Original Research Paper

Obstetrics & Gynaecology

THE ROLE OF MATERNAL CHARACTERISTICS, MEAN ARTERIAL PRESSURE, AND UTERINE ARTERY DOPPLER IN FIRST TRIMESTER IN PREDICTING FETOMATERNAL OUTCOMES: A STUDY AT K.V.G. MEDICAL COLLEGE HOSPITAL, INDIA

Dr. Supriya N S	Junior resident Dept of OBG
Dr Bhavya H U	Associate professor, Department of OBG, Kvg medical College and hospital sullia.
Dr Geeta Doppa	Head of department, Kvg medical College and hospital sullia.

ABSTRACT Hypertensive disorders in pregnancy are a significant cause of maternal and perinatal morbidity and mortality. This study aims to evaluate the role of maternal characteristics, mean arterial pressure (MAP), and uterine artery Doppler indices in the first trimester as predictors of adverse fetomaternal outcomes. Conducted at K.V.G. Medical College Hospital in Sullia, India, this longitudinal observational study included 138 singleton pregnancies between 11-13+6 weeks gestation. The study found that elevated BMI, MAP, and uterine artery pulsatility index (PI) are significant predictors of adverse outcomes, such as gestational hypertension, oligohydramnios, intrauterine growth restriction (IUGR), and preeclampsia.

INTRODUCTION:

Hypertensive disorders complicate 5-10% of pregnancies[1] worldwide and are a leading cause of maternal and perinatal complications. In India, 15% of pregnancies are categorized as high-risk, with hypertensive disorders contributing significantly to maternal and perinatal morbidity and mortality. Early identification and management of these conditions are crucial for improving outcomes. According to National institute of clinical excellence (NICE) guidelines maternal characteristics like age, Body Mass Index (BMI), parity and other medical conditions are considered high risk for hypertensive disorder. Thus they recommended level of risk for adverse pregnancy outcome should be evaluated at the first prenatal visit to plan for the further visits[2].

Mean Arterial Pressure(MAP) is a possible indicator of cardiovascular adaptations in pregnancy. It has been shown that women destined to develop preeclampsia have higher mean arterial pressure in first and second trimester. Therefore Mean arterial pressure screening provides an important adjunctive tool for the early identification of women at increased risk of obstetrical complications and adverse fetal outcome.[3]

Uterine artery Pulsatility Index (PI) is an indirect measure of uteroplacental perfusion, and the postulated hypothesis is that high PI implies impaired placentation with the consequent increased risk of developing preeclampsia, foetal growth restriction, abruption and stillbirth[5]. Uterine artery Doppler waveform analysis has been extremely studied in the second trimester of pregnancy as a predictive marker for the late development of preeclampsia and fetal growth restriction. The use of Doppler interrogation of this vessel in the first trimester has gained momentum in recent years.

Various biochemical markers like soluble fms like tyrosine kinase1(sFLT1), Placental growth factor(PGF), Pregnancy associated plasma protien-A(PAPP-A), placental protien B can predict preeclampsia with modest effeciency but they are costly and not widely available everywhere[4]

In a low-resource settings like the India, it is common to encounter patients with severe preeclampsia and its complications like eclampsia, Hemolysis Elevated liver enzyme, low platelet (HELLP syndrome), placental abruption, disseminated intravascular coagulation, intrauterine growth retardation and intrauterine death. An effective predictive test for preeclampsia would facilitate early diagnosis, targeted surveillance and timely intervention. Hence this study is undertaken to determine the 'role of maternal characteristics, mean arterial pressure and uterine artery Doppler in prediction of preeclampsia, fetal growth restriction and its relation to fetomaternal outcome.

Objectives:
1. To assess the contribution of maternal characteristics in predicting fetal growth restriction or preeclampsia and its relation to fetomaternal outcomes.
2. To evaluate the role of MAP and uterine artery Doppler in predicting fetomaternal outcomes in the first trimester.

Methodology

This study was conducted from August 1, 2022, to January 31, 2024, involving 138 pregnant women attending the antenatal clinic at K.V.G. Medical College Hospital. Maternal characteristics, including age, BMI, and parity, were recorded. MAP was calculated using the formula: MAP = Diastolic BP + 1/3 (Systolic BP – Diastolic BP). Uterine artery Doppler was used to measure the pulsatility index (PI), with a mean PI > 1.79 considered high risk for adverse outcomes. Data were analyzed using IBM SPSS version 21.

Sample size:
Prevalence Of Hypertensive Disorders Of Pregnancy - 10%
According to study conducted by Dhinwa M, Gawande K, Jha N, Anjali M, Bhadoria AS, Sinha S on Prevalence of hypertensive disorders of pregnancy in India in 2021 May, it was found that hypertensive disorders in pregnancy in India is 10%.[5] using this as 'p' and substituing in the formula $Z^2p(1-p)/d^2$, sample size calculated
$(1.96)^2(10)(90)/5^2 = 3.84 \times 10 \times 90/25 = 138.29$
it was approximated to be 138

Sampling Method : systematic random sampling.
Every 3rd patient visiting the kvg medical college obg opd, who will meet the inclusion criteria are included in the study, till the sample size reaches 138.

Method Of Collection Of Data-
Inclusion Criteria:
All singleton pregnant women who are booked case attending antenatal checkup in KVGMCH .between 11-13 wks+6 days gestational age.

Exclusion Criteria:
- Twin pregnancy
- Chronic hypertension, Diabetes Mellitus
- Past history of preeclampsia

- Dyslipidemia
- Chromosomal abnormality
- Not willing to participate in the study

Methodology:

A prospective observational study done in in kvg medical college and hospital on every third booked pregnant women attending antenatal clinic during 11-13+6weeks gestation who fulfill the inclusion criteria during the mentioned period of study was selected as study population.

Data collected after taking written and informed consent and entered in the proforma. Detailed maternal history, demographic details, obstetric history, past medical history was taken, height weight, BMI calculated. Blood Pressure measured and mean arterial pressure calculated.

Blood pressure measured by appropriate cuff size (cuff should encircle 80% or more of the arm and cover 2/3rd of the length of the arm) Patient was seated resting for 5 minutes, with the arm at the level of chest and legs not crossing and not talking. After obtaining BP records, MAP was calculated using the following formula:
MAP = Diastolic BP + 1/3 (Systolic BP – Diastolic BP).
Mean arterial pressure more than 89.7(90) mmhg was taken as cut off for high risk of preeclampsia and fetal growth restriction[6].

Detailed anueploidy scan was performed to all the study participants in first trimester between 11-13+6weeks of gestation at the same time uterine artery Doppler done and PI values noted.

To perform uterine artery Doppler, womens were placed in the semi recumbent position and trans abdominal ultrasound was used to obtain a sagital section of the uterus and cervical canal. The internal cervical os was first identified, then the transducer gently tilted from side to side and color flow mapping was used to identify the uterine arteries as vessels coursing along the side of the cervix and uterus. Pulsed wave Doppler was used to obtain flow velocity waveforms from the ascending branch of the uterine artery at the point closest to the internal os. When three similar consecutive waveforms were obtained the PI values measured and the mean PI of the left and right arteries calculated.

Uterine artery mean PI more than 1.79 is considered as high risk for preeclampsia and fetal growth restriction[7]

All the study participants was followed up through out the antenatal period till delivery Maternal outcomes like development of preeclampsia, eclampsia, fetal growth restriction, gestational age at delivery, spontaneous or induced labour, mode of delivery and if caesarean section then indication of caesarean section was recorded. Neonatal outcomes like birth weight, APGAR score, need for NICU admission was recorded and its relation with the parameters like maternal characteristics, MAP and uterine artery Doppler at first trimester was analysed.

RESULTS :
1. Age Distribution Of Study Population

AGE	NO. OF PARTICIPANTS (N=138)	PERCENTAGE(%)
HIGH RISK (<19Y >35Y)	15	10.87%
LOW RISK (19-35Y)	123	89.1%

It categorizes the participants into two groups based on age and risk: high risk and low risk.

The high-risk group consists of individuals under 19 years old or over 35 years old, comprising 15 people, which represents 10.87% of the total sample.

In contrast, the low-risk group includes individuals aged 19 to 35 years, making up the majority with 123 people, accounting for 89.1% of the sample.

2. Parity Status Of Study Population

PARITY	NO. OF PARTICIPANTS (N=138)	PERCENTAGE (%)
PRIMIGRAVIDA (HIGH RISK)	64	46.4%
MULTIGRAVIDA	74	53.6%

In this study, 64 women, accounting for 46.4% of the total population, were primigravida. In contrast, 74 women, making up 53.6% of the population, were multigravida. This distribution indicates a slightly higher prevalence of multigravida women in the study.

3. Distribution Of BMI In The Population

BMI	NO. OF PARTICIPANTS (N=138)	PERCENTAGE(%)
LOW BMI/UNDERWEIGHT(<18.5)	6	4.29%
NORMAL BMI (18.5-24.9)	88	62.86%
OVERWEIGHT (25-29.9)	46	32.86%

The majority of the study population, 62.86%, falls within the normal range of 18.5-24.9 BMI , 32.86%, falls within the 25-29.9 range, indicating that almost a third of the population is overweight. Only 4.29% of the population is in the 18-19.9 range, which is considered underweight.

4. Mean Arterial Pressure Distribution In The Population

MAP	NO. OF PARTICIPANTS (N=138)	PERENTAGE (%)
NORMAL MAP (<89.7)	102	74.46%
INCREASED MAP(>89.7)	36	26.08%

The data table presents the distribution of Mean Arterial Pressure (MAP) among 138 individuals. It categorizes them into two groups based on their MAP values: those with a normal MAP, defined as less than 89.7 mmHg, and those with an increased MAP, defined as 89.7 mmHg or above
Out of the total, 102 individuals (74.46%) have a normal MAP, while 36 individuals (26.08%) have an increased MAP

5. Uterine Artery Doppler Distribution In Study Population

PI INTERVAL	NO. OF PARTICIPANTS (N=138)	PERCENTAGE(%)
NORMAL PI <1.79	94	67.63%
ABNORMAL PI >1.79 (HIGH RISK)	45	32.37%

the pulsatility index (PI) measurements were categorized into two intervals:

A PI of less than 1.79 is considered normal, which is observed in 94 individuals, accounting for 67.63% of the sample. Conversely, a PI greater than 1.79 is classified as abnormal or high risk, encompassing 45 individuals, which represents 32.37% of the total.

Relationship Of High Risk Factors With Fetomaternal Outcome

RISK FACTOR	GROUP	N	NORMAL OUTCOME	ADVERSE OUTCOME	P-VALUE
AGE	<19,>35Y	15	8	7	0.6102
	19-35Y	123	70	53	
	TOTAL	138	78	60	
BMI	<18.5 >24.9	33	2	31	<0.001
	18.5-24.9	105	85	20	
	TOTAL	138	87	51	
PARITY	NULLIPAROUS	64	42	22	0.9255
	MULTIPAROUS	74	48	26	
	TOTAL	138	90	48	
MAP	<89.7	87	74	13	<0.0001
	>89.7	51	15	36	
	TOTAL	138	89	49	
MEAN UT A PI	<1.79	80	65	15	<0.0001
	>1.79	58	23	35	
	TOTAL	138	88	50	

In the present study, BMI, mean arterial pressure and mean uterine artery PI is found to be statistically significant as a cause for maternal adverse effects

Age and parity has not come statistically significant.

Overall Results:

- **Maternal Characteristics and Outcomes:** Maternal age and parity did not significantly predict adverse outcomes. However, BMI, MAP, and uterine artery PI were significant predictors.
- **BMI:** A significant correlation was found between BMI >24.9 and adverse outcomes (p<0.001).
- **MAP:** MAP >89.7 mmHg was associated with adverse outcomes (p<0.0001).
- **Uterine Artery PI:** PI >1.79 was linked to higher rates of adverse outcomes (p<0.0001).

DISCUSSION:

The findings suggest that elevated BMI, MAP, and uterine artery PI in the first trimester can serve as significant predictors for adverse fetomaternal outcomes, including gestational hypertension, oligohydramnios, IUGR, and preeclampsia. These markers can help in early identification and intervention, potentially improving pregnancy outcomes.

David Wright, Argyro Syngelaki , Ranjit Akolekar et al[8] conducted a screening study of 120,492 in their study on "competing risk model in screening for preeclampsia by maternal characteristics and medical history" in singleton pregnancies at 11-13 weeks gestation. They said that the chances of development of preclampsis increases by advancing maternal age, increasing weight, Afro-Caribbean and South Asian racial origin, medical history of chronic hypertension, diabetes mellitusand systemic lupus erythematosus or antiphospholipid syndrome, family history and personal history of preeclampsia, and conception by in vitro fertilization. They also said that At a screen-positive rate of 11%, as defined by NICE, their study predicted 40%, 48%, and 54% of cases of total preeclampsia and preeclampsia requiring delivery at <37 and <34 weeks' gestation, respectively, which were significantly higher than the respective values of 35%, 40%, and 44% achieved by application of NICE guidelines, the results of their study is consistent with our results except that maternal age and parity did not come significant in our study

K Melchiorre et al[9] conducted a randomized control trial involving 3058 singleton pregnancies in their study on "first trimester uterine artery Doppler indices in term and preterm preeclmpsia", in this prospective study, uterine artery Doppler findings in first trimester, correlated with the onset of preeclampsia, they said that he first-trimester uterine artery resistance index (RI) was significantly higher in women who subsequently developed preterm pre-eclampsia (mean RI, 0.79) than in those with a normal outcome (mean RI, 0.70; P = 0.0001) or those who developed pre-eclampsia at term (mean RI, 0.72; P = 0.002) and the results of our study is consistent with their results

CONCLUSION:

Monitoring maternal characteristics, MAP, and uterine artery Doppler indices in the first trimester can significantly predict and potentially mitigate adverse fetomaternal outcomes. This study emphasizes the importance of early screening and intervention in high-risk pregnancies.

REFERENCES:

1. Majella MG, Sarveswaran G, Krishnamoorthy Y, Sivaranjini K, Arikrishnan K, Kumar SG. A longitudinal study on high risk pregnancy and its outcome among antenatal women attending rural primary health centre in Puducherry, South India. J Educ Health Promot. 2019 Jan 29;8:12.
2. Wright D, Syngelaki A, Akolekar R, Poon LC, Nicolaides KH. Competing risks model in screening for preeclampsia by maternal characteristics and medical history. American journal of obstetrics and gynecology. 2015 Jul 1;213(1):62-e1
3. Poon LC, Nicolaides KH. Early prediction of preeclampsia. Obstetrics and gynecology international. 2014 Jul 17;2014.
4. Jasovic Siveska E. Clinical and Biochemical Markers for Prediction of Preeclampsia. Obstetrics & Gynecology International Journal. 2017.
5. Dhinwa M, Gawande K, Jha N, Anjali M, Bhadoria AS, Sinha S. Prevalence of hypertensive disorders of pregnancy in India: A systematic review and meta-analysis. J Med Evid. 2021 May 1;2:105-2.
6. Levin RJ. Should the definition of preeclampsia include a rise in diastolic blood pressure >15 mm hg? Am J Obstet Gynecol. 2000;182:225-227.
7. Gómez O, Figueras F, Fernández S, Bennasar M, Martínez JM, Puerto B et al Reference ranges for uterine artery mean pulsatility index at 11–41 weeks of gestation. Ultrasound in Obstetrics and Gynecology: The Official Journal of the International Society of Ultrasound in Obstetrics and Gynecology. 2008 Aug;32(2):128-32.
8. Wright D, Syngelaki A, Akolekar R, Poon LC, Nicolaides KH. Competing risks model in screening for preeclampsia by maternal characteristics and medical history. American journal of obstetrics and gynecology. 2015 Jul 1;213(1):62-e1.
9. Melchiorre K, Wormald B, Leslie K, Bhide A, Thilaganathan B. First trimester uterine artery Doppler indices in term and preterm pre eclampsia. Ultrasound in Obstetrics and Gynecology: The Official Journal of the International Society of Ultrasound in Obstetrics and Gynecology. 2008 Aug;32(2):133-7