A Comparative Study of Umbilical Artery and Brachial Artery Flow in Pre-Eclampsia and FMD of Brachial Artery

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ABSTRACT

Objective: The flow mediated dilation of right brachial can evaluate the endothelial dysfunction in pre-eclamptic women at 3rd trimester and compare the flow in umbilical artery and right brachial artery.

Materials and Method: Fifteen preeclampsia multigravida pregnant women were scanned during 3rd trimester. Their ages range between (19-40) years old. Doppler indices obtained from umbilical artery and brachial artery before and after cuff measured the flow mediated dilation (FMD)

Results: The brachial artery means diameter before cuff was significantly higher (5.55 mm ± 0.78) than after cuff (4.52 mm ± 0.82) in preeclampsia pregnant women at 3rd trimester. Also, PI was significantly different between brachial artery after cuff the mean was (6.24 ± 8.80), (2.64 ± 2.50) for brachial artery before cuff and (0.94 ± 0.50) for umbilical artery. In addition, S/D of pregnant women at their 3rd trimester whose preeclampsia was significantly different in mean between brachial artery after cuff the mean was (9.04 ± 6.33), (5.55 ± 3.88) for brachial artery before cuff and (3.85 ± 3.56) for umbilical artery. Furthermore, FMD < 10% is detected in the pregnant women with pre-eclampsia at 3rd trimester.

Conclusion: Pregnant women with pre-eclampsia at 3rd trimester, the FMD of brachial artery marked the pre-eclampsia morbidity and assessed the endothelial function. Also the differences in Doppler blood flow indices between umbilical and brachial artery worsening endothelial function.

KEY WORDS
brachial artery, umbilical artery, preeclampsia, endothelium, Doppler

INTRODUCTION

Pre-eclampsia is connected with endothelial dysfunction and stand out amongst the most detorious disease in obstetric. It is so far, considered a two — stage case. The first leads to an insufficiency in placentation which is due to a rise in the resistance of uteroplacental circulation. The second stage appears through the activation of the inflammatory response and endothelial cell dysfunction. In the plasma of pre-eclamptic women, some substance are elevated such as phosphodiesterase enzyme, a substance that is associated with endothelial dysfunction. Additionally, increases in the vasoconstricctor; leukocyte adhesion and platelet, migration of cells from the smooth vascular muscle, and the expression of adhesion molecules, such loss of endothelial functional integrity is associated with arterial hypertension, diabetes, dyslipidemia, which all lead to endothelial dysfunction.

A brachial artery flow mediated dilation (FMD) parameter has been used to assess endothelial dysfunction in humans. The non-invasive ultrasound imaging is currently used for the assessment of brachial artery FMD. Higher reactivity and reduced dilatation is present in arteries of Preeclampsia, due to the alteration of metabolic pathways, such as the nitric oxide. In the first half of the pregnancy period, though available, the nitric oxide has not constituted a significant impact in the physiological endothelial function, whilst decreased measurements represent endothelial dysfunction. Guidelines for FMD have been well established since 2002 and this allowed certain uniformity in studies. Besides, by using this non-invasive maneuver, the presence of altered endothelium —dependent vasodilation has been observed in the brachial artery of patients with cardiovascular risk factor such as smoking, hypercholesterolemia, hyperlipidemia, and diabetes.

METHODOLOGY

Fifteen 15 patients with preeclampsia were involved in this a prospective study. All patients were seen inside obstetrics care in Al-Fallujah Maternity Hospital, during the period from October 2012-2013. A pregnant women were recruited in the present study their age range between (19-40) years. Pregnant women with a history of chronic hypertension, diabetes mellitus, Venus and arterial thrombosis, smoker, drug users were excluded in this study.

Fifteen pre-eclampsia multigravida pregnant women were scanned during 3rd trimester and Doppler study for brachial artery, before and after rubbed spagyromamomemter cuff, Doppler study for umbilical artery use 3.5MHZ curvilinear probe. Use 7MHZ.liner probe of 2-D color Doppler (color medicine) use for Doppler of brachial artery the probe was placed on the medial side of the arm longitudinal and perpendicularly to the skin 5 cm above the antecubital fossa insonating directly
to the right brachial artery below the biceps. The pre-eclamptic women were seated comfortably, with abduction of right arm and hand supination, in order to expose the anteromedial side of the arm for measurement. An FMD was carried out in the right brachial artery of the patients by measurement of right brachial artery diameter which has been longitudinally scanned in a two dimensional mode in which the proximal and distal lumen –intimal are visualized. After the basal diameter (D1) was verified, the skin was marked with aperture at the place where measurement was taken by the transducer. The endothelial function was measured by brachial artery FMD. For each woman the sphygmomanometer blood pressure cuff around the upper right arm, has inflated to 200 mmHg elevating the blood pressure and maintaining the occlusion for 5 minutes. The post occlusion diameter (D2) was measured; one minute after the cuff was removed with a tolerance of 30 seconds.

Doppler indices obtained from brachial artery before and after cuff, and Umbilical artery the measurements included Resistance index (RI), Pulsatility index (PI), Systolic and diastolic flow velocities, S/D ratio and volume mean.

The flow mediated dilatation of brachial artery was carried out according to the recommendations of international brachial artery reactivity. The FMD value was obtained from the following calculation: FMD % = [(D2 - D1) /D1] \times 100, where D1= basal diameter and D2 = post-occlusion diameter. FMD values > 10% was considered normal according Quyyumi\textsuperscript{20}. Afterward, ultrasonography was also performed to assess the fetal status and to carry out an analysis with Doppler velocimetry of the maternal, placental and fetal compartments and FMD measurement. The data regarding the FMD, patient's clinical information, obstetric echography, obstetric Doppler were entered into an Excel spreadsheet. The data were evaluated by the statistical package for social sciences (SPSS) program. Data were analyzed by measures of central trend and dispersion (mean ± standard deviation) or median. The data for all parameters were tested for normality. Reference ranges and the 5\textsuperscript{th}, 50\textsuperscript{th} and 95\textsuperscript{th} centiles are shown. P value of < 0.05 was regarded as significant.

### RESULTS

A total number of fifteen pregnant women were enrolled in this study. All pregnant women were seen at 3\textsuperscript{rd} trimester between 32 and 39 weeks of gestation, The Doppler flow examination of patients with pre-eclampsia at 3\textsuperscript{rd} trimester was taken for both umbilical and brachial arteries before and after placement of the cuff and different parameters were measured including, brachial artery diameter before & after cuff (post-occlusion) were calculated for flow –mediated dilatation and Resistivity index (RI), Pulsatility index (PI), Velocity in systolic (Vs,cm/s), Velocity in diastolic (Vd,cm/s), Systolic / Diastolic flow (S/D). As shown in Figure 1, PI was significantly different between brachial artery after cuff the mean was (6.24 ± 8.80), (2.64 ± 2.50) for brachial artery before cuff and (0.94 ± 0.50) for umbilical artery. Furthermore, S/D of pregnant women at their 3\textsuperscript{rd} trimester whose pre-eclampsia was significantly different in mean between brachial artery after cuff the mean was (9.04 ± 6.33), (5.55 ± 3.88) for brachial artery before cuff and (3.85 ± 3.56) for umbilical artery; Figure 2.

In addition, RI was significantly higher in brachial artery after cuff (0.78 ± 0.20), than before cuff (0.76 ± 0.16) and brachial artery after cuff also significantly higher than umbilical artery (0.67 ± 0.13); Figure 4.- It has been observed that there was a significant (P < 0.05) positive (r = 0.29) correlation between U/S gestational age and Brachial artery diameter before cuff in pre-eclampsia pregnant women at their 3\textsuperscript{rd} trimester. While the same correlation was absent between the U/S gestational age and brachial artery diameter after cuff in Pre-eclampsia pregnant women at their 3\textsuperscript{rd} trimester.

### DISCUSSION

The present pilot study suggests that Doppler of Rt. Brachial artery before and after cuff and umbilical artery at 3\textsuperscript{rd} trimester is capable of assessing the endothelial function in pre-eclampsia syndrome. In the current study the Pre-eclampsia pregnant women at their 3\textsuperscript{rd} trimester, the RI of Brachial artery after cuff was significantly higher as compared to the RI of Brachial artery before cuff and umbilical artery. In addition, Brachial artery PI after cuff of pregnant pre-eclamptic women at their 3\textsuperscript{rd} trimester was significantly higher (P < 0.05) as compared to their PI of both Brachial artery before cuff and umbilical artery of pre-eclampsia pregnant women at 3\textsuperscript{rd} trimester. These results indicate a poor endothelial circulation which in turn leads to an insufficient placentalation. These results are supported by Roberts etal. 2009 who found that an increase in the resistance of uteroplacental circulation leads to insufficient placentalation. Also, in this study, the diastolic flow velocity of brachial artery before cuff was higher than diastolic flow velocity of both brachial artery after cuff and umbilical artery in pre-eclampsia pregnant women at their 3\textsuperscript{rd} trimester. Similarly, this high in diastolic flow velocity may reflect a poor endothelial circulation which is associated with pregnant women at risk of pre-eclampsia at 3\textsuperscript{rd} trimester.

In addition, this sample of pregnant women with pre-eclampsia at their 3\textsuperscript{rd} trimester show low diastolic flow velocity of brachial artery after cuff and umbilical artery, with a small diameter associated with brachial artery that follow the cuff. This goes parallel with a previous study conducted by Lees etal. 1999\textsuperscript{21} who identified low venous velocities and small diameters associated with brachial artery before cuff in preeclampsia. Furthermore, the decrease in FMD in the pre-eclampsia pregnant women at 3\textsuperscript{rd} trimester with cut off values < 10\% and the brachial artery mean diameter before cuff was significantly higher than after cuff in preeclampsia in present study assessed the endothelial function in pre-eclampsia. This may reflect the worst association in endothelial dysfunction in pre-eclampsia. The result of this study is supported by a study conducted by Edson vieirada etal. 2009\textsuperscript{22} who observed that in SEP, the median of the flow mediated dilatation (FMD) has decreased in comparison with PE. The recent study assessed the endothelial function; in differential diagnosis of pre-eclampsia syndrome “the median FMD in PE group and when analyzed the sample with cut off values < 10\% the following distribution was observed. 1.3 with PE and more than 2/3 with SEP had endothelial dysfunction “(Edson Vieirada etal 2009)\textsuperscript{23}

According to Matijevic, Johnston, 1999\textsuperscript{24}, in pre-eclampsia, endovascular trophoblast does not invade the myometrial segments of the spiral arteries. A decrease in nitric oxide in pre eclampsia leads to impaired vascular endothelial function and a rise in the flow mediated dilatation in the brachial artery. It has been found that the FMD in the
subcutaneous artery to be impaired in pre-eclampsia, thus suggest the existence of endothelial dysfunction in pre-eclampsia. Cockell et al[20].

The finding of present study which involve a decrease in FMD, small Brachial artery diameter after cuff and low diastolic flow velocity of brachial artery after cuff and umbilical artery in pregnant women with pre-eclampsia, suggest the evidence of endothelial dysfunction in pre-eclampsia. It is also concludes that FMD (flow mediated dilatation) is a prognostic marker, these results are supported by Matias et al[2013] who observed that FMD of brachial artery as a marker of morbidity in pre-eclampsia. Minerva Ginecol.[2015] found that FMD of brachial artery can evaluate the endothelial dysfunction in preeclampsia. The impaired FMD is due to inability of the vascular smooth muscle to respond to nitric oxide or as a result of reduced endothelial nitric oxide. Other study conducted by Wellings, Brockelsby Jc et al.[1998] reported there has still been no study showing a decreased nitric oxide production in pre-eclampsia patients.

Also, this study demonstrates that there was a positive correlation between U/S gestational age and brachial artery diameter before cuff in pregnant women with pre-eclampsia at their 3rd trimester. The brachial artery diameter before cuff increase with gestational age due to open a new vascular channels attributed to growth of placenta and good perfusion. While the same correlation was absent between the U/S gestational age and brachial artery diameter after cuff in pregnant women with pre-eclampsia at their 3rd trimester this may be obliteration of small muscular arteries.[Fox 1978][24]

Our data described that there was a positive correlation between brachial artery diameter after cuff and PI in pregnant women with pre-eclampsia at their 3rd trimester. This correlation may be due to induces release of nitric oxide from endothelium attributed to a stress stimulus, which reflects endothelium vasodilatation. This goes in line with with Bianchini et al [2006][25]. In the present study to evaluate the endothelial dysfunction in preeclampsia by the FMD of brachial artery.

Despite the small sample size and a conservative statistical method, clinically and statistically significant differences were noted in this study. In the future, a larger study that includes. Also, it would be preferable to assess endothelial function preconception to better understand causality, but this needs large population based studies that might not be easily demonstrated with the currently available techniques for measuring endothelial dysfunction.

REFERENCES

6) Pinheiro da costal BE, Scoccor, Polide Figueiredo CE, Guimaraes JA. Increased serum
phosphodiesterase activity in women with pre-eclampsia. BJOG. 2006; 113(5): 577-9.
16) Quyyumi AA. Prognostic value of endothelial function Amj cardiol 2003; 91 (suppl): 19-24H.
20) Cockell AP, Poston L. flow mediated vasodilation is enhanced in normal pregnancy but reduced in pre-eclampsia, hypertension 1997; 30: 247-251.
23) Wellings RP, Brockelsby Jc, Baker PN. Activation of endothelial cells by plasma from women with pre-eclampsia: differential effects on four endothelia cell type, J Sco Gynecol Invest 1998; 5; 31-37.