

Uterine Artery Doppler and Prediction of Pre-eclampsia

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Abstract

The study aimed to examine the Uterine artery Doppler screening as a predictor of pre-eclampsia. About 1-5% of pregnancies worldwide are complicated with preeclampsia. It is believed that pre-eclampsia develops when the maternal spiral arteries are not adequately invaded by trophoblast. Doppler imaging is important in high-risk pregnancies as it provides a non-invasive method of evaluating the utero-placental circulation. To test the hypothesis that uterine artery spectral Doppler screening is able to detect people at risk for developing pre-eclampsia, a prospective quantitative experimental investigation was done. Pregnant women who attended the antenatal clinic at Private hospitals in Erbil between February of 2020 to February of 2021 were enrolled in the study through the use of convenience sampling. It was possible to analyze a complete record of 121 participants in the end. 7 (5.8%) participants had pre-eclampsia as a result of this study. Race is considered the most significant independent variable with an odds ratio of 1.5, and a 9:1 likelihood of developing PET in the 2nd and 3rd trimesters. The Uterine Artery Doppler is expected to succeed, If offered to high-risk pregnant women, an ultrasound screening program could detect the condition before it develops.

Keywords— uterine artery Doppler, preeclampsia, screening, Erbil, Kurdistan Region of Iraq.

I. INTRODUCTION

Preeclampsia affects around 1 % to 5% of all pregnancies, however it is a difficult disease to anticipate and treat because of its unpredictable nature (Tianthong & Phupong, 2021). Preeclampsia is an intriguing target for researchers looking to develop a reliable screening test since it affects so many pregnant women (Oancea et al. 2020). If we could identify people who are at risk, we could strengthen their prenatal surveillance and, as a result, reduce the intrinsic maternal and fetal morbidity and mortality that are linked with severe preeclampsia and eclampsia, as well as the associated maternal and fetal mortality (Prakansamut & Phupong, 2019).

Estimating each woman's unique risk would allow for more appropriate antenatal surveillance, as well as the testing of preventive treatments such as low-dose aspirin in high-risk groups that were previously identified (Cui et al. 2017). However, it is expected that the use of prophylactic treatments will be more effective if they are initiated earlier in pregnancy, preferably before 16 weeks. The development of a reliable mechanism for the early identification of high-risk populations would be critical in this regard. Women who are at risk are currently recognized primarily based on their clinical history. When it comes to developing

preeclampsia, nulliparity is considered to be one of the most significant clinical risk factors (Soongsatitanon & Phupong, 2020). A higher body mass index, as well as other medical disorders such as pre-pregnancy diabetes, prior preeclampsia, or chronic hypertension, are also considered important. However, screening for preeclampsia based solely on maternal history will only uncover 30% of women who may develop preeclampsia in the future (Pedroso et al. 2018). The clinical risk-based technique is ineffective in the case of nulliparous women who do not have any additional risk factors. When maternal serum indicators and uterine artery Doppler (uAD) are combined, it may be possible to increase the accuracy of illness prediction in this population. PAPP-A, placental protein (PP), Inhibin-A, placental growth factor, and A disintegrin and metalloprotease have all been proposed as blood markers for preeclampsia screening during the first trimester of pregnancy (Rashid et al. 2020). Although uAD screening has primarily been examined in the second trimester of pregnancy, Doppler ultrasound in the first trimester of pregnancy has lately showed some promise. 18-20 According to the findings of a systematic review of screening tests for preeclampsia, no single test is currently available that has a high degree of diagnostic accuracy. A combination screening approach including a number of

relevant markers is more likely to yield the most accurate results. Preventive screening during the first trimester would have significant advantages over screening during the second trimester since it would allow for more timely and effective treatment options (Salem & Ammar, 2018).

According to the literature, preeclampsia is characterized as high blood pressure ($>140/90$) with proteinuria ($>300\text{mg}$ in 24h specimen) after 20 weeks of pregnancy (Okwudire et al. 2019). The condition is further split into mild and severe variants, with HELLP syndrome (hemolysis, increased liver function tests, and low platelets) occurring at various points throughout the spectrum of the disease's progression. Preeclampsia is recognized to have its origins in faulty placentation and insufficient trophoblastic invasion of the spiral arteries, which are the main blood vessels of the body (Allen & Aquilina, 2018). Normally, throughout pregnancy, the spiral arteries undergo remodeling, transitioning from a high resistance vascular bed to a low resistance vascular bed over the length of the pregnancy. In individuals who eventually develop preeclampsia, we know that this does not occur in the usual course of events because of histologic examination (Razavi et al. 2019).

However, despite the fact that research continues to find vasoactive mediators and characteristics that may be causal or predictive of preeclampsia, we still lack the ability to detect at-risk patients and perhaps treat them before the condition manifests itself. It is possible that the use of uterine artery Doppler waveform interrogation at various time periods during pregnancy, in conjunction with or without biomarkers, will provide the best possibility for early identification. These procedures have ranged from serum tests and the Roll-over Test to Angiotensin II infusions to identify patients who are at risk of developing hypertension. Despite the fact that several tests appeared promising, subsequent study has revealed that there is no screening test that meets the characteristics of being inexpensive, simple to do, and sensitive, as well as having a therapy for it. Other prerequisites to early detection of preeclampsia include the necessity for a screening that occurs before the first wave of placental angiogenesis/branching, which allows any preventative methods to be tested and implemented when they are most likely to be beneficial (Tianthong & Phupong, 2021).

The introduction of pulsed wave Doppler ultrasound techniques has resulted in improvements in a number of areas of obstetrics and holds out the prospect of the development of a screening test for preeclampsia in the future. Testing has been carried out at various periods of pregnancy, and for the sake of this review, the studies have been split by trimester.

First, the transducer is inserted into the patient's inguinal canal and moved along the uterine artery to obtain a pulsed wave Doppler flow velocity waveform of the uterine artery. After that, two-dimensional ultrasound imaging with color Doppler is used to detect the iliac and uterine vessels just lateral to the uterus, which are then removed. By putting the transducer in the inguinal canal and identifying the external iliac vessels, the uterine artery Doppler can be acquired using color Doppler. The uterine artery can be seen crossing

these veins at a nearly 90-degree angle, indicating that it is present. When compared to the iliac vessels, the uterine vessel can be sampled from either the distal or proximal region of the vessel, depending on the situation. When the angle of insonation between the Doppler waveform and the vessel is kept as near to 0 degree as possible, it is possible to obtain the optimal flow velocity waveform profile. This requirement for minimizing the angle of insonation to less than 30 degrees is only necessary when determining a genuine volume flow (for example, mL/min). The absolute value of the blood's velocity (for example, cm/s) must be included in the computation in order to determine flow volumes. Resistance indices, on the other hand, are determined by comparing relative values rather than absolute values (systolic to diastolic ratio, resistance index, and pulsatility index), hence the angle of insonation is not crucial for the measurements (Prakansamut & Phupong, 2019).

II. METHODS

To investigate the idea that in-womb Doppler spectral screening can detect patients at risk of developing preeclampsia, a prospective quantitative experimental investigation was done. Using convenience sampling, all patients who attended the antenatal clinic at private hospitals in Erbil from February 2020 to February in the year 2021 were recruited. Those patients whose symptoms or illnesses did not allow them to take part in the trial are:

- Multiple pregnancies because of increase chance of placental insufficient.
- Chronic hypertensin because treatments may change the outcome.

Permission was obtained from the women who agreed to participate in the study after describing the study's aims. After an intra-uterine pregnancy had been verified, we used a GE Vivid 3 ultrasound device to perform a transabdominal Doppler examination, which included UA spectral Doppler assessment.

To identify the uterine artery, the probe was positioned laterally next to the uterus and the transducer was then gently rotated toward the abdomen, bringing the UA to where it passed over the external iliac artery. Three successive UA waveforms were obtained from the artery by placing a gate over the entire diameter of the artery and pulsing wave Doppler. After this, the bilateral measure of the pulsatility index was taken.

At 11-14 weeks, 22-24 weeks, and again between 28 and 32 weeks, the Doppler evaluation was repeated. Ultrasound criteria for evidence of high resistance flow and uterine artery notching evaluated.

Vascular resistance in the placental bed increased with the presence of UA notching and a PI > 1.5 during the first trimester.

III. RESULTS

Table 1- Pre-eclampsia was seen in patients who developed pregnancy

No	Background	Pulsatility index/ trimester			GA/Onset Wks	GA/ del Wks
		1st	2nd	3rd		
1	24 y/o	1.75	2.25	2.28	23	24
2	30 y/o	1.45	1.4	1.9	28	29
3	26 y/o	1.5	1.35	0.75	30	32
4	22 y/o	1.25	1.2	1.05	28	32
5	34 y/o	1.25	1.2	1.05	35	37
6	28 y/o	1.3	1.2	1.1	34	40
7	37 y/o	0.9	0.8	0.8	36	40

Uterine artery notching

Uterine Aberration notching in the first and second trimesters were two out of the seven and in the in the third trimester was found in three of the seven pregnant women who had pre-eclampsia. Due to the fact that one delivered at 27 weeks' gestation, the result for one patient was not available.

Odds Ratios

When it was discovered that PET looked to be the most significant independent variable in the study, odds ratios for the study participants' development of PET were calculated and used exclusively on individuals.

In order to calculate the odds of women getting pre-eclampsia, we calculated the following:

First trimester	Odds without notching: 2/23 1/4 0.086 to 1.
	Odds with notching: 2/15 1/4 0.13 to 1.
	Odds ratio notching vs. no notching: 0.13/0.086 1/4 1.5 to 1.
Second trimester	Odds without notching: 1/34 1/4 0.029 to 1.
	Odds with notching: 3/4 1/4 0.75 to 1.
	Odds ratio notching vs. no notching: 0.75/0.029 1/4 25.86 or 26 to 1.
Third trimester	Odds without notching: 2/34 1/4 0.058 to 1.
	Odds with notching: 1/2 1/4 0.5 to 1.
	Odds ratio notching vs. no notching: 0.5/0.058 1/4 8.6 or 9 to Women with notching in the first trimester are thus 1.5 times, in the second trimester 26 times and in the third trimester 9 times more likely to develop pre-eclampsia than those without notching.

IV. Discussion

Hypertensive disorders complicate approximately 5-10% of pregnancies worldwide. In our study 5.8% of the population developed pre-eclampsia, demonstrating the magnitude of the problem in Private hospitals in Erbil.

The mean first trimester PI value of 1.3 in our study is considerably lower than 1.7 (50th centile) proposed by Tianthong & Phupong, (2021), however, in clinical practice a first trimester PI value of >1.5 is deemed as elevated and warrants monitoring (Oancea et al. 2020). With only one of seven PI values above Gomez's 50th centile value in the first trimester, five in the second trimester and four in the third trimester, it can be concluded that PI values did not perform well as a predictor of pre-eclampsia when Gomez's guidelines or a cut-off value of 1.5 were used.

The presence of notching in the second trimester has been associated with a high probability for developing pre-eclampsia (Soongsatitanon & Phupong, 2020). In the study, UA notching predicted the disease in three out of the four most severe cases who developed PET before 32 weeks. This compares favourably with the suggestion that the clinical value of UA Doppler looks promising in the prediction of severe adverse outcomes in patients at high risk for pre-eclampsia (Rashid et al. 2020).

Since the majority (73%) of pre-eclamptic patients, cross-tabulations were completed using notching as a predictor of pre-eclampsia in the first, second and third trimesters in the population. Once again the presence of notching in the second trimester was the best predictor for the development of pre-eclampsia, with an odds ratio of 26:1. Odds ratios for women with notching did not fare as well in the other trimesters, with a risk increase of 1.5:1 in the first and 9:1 in the third trimesters.

The researchers simply aimed to establish an ultrasound screening routine, not a system in which both biochemistry and blood pressure values are incorporated. Additionally, when utilized combined, biochemistry and ultrasound screening have the ability to improve the sensitivity of screening for PET.

V. Conclusion

Our study found little justification for the routine use of ultrasound Doppler for all pregnant patients at private hospitals in Erbil. The most severe cases of PET are predicted by an aberrant Doppler flow pattern and flow resistance in the UA, and hence women at high risk for these unfavorable pregnancy outcomes should be offered ultrasound screening. Because there is no on-site biochemical screening for most of the private hospitals in Erbil, physicians must act on the clinical manifestation of the disease rather than wait for biochemical screening results. Uterine artery notching was the most important predicting ultrasound sign for pre-eclampsia in our study. Further research based on our findings should be used to establish the usefulness of routine UA Doppler screening in patients at higher risk.

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