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VALUE OF 3-D USS OF PLACENTAL VOLUME, UTERINE AND UMBILICAL ARTERY DOPPLER IN PREDICTION OF PRE-ECLAMPSIA

By

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ABSTRACT

Background: Preeclampsia is a multisystem disorder of pregnancy defined by the combination of new-onset hypertension and proteinuria that contribute substantially to perinatal morbidity and mortality worldwide. Ultrasound can currently be used in the detection of adverse pregnancy outcome for example in Pre-eclampsia where Doppler indices and spectral wave forms are used.

Objective: To use Doppler ultrasound for evaluation on of placental volume changes using 3-D USS, as well as abnormalities in uterine and umbilical artery Doppler indices in prediction of pre-eclampsia.

Patients and Methods: This study was conducted in Department of Obstetrics and Gynecology of Al-Hussein Hospital, Al-Azhar University during the periods May 2016 till April 2017. This was a prospective observational study that carried on two hundred pregnant women enrolled into two equal groups. Group "A" consisted of 50 primipara and 50 multipara women with known risk factor to develop pre-eclampsia like previous history or medical disorder such as chronic hypertension and Group "B" consisted of 50 primipara and 50 multipara women without any risk factor to develop pre-eclampsia.

Results: There was no statistically significant difference between both groups as regard to umbilical artery pulsatility index (PI), while umbilical artery resistance index (RI) and abnormality have higher statistically significant values in group A. There was a statistically significant difference between both groups as regards uterine artery PI, RI, abnormality and persistent notch (p value= 0.025, 0.037, 0.001 and 0.001 respectively). There was statistically significant difference between PC and MG as regards to uterine artery abnormality and persistent notch. There was no statistically significant difference between both groups as regards to placental volume. ROC results revealed that umbilical artery RI, uterine RI, and placental volume cutoff values were higher than 0.67, 0.56, and 43 and the area under the ROC curve was equal to 0.672, 0.851 and 0.527. The sensitivity values of umbilical artery RI, uterine RI, and placental volume were 83.0, 86.5 and 79.2 respectively and the specificity values were 73.3, 60.0 and 62.5 respectively.

Conclusion: Three-dimensional Doppler ultrasound results, as well as resistance index from umbilical artery and uterine artery pulsatility index, resistance index, abnormality and persistent notch, could be considered as tools to determine hemodynamic repercussion caused by preeclampsia.

Keywords: Value of 3-D USS, Placental Volume, Uterine and Umbilical Artery Doppler, Pre-eclampsia.

INTRODUCTION

Pre-eclampsia (PE) is defined as a new onset of hypertension and proteinuria during pregnancy, after 20 weeks of gestation. It occurs in about 3–5 % of pregnancies and causes substantial maternal and neonatal morbidity and mortality *(Minire et al., 2013)*. Pre-

eclampsia is thought to be caused by multiple factors, including placental ischemia, endothelial cell dysfunction, vasospasm, inflammation, improper angiogenesis and oxidative stress *(Alves et al., 2018)*.

Many investigators believe that the placenta is the trigger for endothelial cell injury. Placental hypoperfusion or ischemia in preeclampsia has many causes. Preexisting vascular disorders such as hypertension and connective tissue disorders can result in poor placental circulation *(O'Brien et al., 2013)*.

The ultrasonography is a non-invasive method that allows the study of several placental parameters since its formation. Through two-dimensional ultrasonography, the placenta can be assessed according to thickness and maturity *(Nagpal et al., 2018)*. The three-dimensional ultrasonography (3DUS) is one of the most recent technological advances in diagnostic medicine *(Pomorski et al., 2012)*.

One of the applications of 3DUS is related to the vascularization assessment of organs and structures through three-dimensional power Doppler (3DPD) *(Pomorski et al., 2012)*. The 3D power Doppler allows the assessment of the architecture of the placental tree. Such information is very important considering that problems on the normal development of the placenta *(Hata et al., 2011)*.

The shallow placentation noted in preeclampsia is a result of the inability of trophoblasts to invade the decidual vessels this invasion of the decidual arterioles is incomplete. The invasive cytotrophoblasts fail to replace tunica media, resulting in mostly intact arterioles that are capable of vasoconstriction. An abnormally elevated impedance to blood flow in the umbilical artery is an indirect reflection of placental pathology *(Linask et al., 2014)*.

Currently, it is possible to assess women's risk to develop pre-eclampsia by performing uterine artery Doppler both in 1st and 2nd trimesters to investigate impaired trophoblastic invasion within spiral artery and hence impaired uterine flow *(Scandiuzzi et al., 2016)*.

Determination of placental size is a part of overall assessment of intra-uterine environment. 3-D USS measurement of placental volume is a reliable index in cases of pre-eclampsia *(Soongsatitanon and Phupong, 2019)*. In isolation, this form of screening is felt to be the most accurate as it can predict 81% of women with early onset pre-eclampsia *(Thangaratinam et al., 2011)*.

This study was conducted to evaluate the placental volume changes using 3-D USS as well as abnormalities in uterine and umbilical artery Doppler indices in prediction of pre-eclampsia.

PATIENTS AND METHODS

This study was conducted in Department of Obstetrics and Gynecology of Al- Hussein Hospital Al-Azhar University during the periods May 2016 till April 2017. This a prospective observational study carried on two hundred pregnant women enrolled into two equal groups.

Group "A" consisted of 50 primipara and 50 multipara women with known risk factor to develop pre-eclampsia like

previous history or medical disorder such as chronic hypertension.

Group "B" consisted of 50 primipara and 50 multipara women without any risk factor to develop pre-eclampsia.

Exclusion Criteria: Congenital fetal anomalies, presence of any other medical disorder with pregnancy and congenital placental or umbilical artery abnormalities.

Cases were subjected to 3-D USS to measure placental volume from 18-20 weeks in addition to uterine artery and umbilical artery Doppler.

These parameters repeated on a four-week basis until 34 weeks. The abnormality in Doppler and 3-D USS results were analyzed to detect its sensitivity in predicting occurrence of pre-eclampsia.

Pre-eclampsia was diagnosed if B.P equals or more than 140/90 detected in pregnant women after 20 weeks' gestation with appropriate cuff and supine position in at least two occasions 6 hours apart and random proteinuria equals or more than +1.

All participating women underwent: History in details, physical examination, measuring of albumin level in urine and 3DPD ultrasound examination.

Ultrasounds were done for all cases including fetal biometry, placental morphology assessment and 3D Doppler ultrasound for uterine and umbilical artery. Each patient had a 3D power Doppler ultrasound exam. Automatic volume acquisition of the most vascular area of the placenta was obtained. The Virtual Organ Computer-aided Analysis (VOCAL) imaging was activated and histogram program was used to calculate vascularization index (VI), flow index (FI) and vascularization flow index (VFI) for all cases. Six steps measurements by the manual scanning around the area of interest and fastest scan quality. The same steps were done for all controls.

Upon participation or admission women were reminded of the study and written consents were obtained.

Statistical analysis:

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp). Qualitative data were described using number and percent. Quantitative data were described using mean and standard deviation Comparisons between groups for categorical variables were assessed using Chi-square test. Student t-test was used to compare two groups. Friedman test was used to compare between more than two periods. Significance of the obtained results was judged at the 5% level. Receiver operating curve (ROC) was used to determine the cutoff values of Umbilical Artery RI, Uterine RI, and Middle cerebral RI as predictors of PE.

RESULTS

There was no statistically significant difference between both groups as regards maternal age, BMI and gestational age at birth. Group A showed that 36% of PG and 26% of MG developed PIH, while group B showed that 4% of PG and 2% of MG with statistically significant difference between both groups **(Table 1)**.

Table (1): Comparison between both group as regard to demographic data and PIH

Groups / Parameters	Group A (n=100)			Group B (n=100)			Pp_1
	PG (n=50) Mean ±SD	MG (n=50) Mean ±SD	P value	PG (n=50) Mean ±SD	MG (n=50) Mean ±SD	P value	
Maternal age (year)	25.41±4.28	29.17±4.15	<0.001*	23.25±2.38	30.11±5.19	<0.001	0.284
BMI (kg/m2)	23.14±2.29	25.18±4.16	0.003*	23.72±2.54	24.17±2.47	0.371	0.608
Gestational age at birth (wk)	38.62±7.15	37.16±5.37	0.251	39.35±7.26	39.62±5.81	0.838	0.079
PIH No (%)	18 (36%)	13 (26%)	0.280	2 (4%)	1 (2%)	1.000	<0.001

Qualitative data were described using number and percent and was compared using Chi square test while quantitative data was expressed in mean ± SD

p: p value for Student t-test for comparing between PG and MG in each group

p1: p value for Student t-test for comparing between group A (PG + MG) and group B (PG + MG)

Group A showed that 45% of patients have history of PE, 21% chronic HTN, 8% D.M, 4% kidney diseases, 16% obesity and 6% have other risk factors for PE **(Table 2)**.

Table (2): Comparison between both groups as regard to risk factors of PE

Groups / Parameters	Group A (n=100) No (%)
History of PE	45 (45%)
Chronic Hypertension	21 (21%)
D.M	8 (8%)
Kidney diseases	4 (4%)
Obesity	16 (16%)
Others	6 (6%)

There was no statistically significant difference between both groups as regard to umbilical artery PI, while Umbilical Artery RI and abnormality have higher statistically significant values in group A. No significant difference was found between different periods in each group **(Table 3)**.

Table (3): Comparison between both groups as regards umbilical artery Doppler

Groups / Umbilical Artery	Group A (n=100)			Group B (n=100)			p_1
	PG (n=50)	MG (n=50)	P	PG (n=50)	MG (n=50)	P	
PI	**1.29 ±0.71**			**1.12 ±0.55**			**0.060**
At 20 wk	1.26±0.54	1.24±0.61	0.863	1.14±0.59	1.16±0.62	0.869	
At 24 wk	1.29±0.72	1.27±0.57	0.879	1.12±0.45	1.10±0.52	0.837	
At 28 wk	1.30±0.81	1.28±0.38	0.875	1.05±0.36	1.08±0.28	0.643	
At 32 wk	1.33±0.78	1.31±0.52	0.880	0.962±0.17	0.957±0.31	0.921	
Overall (PI)	**0.76 ± 0.54**	**1.28 ±0.52**	**0.873**	**1.07+0.71**	**1.07+0.52**	**1.000**	
p_2	**>0.05**			**>0.05**			
RI	**0.760 ±0.54**			**0.601 ±0.59**			**0.048**
At 20 wk	0.743±0.48	0.751±0.48	0.934	0.724±0.64	0.732±0.55	0.947	
At 24 wk	0.762±0.57	0.767±0.57	0.965	0.712±0.52	0.718±0.78	0.964	
At 28 wk	0.775±0.63	0.785±0.63	0.937	0.652±0.41	0.664±0.84	0.928	
At 32 wk	0.798±0.49	0.791±0.49	0.943	0.625±0.65	0.637±0.71	0.930	
Overall (RI)	**0.770±0.54**	**0.774±0.58**	**0.972**	**0.678±0.56**	**0.688±0.72**	**0.938**	
p_2	**>0.05**			**>0.05**			
Abnormality N (%)	15 (30%)	11 (22%)	0.362	1 (2%)	0 (0%)	1.000	<0.001

Qualitative data were described using number and percent and was compared using Chi square test while quantitative data was expressed in mean ± SD

p: p value for Student t-test for comparing between PG and MG in each group

p1: p value for Student t-test for comparing between group A (PG + MG) and group B (PG + MG)

p2: p value for Friedman test for comparing between different periods in each group

There was statistically significant difference between groups as regard to uterine artery PI, RI, abnormality and persistent notch (p value= 0.025, 0.037, 0.001 and 0.001 respectively). Also, there is no statistically significant difference between PC and MG as regard to uterine artery abnormality and persistent notch.

No significant difference was found between different periods in each group **(Table 4)**.

Table (4): Comparison between both groups as regard to uterine artery Doppler

Groups / Uterine Artery	Group A (n=100)			Group B (n=100)			p1
	PG (n=50)	MG (n=50)	P	PG (n=50)	MG (n=50)	P	
PI	**1.52 ±0.72**			**0.985 ±0.49**			**<0.001**
At 20 wk	1.65±0.52	1.54±0.71	0.379	1.37±0.29	1.25±0.67	0.248	
At 24 wk	1.47±0.77	1.67±0.37	0.101	1.08±0.85	0.96±0.55	0.404	
At 28 wk	1.55±0.56	1.38±0.78	0.214	0.85±0.16	0.88±0.24	0.464	
At 32 wk	1.37±0.72	1.51±0.92	0.947	0.72±0.37	0.75±0.37	0.686	
Overall (PI)	**1.51± 0.64**	**1.53+0.70**	**0.882**	**1.01 ±0.42**	**0.96 ±0.46**	**0.572**	
p2	**>0.05**			**>0.05**			
RI	**0.706 ±0.64**			**0.499 ±0.57**			**0.016**
At 20 wk	0.675±0.68	0.685±0.46	0.931	0.554±0.34	0.574±0.35	0.773	
At 24 wk	0.688±0.55	0.710±0.59	0.847	0.512±0.82	0.497±0.28	0.903	
At 28 wk	0.712±0.83	0.723±0.63	0.941	0.482±0.71	0.475±0.44	0.953	
At 32 wk	0.721±0.66	0.733±0.39	0.912	0.445±0.65	0.452±0.51	0.952	
Overall (RI)	**0.699 ±0.68**	**0.713 ±0.52**	**0.908**	**0.498 ±0.63**	**0.500 ±0.40**	**0.985**	
p2	**>0.05**			**>0.05**			
sAbnormality N (%)	12 (24%)	9 (18%)	**0.461**	0 (0%)	0 (0%)	–	**<0.001**
Persistent notch N (%)	9 (18%)	5 (10%)	**0.249**	0 (0%)	0 (0%)	–	**<0.001**

Qualitative data were described using number and percent and was compared using Chi square test while quantitative data was expressed in mean ± SD

p: p value for Student t-test for comparing between PG and MG in each group

p1: p value for Student t-test for comparing between group A (PG + MG) and group B (PG + MG)

p2: p value for Friedman test for comparing between different periods in each group

There was no statistically significant difference between both groups as regards placental volume **(Table 5)**. No significant difference was found between different periods in each group.

Table (5): Comparison between both groups as regard to placental volume (Mean+SD)

Groups	Group A (n=100)			Group B (n=100)			p_1
	PG (n=50)	MG (n=50)	P	PG (n=50)	MG (n=50)	P	
Placental volume	**50.48 ±6.1**			**52.26 ±6.89**			**0.054**
At 20 wk	37.28±4.18	35.61±4.25	0.049*	45.41± 7.32	43.27± 7.16	0.143	
At 24 wk	42.34±3.92	42.24±3.36	0.891	48.91± 5.16	45.17± 4.28	0.001	
At 28 wk	51.29±6.27	50.63±6.71	0.613	56.45± 8.25	54.35± 7.63	0.189	
At 32 wk	55.41±6.35	54.25±7.62	0.410	62.81± 7.32	61.66± 5.72	0.384	
Overall	**46.58 ±5.18**	**45.68 ±5.49**	**0.401**	**53.40 ±7.01**	**51.11 ±6.20**	**0.087**	
p_2	**>0.05**			**>0.05**			

Data was expressed in mean ± SD
p: p value for Student t-test for comparing between PG and MG in each group
p1: p value for Student t-test for comparing between group A (PG + MG) and group B (PG + MG)
p2: p value for Friedman test for comparing between different periods in each group

Our ROC results revealed that Umbilical Artery RI, Uterine RI, and Placental volume cutoff values are higher than 0.67, 0.56, and 43 and the area under the ROC curve is equal to 0.672, 0.851 and 0.527. The sensitivity values of Umbilical Artery RI, Uterine RI, and Placental volume were 83.0, 86.5 and 79.2 respectively and the specificity values were 73.3, 60.0 and 62.5 respectively **(Table 6** and **Fig. 1)**.

Table (6): Umbilical Artery RI, Uterine RI and Placental volume as predictors of PE

Test Result Variable(s)	Cut off*	AUC	P-value	95% C. I.		Sensitivity	Specificity
Umbilical Artery RI	≥ 0.67	0.672	0.005	0.565	0.780	83.0	73.3
Uterine RI	≥ 0.56	0.851	0.001	0.772	0.924	86.5	60.0
Placental volume	≤ 43	0.527	0.175	0.436	0.641	79.2	62.5

AUC: Area Under a Curve p value: Probability value CI: Confidence Intervals

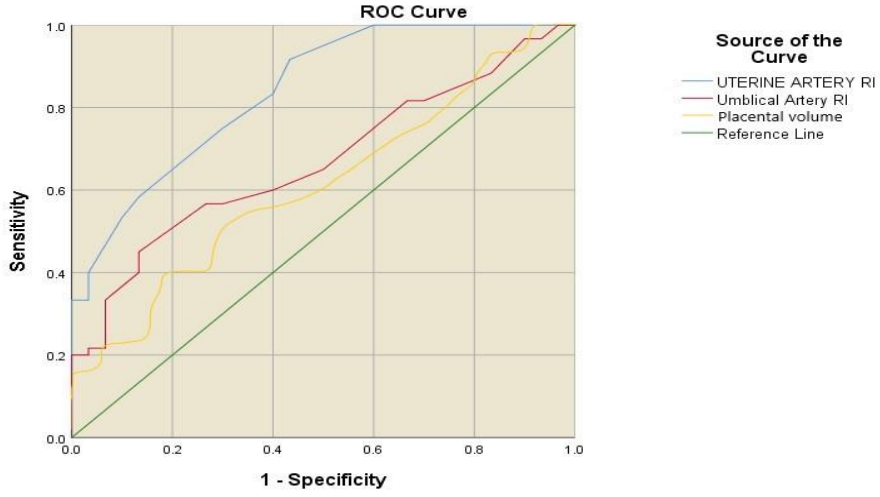

Figure (1): ROC curve of Umbilical Artery RI, Uterine RI and placental volume

DISCUSSION

In the present study, mean maternal age in primipara and multipara women with known risk factor to develop pre-eclampsia was 25.41±4.28 and 29.17±4.15 years respectively. While mean maternal age in primipara and multipara women without any risk factor to develop pre-eclampsia which was 23.25±2.38 and 30.11±5.19 years respectively, but with no noted statistically significant differences between both groups as regard maternal age. Furthermore, there was no statistically significant difference both groups as regard to BMI and gestational age at birth.

Hashish et al. (2015) conducted a prospective case control study including women with singleton pregnancies. Mean of age in Normal group was 26.8 ± 6.4 and High-risk group was 28.7 ± 5.8 with no statistically significant difference between both groups. Also, they did not find any statistically difference between groups as regard BMIs.

Adil et al. (2018) carried out a prospective observational study to evaluate the role of three dimensional power Doppler ultrasonography (3D PDUS) of the uteroplacental circulation in early pregnancy as a screening tool for prediction of preeclampsia. They reported that there is no statistically significant difference between pregnant females who developed preeclampsia and others who did not regarding age, BMI and gestational age.

Group A in our study showed that 45% of patients have history of PE, 21% chronic HTN, 8% D.M, 4% kidney diseases, 16% obesity and 6% have other risk factors for PE. Our study revealed 36% of PG and 26% of MG in Group A developed PIH, while group B showed that 4% of PG and 2% of MG with highly statistically significant difference between both groups.

Magee et al. (2014) reported that the incidence is higher in women with a history of preeclampsia, multiple gestations, chronic hypertension, and underlying renal disease. In addition, obesity, diabetes, thrombophilia, and age older than 40 years are risk factors that put a woman at an increased risk of developing preeclampsia.

Our study demonstrated there was no statistically significant difference between both groups as regards umbilical artery PI, while umbilical Artery RI and abnormality have highly statistically significant values in group A. The mean umbilical PI of pregnant women without PE was lower than the mean umbilical PI of women that developed PE. Furthermore, pregnant women who did not develop PE had lower mean umbilical RI than in women who developed PE RI. There was a statistically significant difference between groups as regard to uterine artery PI, RI, abnormality and persistent notch. In addition, there was a statistically significant difference between PC and MG as regard to uterine artery abnormality and persistent notch.

In corroborate to our results, de Almeida et al. (2014) published a prospective case-control study, Placental volumes and vascularity were evaluated by 3-dimensional sonographic, 3-dimensional power Doppler histographic, and 2-dimensional color Doppler studies. Pregnant women were classified as normotensive or hypertensive and

stratified by the nature of their hypertensive disorders. There was no statistical difference between these groups with regard to the PI in the umbilical arteries. However, a higher PI in both right and left uterine arteries was observed in hypertensive patients.

Also, *Adekanmi et al. (2019)* conducted a longitudinal cohort study, high-risk singleton pregnant women enroled between had uterine and umbilical artery Doppler sonography at 22–24 weeks and 32–34 weeks gestation.

The mean umbilical PI of pregnant women without PE was significantly lower than the mean umbilical PI of women that developed PE. Furthermore, pregnant women who did not develop PE had lower mean umbilical RI than in women who developed PE RI *(Adekanmi et al., 2019).*

Hashish et al. (2015) they stated that uterine artery RI and PI are significantly higher in the study group. Uterine artery PI is negatively correlated with placental volume and vascularization indices.

Mallikarjunappa et al. (2013) reported a significant association of preeclampsia and abnormalities of Doppler velocity waveforms in the umbilical, the uterine, and the middle cerebral arteries. This was also corroborated by *Adekanmi et al. (2019).*

The most frequently studied vessel to predict PE through Doppler US was the uterine artery, being representative of the condition of maternal vascular obstetric circulation. Some authors only focused on the uterine arteries to predict pregnancy complications. Harrington et al. reported results from a cross-sectional study of 191 pregnant women followed up at 24 weeks of gestation through analysis of Doppler US of uterine arteries waveforms (notching). The authors found abnormal uterine Doppler findings (including uni‑ or bilateral notching) in 110 (57.6%) patients. They concluded that there is a clear link between high-resistance uterine waveforms (RI) and an increase in adverse outcomes of pregnancy, including preeclampsia. *Papageorghiou and Leslie (2010)* confirmed that those with increased mean PI have a six‑fold rise likelihood of serious pregnancy complications.

Regarding to placental volume; we found that there was no statistically significant difference between both groups as regard to placental volume. They found that PE was seen in 7.7%, GH in 9.0% and SGA in 8.0%. Placental volume was not significantly different between the pregnancies with adverse outcomes and those without.

Similarly, de Almeida et al. (2014) reported that placental volumes were not statistically different among the different groups. However, patients with superimposed preeclampsia had a significantly lower placental volume-to-estimated fetal weight ratio than normotensive pregnant women.

The performance of these tests was also compared using areas under receiver operator curves (AUC); Receiver operating curve (ROC) was used to determine the cutoff values of Umbilical Artery RI, Uterine RI, and Placental volume as predictors of PE. Our ROC results revealed that umbilical artery RI, uterine RI, and placental volume cutoff values were higher than 0.67, 0.56, and 43

and the area under the ROC curve was equal to 0.672, 0.851 and 0.527. The sensitivity values of Umbilical Artery RI, Uterine RI, and Placental volume were 83.0, 86.5 and 79.2 respectively and the specificity values were 73.3, 60.0 and 62.5 respectively.

Lopez-Mendez et al. (2013) reported that the general Doppler result had the most representative values with specificity and PPV of 75.7% and 78.6%, respectively. The sensitivity and the NPV for the general US examination were calculated in 50.8% and 46.7%, respectively.

The results of current study were also similar to those obtained by *Odibo et al. (2011)* who stated that the ROC curve for the prediction of PE was 0.71, 0.69 and 0.70 for VI, FI and VFI, respectively.

Dhakar and Naz (2017) reported that in umbilical artery Doppler sensitivity for all indices i.e. S/D ratio, RI and combined parameters were same. In umbilical artery Doppler RI had specificity of 93.68% and PPV of 25% and combination of parameters had specificity of 91.58% and PPV of 20%. NPV of all the indices was found to be in range of 96-97%. Thus, out of parameters of umbilical artery Doppler S/D ratio is considered to be best indicator.

CONCLUSION

Three-dimensional Doppler US result, as well as RI from umbilical artery, and uterine artery PI, RI, abnormality and persistent notch, may be considered as tools to determine hemodynamic repercussion caused by PE. Early recognition of women of preeclampsia can help in identifying high risk women who may benefit from early prophylaxis and enhanced surveillance.

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القيمة التنبؤية للموجات فوق الصوتية ثلاثية الأبعاد لحجم المشيمة و دوبلر الشريان الرحمى و الشريان السري في التنبوء بحالات ما قبل الإرتعاج

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خلفيــة البحــث: يعـد تسـمم الحمـل (الارتعـاج) مـن أخطـر الأمـراض التـى تحـدث بنسـبة 2-8 % فـى العـالم. مـن أهـم الأعـراض المصـاحبة لـه ارتفـاع ضـغط الـدم والـزلال وذلـك بعـد 20 أسـبوع مـن بدايـة الحمـل. وتعتبـر موجـات الـدوبلر ثلاثيـة الأبعـاد مـن أحـدث الوسـائل المسـتخدمة فـى الكشـف عـن التغيـرات الغيـر طبيعيـة التـي تحـدث بالأوعيـة الدمويـة المشـيمية داخـل الـرحم وذلـك لمـا لهـا مـن خصـائص ومعـايير خاصـة تسـاعد علـى تقيـيم التغيـرات التـى تحـدث بالأوعيـة الدمويـة المشـيمية فـى حـالات الارتعاج والمخاطر الناتجة عنها للأم والجنين على حد سواء.

الهـدف مـن البحـث: تقيـيم قيمـة التغيـرات فـي حجـم المشـيمة باسـتخدام الموجـات فـوق الصـوتية ثلاثيـة الأبعـاد, وكـذلك الشـذوذ فـي مؤشـرات دوبلـر فـي الشـريان الرحمـى والشريان السري في التنبوء بتسمم الحمل.

المريضــات وطــرق البحــث: أجريـت هـذه الدراسـة فـي قسـم أمـراض النسـاء و التوليـد بمستشـفى الحسـين الجـامعى، جامعـة الأزهـر, حيـث تـم قيـاس حجـم المشـيمة وكـذلك متوسـط الممانعـة بالشـريانين الـرحميين و والشـريان السـرى بواسـطة الـدوبلر وتقيـيم الـدورة الدمويـة للـرحم و والمشـيمة وربطـه باحتماليـة حـدوث مـا قبـل تسـمم الحمـل. وقـد خضـعت للدراسـة تـم تسـجيل مـائتي امـرأة حامـل فـي مجمـوعتين متسـاويتين: **المجموعــة "أ":** تتكـون مـن 50 امـرأة حامـل للمـرة الاولـى و 50 امـرأة متعـددة الحمـل مـع وجـود عامـل خطـر معـروف للإصـابة بمقـدمات الارتعـاج مثـل التـاريخ السـابق أو الاضـطراب الطبـي مثـل إرتفـاع ضـغط الـدم المـزمن, و**المجموعــة "ب":** تتكـون مـن50 امـرأة حامـل للمـرة الاولـى و 50 امـرأة متعـددة الحمـل بـدون أي عامـل خطر للإصابة بمقدمات الارتعاج.

نتـائج البحـث: لـم توجـد فـروق ذات دلالـة إحصـائية بـين المجموعـات فيمـا يتعلـق بعمـر الأم ، مؤشـر كتلـة الجسـم وسـن الحمـل عنـد الـولادة. لـم يكـن هنـاك فـرق ذو دلالـة إحصـائية بـين المجمـوعتين فيمـا يتعلـق بالشـريان السـري PI بينمـا الشـريان السـري RI والشـذوذ لهمـا قـيم ذات دلالـة إحصـائية أعلـى فـي المجموعـة أ. وكـان هنـاك فـرق ذو دلالـة إحصـائية بـين المجمـوعتين فيمـا يتعلـق بالشـريان الرحمـي PI، RI، والشـذوذ والثبـات. وتوجـد فـروق ذات دلالـة إحصـائية بـين كـلا المجمـوعتين الفـرعيتين فـي المجموعـة (أ) فيمـا يتعلـق باضـطراب الشـريان الرحمـي والشـق المسـتمر. ولا توجـد فـروق ذات دلالـة إحصـائية بـين المجمـوعتين فيمـا يتعلـق بحجـم المشـيمة. وأظهـرت نتـائج ROC أن قـيم قطـع الشـريان السـري الرحمـي RI و RI و حجـم المشـيمة أعلـى مـن 0.67 و 0.56 و 43 والمسـاحة الواقعـة تحـت منحنـى ROC تسـاوي 0.672 و 0.851 و 0.527. كانـت قـيم حساسـية الشـريان السـري الرحمـي RIو RI و حجـم المشـيمة 83.0 و 86.5 و 79.2 علـى التـوالي وقـيم النوعيـة 73.3 و 60.0 و 62.5 على التوالي.

الإسـتنتاج: يمكـن إعتبـار نتيجـة الموجـات فـوق الصـوتية دوبلـر ثلاثيـة الأبعـاد، وكـذلك مؤشـر المقاومـة مـن الشـريان السـري ومؤشـر نـبض الشـريان الرحمـي، ومؤشـر المقاومـة، والشـذوذ والشـق المسـتمر، كـأدوات لتحديـد الانعكـاس الـديناميكي للدورة الناجم عن تسمم الحمل.

الكلمـات الدالـة: القيمـة التنبؤيـة للموجـات فـوق الصـوتية ثلاثيـة الابعـاد، حجـم المشيمة، دوبلر الشريان الرحمى و الشريان السرى، ماقبل الارتعاج.