

## Role Of Uterine Artery Doppler For Prediction Of Fetal Outcome In Preeclamptic Patients

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### Abstract

**Objective:** The aim of this prospective observational study is to assess the accuracy of Doppler indices of uterine artery during third trimester in predicting poor fetal outcome in women with preeclampsia.

**Methods :Studydesign:**Cohort observational study among women with preeclampsia.

**Studysetting:** One hundred cases who were at 32 to 40 weeks of gestation with preeclampsia(from March 2017 to March 2018) attended antenatal clinic and emergency room at obstetrics and gynecology department, faculty of medicine, Sohag University Hospital. Ultrasound was performed at fetal care unit at Sohag University Hospital.

**Results :**This observational cross-sectional study was designed to assess Doppler indices of uterine artery as predictor of neonatal outcome among women with preeclampsia.A total 100 pregnant women with preeclampsia were recruited in the study

**Conclusion :** We recommend adding mean uterine artery Doppler indices to routine antepartum fetal surveillance from 32 weeks gestations for women with preeclampsia as there is a strong correlations between it and poor neonatal outcome.

**Keywords :**Preeclampsia, uterine artery, Neonatal outcome.

### Introduction

Preeclampsia is defined as the presence of a systolic blood pressure (SBP) greater than or equal to 140 mm Hg or a diastolic blood pressure (DBP) greater than or equal to 90 mm Hg or higher, on two occasions at least 4 hours apart in a previously normotensive patient (*Lagna et al., 2015*). In addition to the blood pressure criteria, proteinuria of greater than or equal to 0.3 grams in a 24-hour urine specimen, a protein (mg/dL)/creatinine (mg/dL) ratio of 0.3 or higher, or a urine dipstick protein of 1+ (if a quantitative measurement is unavailable) is required to diagnose preeclampsia (*Lagna et al., 2015*). Doppler ultrasound velocimetry of uterine artery has become established method of antenatal monitoring(*Coppens et al., 2014*).In

order to evaluate Uteroplacental perfusion, examinations performed at uterine arteries (UtA) give more accurate information than the arcuate arteries. Velocities obtained from UtA are higher than from arcuate arteries. In the second and third trimester of pregnancy the UtA diameter enlarge, the systolic peak velocity and volume flow rates increase, and a progressive fall in impedance to blood flow (*Den Ouden et al., 2010*). The early diastolic notch and the difference between S/D ratios of the placental versus non placental sites should disappear after 24–26 weeks' gestation. Blood flow velocities in uterine arteries depend on the localization of placenta and gestational age(*Palmer et al., 2012*). If the placenta is laterally located, blood flow velocities in the ipsilateral uterine

artery are more important than the flow velocities of the contralateral vessel. Differences between flow velocities of the right and left uterine artery are evident at early stages of pregnancy. But in the third trimester, the difference between the S/D ratio of the vessels decrease to a minimum (Mires et al., 2015). At early stages of pregnancy end-diastolic flow velocities in placental arteries are low, but systolic flow is evident. With trophoblastic invasion and maturation of the uteroplacental vessels, beyond the second trimester the high pressure system is converted to a low pressure system, and vascular resistance declines. The biologic variability after 20–24 weeks' gestation becomes almost stable (Brosens et al., 2007). Before 24 weeks' gestation early diastolic notching, due to the immature uteroplacental vascular system, is normally observed. Beyond this gestational age, persistent early diastolic notching is associated with preeclampsia. Elevated RI, PI, or S/D ratios and the presence of a diastolic notch are considered as abnormal UtA FVWs (Trudinger et al., 2015). Pregnancies complicated with preeclampsia and IUGR show evidence of impaired trophoblastic invasion and maturation. Several studies were reported about the potential role of uteroplacental Doppler sonography to identify the risk for preeclampsia, perinatal outcome. In most of the studies uteroplacental Doppler was advocated as effective in predicting a high risk population for preeclampsia and IUGR (Hanretty et al., 2015).

**Patients and Methods: Study design:** Cohort observational cross-sectional study among women with preeclampsia. **Study setting:** One hundred cases who were at 32 to 40 weeks of gestation with preeclampsia (from March 2017 to March 2018)

attended antenatal clinic and emergency room at obstetrics and gynecology department, faculty of medicine, Sohag University Hospital. **Participant: Inclusion criteria:** Age (20-35) years old, Gestational age more than 32 weeks that was confirmed, either by menstrual dates or by first trimester ultrasonography, Singleton intrauterine pregnancy, Living fetus, Preeclampsia diagnosed as new onset hypertension (Systolic blood pressure of 140 mm Hg or higher, or diastolic blood pressure of 90 mmHg or higher, on two occasions at least 6 Hours apart while the patient is on bed rest unless antihypertensive therapy is initiated before this time) and

Proteinuria (>300mg/24h) (*American College of Obstetricians and Gynecologists, 2013*).

**Exclusion criteria:** Women with multiple pregnancies, A history of chronic hypertension, Diabetes mellitus, Autoimmune diseases, Intrauterine fetal death on admission, Congenital abnormalities of the fetus, The pregnant woman in labour, HELLP syndrome, Impending eclampsia. **Sample size**

**justification:** Sample size has been calculated using PASS<sup>®</sup> version 11 program (*Hintze, 2011*). It was estimated that a total sample (minor accepted) 100 women according to inclusion criteria, was required to achieve a power of 80 % (accepted margin of error 5%) and confidence level 95%, for detection of statistical significance as regards the correlation between 3<sup>rd</sup> trimester middle cerebral artery, umbilical artery Doppler parameters and neonatal outcome.

**Sampling plan:** Systemic random sample was used for selection of cases.

**Methodology:** All women were subjected to: Complete history to exclude any preexisting maternal disease or pregnancy complication

:Personal history: including name, age, occupation, marital status, residency and special habits of medical important, Present history: including calculation of the gestational age in weeks, any complaints during pregnancy, the warning symptoms and all investigations she had done in that pregnancy, Menstrual history: including LMP, Obstetric history, Contraceptive history, Past history for the presence of any medical disorders, Family history for any medical disorders in the family especially hypertension, **General examination:** Blood pressure was measured in a semi-recumbent positions with the head and chest slightly elevated using standard mercury sphygmomanometer. Two blood pressure recordings 6 hours apart as recommended by the [American College of Obstetricians and Gynecologists](#). Chest and heart examination. Edema was tested for pitting in the lower limbs, ankles and shin of the tibia, checking for edema of the lower abdomen and testing for ascites. **Abdominal examination:** for edema and loin exam. **Laboratory investigations:** complete blood picture, complete urine analysis, random blood glucose, liver function test, renal profile, blood coagulation profile, prothrombintime. **Ultrasonography:** for number of fetuses, presence of fetal heart activity, fetal biometry, presence of any apparent congenital anomalies, amount of liquor and placental site. The four standard biometric parameters commonly used to estimate gestational age and/or fetal weight in the second and third trimesters are: biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL) (*Hadlock, 1991*). **Intervention:** Doppler studies among preeclamptic women done to measure the uterine artery Doppler indices

especially pulsatility index and S / D ratio and values below the 5th percentile were considered as abnormal. bilateral uterine arteries Doppler evaluation was performed and the mean uterine artery Doppler was considered. All sonographic examinations were performed trans-abdominally using a GE Voluson S6 ultrasound machine at the tertiary care center at Sohag Hospital.

**Mode of delivery:** Vaginal delivery (Induction of labor or Spontaneous vaginal delivery) or Cesarean section (Elective C.S. or Urgent C.S.) **Fetal outcomes:** The neonates were observed for major and minor adverse outcomes. **Major adverse outcomes:** Perinatal deaths, hypoxic ischemic encephalopathy, intraventricular hemorrhage, sepsis and necrotizing enterocolitis. **Minor adverse outcomes:** Caesarean delivery for fetal distress, fetal asphyxia, low birth weight and preterm delivery. **Neonatal assessment by APGAR score.** A useful clinical tool to identify those neonates who require resuscitation as well as to assess the effectiveness of any resuscitative measures is the Apgar scoring system (*Cunningham et al., 2005*), each of the five easily identifiable characteristics heart rate, respiratory effort, muscle tone, reflex irritability, and color is assessed and assigned a value of 0 to 2. The total score, based on the sum of the five components, is determined 5 minutes after delivery. The 5 minute score, is a useful index of the effectiveness of resuscitative efforts. The 5 minute Apgar score also has prognostic significance for neonatal survival is related closely to the condition of the infant in the delivery room (*Cunningham et al., 2005*). According to the study done in the emergency room on 100 pregnant women who are at 32 to 40 weeks of gestation with preeclampsia, the

majority of them were admitted to the labor theater and delivery room were they spent few days till delivery. fetal blood pH measurement was done within 5 minutes of delivery. Apgar score was determined at 1 minute and 5 minutes after birth Neonatal morbidity was established if Apgar score <7 at 5 minutes. Neonatal academia of pH<7.2. Newborn was admitted to the neonatal intensive care unit (NICU). **Statistical analysis:** The collected data was revised, coded, tabulated and introduced to a PC using Statistical package for Social Science

(SPSS 20 for windows; SPSS Inc, Chicago, IL, 2001).

Quantitative variables are expressed as mean and SD or as median and interquartile range (IQR) in cases of non-parametric variables. Qualitative variables was expressed as frequencies and percent. **Student t test** and **Mann Whitney Test** were used to compare a continuous variable between two study groups. **Chi square** and **Fisher's exact tests** were used to examine the relationship between Categorical variables. P-value <0.05 was considered statistically significant.

### Result:

BUTA_PI	MAO(Yes)	MAO(No)	
Abnormal	4(70.00%)	2(33.27%)	
Normal	47(30.00%)	47(66.23%)	
<b>Total</b>	<b>51(51.00%)</b>	<b>49(49.00%)</b>	
Measure	Estimate	95% Confidence Interval (Upper)	95% confidence Interval (Lower)
Sensitivity	5.77%	2.023	16.82
Specificity	96.95%	88.32	98.74
PPV	75.00%	30.06	95.44
NPV	50.00%	40.19	59.81
Diagnostic accuracy	51.02%	41.36	60.57

**Table (1):** Efficacy of Mean Uterine Artery Doppler indices in predicting minor and major adverse outcome. Pulsatility Index

Among study population 70% patients with abnormal UtA PI had evidence of minor and major adverse outcome while, 30% patients had minor adverse outcome despite normal index

Ut.A_PI	Range	0.4-2.7
	Mean ±SD	1.3±0.3
Ut.A_RI	Range	0.4-1.9
	Mean ±SD	0.8±0.2
Ut.A_S/D ratio	Range	0.6-3.1
	Mean ±SD	1.6±0.6

**Table (2):** Doppler indices of Mean Uterine Artery in the study population

PI Pulsatility index

RI Resistance index

S/D ratio Systolic/Diastolic ratio

Age (years)	Range	20-35
	Mean $\pm$ SD	28.6 $\pm$ 4.2
Gestational age (weeks)	Range	32-40
	Mean $\pm$ SD	34.2 $\pm$ 1.6
Body mass index(kg/m <sup>2</sup> )	Mean $\pm$ SD	24.1 $\pm$ 1.4

**Table (3):** Characteristics of the study population

BUTA_PI	MAO(Yes)	MAO(No)	
Abnormal	36(73.5%)	7(15.3%)	
Normal	15(26.5%)	42(84.7%)	
Total	51(51.00%)	49(49.00%)	
Measure	Estimate	95%Confidence Interval (Upper)	95%confidence Interval (Lower)
Sensitivity	73.56%	58.15	84.79
Specificity	84.77%	71.86	93.47
PPV	82.22%	68.67	90.71
NPV	74.55%	61.7	78.98
Diagnostic accuracy	77.00%	67.83	84

**Table (4):** Efficacy of Mean Uterine Artery Doppler indices in predicting minor and major adverse outcome. S/D ratio

Among study population 73.5% patients with abnormal UtA S/D ratio had evidence of minor and major adverse outcome while, 26.5% patients had minor adverse outcome despite normal index.

Among study population 70% patients with abnormal UtA PI had evidence of minor and major adverse outcome while, 30% patients had minor adverse outcome despite normal index.

## Discussion

Rehana et al. (2016), in their retrospective study that included 150 patients between 28\_40 weeks of gestation ,they found UtA PI had 90.91% sensitivity and 78.04% specificity to detect fetus at risk of academia ,with 52.63% positive and 96.97% negative predictive values.

There was a positive correlation UtA PI and NICU admission, they found UtA PI had 75% sensitivity and 82.92% specificity, with 63.15% positive and 89.47% negative predictive values to detect NICU admission and for the detection of the fetal distress the values were 90.91%

sensitivity, 78.04% specificity, 52.63% positive and 96.97% negative predictive values. In our study, it was found that the UtA PI had excellent correlation predictive value for prediction of the incidence of neonatal ICU admission as evidence by 95% of CI (0.668-8.429), with 62.5% sensitivity, 71.43% specificity estimated positive predictive value = 29.41% and negative predictive value = 90.91%. The current study agreed with **Ozerena et al (2009)**, in their cross sectional prospective study that conducted on 125 normal pregnancy and 62 postterm pregnant patients to determine the best index for predicting adverse perinatal outcome. The diagnostic accuracy of PI was lower than the S/D ratio of UtA denoting a strong relation between UtA Doppler indices and adverse perinatal outcome. the UtA S/D ratio showed a higher sensitivity and diagnostic accuracy 88% and 94% in predicting adverse perinatal outcome. **Conclusion and Recommendations:** We recommend adding mean uterine artery Doppler to routine antepartum fetal surveillance from 32 weeks gestations for women with preeclampsia as there is a strong

correlations between it and poor neonatal outcome.

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