Research Article

High-Sensitivity Cardiac Troponin I Level and Left Ventricular Diastolic Dysfunction on Severe Preeclampsia

Kadar High Sensitivity Cardiac Troponin I dan Disfungsi Diastolik Ventrikel Kiri pada Preeklamsia Berat

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Abstract

Objective: To know the relationship between high-sensitivity cardiac Troponin I (hscTnI) level with left ventricular dysfunction on severe preeclampsia.

Methods: An observational analytics study with a cross-sectional approach of ten pregnant women with severe preeclampsia who underwent delivery or termination pregnancy and then performed a transthoracic echocardiography examination and serum levels of hscTnI.

Results: There is a significant relationship between hscTnI levels and left ventricular diastolic dysfunction ($p < 0.05$)

Conclusions: These findings of this study have significant implications that severe preeclampsia is associated with heart remodelling and significant change in cardiac function especially left ventricular dilatation and elevation of hscTnI. Early identification and intervention may ameliorate subsequent cardiovascular disease so this requires regular and close follow-up of this target group.

Keywords: high-sensitivity cardiac Troponin I, left ventricular diastolic dysfunction, severe preeclampsia.

Abstrak

Tujuan: *Untuk mengetahui hubungan antara kadar high-sensitivity cardiac Troponin I (hscTnI) dengan disfungsi ventrikel kiri pada preeklamsia berat.*

Metode: *Studi observasional dengan pendekatan potong lintang terhadap sepuluh ibu hamil dengan preeklamsia berat yang menjalani persalinan atau terminasi kehamilan kemudian dilakukan pemeriksaan ekokardiografi dan kadar hscTnI serum.*

Hasil: *Ada hubungan yang bermakna antara kadar hscTnI dengan disfungsi diastolik ventrikel kiri ($p < 0,05$).*

Kesimpulan: *Temuan penelitian awal ini memiliki implikasi yang signifikan bahwa preeklamsia berat berhubungan dengan remodeling jantung dan perubahan signifikan pada fungsi jantung terutama dilatasi ventrikel kiri disertai peningkatan kadar hscTnI. Identifikasi dan intervensi dini dapat memperbaiki perjalanan penyakit kardiovaskular sehingga diperlukan pengawasan lanjut pada kelompok pasien ini.*

Kata kunci: *disfungsi diastolik ventrikel, high-sensitivity cardiac troponin I jantung sensitivitas tinggi, kiri, preeklamsia berat*

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INTRODUCTION

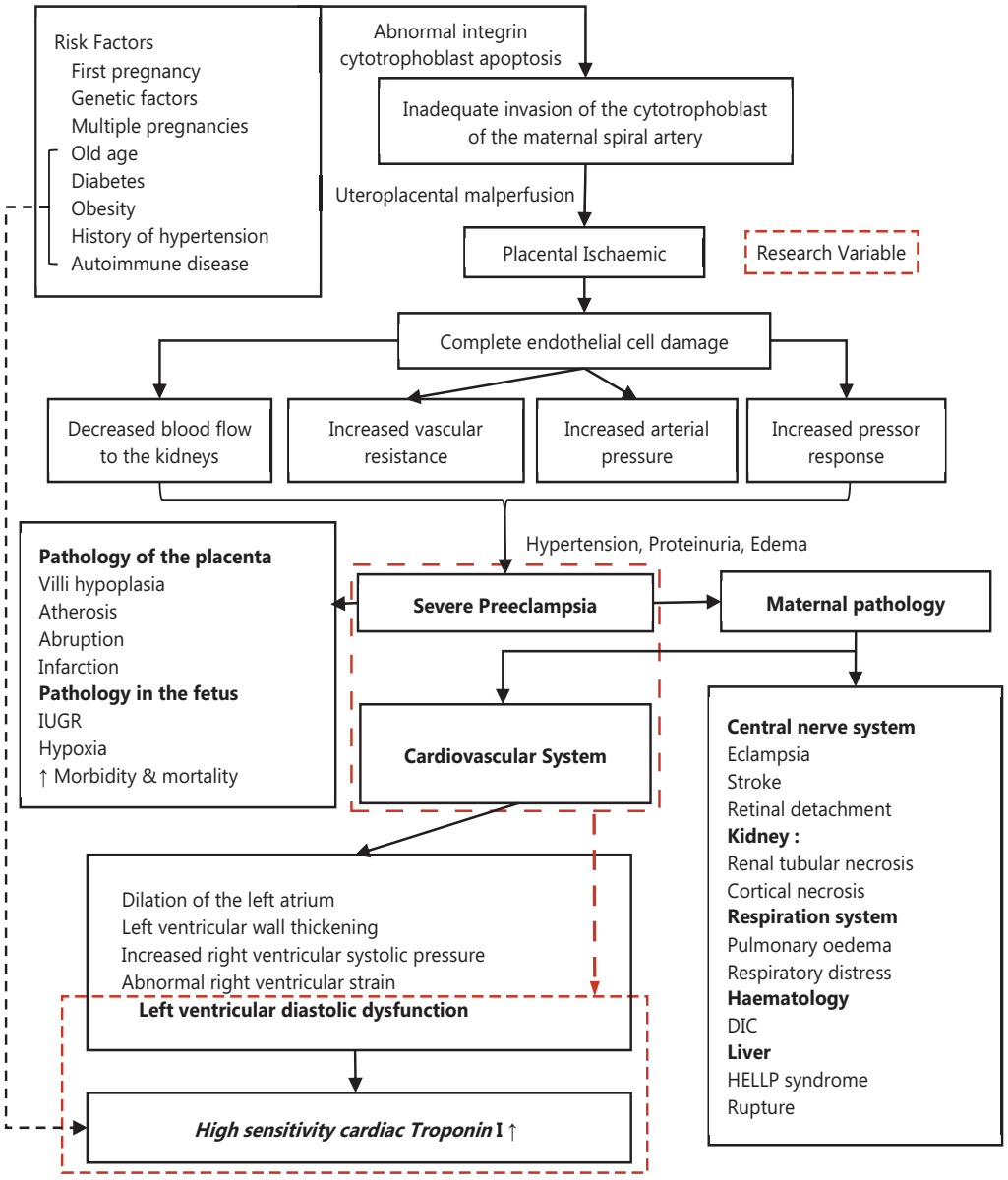
Preeclampsia is one of the leading causes of maternal and fetal death in developing countries. The pathogenesis of preeclampsia is not fully understood. The main causative factor is thought to be poor uteroplacental circulation caused by inadequate remodelling of the spiral arteries at between 8 and 18 weeks of gestation.1The result of this poor placentation process is placental hypoperfusion and oxidative stress. Maternal signs and symptoms result from concomitant endothelial dysfunction and vascular inflammation. Endothelial cells in the uteroplacental circulation that undergo hypoperfusion will release free radicals and fat peroxides.[1,2]

Cardiovascular function and hemodynamics undergo significant changes during pregnancy, especially at delivery until one week postpartum there is a maximal cardiac change in morphology. The main change that occurs during pregnancy is an increase in cardiac output. These changes are associated with an increase in heart rate and blood volume, as well as a decrease in systemic vascular resistance during pregnancy. Conversely, preeclampsia is associated with decreased intravascular volume and increased arteriolar vasospasm leading to decreased cardiac output and increased systemic vascular resistance. In preeclampsia, there will be an excessive activity of the sympathetic system so that it will decrease blood reserves in the splanchnic organs causing increased venous return. This increase increases inferior vena cava diameter and left atrial volume so that patients with preeclampsia increase the risk of developing heart failure.[3-5] Decreased stroke volume, diastolic dysfunction, and left ventricular remodelling were most common in severe preeclampsia.[6] Research on the complications of preeclampsia in the incidence of heart failure has been investigated by several centres in Indonesia. Fifteen per cent of pregnant patients with heart failure at Kariadi General Hospital Semarang is caused by preeclampsia.[7]

Determining the presence of damage to the heart is an important factor for the evaluation of a patient with preeclampsia and plays an important role in the management and determination of the patient's prognosis. Cardiac biomarkers can be used for early identification of potential heart problems, one of which is troponin. The Troponin complex plays an important role in the regulation of the contraction of the skeletal and cardiac muscles. The complex consists of 3 subunits, namely Troponin T, Troponin I and Troponin C. Troponin I and T are both typical for the heart, however cardiac Troponin I is expressed exclusively in the heart muscle in contrast to cardiac Troponin T which may still be expressed by diseased skeletal muscle. Cardiac Troponin I reflect cardiac remodelling and can be used as a predictor of patients with heart failure. The level increases in response to myocardial damage and is one of the most specific and sensitive markers of ischemic or non-ischemic myocardial damage.[8-10] However, several other studies suggest that there is no association between increased cardiac Troponin I and preeclampsia.[11-13]

Recent advances in testing technology have resulted in increased sensitivity, now being able to calculate troponin levels with a high degree of precision at very low plasma concentrations. High sensitivity cardiac Troponin I (hscTnI) can detect troponin in more than 50% of the reference normal population and can identify patients above or below the 99th percentile with optimal accuracy.[10,14] This study aimed to assess the relationship between hscTnI levels and left ventricular diastolic dysfunction in patients with severe preeclampsia obtained from echocardiographic examinations.

FRAMEWORK



METHODS

This research was conducted in the Department of Maternal-Fetal Medicine and Department of Cardiology Vascular Medicine, Dr. Kariadi General Hospital, Semarang. The inclusion criteria were patients with severe preeclampsia according to the 2016 PNPK Preeclampsia criteria with single pregnancy and delivery/termination at this hospital. The exclusion was made if there was a history of Diabetes mellitus, chronic hypertension, previous heart disease (congenital, acquired, cardiomyopathy and arrhythmias), chronic kidney disease, and receiving inotropic drugs and methylergometrine maleate. Study subjects were selected using consecutive sampling.

Observational analytic, Cross-sectional research was done in severe preeclampsia women who underwent echocardiography to assess the left ventricular diastolic dysfunction and measured hscTnI levels. Ten pregnant women were included in this study. The study was approved by the Ethical Committee of the Medical Faculty of Universitas Diponegoro and Dr. Kariadi General Hospital.

Patients with severe preeclampsia who met the inclusion and exclusion criteria were tested for transthoracic echocardiography (TTE), including 2-dimensional images, M-mode, color doppler, and tissue doppler by Cardiologists who served in the echocardiography diagnostic room. Echocardiography is performed a maximum of

48 hours after delivery. Echocardiography results obtained were then determined the presence of diastolic dysfunction according to the guidelines and recommendations of the American Society of Echocardiography.[15] Blood samples were taken on the same day the patient was examined for echocardiography and then frozen and sent to the laboratory, serum hscTnI was measured by the ARCHITECT STAT (Abbott) immunoassay kit, then analyzed for the presence of left ventricular dysfunction.

SPSS software was used for statistical analysis. A comparison between groups was analyzed with an independent t-test. Data with abnormal distribution were analyzed using the Mann-Whitney U test. Non-parametric data were analyzed using Fisher's Exact test. A value of $p < 0.05$ was considered significant.

RESULTS

At the end of the study, 10 subjects with severe preeclampsia were obtained and valid for analysis. The mean age was 30±6 years and advanced maternal age (≥35 years) was observed in 30%. Fifty per cent of cases occur when gestational age is less than 34 weeks (early-onset severe preeclampsia). Cesarean section accounted for 60% of deliveries. The average weight of a baby born was 2107±559 grams.

Table 1. Bivariate Test for the Relationship between Several Factors and Left Ventricular Diastolic function

Variable	Normal function		Diastolic disfunction		*P-value*
	Mean (SD)	N (%)	Mean (SD)	N (%)	
Age (years)	31 (3)		29 (9)		0.635¥
< 35		4 (40)		3 (30)	
≥ 35		1 (10)		2 (20)	
Gestational age (weeks)	35 (2)		34 (2)		0.544¥
Early-onset (< 34)		2 (20)		3 (30)	
Late-onset (≥ 34)		3 (30)		2 (20)	
Systolic blood pressure (mmHg)	168 (8)		170 (17)		0.841*
Diastolic blood pressure (mmHg)	97 (8)		98 (13)		0.841
Body mass index (kg/m2)	34.3 (2.4)		30.6 (3.4)		0.090¥
< 30		0 (0)		3 (30)	
≥ 30		5 (50)		2 (20)	
Glomerular filtration rate (GFR)	132 (17)		122 (17)		0.310*
Mode of delivery					
Vaginal delivery		2 (30)		2 (20)	1.000Σ
Cesarean section		3 (30)		3 (30)	
Parity	1 (1)		1 (1)		1.000*
Nulliparity		0 (0)		2 (20)	
Primiparity		4 (40)		0 (0)	
Multiparity		1 (10)		3 (30)	
Birth weight (grams)	2382 (612)		1832 (493)		0.158¥
< 2500		3 (30)		4 (40)	
≥ 2500		2 (20)		1 (10)	

*¥: Independent t-test, *: Mann-Whitney U test, Σ: Fisher's Exact test, significant if p < 0.05*

Based on table 1, age, gestational age, systolic and diastolic blood pressure, body mass index (BMI), glomerular filtration rate, mode of delivery, parity, and birth weight were not associated with left ventricular diastolic dysfunction (p> 0.05).

Table 2. Relationship of High Sensitivity Cardiac Troponin I Levels with Left Ventricular Diastolic Dysfunction

Left Ventricular diastolic function	high sensitivity cardiac Troponin I (Mean ± SD)	*P-value*	PR (CI 95%)
Normal function	3.50 ± 0.18	0.047*	6 (1.4 – 11.8)
Disfunction	9.50 ± 2.11		

** : Independent t-test, significant if p < 0.05*

The Shapiro-Wilk normality test was used to determine the distribution of hscTnI level data. From the normality test, the data distribution of hscTnI levels was normal so that the Independent T-Test was carried out between the hscTnI level and left ventricular diastolic dysfunction and obtained $p = 0.047$ ($p<0.05$). Based on the above results, there is a significant relationship between hscTnI levels and left ventricular diastolic dysfunction.

DISCUSSION

Our study was conducted to determine the relationship between hscTnI levels and left ventricular diastolic dysfunction in patients with severe preeclampsia. Increased cardiac troponin I level in preeclampsia, as examined in this study, suggests the possibility that preeclampsia may have a deleterious effect on heart cells in pregnant women with preeclamptic conditions. Preeclampsia is associated with impaired vascular reactivity, hemodynamic index, and left ventricular function. Thus, left ventricular remodelling abnormalities as seen in some patients with preeclampsia can lead to left ventricular hypertrophy. Left ventricular involvement in preeclampsia is thought to cause cardiac ischemia, which can result in changes in several biomarkers of heart function.[16] This study is consistent with the study of Morton et al. which measured hscTnI levels in 40 asymptomatic preeclamptic women results showed that hscTnI levels increased by 25% of the sample. Echocardiographic studies that were also carried out showed the presence of diastolic dysfunction in about 20% of women with preeclampsia.[14] This is also following the study who compared hscTnI levels in normal pregnancy and preeclampsia and its relationship with impaired left ventricular function at the cellular level.[10]

Serum cardiac troponin is a specific and sensitive biomarker of cardiac injury that can detect even minor cardiac injury. Elevated cardiac troponin I after delivery could indicate myocardial injury during the delivery, significant rise in the early postpartum period. Preeclampsia induces the release of antiangiogenic factors, which impair vascular endothelial function in the placental and maternal circulation. These changes could lead to myocardial injury due to microcirculatory disorders in addition to hypertension's effects.3 Transient damage of this myocyte with or without pathological cardiac remodelling occurred even in normal pregnant women postpartum because of cardiovascular maladaptation to the volume-overloaded state at term.[17]

Limitations of this study included small study size, absence of control group of normotensive pregnancy, and the measurement of hscTnI on only one occasion. HscTnI assays also more prone than sensitive assays to analytical problems because small differences can be of such importance.[14]

CONCLUSION

These findings of this study have significant implications that severe preeclampsia is associated with heart remodelling and significant change in cardiac function especially left ventricular dilatation and elevation of cardiovascular biomarkers (hscTnI). Early identification and intervention may ameliorate subsequent cardiovascular disease so this requires regular and close follow-up of this target group.

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