MEAN ARTERIAL PRESSURE AS A PREDICTOR OF GESTATIONAL HYPERTENSION AND PRE-ECLAMPSIA

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ABSTRACT

AIM
To determine the potential value of mean arterial pressure in the prediction of gestational hypertension and pre-eclampsia.

INTRODUCTION
Pregnancies complicated by pre-eclampsia, gestational hypertension or both, are at significantly increased risk of adverse outcomes. In low risk women, mean arterial pressure was a better predictor of pre-eclampsia than systolic blood pressure or diastolic blood pressure.

METHODOLOGY
Sample Size: 100.
This is a prospective observational study done from August 2013 to August 2015 at K.A.P.V. Medical College and M.G.M. Government Hospital, Trichy. Various data analysed regarding age, parity, gestational age at the time of delivery, socioeconomic status, and mean arterial pressure.

RESULTS
In this study, all patients were with mean arterial pressure more than 90 mmHg. Among them, 68 developed hypertensive disorder of pregnancy and 32 were remained normotensive.

CONCLUSION
Mean arterial pressure more than 90 mmHg in first trimester and in early second trimester has significant impact on the incidence of hypertensive disorders of pregnancy.

KEYWORDS
Mean arterial pressure, Gestational hypertension, Pre-Eclampsia.

INTRODUCTION: Hypertensive disorders complicate 5 to 10% of all pregnancies and together they form one member of deadly triad along with haemorrhage and sepsis.[1]

Extensive research in the last two decades has focused on prediction of pregnancies at high risk for pre-eclampsia with the objective of firstly undertaking pharmacological interventions to prevent the development of the disease and secondly for those who develop pre-eclampsia to diagnose the condition at its early stages and improve outcome by close monitoring for timely delivery. The likelihood of developing pre-eclampsia is increased by a number of factors in the maternal history including ethnicity, nulliparity, high body mass index, and previous or family history of pre-eclampsia. According to a report from ACOG, no screening tests are recommended to predict pre-eclampsia other than appropriate maternal history to evaluate risk factors.[2] Conde-Agudelo et al (1993) suggests that mean arterial pressure in late first trimester and second trimester is a better predictor of gestational hypertension and pre-eclampsia.

AIM: To determine the potential value of mean arterial pressure in the prediction of hypertensive disorders of pregnancy.

MATERIALS AND METHODS: A prospective study conducted in Annal Mahathma Gandhi Memorial Government Hospital, Tiruchirappalli, in the Department of Obstetrics and Gynaecology during the period September 2013 to September 2015.

Inclusion Criteria: Antenatal patients with singleton pregnancies with mean arterial pressure ≥90 mmHg detected in late first trimester and second trimester.

Exclusion Criteria:

1. Thyrotoxicosis.
2. Chronic hypertension.
3. Multiple gestation.
4. Vesicular mole.
5. Pheochromocytoma.
6. Systemic lupus erythematosus.

METHODS:

Maternal History and Characteristics: A detailed history regarding age, parity, gestational age, history of hypertensive disorders of pregnancy in previous pregnancies and interpregnancy interval in multipara, family history of hypertensive disorder in mother and siblings, socioeconomic status.

Body mass index recorded. Blood pressure and mean arterial pressure recorded. Mean arterial pressure ≥90 mmHg were included in the study.

Ultrasound done to confirm the gestational age.

Mean Arterial Pressure: The mean arterial pressure was measured by mercury sphygmomanometer. The women were in sitting position, their arms were supported at the level of heart, and small, normal, or large size adult cuff was used depending on the mid arm circumference. After rest for 5 minutes, two recordings of blood pressure were made in both arms simultaneously. Mean arterial pressure calculated from all four measurements.

Women with mean arterial pressure ≥90 mmHg were included in the study and followed up for the occurrence of gestational hypertension and pre-eclampsia. They were followed up in 24 weeks, 28 weeks, 32 weeks, and 36 weeks of gestation. In each follow up, blood pressure and spot urine albumin was recorded.

Outcome Measures: Data was collected in further followup. The definition of gestational hypertension and pre-eclampsia was that of the National High Blood Pressure Education Program Working Group report on High Blood Pressure in Pregnancy (2000).

RESULTS:

Sl. No.	Age Group	Gestational Hypertension	Pre-Eclampsia	Normotensive
1.	<20	2 (25%)	5 (62.5%)	1 (12.5%)
2.	20-29	5 (6.2%)	45 (56.2%)	30 (37.5%)
3.	≥30	0 (0%)	11 (91.7%)	1 (8.3%)
4.	Total	7 (7%)	61 (61%)	32 (32%)
MEAN 24.47				
P-VALUE: 0.03				
Table 1: Age Distribution Let the Frequency be 5 Not Ten for Better Results				

91.1% of the patients who were 30 years and above-developed pre-eclampsia. Thus, maternal age of 30 years and above is a significant risk factor for pre-eclampsia.

Sl. No.	Parity	Gestational Hypertension	Pre-Eclampsia	Normotensive	Total
1.	Primigravida	5 (6.9%)	40 (55.6%)	27 (37.5%)	72
2.	Multigravida	2 (7.1%)	21 (75%)	5 (17.9%)	28
3.	Total	7 (7%)	61 (61%)	32 (32%)	100
P-value: 0.15					
Table 2: Parity					

Though, parity does not have significant impact on occurrence of gestational hypertension and pre-eclampsia, 75% of multigravida in this study group developed pre-eclampsia and 55.6% of primigravida in this study group developed pre-eclampsia.

Sl. No.	Socioeconomic Status	Gestational Hypertension	Pre-Eclampsia	Normotensive	Total
1	Lower	3 (11.1%)	17 (63%)	7 (25.9%)	27
2	Middle	4 (5.5%)	44 (60.3%)	25 (34.2%)	73
Table 3: Socioeconomic Status					

P-value: 0.51.

63.3% of lower socioeconomic class of this study group developed pre-eclampsia.

Sl. No.	Previous H/O PIH	Gestational hypertension	Pre-Eclampsia	Normotensive	Total
1.	With previous history	0 (0%)	10 (100%)	0 (0%)	10 (100%)
2.	Without any previous history	2 (11.11%)	11 (61.11%)	5 (27.77%)	18 (99.99%)
3.	**Total**	**2**	**21**	**5**	**28**

Table 4: Previous H/O PIH in Multigravida

100% of the multigravida who had previous history of hypertensive disorders of pregnancy developed pre-eclampsia.

Sl. No.	Family H/O PIH	Gestational Hypertension	Pre-Eclampsia	Normotensive	Total
1.	With Family History	1 (14.3%)	4 (57.1%)	2 (28.6%)	7 (100%)
2.	Without Family History	6 (6.5%)	57 (61.3%)	30 (32.3%)	93 (100%)
3.	**Total**	**7 (7%)**	**61 (61%)**	**32 (32%)**	**100 (100%)**
P-value: 0.73					

Table 5: Family H/O PIH

61.3% of the study population without any family history of gestational hypertension had developed pre-eclampsia. Family history of gestational hypertension doesn't significantly affect the occurrence of gestational hypertension or pre-eclampsia.

Sl. No.	Diastolic BP (mmHg)	Gestational Hypertension	Pre-Eclampsia	Normotensive	Total
1.	>80	5 (8.1%)	42 (67.7%)	15 (24.2%)	62
2.	<80	2 (5.3%)	19 (50%)	17 (44.7%)	38
3.	**Total**	**7**	**61**	**32**	**100**
P-value: 0.10					

Table 6: Diastolic BP

Though, the diastolic BP doesn't affect the occurrence of gestational hypertension or pre-eclampsia significantly, 67.7% of the patients with diastolic BP more than 80 mmHg in this study group developed pre-eclampsia.

Sl. No.	BMI	Gestational Hypertension	Pre-Eclampsia	Normotensive	Total
1.	25 and above	2 (5.6%)	32 (88.8%)	2 (5.6%)	36
2.	<25	5 (7.8%)	29 (45.3%)	30 (46.9%)	64
3.	**Total**	**7**	**61**	**32**	**100**
P-value: 0.001					

Table 7: Body Mass Index (BMI)

The mean body mass index is 23.74 and p-value is 0.001, which is highly significant. 88.8% of the patients with body mass 25 and above-developed pre-eclampsia. Thus, body mass index significantly affects the incidence of pre-eclampsia.

Sl. No.	Interpregnancy Interval	Gestational Hypertension	Pre-Eclampsia	Normotensive	Total
1.	<5	0 (0%)	5 (50%)	5 (50%)	10
2.	5 and above	2 (11.8%)	16 (88.2%)	0 (0%)	18
3.	**Total**	**2**	**21**	**5**	**28**
P-value: 0.02					

Table 8: Interpregnancy Interval

88.2 % of the multi gravida with inter pregnancy interval 5 and above developed pre-eclampsia. Thus inter pregnancy interval had significant impact on the occurrence off pre-eclampsia.

Sl. No.	Hypertensive Status	No. of Patients	Mean of the Map	P-value
1.	Hypertensive	68	92.85	0.001
2.	Normotensive	32	91.56	

Table 9: Mean Arterial Pressure (MAP) >90 mmHg

P-value is 0.001, which is highly significant. Thus, mean arterial pressure more than 90 mmHg has significant impact on the incidence of hypertensive disorders of pregnancy.

Sl. No.	Hypertensive Status	Mean of Map	No. of Patients	P-value
1.	Gestational hypertension	92.29	7	
2.	Pre-eclampsia	92.92	61	0.001
3.	Normotensive	91.56	32	
Table 10: Mean Arterial Pressure (MAP): >90 mmHg				

P-value is 0.001, which is highly significant. Thus, mean arterial pressure has significant impact on the occurrence of gestational hypertension and pre-eclampsia.

Hypertensive Status	Hypertensive Status	Mean Difference	P-value
Gestational hypertension	Pre-eclampsia	-6.32	0.88
	Normotensive	0.72	
Pre-eclampsia	Gestational hypertension	0.63	0.001
	Normotensive	1.35*	
Normotensive	Gestational hypertension	-0.72	0.001
	Pre-eclampsia	-1.35*	
Table 11: Comparison of the Value of Mean Arterial Pressure Among the Three Hypertensive Status (Gestational Hypertension, Pre-Eclampsia, Normotensive)			

In comparing the value of mean arterial pressure in gestational hypertension with pre-eclampsia and normotensive, p-value is 0.88, which is not significant. Thus, mean arterial pressure doesn't differ significantly between normotensive and gestational hypertension and also between gestational hypertension and pre-eclampsia.

In comparing the value of mean arterial pressure in pre-eclampsia with gestational hypertension and normotensive, the p-value is 0.001, which is significant. Thus, the mean arterial pressure significantly differs between normotensive and pre-eclampsia group.

DISCUSSION: The basic pathogenesis of hypertensive disorder of pregnancy is associated with changes in vascular anatomy leading to systemic vascular resistance, vascular factors, and tissue factors resulted in changes in heart rate, inotropy, venous compliance. These changes in systemic vascular resistance, heart rate, cardiac output, inotropy, venous compliance greatly affects mean arterial pressure.

In a report published by the Confidential Enquiry into Maternal and Child Health (CEMACH), pre-eclampsia and eclampsia was the second most common cause of direct maternal mortality in United Kingdom between 2003 and 2005.[3]

Though, hypertensive disorder of pregnancy is totally not a preventable disease, some measures like dietary modification, anti-thrombotic agents may help in prevent early onset pre-eclampsia, and severe thrombotic events associated with severe pre-eclampsia.

In this study, women with mean arterial pressure ≥90 mmHg detected in late first trimester and second trimester were followed up with blood pressure and urine albumin.

Age: A study in N.W.M. Hospital, in 1989 reveals that 40.5% were under 20 years, 56.8 were between 21 and 29 years of age and 2.7% were above 30 years. A study by Lolkand and colleagues in 1997 found that 40.7% were under 20 years.

In this study, the mean age is 24.47 yrs. 91.1% of the patients who were 30 years and above developed pre-eclampsia.

Parity: In a number of trials reviewed by Sibai and Cunningham (2009), the incidence of pre-eclampsia in a nulliparous population ranges from 3 to 10 percent. The incidence of pre-eclampsia in multiparas is also variable, but is less than that for nulliparas. However, Ananth and Basso (2009) reported that the risk for stillbirths was more likely in multiparas compared to nulliparas.

In a study by Duckitt et al, primiparity is one of the risk factor for pre-eclampsia.[4]

In this study group, 72 were primigravida and 28 were multigravida. Though, parity does not have significant impact on occurrence of gestational hypertension and pre-eclampsia, 75% of multigravida in this study group developed pre-eclampsia, and 55.6% of primigravida in this study group developed pre-eclampsia.

Socioeconomic Status: The incidence of gestational hypertension and pre-eclampsia were greatly influenced by environmental, socioeconomic, and even seasonal changes (Lawlor, 2005; Palmer, 1999; Spencer, 2009; and their colleagues).

In this study group, 27 were in the lower socioeconomic class and 73 were in the middle socioeconomic class. Though, socioeconomic status has not have any significant impact on the occurrence of gestational hypertension and pre-eclampsia, 63.3% of lower socioeconomic class of this study group developed pre-eclampsia.

Past History of Hypertensive Disorders of Pregnancy: 100% of the multigravida who had previous history of hypertensive disorders of pregnancy developed pre-eclampsia.

Family History of Hypertensive Disorders of Pregnancy: The familial tendency of pre-eclampsia was described as early as 1873 by Elliot, which was included in review by Chesley in 1968.

Family and personal history of pre-eclampsia increases the risk of development of pre-eclampsia by 7-fold and 3-fold increase in the incidence of pre-eclampsia respectively.[5] Both mother and father may contribute to the genetic risk of pre-eclampsia.

The association of paternal risk is less stronger.[6] 61.3% of the study population without any family history of gestational hypertension had developed pre-eclampsia.

Family history of gestational hypertension doesn't significantly affect the occurrence of gestational hypertension or pre-eclampsia.

Interpregnancy Interval: Interpregnancy interval more than 10 years is one of the risk factor for pre-eclampsia.[7]

88.2% of the multigravida with interpregnancy interval 5 and above developed pre-eclampsia. Thus, interpregnancy interval had significant impact on the occurrence of pre-eclampsia.

Diastolic BP: Traditionally, the criteria used to define pre-eclampsia have lacked consistency and have over emphasised diastolic blood pressure. This is because, historically, systolic blood pressure has been thought to be very reliable in pregnancy.[8]

Cnossen et al showed that in a women at risk, diastolic BP of 75 mmHg or more at 13 to 20 weeks of gestation best predicted pre-eclampsia.

Diastolic only thresholds are still recommended for diagnosis in the community in the UK; this maybe reasonable for pragmatic reasons to avoid confusion arising from multiple endpoints.

Though the diastolic BP doesn't affect the occurrence of gestational hypertension or pre-eclampsia significantly, 67.7% of the patients with diastolic BP more than 80 mmHg in this study group developed pre-eclampsia.

Body Mass Index: The risk of pre-eclampsia in obese is documented in the study by Sibai and co-workers.[9]

The association between maternal weight and the risk of pre-eclampsia is progressive. It raises from 4.3 percent for women with a body mass index <20 kg/m2 to 13.3 percent in those with a body mass index >35 kg/m2.

In this study, 88.8% of the patients with body mass 25 and above developed pre-eclampsia. Thus, body mass index significantly affects the incidence of pre-eclampsia.

Mean Arterial Pressure: A study conducted in the Harris Birth Right Research Centre for Foetal Medicine, King's College Hospital, London, United Kingdom, concluded that at a 10% false positive rate, the detection rate of pre-eclampsia was 43.3% for history alone, 37.5% for mean arterial pressure alone and 62.5% for combined testing and the respective values for gestational hypertension were 27.8%, 32.0%, and 41.2%.

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.

Cnossen et al documented that mean arterial pressure was a better predictor of pre-eclampsia than systolic BP and diastolic BP and an increase in BP in first and second trimester of pregnancy.

In this study group, all patients were with mean arterial pressure more than 90 mmHg. Among them, 68 developed hypertensive disorder of pregnancy and 32 were remained normotensive. P-value is 0.001, which is highly significant. Thus, mean arterial pressure more than 90 mmHg has significant impact on the incidence of hypertensive disorders of pregnancy.

CONCLUSION: Mean arterial pressure is one among the many predictors of gestational hypertension and pre-eclampsia. There are many clinical and biochemical predictors of pre-eclampsia. No single predictor solely has significant predictive value in this study, past history of hypertensive disorders of pregnancy, diastolic blood pressure, and mean arterial pressure has significant value. All other factors though not having significant value, they influence the incidence of gestational hypertension and pre-eclampsia to a greater extent.

Though hypertensive disorders of pregnancy is not a totally preventable disease, some measures like lifestyle modification and anti-thrombotic agents may significantly prevent early onset pre-eclampsia and severe thrombotic events associated with pre-eclampsia.

In conclusion, no significant factor predicts gestational hypertension and pre-eclampsia, some maternal history and characteristics like diastolic blood pressure, body mass index and mean arterial pressure may help in predicting gestational hypertension and pre-eclampsia.

REFERENCES

1. Cunningham FG, Leveno KJ, Bloom SL, et al. Pregnancy hypertension. Chapter 34. In: Cunningham FG, Leveno KJ, Bloom SL, et al, ed. Williams Obstetrics. 23rd edn. New York: McGraw-Hill 2010:706.

2. Hypertension in pregnancy: executive summary. Obstet Gynaecol 2013;122(5):1122-1131.

3. Lewis G, ed. Saving mothers lives: Reviewing maternal deaths to make motherhood safer 2003-2005. The seventh report on confidential enquiries into maternal deaths in the United Kingdom. London: CEMACH, 2007.

4. Duckitt K, Harrington D. Risk factors for pre-eclampsia at booking antenatal visit. A systematic review of controlled studies. BMJ 2005;330(7491):565.

5. Skjaerven R, Vatten LJ, Wilcox AJ, et al. Recurrence of pre-eclampsia across generations: exploring foetal and maternal genetic components in a population based cohort. Br Med J 2005;331(7521):877.

6. Davey DA, MacGillivray l. The classification and definition of hypertensive disorders of pregnancy. Am J Obstet Gynaecol 1988;158(4):892-898.

7. Sibai BM, Ewell M, Levine RJ, et al. Risk factors associated with pre-eclampsia in healthy nulliparous women. Am J Obstet Gynaecol 1997;177(5):1003-1010.

8. Farag K, Hassan l, Ledger WL. Prediction of pre-eclampsia: can it be achieved? Obstet Gynaecol Sur 2004;59(6):464-482.

9. Cnossen JS, Vollebregt KC, de Vrieze N, et al. Accuracy of mean arterial pressure and blood pressure measurements in prediction of pre-eclampsia: a systemic review and meta-analysis. BMJ 2008;336:1117-1120.