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# Mean Arterial Pressure And It's Association with Systolic Blood Pressure, Diastolic Blood Pressure And Body Mass Index In Normotensive Pregnant Women And Women With Preeclampsia In Oredo Local Government Area, Benin City, Edo State Nigeria

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***Abstract***
***Background***
*Preeclampsia is a pregnancy specific disease with associated morbidity and mortality, when not detected early and appropriate intervention instituted. Early detection of preeclampsia will help reduce associated morbidity and mortality.*
*The search for biomarkers for predicting preeclampsia is still on. Mean arterial blood pressure which has the advantage of presenting a single cut off value compared with the use of systolic and diastolic blood pressure measurements, deserves evaluation on its usefulness in detecting the disease.*
***Aim/Objective***
*To evaluate mean arterial blood pressure in normotensive pregnant women and women with pre eclampsia with the aim of determining its usefulness in early detection of pre eclampsia and its management.*
***Materials and Methods***
*This was a Cross sectional pilot study carried out in the State Specialist Hospital Benin City, Edo State Nigeria in May 2018. A total of 30 subjects (20 normotensive pregnant women, 10 women with preeclampsia) were studied.They all had singleton pregnancies and were in second and third trimester of pregnancy. Physical examination included blood pressure measurements, height and weight measurement. Body mass index was calculated. Mean arterial pressure was calculated by dividing the sum of systolic and twice the diastolic blood pressure by three. Statistical analysis was done with SPSS version 21. Level of significance set at p≤0.05.*
***Result:*** *Mean systolic blood pressure was significantly elevated in the preeclamptic subjects (154.3±19.0mmHg) than in the normotensive pregnant subjects (101.6± 12mmHg) P<0.05.*
*Mean diastolic blood pressure was significantly higher in the preeclamptic subjects (98.6 ±6.9 mmHg) than in the normotensive pregnant subjects (59.5 ± 10.3 mmHg) p< 0.05.*
*Mean arterial pressure was significantly higher in the preeclamptic subjects (117.1 ±8 mmHg) than in the normotensive pregnant subjects (73.5 ± 9.8mmHg), p<0.05.*
*Mean arterial blood pressure showed a strong positive correlation with systolic blood pressure r = 0.820, p<0.05 in the preeclamptic subjects and in the normotensive pregnant subjectsr=0.820, p<0.05. It also showed a strong positive correlation with body mass index in the normotensive pregnant subjects r = 0.642, p< 0.05.*
*Mean body mass index was significantly higher in the preeclamptic subjects (30.9±12kg/m$^2$) than in the normotensive pregnant subjects (28.9 ±4.0kg/m$^2$) p<0.05.*
***Conclusion:*** *Mean arterial pressure may be a useful tool in screening for and early detection of preeclampsia, and in deciding appropriate treatment modalities and intervention.*
***KEY WORDS;****Mean arterial pressure, Body Mass Index, Preeclampsia.*

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## I. Introduction

Preeclampsia is a hypertensive disorder of pregnancy, complicating 5 – 10%, of all pregnancies with significant maternal and perinatal mortality and morbidity[1,2,]. In developing countries, it is a common cause of maternal mortality second only to postpartum haemorrage[1,3,4]. Other perinatalcomplications of preeclampsia include prematurity, intrauterine growth retardation, impaired neurocognitive function.

The pathophysiology of preeclampsia is heterogeneous, complex and poorly understood involving both maternal and placental factors[5]. Abnormalities in the development of placental vasculature is considered to be a primary cause of the placental hypoxia and ischaemia, which then leads to release of numerous bioactive factors into the maternal circulation, causing wide spread endothelial dysfunction[6] and culminating in hypertension,

proteinuria, and other manifestations of the disease affecting the liver, renal, haemotologic and central nervous system[7]. Early detection of eclampsia would allow for appropriate monitoring and management to reduce foetal and maternal complications, and prevent poor foetal and maternal outcomes. The need for biomarkers that will help in early detection of the disease is paramount.

A combination of markers targeting the different pathways of disease pathogenesis to create an algorithm that will predict preeclampsia with good diagnostic sensitivity and specificity appears to be the current trend[1,8]

Pulsatility index, maternal risk factors, mean arterial blood pressure, (MARP) maternal serum pregnancy associated plasma protein A (PAPP-A), placental placenta protein 13 (PP13), placental growth factor (PIGF) and foetalhaemoglobinlevels at the time of first trimester, aneuploidy screening have been used in combination to identity pregnancies at high risk for preeclampsia.[1,9,10]

Considering the low income to medium income earners, who form the largest number of clients seen in the area of study, and may not be able to afford expensive investigations, we aimed in this pilot study to investigate cheap and readily available biomarkers that can help in early detection of preeclampsia and appropriate management. Mean arterial pressure has been reported to be a better predictor of preeclampsia than systolic or diastolic blood pressure alone in first and second trimester of pregnancy.[11]

## II. Materials and Methods:

This was a cross sectional pilot study carried out in May 2018, involving 30 subjects. 20 were normotensive pregnant and 10 were women with pre eclampsia.They all had singleton pregnancies and were the second and third trimester of pregnancy. They were recruited consecutively from the antenatal clinic of the State Specialist Hospital, Benin City, Edo State Nigeria.Informed consent was obtained from the subjects. Study was approved by the Ethical committee of the Hospital.Relevant demographic data and medical historywas obtained using a structured questionnaire.

Pre eclampsia was defined as blood pressure ≥140/90 mmHg, or rise in blood pressure of systolic >30mmHg and diastolic > 15mmHg above booking blood pressure, in at least two occasions and proteinuria ≥300m/ 24 hours or 2+ dipstick after 20 weeks gestation.

Blood pressure was measured using Accouson's mercury syphgmomanometer with appropriate cuff size. The subjects were sitted and rested for 5 minutes before measurement was taken. Systolic blood pressure was taken at the fifth korotkoff sound.Mean arterial pressure was calculated by dividing the sum of the systolic and twice the diastolic blood pressure by three.[9]Height was measured with a stadiometer and weight measured with a weighing scale. Body mass index was calculated using the formula height/weight and expressed in $Kg/m^2$

**Statistical Analysis**

This was done using SPSS version 21. Difference between means of variables was determined using the student "t" test. Correlation between variables was determinedusing Pearsons correlation. Level of significance was set as $P \leq 0.05$.

## III. Results

There were 30 participants in the study.

Mean age of pre-eclamptic and normotensive pregnant subjects was 27.7±5.2 years, 30.5 ± 3.7 years respectively (Table 1)Mean systolic blood pressure was 154.3±19.0mmHgand 101.6 ± 12 mmHg in the pre-eclamptic and normotensive pregnant woman respectively. Difference was statistically significant P<0.001 (Table 1).

Mean diastolic blood pressure was 98.6±6.9 mmHg and 59.5 ±10.3 mmHg in the pre-eclampticand normotensive pregnant subjects respectively. Difference was statistically significant P< 0.001 (Table 2).

Mean arterial pressure was 117.1 ± 8.0 mmHg in the pre-eclamptic subjects and 73.5±8 mmHg in the normotensive pregnant subjects. Difference was statistically significant P<0.001 (Table 1).

Mean body mass index was 30.9±4.2 mmHg in the pre-eclamptic subjects and 28.9±4.0mmHg in the normotensive pregnant woman difference was statistically significant. P = 0.010 (Table 1)

Mean arterial blood pressure showed a significant positive correlation with systolic blood pressure in the pre eclamptic subjects r=0.820, p = 0.02 and normotensive pregnant subjects r = 0.820, p = 0.001. (Table2). It showed a non-significant correlation with diastolic blood pressure r = 0.616 p=0.141 and body mass index r =0.320, p=0.485 in the pre-eclamptic subjects, (Table 2). Correlation was significant with diastolic blood pressure r = 0.936, p = 0.001 and body mass index r = 0.642, p = 0.003, in the normotensive subjects (Table 2).

## IV. Discussion

Pre-eclampsia is a very important cause of foetaland maternal morbidity and mortality in Nigeria. The need for prevention, early detection and control of the disease is important. Mean age in the pre-eclamptic subjects and normotensive pregnant subjects was similar to that reported byEnaruna ON[12] and co-authors in their study on women with pre-eclampsia in Benin city Nigeria.

Mean systolic blood pressure was significantly elevated in the pre-eclamptic subjects compared with normotensive pregnant subjects. Awareness of the importance of systolic blood pressure in pregnancy has improved, and currently both the International Society for the study of hypertension in pregnancy and the Working Group of the National high blood pressure Education programme in the United States define pre-eclampsia as either systolic blood pressure ≥ 140mmHg, or diastolic blood pressure ≥ 90mmHg with associated proteinuria after 20 weeks of gestation[13,14,15.]This means that systolic and diastolic blood pressure measurements are still important criteria in detecting preeclampsia.

Mean diastolic blood pressure was significantly elevated in the pre eclamptic subjects compared with the normotensive pregnant subjects. From the recommendation of the Working Group of the National high blood pressure Education Programme in United States, pre-eclampsia can be defined as a diastolic blood pressure of ≥ 90mmHg with associated proteinuria. Diastolic only thresholds are reported to be recommended for diagnosis in the community in the UK[15]. This may be reasonable for pragmatic reasons to avoid confusion arising from multiple endpoints[16].

Mean arterial pressure was significantly elevated in the pre-eclamptic subjects compared with the normotensive pregnant subjects. It has been observed that increasingly, automated blood pressure devices are being used in pre-eclampsia and these devices may underestimate systolic blood pressure and overestimate diastolic blood pressure[13,17]. As such many authorities recommend using the mean arterial pressure in severe pre-eclampsia protocols, with 125 mmHg being the most commonly used cut off point[13]. Some other studies have evaluated use of mean arterial pressure in predicting or detecting pre-eclampsia. UdenzeIC[1] and co-authors in a prospective cohort study of the clinical utility of mean arterial blood pressure in prediction of late onset pre-eclampsia among Nigerian women, reported that mean aterial blood pressure performed moderately in the prediction of pre-eclampsia in Nigerian women. Cnossen JB[11] and coauthors also reported that whenblood pressure is measured in the first and second trimester of pregnancy; the mean arterial pressure is a better predictor of pre-eclampsia than systolic blood pressure, diastolic blood pressure or an increase of blood pressure.

Mean arterial blood pressure correlated positively and significantly with systolic blood pressure in the pre-eclamptic subjects and the normotensive pregnant subjects. It also showed a non-significant correlation with diastolic blood pressure in the pre-eclamptic subjects, and a significant correlation with diastolic bloodpressure in the normotensive pregnant subjects. From these findings, we can infer that mean arterial pressure may be of use in predicting and detecting pre-eclampsia, it may also be of use in developing management protocolsviz a viz cut off points for instituting pharmacotherapy or delivery interventions. In the pre-eclamptic subjects, mean arterial pressure correlated significantly only with systolic blood pressure, from this we may infer that in taking management decisions, systolic blood pressure readings along with mean arterial pressure readings may take precedence over diastolic blood pressure readings. Evaluation of utility of mean arterial blood pressure in predicting preeclampsia and determination of cut off value of mean arterial pressure in diagnosing preeclampsia are areas for further research studies.

Mean body mass index was significantly higher in the pre-eclamptic subjects than the normotensive subjects. Studies have reported obesity to be a risk factor in preeclampsia.

Poorolojai[18] and co-authors in the study reported that overweight and obesity can be considered as a predictor of preeclampsia.Bodnar LM[19] and co-authors also reported that preeclampsia risk rises throughout most of the BMI distribution. These reports along with our findings strongly support the role obesity may play as a risk factor in the pathogenesis of preeclampsia. Body mass index also correlated strongly andsignificantly with mean arterial pressure in the normotensive pregnant subjects but correlation was not significant in the preeclamptic subjects. Body mass index may also be a useful tool in screening for and early detectionofpreeclampsia.Further research studies will be carried out to confirm this.

In this pilot study, mean arterial pressure was significantly higher in preeclamptic subjects than in normotensive subjects, and it showed a strong positive and significant correlation with systolic blood pressure in the preeclamptic subjects.

Body mass index was also significantly higher in preeclamptic subjects than in normotensive pregnant subjects and it correlated strongly with mean arterial pressure in normotensive pregnant subjects.

## V. Conclusion

Mean arterial pressure may be a useful tool in screening for and early detection of preeclampsia, and in deciding appropriate treatment modalities and intervention.

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**Table 1: Demographic characteristics, blood pressure measurements and body mass index in the pre eclamptic and normotensive pregnant subjects**

| | **Pre-eclampsia n=10 mean ± SD** | **Normotensive pregnant n = 20 mean ± SD** | **P value** |
|---|---|---|---|
| **Age (years)** | **27.7±5.2** | **30.5 ± 3.7** | |
| **Gestational age (weeks)** | **25.5±7.0** | **28.6±5.8** | **0.138** |
| **Systolic blood Pressure (mmHg)** | **154.3 ± 19.0** | **101.6 ±12** | **<0.001** |
| **Diastolic blood Pressure (mmHg)** | **98.6 ± 6.9** | **59.5 ± 10.3** | **<0.001** |
| **Mean Arterial Pressure (mmHg)** | **117.1 ± 8.0** | **73.5 ± 9.8** | **<0.001** |
| **Body Mass Index ($kg/m^2$)** | **30.9 ± 12** | **28.9 ± 4.0** | **0.010** |
| | | | |

**Table 2: Correlation of mean arterial pressure with systolic blood pressure, diastolic blood pressure and body mass index in preeclamptic and normotensive pregnant subjects.**

| | Preeclampsia | | Normotensive pregnant | |
|---|---|---|---|---|
| | r | p | r | p |
| **Systolic blood pressure (mmHg)** | **0.820** | **0.024** | **0.820** | **0.001** |
| **Diastolic blood pressure (mmHg)** | **0.616** | **0.141** | **0.936** | **0.001** |
| **Body mass index (kg/m$^2$)** | **0.320** | **0.485** | **0.642** | **0.003** |
| | | | | |

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