delivery at our institute.

Exclusion criteria

- Patients who are not compliant or available for follow up.
- Fetal congenital malformations.
- Multiple gestations.

Informed consent from each patient was obtained. Gestational age was calculated from the last menstrual period and confirmed by crown—rump length measurement. Abiding by the inclusion

exclusion criteria patients were selected into the study. Clinical history including clinical risk factors to develop hypertension in pregnancy were noted, physical examination was done. IAA Doppler wave form analysis was done anywhere in between 10 weeks 6 days to 14 weeks of gestation along with nuchal translucency (NT) scan, again UtA doppler was done at any time between 19 to 24 weeks as a part of fetal anomaly scan. Sample size was 247 pregnancies out of which we obtained 217 cases. From the 217 cases, 20 cases were lost to follow up and 4 resulted in first trimester abortions. So finally after tending to the inclusion criteria we had a total of 193 pregnant followed up throughout their pregnancy into the Women.

We used Philips HD 11 XE machine with the cy of 3.5-5 MHz. The Doppler filter was set 50-100 Hz. Analysis of for prediction of abnormal pregnancy outcomes was improved by the h Pulsed doppler and assessment of notching. With Color doppler, identification of right and left uterine arteries at the level of the cervicocorporeal junction was done transabdominally.

Results**Table 1:** Distribution of patients in 11-14 weeks by RI in association with complications, adverse outcomes and high risk pregnancy

	R1-I (193)			P value
	<5 th percentile(4)	≥ 5 to < 95 th percentile 166)	≥ 95 th percentile (23)	
GH	0/4	5/166(3%)	2/23(8.6%)	0.424
FGR	0/4	6/166(3.6%)	4/23(17.3%)	0.055
GDM/Overt	0/4	7/166(4.2%)	0/23	0.341
Preterm	0/4	9/166(5.4%)	4/23(17.3%)	0.134
Abruption	0/4	3/166(1.8%)	2/23(8.6%)	0.248
Preeclampsia	0/4	1/166(6%)	1/23(4.3%)	0.404
Olgoaminos	0/4	8/166(4.8%)	4/23(17.3%)	0.104
LBW	0/4	12/166(7.2%)	5/23(21.7%)	0.090
MSAF/FD	¼(25%)	8/166(4.8%)	1/23(4.3%)	0.402
Outcome	¼(25%)	37/166(22.2%)	9/23(39.2%)	0.241
Highrisk	0/4	21/166(12.6%)	4/23(17.3%)	0.474

Analysis of first trimester mean RI values with adverse outcomes showed no significance.

Table 2: Distribution of patients in 11-14 weeks by PI in association with complications, adverse outcomes and high risk pregnancy

	P1-I (193)			P value
	<5 th percentile(36)	≥ 5 to < 95 th percentile (148)	≥ 95 th percentile (9)	
GH	1/36(2.7%)	5/148(3.37%)	1/9(11.1%)	0.591
FGR	0/36	9/148(6.08%)	1/9(11.1%)	0.103
GDM/Overt	2/36(5.5%)	4/148(2.7%)	1/9(11.1%)	0.433
Preterm	3/36(8.3%)	8/148(5.4%)	2/9(22.2%)	0.242
Abruption	0/36	4/148(2.7%)	1/9(11.1%)	0.188
Preeclampsia	0/36	0/148	2/9(22.2%)	0.002
Olgoaminos	1/36(2.7%)	10/148(6.7%)	1/9(11.1%)	0.526
LBW	1/36(2.7%)	13/148(8.7%)	3/9(33.3%)	0.041
MSAF/FD	3/36(8.3%)	5/148(3.3%)	2/9(22.2%)	0.092
Outcome	9/36(25%)	32/148(21.6%)	6/9(66.6%)	0.020
Highrisk	3/36(8.3%)	19/148(12.8%)	3/9(33.3%)	0.198

Mean PI in 1st trimester showed significant p values for preeclampsia, LBW and adverse outcomes.

Table 3: Distribution of patients in 11-14 weeks by S/D in association with complications, adverse outcomes and high risk pregnancy

		Mean	Std. Deviation	P value
GH	n(186)	3.51	1.03	0.899
	y(7)	3.45	1.06	
FGR	n(183)	3.50	1.008	0.778
	y(10)	3.59	1.51	
GDM/Overt	n(186)	3.53	1.04	0.075
	y(7)	2.82	0.58	
Preterm	n(180)	3.51	1.02	0.798

	y(13)	3.43	1.23	
Abruption	n(188)	3.49	1.03	0.430
	y(5)	3.87	1.06	
Preeclampsia	n(191)	3.50	1.02	0.414
	y(2)	4.10	2.19	
Olgoaminos	n(181)	3.49	1.02	0.573
	y(12)	3.67	1.20	
LBW	n(176)	3.47	1.00	0.124
	y(17)	3.87	1.33	
MSAF/FD	n(183)	3.52	1.02	0.226
	y(10)	3.12	1.24	
Outcome	n(146)	3.53	0.985	0.534
	y(47)	3.42	1.187	
Highrisk	n(168)	3.50	1.05	0.989
	Y(25)	3.51	0.948	

No significance for mean S/D values were obtained in 1st trimester.

Table 4: Distribution of patients in 11-14 weeks by Notch in association with complications, adverse outcomes and high risk pregnancy

	Notch -1		P value
	Early diastolic notch (19)	No Early diastolic notch (174)	
GH	5/19(26.3%)	2/174(174%)	0.0001
FGR	4/19(21%)	6/174(3.44%)	0.009
GDM/OVERT	1/19(5.2%)	6/174(3.44%)	0.704
PRETERM	4/19(21%)	9/174(5.17%)	0.028
ABRUPTION	2/19(10.5%)	3/174(1.72%)	0.069
PREECLAMPSIA	2/19(10.5%)	0/174	0.002
OLGOAMINOS	4/19(21%)	8/174(4.59%)	0.020
LBW	4/19(21%)	13/174(7.47%)	0.081
MSAF/FD	0/19	10/174(5.74%)	0.144
OUTCOME	10/19(58.8%)	37/174(2.2%)	0.006
HIGHRISK	8/19(42%)	17/174(9.7%)	0.0001

Early diastolic notch in the first trimester was significant for GH, preeclampsia and the complications of hypertensive diseases of pregnancy being FGR, oligoaminos and preterm

deliver. Significance with outcome and high risk pregnancy was also observed.

Table 5: Distribution of patients in 19-24 weeks by R1 in association with complications, adverse outcomes and high risk pregnancy

	RI-2		P value
	≥5 percentile to < 95 th percentile (143)	> 95 th percentile (50)	
GH	1/143(1.69%)	6/50(12%)	0.001
FGR	2/143(1.39%)	8/50(16%)	0.001
GDM/OVERT	4/143(2.79%)	3/50(6%)	0.322
PRETERM	7/143(4.89%)	6/50(12%)	0.103
ABRUPTION	2/143(1.39%)	3/50(6%)	0.103
PREECLAMPSIA	0/143	2/50(4%)	0.019
OLGOAMINOS	3/143(2.09%)	9/50(18%)	0.0001
LBW	8/143(5.59%)	9/50(18%)	0.012
MSAF/FD	7/143(4.89%)	3/50(6%)	0.765
OUTCOME	24/143(13.98%)	23/50(40%)	0.0001
HIGHRISK	14/143(9.79%)	11/50(22%)	0.035

Mean RI in the Second trimester was significant for GH, preeclampsia and the complications of hypertensive diseases of pregnancy being FGR, oligoaminos and preterm delivery.

Significance with outcome and high risk pregnancy was also observed.

Table 6: Distribution of patients in 19-24 weeks by P1 in association with complications, adverse outcomes and high risk pregnancy

	P1-2 (193)			P value
	<5 th percentile(1)	≥ 5 percentile to < 95 th percentile (164)	≥ 95 th percentile (9)	
GH	0/1	1/164(0.60%)	6/28(21.4%)	0.0001
FGR	0/1	4/164(2.4%)	6/28(21.4%)	0.003
GDM/OVERT	0/1	5/164(3.04%)	2/28(7.1%)	0.601
PRETERM	0/1	11/164(3.04%)	2/28(7.1%)	0.929
ABRUPTION	0/1	3/164(1.82%)	2/28(7.1%)	0.361
PREECLAMPSIA	0/1	1/164(0.60%)	1/28(3.5%)	0.488

OLGOAMINOS	0/1	5/164(3.04%)	7/28(25%)	0.001
LBW	0/1	12/164(7.31%)	5/28(17.8%)	0.232
MSAF/FD	0/1	9/164(0.54%)	1/28(3.5%)	0.860
OUTCOME	0/1	33/164(16.4%)	14/28(46.4%)	0.005
HIGHRISK	1/1	16/164(10.94%)	8/28(25%)	0.005

The analysis of mean PI of second trimester showed significance for only GF, FGR, oligoaminos. The adverse outcomes and high risk pregnancies also had significant p values.

Early diastolic notch in the Second trimester was significant for GH, preeclampsia, FGR, oligoaminos and LBW. However Significance was present only to observe outcomes and not for the high risk pregnancies.

Discussion

Melchiorre K *et al.* in a study in 2008 showed that the first-trimester UtA RI was significantly higher in women who subsequently developed preterm preeclampsia (mean RI 0.79) than in those with a normal outcome (mean RI 0.70; $p = 0.0001$) or those who developed preeclampsia at term (mean RI 0.72; $p = 0.002$). There were no significant differences in first-trimester mean uterine artery RI ($p = 0.136$) or prevalence of bilateral notches ($p = 0.459$) between women who had a normal pregnancy outcome and those who developed preeclampsia at term.¹⁵ The majority of research has centered on an elevation in the RI or PI, or the persistence of a uterine artery diastolic notch to detect the presence of increased uteroplacental vascular resistance^[5].

Sciscione *et al.* in 2009 came to conclusion that, criteria for an abnormal RI have varied from a single cutoff (eg, RI > 0.58) to a percentile cutoff value (eg, 75th, 90th, 95th).¹⁶ The Faster study, found a uterine artery Doppler RI value above the 75th percentile at 10-14 weeks gestation to predict a 5.5 times more likely to have FGR (95% CI 1.6-18.7) than those with a lower value^[6].

Arduini *et al.* examined 60 women who had hypertensive disorders of pregnancy. They measured impedance to flow in the arcuate arteries at 18-20 weeks of gestation and defined as an abnormal result a RI > 0.57. Sensitivity was 64% for pregnancies that subsequently developed pregnancy-induced hypertension^[7]. Jacobson *et al.* examined 91 women. They measured impedance to flow in the arcuate arteries at 24 weeks of gestation and defined as an abnormal result a RI > 0.57. The sensitivity of the test For pregnancy-induced hypertension was 44%. This study also examined prediction of intrauterine growth restriction, the sensitivity and positive predictive values were 71% and 33%, respectively^[8].

Zimmermann *et al* defined an abnormal result by a RI > 0.68. The prevalence of preeclampsia and/or intrauterine growth restriction was 18% and the sensitivity of increased impedance in the prediction of this complication was 56%^[9].

Gomez *et al.* in 2005 in their study uterine artery Doppler at 11-14 weeks of gestation to screen for hypertensive disorders and associated complications in an unselected population, evaluated the uterine artery PI and notch. Both the mean UtA PI and the prevalence of bilateral notches showed a significant linear decrease between 11 and 14 weeks gestation in women with a normal outcome however complicated pregnancies (preeclampsia and FGR) showed a significantly higher mean PI (2.04 vs. 1.75; $p < 0.05$, t-test) and a higher prevalence of bilateral notching (58% vs. 41%; $p < 0.05$, Chi-square test). Using the 95th percentile in mean UtA PI as a cut-off, 23.9% (95% CI, 13.7-34.1) of complicated pregnancies and 30.8% (95% CI, 5.68-55.85) of severe cases were identified. However,

the use of a single uterine Doppler measurement for screening purposes in unselected early pregnancy populations has limited clinical value^[10].

A.M. Martin *et al.* in 2001 in a study of Screening for preeclampsia and fetal growth restriction by uterine artery Doppler at 11-14 weeks of gestation, found that the sensitivity for 11-14 weeks mean PI > 2.35 for preeclampsia (with or without fetal growth restriction) was 27.0% but for fetal growth restriction alone it was 11.7%. The respective sensitivities for these complications requiring delivery before 32 weeks of gestation were 60.0% and 27.8%, respectively^[11].

Crossen J *et al.* in 2008 study of use of uterine artery Doppler ultrasonography to predict preeclampsia and intrauterine growth restriction, concluded that a PI with notching had the best predictive value for pregnancy outcomes^[12].

Conclusion

The analysis of mean PI of second trimester showed significance for only GF, FGR, oligoaminos. The adverse outcomes and high risk pregnancies also had significant p values.

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