

“Prospective Study of Umbilical and Uterine Artery Doppler in Predicting Pregnancy Outcome in High-Risk Pregnancies”

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Abstract

Introduction: Bilateral uterine arteries supplying gravid uterus undergoes physiological changes in pregnancy to maintain its high volume. In our country, pregnancy is very important stage for every women. Foetal morbidity and mortality is very high due to pre-eclampsia, it can also lead to complications like HELLP syndrome, DIC, abruption and increased chances of caesarean section. It can cause foetal complications like FGR, preterm labour, intra uterine foetal death. Doppler ultrasound helps to screen and diagnose complications early in the pregnancy. High risk pregnancies can lead to maternal and foetal mortality and morbidity. Early identification of the risk factors can protect mother and foetus from harmful effects of pregnancy. Doppler ultrasound is a recent advance in the field of foetal medicine, cost effective, non-invasive technique without any exposure to contrast media or harmful radiation during pregnancy to identify high risk factors to prevent pregnancy complications.

Material and methods: Role of umbilical and uterine artery Doppler in predicting pregnancy outcome in high risk pregnancies. We will do a prospective study on 150 patients with high

risk factors having chronic or pregnancy induced hypertension, eclampsia or pregnancy induced hypertension in previous pregnancy, anemia, diabetes mellitus or gestational diabetes mellitus, elderly gravida (>35 years), grand multipara (≥ 5). We will perform Doppler study of Umbilical and Uterine artery at 16-22 weeks. Study design-prospective observational study.

Results Out of 150 patients 43 had PIH, 36 had anemia, 25 had gestational diabetes mellitus. Abnormal Doppler study consisted of presence of uterine artery notching, increased PI > 1.45 and increased RI > 0.58. In our study out of 150, abnormal uterine artery Doppler results were noted in 40%. In umbilical artery Doppler Out of 150 patients 97 had raised RI, PI and 53 had Normal RI, PI. Out of 97, 74 had poor perinatal outcome, 16 had good perinatal outcome and 7 had IUD. Out of 150 patients 90 had raised S/D ratio, 52 had normal S/D ratio and 8 had absent S/D ratio. Among those with abnormal Doppler results, pre-eclampsia was seen in 11.3%, 6.6% foetuses had IUGR and were small for gestational age, 6% required NICU admission. Intrauterine death occurred in 4.6% cases. Pre-eclampsia was seen in 84% having high RI with DN whereas only 16% pre-eclampsia had raised RI without DN. Pre-eclampsia was not found in 76.6% having high RI without DN whereas only 23.4% has pre-eclampsia having high RI with DN.

Conclusion Our data confirmed the efficacy of second trimester screening of high risk pregnancies using Doppler studies. Raised RI, PI and S/D ratio of umbilical artery could predict IUGR, poor perinatal outcome and risk of intrauterine foetal death with good sensitivity. The presence of high RI of uterine artery Doppler and/or the appearance of DN is associated with an increased risk of development of preeclampsia. Therefore, we recommend the introduction of this technique into routine antenatal care for high risk pregnancies.

Keyword high risk pregnancy, Resistance index, Pulsatility index, Diastolic notch, Doppler study.

Introduction

Foeto placental circulatory system maintains normal foetal growth during intrauterine life and normal pregnancy outcome. Its ability to withstand the stress of labour depends to a great extent upon adequate umbilical and uterine circulation.^[1] Blood flow in uterine artery in non-gravid state is 50ml per minute and it increases to about 700ml/min in third trimester. Hence by mid second trimester, uterine artery waveforms show high end diastolic velocity with continuous forward flow throughout diastole. Failure of normal trophoblastic invasion can lead to increased resistance and reduced perfusion of placenta.^{[2][3]} In non-pregnant state and in early pregnancy uterine artery flow is of high pulsatility with a high systolic and low diastolic flow. Early diastolic notch may be present physiologically which disappears by 24 weeks of pregnancy.^[4] If end diastolic flow does not increase or if notching is evident at the start of diastole, this may be associated with pregnancy induced hypertension ,pre-eclampsia , abruption placenta, intrauterine growth restriction.^[5] Prolonged foetal hypoxic stress results in circulatory adaptation with redistribution of the cardiac output to provide a constant oxygen supply to the brain and other essential organs leads to changes in Doppler parameters and intrauterine growth restriction(estimated foetal weight below the 10th percentile for gestational age)^[1].Decreasing diastolic flow ,absent diastolic flow and reversed diastolic flow in umbilical artery during cardiac cycle are signs of worsening IUGR^[6].High resistive index(RI),persistent notching of uterine artery and high pulsatility index(PI)are the best screening tools for placental insufficiency^[4].

Material and methods:

The study is carried out in GMERS sola civil hospital, a tertiary health care institution in Ahmedabad ,Gujarat ,India.Study Duration from 6th September 2023 to 6th February 2024.It is a prospective study of 150 antenatal women who met the inclusion criteria at the time of booking in antenatal clinic of sola civil hospital with high risk factors having chronic or pregnancy induced hypertension, eclampsia or pregnancy induced hypertension in previous pregnancy,anemia, diabetes mellitus or gestational diabetes mellitus, elderly gravida(>35 years),grand multipara(>=5). Doppler study of Umbilical and Uterine artery at 16-22 weeks was done.

Study design-prospective observational study

Inclusion criteria-Patient willing for study, Patient having high risk factors like Chronic hypertension, Eclampsia, Pre-eclampsia or Pregnancy induced hypertension in previous pregnancy, Anemia, Diabetes mellitus or Gestational diabetes in previous pregnancy, Elderly gravida(>35 years), Grand multipara(>=5).

Exclusion criteria-Patient not willing for study, Low risk, normal pregnancies were excluded from the study

Sample size:

$N=150$ ($n=z^2pq/d^2$ and the prevalence of pre eclampsia is 10%)

n =minimum sample size required

z =standard normal deviate =1.96

p =prevalence of the condition in a previous study/100=0.1

q =complimentary probability=1- p

d =degree of precision=0.05

thus $n=1.96^2(0.1)(1-0.1)/(0.05)=138$

$n=138$

This gives a minimum sample size of 138 which was approximated to 150 by adding 10% due to attrition.

Ultrasound scan was carried out on the women to determine gestational age, number of foetuses and foetal biometry. At 16th to 22nd weeks of gestation, the principal researcher together with a consultant radiologist carried out Doppler ultrasonography of the uterine and umbilical artery via the trans abdominal route on the women recruited in the study. Doppler flow measurement of the uterine arteries was done using mind ray convex transducer probe.

The uterine artery will be identified through trans abdominal scan on a longitudinal view with a lateral aspect of the lower uterine segment also showing the bifurcation of the common iliac artery. These were identified using color Doppler mode. The recording will be made at the crossing between the uterine and the external iliac arteries as demonstrated using color flow Doppler. Thereafter, the spectral waveform was obtained at an optimal insulating angle of 60 degree. The Doppler tracing was obtained and recorded by placing a gate of 2.4mm (adjusted when necessary) over the artery, utilizing lowest possible filter and selecting smallest scale that displayed the flow without aliasing. The height of the Doppler waveforms was maximized to facilitate measurement, A trend of at least three similar sequential Doppler waveforms was obtained during suspended respiration. Then the measurement of RI was determined using the internal callipers and analytic software of the sonography unit. The RI was calculated using the formula (Peak systolic frequency shift – peak diastolic frequency shift/peak systolic frequency shift). RI was considered abnormal if >0.57 . At this time, the presence of an early DN in one or both uterine arteries was also considered.

Results

Table 1: Distribution of cases as per clinical presentation

Clinical presentation		Present study N=150	Present study Percentage (%)	Hiral Parekh et al (%) ^[1]
Hypertension	Chronic hypertension	11	7.3	12(24)
	Pre-eclampsia	17	11.3	-
	Eclampsia	5	3.3	-
	PIH	43	28.6	-
	PIH in previous pregnancy	2	1.3	-
Diabetes	Diabetes type 1 or 2	4	2.6	-
	Gestational diabetes	25	16.6	4(8)
Elderly gravida		3	2	-
Grand multipara		4	2.6	-
Anaemia		36	24	6(12)

Out of 150 patients 43 had PIH ,36 had anemia,25 had gestational diabetes mellitus compare to Hiral Parekh et al^[1] 24 had chronic hypertension,12 had anemia,8 had gestational diabetes mellitus.

Table 2: Abnormal uterine artery Doppler

Abnormal uterine artery Doppler	Present study(N=150)	Present study Percentage(%)	V.s. prasanna kuar reddy et al ^[4] (%)
Present	60	40	19
Absent	90	60	81
Total	150	100	100

Abnormal Doppler study consisted of presence of uterine artery notching, increased PI>1.45 and increased RI>0.58. In Our study out of 150, abnormal Doppler results were noted in 40%.whereas in V.s. prasanna et al^[4] abnormal Doppler was found in 19%.

Table 3: Correlation of parameters of umbilical artery with respect to perinatal outcome

Perinatal outcome	Resistance index (RI)		Pulsatility index (PI)		S/D ratio		
	Normal	Raised	Normal	Raised	Normal	Raised	Absent
IUD	-	7	-	7	-	4	2
Poor	4	74	4	74	3	70	6
Good	49	16	49	16	49	16	-
Total	53	97	53	97	52	90	8

Out of 150 patients 97 had raised RI, PI and 53 had Normal RI, PI. Out of 97, 74 had poor perinatal outcome,16 had good perinatal outcome and 7 had IUD. Out of 150 patients 90 had raised S/D ratio,52 had normal S/D ratio and 8 had absent S/D ratio

Table 4: Pre-eclampsia and perinatal outcomes in women with abnormal uterine artery Doppler

Outcome	Number of women	Percentage	V.s prasanna kumar Reddy et al ^[4]
Pre –eclampsia	17	11.3	84.2
IUGR	10	6.6	42
NICU admission	9	6	31.5
Intrauterine foetal death	7	4.6	10.5

Among those with abnormal Doppler results, pre-eclampsia was seen in 11.3%, 6.6% of fetuses had IUGR and were small for gestational age, 6% required NICU admission. Intrauterine death occurred in 4.6% cases.

Table 5: Occurrence of pre-eclampsia in relation to mean RI and presence of DN

	Present study RI ≥ 0.58 without DN	Murtula Yusuf et al ^[7]	RI ≥ 0.58 with DN	Murtula yusuf et al ^[7]	total
Pre-eclampsia	08(16%)	7(47%)	42(84%)	5(83%)	50
No pre-eclampsia	36(76.6%)	8(53%)	11(23.4%)	1(17%)	47

Pre-eclampsia was seen in 84% having high RI with DN whereas only 16% pre-eclampsia had raised RI without DN. Pre-eclampsia was not found in 76.6% having high RI without DN whereas only 23.4% has pre-eclampsia having high RI with DN.

Table 6 mode of delivery

	Spontaneous vaginal delivery	Induction of labour	Caesarean section
Normal Doppler	90%	8%	2%
Abnormal Doppler	13%	87%	10%

Out of total normal Doppler 90% had spontaneous vaginal delivery whereas induction of labour was seen in 87 % cases of abnormal Doppler.

Discussion:

Out of 150 patients 43 had PIH ,36 had anemia,25 had gestational diabetes mellitus. Abnormal Doppler study consisted of presence of uterine artery notching, increased $PI > 1.45$ and increased $RI > 0.58$. In Our study out of 150, abnormal uterine artery Doppler results were noted in 40%. In umbilical artery Doppler Out of 150 patients 97 had raised RI ,PI and 53 had Normal RI, PI. Out of 97, 74 had poor perinatal outcome,16 had good perinatal outcome and 7 had IUD .Out of 150 patients 90 had raised S/D ratio,52 had normal S/D ratio and 8 had absent S/D ration. Among those with abnormal Doppler results, pre-eclampsia was seen in 11.3%,6.6 % fetuses had IUGR and were small for gestational age,6% required NICU admission. Intrauterine death occurred in 4.6% cases. Pre-eclampsia was seen in 84% having high RI with DN whereas only 16% pre-eclampsia had raised RI without DN. Pre-eclampsia was not found in 76.6% having high RI without DN whereas only 23.4%has pre-eclampsia having high RI with DN.

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References

- 1) : Parekh H, Chaudhari S. Role of colour doppler in high risk pregnancy. *International Journal of Science & Healthcare Research*. 2021; 6(2): 185-191. DOI: <https://doi.org/10.52403/ijshr.20210434>
- 2) Khong TY, De Wolf F, Robertson WB, Brosens I. Inadequate maternal vascular response to placentation in pregnancies complicated by pre-eclampsia and by small-for-gestational age infants. *Br J Obstet Gynaecol*. 1986 Oct;93(10):1049-59. doi: 10.1111/j.1471-0528.1986.tb07830.x. PMID: 3790464.
- 3) Lin S, Shimizu I, Suehara N, Nakayama M, Aono T. Uterine artery Doppler velocimetry in relation to trophoblast migration into the myometrium of the placental bed. *Obstet Gynecol*. 1995 May;85(5 Pt 1):760-5. doi: 10.1016/0029-7844(95)00020-r. PMID: 7724109.
- 4) Reddy V.S.P.K, Manasvi V., Giri A. Role of uterine artery Doppler in early prediction of pre-eclampsia and intrauterine growth restriction at 16-24 weeks of gestation. *Ind J Obstet Gynecol Res*. 2018;5(3):395-398.
- 5) Valcamonico A, Danti L, Frusca T, Soregaroli M, Zucca S, Abrami F, Tiberti A. Absent end-diastolic velocity in umbilical artery: risk of neonatal morbidity and brain damage. *Am J Obstet Gynecol*. 1994 Mar;170(3):796-801. doi: 10.1016/s0002-9378(94)70285-3. PMID: 8141204.
- 6) McCowan LM, Harding JE, Stewart AW. Umbilical artery Doppler studies in small for gestational age babies reflect disease severity. *BJOG*. 2000 Jul;107(7):916-25. doi: 10.1111/j.1471-0528.2000.tb11092.x. PMID: 10901565.
- 7) Yusuf M, Galadanci H, Ismail A, Aliyu LD, Danbatta AH. Uterine Artery Doppler Velocimetry for the Prediction of Preeclampsia among High-risk Pregnancies in Low-

resource Setting: Our Experience at Aminu Kano Teaching Hospital, Kano, Nigeria.

Donald School J Ultrasound Obstet Gynecol 2017;11(3):197-202