

The Role of Uterine Artery Diastolic Notch and Uterine Artery Pulsatility Index to Predict the Event of Early Onset Preeclampsia

Muara Panusunan Lubis^{1*}, Sarma N. Lumbanraja¹, Herman Hariman², Adang Bachtiar³

¹Department of Obstetrics and Gynecology, Faculty of Medicine, Universitas Sumatera Utara, Medan, Indonesia;

²Department of Clinical Pathology, Faculty of Medicine, Universitas Sumatera Utara, Medan, Indonesia;

³Department of Health Policy and Administration, Faculty of Public Health, Universitas Indonesia, Jakarta, Indonesia

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Abstract: The uterine artery wave in the first trimester of pregnancy has a diastolic notch that disappears after 24 weeks of pregnancy. If the picture of this curve persists and the PI and RI values remain high, it means high pressure on the uterine arteries which usually results in preeclampsia. This is a case-control study conducted from March to November 2018 at several hospitals and private clinics in Medan, Indonesia. A total of 70 normal pregnant women within 22-24 weeks gestational age were enrolled and each 35 was grouped into (A) patients with uterine artery diastolic notch and (B) patients without uterine artery diastolic notch. From ultrasound examinations, 27 patients (38.6%) had unilateral uterine artery diastolic notch, and 8 subjects (11.4%) had bilateral uterine artery diastolic notch. Five subjects (14.3%) had early onset preeclampsia, with no significant difference between uterine artery diastolic notch with early-onset preeclampsia. No significant differences were seen in average uterine artery pulsatility index between subjects with and without early-onset preeclampsia, and between the presence of uterine artery diastolic notch and the incidence of early-onset preeclampsia. However, a significant difference was seen between the pulsatile value of the urine artery index and the incidence of early-onset preeclampsia ($P=0.045$).

1 INTRODUCTION

Indonesia is a country with the fourth highest population in the world. The population in Indonesia in 2017 according to the Statistical Yearbook of Indonesia 2017 was estimated to be 258,704,900 people. Indonesia's population growth rate in 2000-2010 was 1.49% per year (Central Statistics Agency, 2017), and the maternal mortality rate in Indonesia is still high at 305 per 100,000 live births. Hypertension is the second highest cause of maternal mortality with a prevalence of 26%. The global target of the 3rd SDGs (Sustainable Development Goals) is to reduce the Maternal Mortality Rate (MMR) to 70 per 100,000 live births by 2030. (Ibrahimaj D, 2017; The Scientific World Journal, 2016)

Based on the Ministry of Health (2010), preeclampsia occurs in around 10% of pregnancies in the world. Developing countries contribute to the incidence of preeclampsia greater than in developed

countries. Many theories suggest that the pathogenesis of preeclampsia is related to the placentation process, but to date, the pathogenesis of preeclampsia is still unclear. Prevention and predictive methods are still unknown. One theory of the pathogenesis of preeclampsia is that it is thought to be related to the failure of cytotrophoblast cells to invade the maternal spiral arteries, thus causing vascular injury and placental ischemia. (Siddiq A, Mose JC, Irianti S, 2015) Preeclampsia is divided into two, namely early onset and late onset. Early onset preeclampsia which accounts for 5-20% of all severe preeclampsia, but often causes severe clinical cases. (Barton JR, Sibai BM, 2008; Akolekar et al, 2008, p 732-39)

In addition to examining the levels of pro-angiogenic and anti-angiogenic factors, Doppler velocimetry examination has been widely used to predict the occurrence of preeclampsia. In Doppler velocimetry, the blood flow can be seen clearly in the uterine artery, arcuate, radial, and spiral around the trophoblast tissue, so that measurements can be

made on the various indices needed. Uterine artery Doppler velocimetry examination to predict the incidence of preeclampsia is better done in the second trimester compared to the first trimester.

On the basis of the background above, the authors are interested in examining the role of uterine artery pulsatility index (PI) and uterine artery diastolic notch in predicting the occurrence of preeclampsia, so that preeclampsia can be predicted as early as possible and strived to prevent the occurrence of complications of preeclampsia. (Nicolaidis, 2002)

2 METHODS

This study used an analytical study design with nested case-control. The study was conducted at Bunda Thamrin Hospital, Tanjung Mulia Mitra Medika Hospital, Sundari Hospital, and a private clinic, from March to November 2018 with a sample of 70 research subjects. The inclusion criteria are pregnant women who were at gestational age 22-24 weeks and agreed to participate. An abnormal Doppler velocimetry of the uterine arteries means that 3 consecutive consistent waves are found in uterine artery notch in either the unilateral or bilateral uterine arteries and/or the pulsatility index average >1.45 . Data were analyzed using bivariate analysis.

The study was approved by the Ethics Committee of the Faculty of Medicine, Universitas Sumatera Utara, Medan, Indonesia.

3 RESULTS

Of 70 pregnant women with gestational age 22-24 weeks, the majority was at 24 weeks (35 subjects, 50%) and were primigravid (31 subjects, 44.3%). Baseline characteristics of patients are described in table 1.

Table 1: Demographic characteristics of subjects

Characteristics	n=70
Age of pregnancy, n (%)	
22 weeks	22 (31.4)
23 weeks	13 (18.6)
24 weeks	35 (50)
BMI, mean (SD), kg/m ²	24.5 (4.0)
Parity, n (%)	
Primigravid	31 (44.3)
Secundigravid	23 (32.9)
Multigravid	16 (22.9)

Using ultrasound it is known that as many as 50% of subjects had no uterine artery diastolic notch (Table 2). A total of 27 subjects (38.6%) had unilateral uterine artery diastolic notch and 8 subjects (11.4%) had bilateral uterine artery diastolic notch.

Table 2: Result of uterine artery diastolic notch examination of right and left uterine artery

Uterine Artery Diastolic Notch, n (%)	n = 70
Without Uterine Artery Diastolic Notch	35 (50.0)
Unilateral Uterine Artery Diastolic Notch	27 (38.6)
Bilateral Uterine Artery Diastolic Notch	8 (11.4)

Observations on all subjects during the study revealed that 65 subjects (92.9%) did not experience preeclampsia, 2 subjects (2.9%) had preeclampsia with proteinuria +3, and 3 people subject (4.3%) with preeclampsia (proteinuria +4).

Of 35 subjects who had uterine artery diastolic notch, there were 5 subjects (14.3%) who had early onset preeclampsia. While a subject in subjects who did not have a uterine artery diastolic notch, no preeclampsia was found. The results of the analysis using Fischer's exact test showed that no significant association was found between uterine artery diastolic notch and the incidence of early-onset preeclampsia ($P=0.054$).

The average PI uterine artery in subjects with early-onset preeclampsia was seen higher with a mean of 1.4 (SD = 0.3) than in subjects who did not experience preeclampsia with a mean of 1.1 (0.4).

Table 3: Relationship between age, parity, BMI, uterine artery diastolic notch uterine artery PI and the incidence of early-onset preeclampsia

	Outcome		P
	Preeclampsia (n=5)	No preeclampsia (n=65)	
Age, n (%)			
>35 years	0 (0)	8 (100)	1.000 ^a
≤35 years	5 (8.1)	57 (91.9)	
Parity			
Primigravid	3 (9.6)	28 (90.4)	0.251 ^a
Secundigravid	0 (0)	23 (100)	
Multigravid	2 (12.5)	14 (87.5)	
BMI, n (%)			
Overweight-obese	1 (3.1)	31 (96.9)	0.169 ^a
Underweight-normoweight	4 (14.8)	23 (85.2)	
Uterine artery			

diastolic notch Found	5 (14.3)	30 (85.7)	0.054 ^a
Not found	0 (0)	35 (100)	
PI uterine artery, mean (SD)	1.4 (0.3)	1.1 (0.4)	0.045 ^b

^a Fischer's Exact; ^bT Independent; Mann Whitney

4 DISCUSSIONS

This study recruited as many as 70 (22-24 weeks) pregnant women who came to the obstetrics and gynecology outpatient clinics in Medan, Indonesia. Patients aged <35 years dominated this study, with an average of Body Mass Index of 24.5 kg/m² which is classified into overweight. Patients with 24 weeks' gestation were the most common ones, and also first pregnancy patients (44.3%). Primigravidas one of the risk factors for early-onset preeclampsia. While the age of pregnant women <35 years and the nutritional status of women in overweight or obese conditions are risk factors for the occurrence of late-onset preeclampsia.

We also found that the mean pulsatility index of the right uterine artery is 1.09 and the left is 1.18, and the total pulsatility index of uterine arteries is 1.135. Further, 50% of subjects had a normal dichotomy, with 38.6% had unilateral uterine artery diastolic notch and 11.4% had bilateral uterine artery diastolic notch. However, this is not a predictor for the incidence of early-onset preeclampsia. When we use the pulsatility index mean value, we found that mean value >1.4 is strongly associated with the incidence of preeclampsia. Although another study has reported a higher pulsatility index mean value >1.55 to predict this occurrence. (Uyar et al, 2015)

Of 35 pregnant women who had a diastolic notch, it was found that five experiencing early-onset preeclampsia. Nevertheless, this association was not significant and may be due to the small number of samples. However, other studies have shown this association where 23 patients with diastolic notch had preeclampsia compared to 4 patient who also had a diastolic notch but did not develop preeclampsia. (Gomez-Arriaga P, et al, 2014)

5 CONCLUSIONS

a. We did not find a significant difference between maternal age, body mass index and the incidence of early-onset preeclampsia

- b. There was no significant difference between the presence or absence of uterine artery diastolic notch and the incidence of early-onset preeclampsia.
- c. However, a significant association was seen between the pulsatility value of the uterine artery index and the incidence of early-onset preeclampsia.
- d. Examination on uterine artery PI can be recommended as the early clinical sign to predict early onset preeclampsia,

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