ORIGINAL RESEARCH PAPER

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PREDICTION OF PREECLAMPSIA BY MEAN ARTERIAL PRESSURE AND WAIST CIRCUMFERENCE

KEY WORDS: Mean arterial pressure, waist circumference, Burton's formula, preeclampsia.

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ABSTRACT

Objective: To evaluate the role of mean arterial pressure and antenatal waist circumference in early detection of preeclampsia. **Methods:** One hundred ninety (190) antenatal women were studied between 14 to 16 weeks of gestation for a period of one year. Mean arterial pressure was calculated by Burton's formula and waist circumference was measured. Mean arterial pressure of 90 mm Hg or more and waist circumference of 80 cm or more was taken as cut off. **Results:** Out of 190 women 30 women had mean arterial pressure >90 mm Hg and out of 30 women 17(56.6%) developed preeclampsia while out of 160 women with mean arterial pressure <90 mm Hg only 21(13.3%) developed preeclampsia. Out of 80 women with waist circumference >80 cm 28 women (35%) developed preeclampsia while out of 110 women with waist circumference < 80 cm only 10(9%) developed preeclampsia. **Conclusion:** Mean arterial pressure is a good predictor of preeclampsia with high specificity 91.4% and negative predictive value of 86.8%.Waist circumference of 80 cm or more upto 16 weeks is a precise method of predicting preeclampsia with high sensitivity of 73.6% and negative predictive value of 90.9%.

Preeclampsia is a pregnancy specific multisystem disorder characterized by the development of hypertension and proteinuria after 20 weeks of gestation. Pre-pregnancy and antenatal risk assessments are the most widely used and simplest means of predicting subsequent pre-eclampsia. Although taking a careful family history and medical history (for obstetric events, hypertension, renal disease, or thrombophilia) can help to stratify the risk of hypertensive disorders of pregnancy, history alone will identify fewer than half the women who later develop pre-eclampsia.[1] Recent guidelines from the National Institute for Health and Clinical Excellence (NICE) also recommend routine screening for specific risk factors for pre-eclampsia [nulliparity, older age, high body mass index (BMI), family history of pre-eclampsia, underlying renal disease or chronic hypertension, multiple pregnancy, more than 10 years between pregnancies, and a personal history of pre-eclampsia].[2] The expected rate of pre-eclampsia when any one of these risk factors is present ranges from 3% to more than 30%, and many women have several risk factors. The absolute risk for an individual will be determined by the presence or absence of these and other predisposing or protective factors not incorporated in the NICE guidelines.[3-6]

Doppler ultrasonography of the uterine arteries at 20- 24 weeks gestation, to detect abnormal trophoblast invasion, predicts about 40% of subsequent pre- eclampsia. Recently, several predictive biochemical markers including placental growth factor, Soluble fms- Like Tyrosine Kinase-1 (sFlt-1), plasma protein 13, and pregnancy associated plasma protein-A (PAPP-A) have been evaluated, but none is currently in routine clinical use.[7-8]

More than 100 clinical, biophysical and biochemical tests have been recommended to predict the development of preeclampsia but none of these methods have been proved as an ideal test for prediction. One of the most striking physiologic changes in preeclampsia is intense systemic vasospasm. When mid trimester mean arterial pressure is > 90 mm of Hg, there is significant increase in frequency of proteinuria, hypertension and diagnosed preeclampsia in the third trimester. Hypertensive disorders are significantly more prevalent in obese pregnant women than in their lean counterparts. Even when overweight is moderate the occurrence of hypertension and preeclampsia is significantly higher. Thus, this study was carried out to evaluate the role of mean arterial pressure and antenatal waist circumference in early detection of preeclampsia.

Methods

The study was done on 190 antenatal women between 14 to 16 weeks of gestation attending outpatient and inpatient department in M.L.N. medical college and associated hospitals over a period of one year. Thorough history was taken (age, parity, socio-economicstatus, past obstetric complications). Women with history ofdiabetes, chronic nephritis, essential hypertension, recent history of steroid use and collagen vascular diseases were excluded from the study. Detailed clinical examination (general and obstetrical) was done. Blood pressure measurement was done by standard mercury sphygmomanometer with patient sitting on stool for at least 2-3 minutes with arm kept on table so that arm and heart were nearly at the same level. Either a normal or large adult cuff was used depending on the mid arm circumference. Korotkoff V was used to determine the diastolic pressure and the value was noted. Mean arterial pressure was calculated by Burton's formula i.e Mean arterial pressure = Diastolic blood pressure + 1/3 pulse pressure. Mean arterial pressure >90 mm hg was taken as abnormal.

Waist circumferencewas measuredmidway betwe n the lowest rib and the iliac crest at the end of gentle exhalation. Waistcircumferenceof >80 cm was used as a cut of. The study was approved by institutional ethics commite . All participating women had given written informed consent. DatawereanalyzedbyusingInStat3 software.

Results

Table 1: Mean arterial pressure in prediction of preeclampsia

Mean arterial Pressure (mmHg)	Preeclampsia	Normotensive	Total
>90	17(a)	13(b)	30
<90	21(c)	139(d)	160
Total	38	152	190
Sensitivity	a/a+c × 100 = 17/38 × 100 = 44.7%		
Specificity	d/b+d× 100 = 139/152 × 100 =91.4%		
Positive predictive value	a/a+b × 100 = 17/30 × 100 = 56.6%		
Negative predictive value	d/c+d × 100 = 139/160 × 100= 86.8%		

Considering the socio-demographic criteria majority of women who developed preeclampsia (65.9%) were young in the age group of 21 to 25 years; primigravida (57.8%) ; belonged to middle socioeconomic status (58%) and were rural dwellers (60%). Out of 30 women who showed mean

arterial pressure >90 mm of Hg, 17(56.6%) developed preeclampsia whereas out of 160 women who had mean arterial pressure <90 mm of Hg, 21(13.3%) developed preeclampsia while majority 139(86.8%) remained normotensive with sensitivity, specificity, positive predictive value and negative predictive value of 44.7%, 91.4%, 56.6% and 86.8% respectively (Table 1). Out of 80 women with waist circumference > 80 cms, 28(35%) developed preeclampsia while out of 110 women with waist circumference <80 cms, 10(9%) developed preeclampsia whereas majority i.e.100 women (90.9%) remained normotensive with sensitivity 73.6%, specificity 65.7%, positive predictive value 35% and negative predictive value 90.9% in prediction of preeclampsia (Table2).

Table 2: Waist circumference in prediction of preeclampsia

Waist circumference	Preeclampsia	Normotensive	Total
>80(cm)	28(a)	52(b)	80
<80(cm)	10(c)	100(d)	110
Total	38	152	190
Sensitivity	a/a+c × 100 = 28/38 × 100 = 73.6%		
Specificity	d/b+d × 100 = 100/152 × 100 = 65.7%		
Positive predictive value	a/a+b × 100 = 28/80 × 100 =35%		
Negative predictive value	d/c+d × 100 = 100/110 × 100 = 90.9%		

Discussion

Several measurements of blood pressure including systolic blood pressure, diastolic blood pressure, pulse, mean arterial pressure, and 24 hour ambulatory pressure have been studied in early pregnancy as predictors of pre- eclampsia. In Cnossen and colleagues' meta-analysis, mid-trimester mean arterial pressure was the best predictor of pre-eclampsia in low risk women, but as the authors concede the low positive likelihood ratio makes it unlikely that this measure would have a clinical effect in isolation.[9] The predictive strength of mean arterial pressure was moderate (area under the receiver operating characteristic curve 0.76). However, the positive and negative likelihood ratios of a second trimester mean arterialpressureof≥90mmHgwere3.5and0.46inthisstudy.Incr easesin mean arterial pressure > 80 mm of Hg had high sensitivity of 88.5% contrary to our study and high specificity of 81.6% similar to our study. In the study by Page and Chrstianson[11](1976) and Phelan[12](1977) results were similar to our study showing low sensitivity of 43% and 20%; high specificity of 87% and 95%; high negative predictive value of 98% and 87%. Leona et al[13] (2008) conducted screening for preeclampsia by maternal medical history and mean arterial pressure at 11-13 weeks. A multivariate Gaussian model was fitted to the distribution of log multiple of the median of mean arterial pressure in preeclampsia and unaffected groups. Likelihood ratio for mean arterial pressure was 0.98. A comparative figure of various authors for sensitivity, specificity, PPV and NPV is presented in table-3.

Table 3: A comparative figure of Mean arterial pressure by various authors for sensitivity, specificity, PPV and NPV

Authors and Year	Sensitivity	Specificity	Pree clamptic value	
			Positive	Negative
Fallis and Langford(1963)[16]	82	88	78	90
Page and Christianson (1967)[11]	43	87	86	98
Friedman and Neff(1977)[17]	64	62	64	98
Quass et al(1982)[18]	65	88	15	76
Phelan(1977)[12]	20	95	43	87
Oney and Kaulhausen(1983)[19]	90	62	20	98
Present Study (2009)	44.7	91.4	56.6	86.8

In obese women incidence of hypertension is fairly high. Out of 38 women who developed preeclampsia 28(73.6%) had waist circumference >80 cms while out of 152 normotensive women only 52(34.2%) had waist circumference >80 cms and 100(65.7%) women hadwaist circumference < 80 cms. Naveed et al[14](2001) carried out a study to assess whether waist circumference at the first systolic blood pressure and diastolic blood pressure over baseline showed poor predictive acuracy.

Mean arterial pressure in the second trimester is a better predictor of preeclampsia than systolic or diastolic increase in blood pressure. In present study out of 38 women who developed preeclampsia 17(44.7%) had mean arterial pressure more than 90 mm of Hg whereas out of 152 normotensive women only 13 (8.5%) had mean arterial pressure more than 90 mm of Hg and 139(91.4%) had mean arterial pressure <90 mm of Hg. Thurnau et al10 (1983) conducted a study to formulate a profile scoring system in which clinical parameters were utilized for early recognition of pregnancy induced hypertension (PIH). The combination of positive roll over test and antenatal visit predicts risk of developing hypertension later in pregnancy. Greater waist circumference was noted in subjects who subsequently developed preeclampsia. The 80 cms cut off gave Mantel Hanszell odds ratio (OR) for preeclampsia 2.7. In contrast to our study they noted high sensitivity of 96% and high specificity of 97%. Logistic regression analysis revealed that the waist circumference was the only significant univariate predictor of preeclampsia (Z=2.04, P=0.04). The case control study by Anjali Gupta et al[15] PGIMS, Rohtak 2015 was aimed to evaluate the waist circumference as an anthropometric parameter in identifying women at risk of developing obstetric complications. The maternal and neonatal complications like preeclampsia (p = 0.0052, RR 0.5062, 95% CI 0.2935 - 0.8728), gestational diabetes mellitus, preterm labor, postdatism, need for induction of labor (p value 0.0081, RR 0.6263, 95% CI 0.4314, 0.9091), instrumental vaginal delivery, cesarean delivery (p = 0.0072, RR 0.5745, 95% CI 0.3696, 0.8929), shoulder dystocia, PPH, macrosomia, neonatal asphyxia, admission to NICU were reported more in Group II women (waist circumference>80 cms) as compared to Group I (waist circumference<80 cms).

Conclusion

Mean arterial pressure is a good predictor of preeclampsia with high specificity and negative predictive value but is only moderately effective due to low sensitivity and positive predictive value. Antenatal waist circumference is a precise, simple, self measurable and reproducible method with high negative predictive value.

Conflict of interest: None.
Disclaimer: Nil.

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