


Original Research Article

# Prevalence of heart failure with preserved ejection fraction in patients with pregnancy-induced hypertension

P. Pachaiyappan \*

Senior Assistant Professor, Department of Cardiology, Government Mohan Kumaramangalam Medical College, Salem, Tamil Nadu, India

\*Corresponding author email: [pachaicardio@gmail.com](mailto:pachaicardio@gmail.com)

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## Abstract

**Introduction:** Preeclampsia is one of the commonest complications of pregnancy and is a major course of maternal and fetal mortality and morbidity. In developing countries, it ranks second to anemia as a cause of maternal mortality and morbidity, complicating 7 – 10% of all pregnancies. Cardiac failure with pulmonary edema may occur in hypertensive patients with a normal heart.

**Aim of the study:** The aim of this study was to determine the left ventricular dysfunction in preeclampsia women by measuring the left ventricular systolic and diastolic indices using echocardiography.

**Materials and methods:** This study was a prospective observational study involving 50 patients who had been admitted in the antenatal ward of Govt. Mohan Kumar Mangalam Medical College, Salem over the period of one year from January 2017 to January 2018 (Group – 1). 50 normal normotensive pregnant patients selected at random who came to the OPD of our institute at the same period constituted (Group – 2). 50 normal non pregnant patients selected at random who come to the OPD of our institute at the same period who were from 18 to 35 year of age constituted (Group – 3).

**Results:** The mean age of these study groups 1, 2, and 3 were 23 years, 24 years, 26 years respectively. The mean EF in three groups was 60%, 58.3%, 58.8% respectively. LV systolic and diastolic function indices were compared among the three groups with significance level. There was a statistically significant LV diastolic dysfunction in the preeclampsia group (p-value <0.001).

**Conclusion:** In our study, LV systolic function was within normal limits in most of the preeclampsia patient. But statistically significant LV diastolic dysfunction was seen in 17/50 (34%) of the preeclamptic patient (p <0.001).

## Key words

Heart Failure, Ejection Fraction, Hypertension.

## Introduction

Heart failure (HF) is a major problem in the West and is likely to become a major problem in India. As per projections, there are at least 8-10 million patients with HF in India with a prevalence of about 1% adult population [1]. Preeclampsia is one of the commonest complications of pregnancy and in a major course of maternal and fetal mortality and morbidity [2]. In developing countries, it ranks second to anemia as a cause of maternal mortality and morbidity, complicating 7 – 10% of all pregnancies. Cardiac failure with pulmonary edema may occur in hypertensive patients with a normal heart. It is emphasized that pregnant women particularly if preeclamptic developed pulmonary edema more often than non – pregnant women [3]. Further preeclampsia is a recognized predisposing factor for Peripartum cardiomyopathy and further cardiovascular disease [4]. Pregnancy is characterized by a number of important hemodynamic changes. Blood volume increases by about 50%. The red cell mass increases by about 10 to 15 beat per minute [5]. Cardiac output increases beginning in early pregnancy around 5<sup>th</sup> week and confines to increases and reaches its peak between the middle of 2<sup>nd</sup> and 3<sup>rd</sup> trimester and remains elevated during the remainder of the pregnancy. Systemic arterial pressure begins to fall during the first trimester, reaches a nadir in mid-pregnancy and return to pregestational level before term. The pulse pressure widens as the fall of diastolic pressure is greater than the fall of systolic pressure. These changes are largely physiological in normal pregnancies [6]. But these changes are critical in patients with preeclampsia. It is also been speculated that associated subminimal left ventricular dysfunction may contribute to cardiac mortality and morbidity. There are only a few data available regarding left ventricular function in pregnancy. So this prospective study on left ventricular systolic and diastolic function by

echocardiography was undertaken in normal and preeclampsia pregnancies [7].

## Materials and methods

This prospective study was conducted of Cardiology, GMKMCH, Salem from January 2017 to January 2018. Among the 50 patients who fulfill the study criteria were selected and they constituted **Group - 1** of the study.

## Inclusion criteria

- Patient with mild preeclampsia which was diagnosed when there is a sustained systolic blood pressure of 140 mmhg or more and or a diastolic blood pressure of 90mmhg or more pressure on two or more occasions at least six hours apart occurring after 20<sup>th</sup> week of gestation associated with a proteinuria of  $\geq 0.3$ gm protein in a 24 hours urine sample or  $\geq 30$  mgdl or  $\geq 1+$  on dipstick in a random urine sample.
- Patient with severe preeclampsia which was diagnosed when blood pressure was  $\geq 160/110$ mmHg or proteinuria  $>5$ gm/24 hours or 2+or more.
- Age 18to 35 years.
- Gestational age 28 to 36 weeks.
- The known period of hypertension averaged 20 days.

## Exclusion criteria

- Patient with pre-existing hypertension.
- Patient with cardiorespiratory disease.
- Patients with Anemic.
- Patient in labor.

Out of 50 patient studied 20 patients fulfilled the criteria for severe preeclampsia. 30 patients fulfilled the criteria for mild preeclampsia. All the patients were put only on table alpha methyldopa 250 mg 8<sup>th</sup> hourly. The severe cases of preeclampsia were put on tablet alpha

methyldopa 250 mg 8<sup>th</sup> hourly and tablet Nifedipine 10 mg 8<sup>th</sup> hourly. None of the patients were studied during labor. Mean age was 23 years. 50 normal normotensive pregnant patients were selected at random who came to OPD of our institute at the same period constituted **Group - 2**. Their gestational age ranged from 18 to 35 years. Mean age was 24 years. 50 normal nonpregnant patients selected at random who came to the OPD of our institute at the same period that was from 18 to 35 years of constituted **Group - 3**. Mean age was 26 years. All the patients were examined by us using Philips 1E33 echo machine with 2.5 Mhz transducers at the Department of Cardiology, GMKMCH, Salem. Echocardiography of left ventricle was obtained under standard conditions during quiet expiration with patients in the left lateral recumbent positions after the patients remained undisturbed in this position for 15 minutes. M. mode 2D and Doppler echocardiographic evaluation were performed in all patients in the standard left parasternal axis view with continuous ECG gating according to the ASE guidelines. LV dimension like EF, ESD, and EDD were measured by 2D and M-mode. Inter ventricular septum and posterior wall diameter was also measured in M-mode using pulse Doppler echocardiography mitral flow velocities IVRT and DT were measured. The normal EF was 50 to 75 % and the normal FS was 25 to 46%. The normal E/A ratio were 0.8 to 1. The normal IVRT was 73 to 110 ms, more than 110ms was considered as prolonged IVRT indicative of diastolic dysfunction. The normal declaration time was 160 to 230 ms and it was prolonged in diastolic dysfunction.

#### Measurements [1, 3, 4]

M-mode, 2D and Doppler echocardiographic evaluation were performed in all patients in the standard left parasternal axis view with continuous ECG gating according to the ASE guidelines. LV dimensions like EF, ESD, and EDD were measured by 2D and M-mode. Inter ventricular septum and posterior wall diameter were also measured in M-mode. Using pulse

Doppler echocardiography mitral inflow velocities IVRT and DT were measured.

#### Parameters used to measure systolic functions were

$$EF = \frac{EDV - ESV}{EDV} \times 100$$

Normal 50 to 75%.

$$FS = \frac{LVED - LVES}{LVED} \times 100\%$$

Normal 25 to 46%.

EDV – end diastolic volume.

ESV – end systolic volume.

LVED – left ventricular end diastolic dimension.

LVES – left ventricular end systolic dimension.

A parameter used to measure diastolic function [5, 6]

**E/A ratio:** early filling/filling due to atrial contraction.

Normal 0.8 to 1.

**IVRT:** Time interval between closure of the aortic valve and the opening of the mitral valve. Normal 73 to 110 m. More than 110 m was considered a prolonged IVRT indicative of diastolic dysfunction.

#### Deceleration time (DT)

Time was taken for left atrial and left ventricular pressures to equilibrate. Normal 160 to 230ms. Prolonged in diastolic dysfunction.

## Results

Classification of women based on pregnancy was as per **Table – 1, 2**. The mean left ventricular end diastolic diameter on group 1, 2 and 3 were 4.82, 4.86 and 4.55 respectively. The mean End systolic dimension of group 1, 2 and 3.1, 3.73 and 3.04 respectively. There were no significant differences in the mean End diastolic and End systolic dimension between preeclamptic and normotensive pregnant women, although the mean end diastolic and end systolic dimension in the two groups of pregnant women were significantly greater than in the non-pregnant group. The mean EF in the three groups were 63%, 57.4%, and 56.6% respectively. They were

comparable and there was no statistical significance. 5 patients in group one showed EF <50% that defines left ventricular systolic dysfunction. Mean FS in the three groups were 31.2%, 30.4%, and 30.8% respectively. Only 5 patient in Group - 1 showed FS <25% that defines left ventricular systolic dysfunction. The mean E/A ratio in the three groups were 1.09, 1.20 and 1.21 respectively. 15 patient in Group - 1 had E/A ratio <1 indicative of diastolic dysfunction. Mean IVRT in the three groups were 110, 90 and

88 respectively. The mean DT in the three groups were 212, 186 and 188 respectively. The same 15 patients who showed reversed E/A ratio also had prolonged IVRT and DT confirming the diagnosis of diastolic dysfunction. LV systolic and diastolic function indices were compared among the three groups using turkey – HSD test with significance level 0.051. There was a statistically significant LV diastolic dysfunction in the preeclampsia group (p-value <0.001) (**Table – 3, Graph – 1**).

**Table – 1:** Classification of women based on pregnancy.

Group 1	Group 2	Group 3
Pre-eclamptic women	Normotensive pregnant women	Normal non – pregnant women

**Table – 2:** Nulliparous and multiparous among pregnant women.

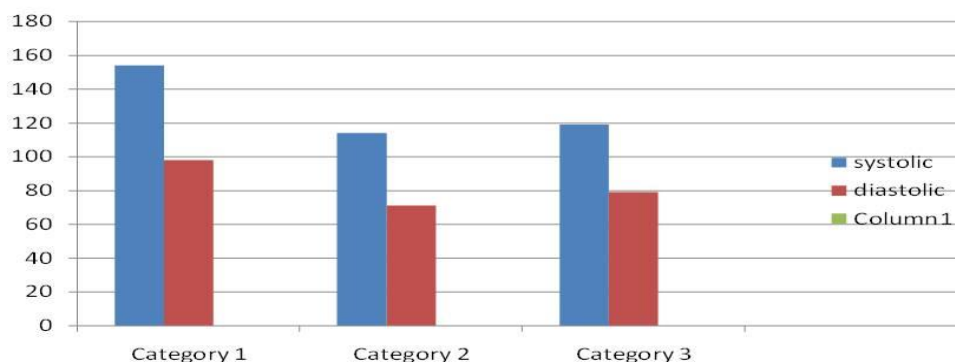
Group	Nulliparous	Multiparous
1	28	26
2	15	35
3	10	40

**Table – 3:** Range of LV systolic and diastolic indices.

	Group – I	Group – II	Group – III
EDD cm	3.12 – 5.50	3.12 – 5.35	3.9 – 5
ESD cm	2.20 – 4.20	2.90 – 4	2.6 – 3.95
EF %	51 – 67	50 – 65	50 – 65
FS	25 – 47.62	25 – 43.21	26.67 – 38.72
E/A	0.7 – 1.32	1.07 – 1.68	1.14 – 1.53
IVRT ms	86 – 136	73 – 106	76 – 110
DT ms	160 – 260	160 – 230	160 – 230

**Graph – 1:** Blood pressure variations among 3 groups.

### Mean blood pressure of three groups



## Discussion

In pregnancies complicated by preeclampsia especially early-onset preeclampsia the diastolic LV function is impaired and levels of biomarkers, NT proBNP and Cystatin C are increased compared to normal pregnancy. Among the 17 patients with LV dysfunction, 12 patients had preeclampsia and 3 patients had severe preeclampsia [8]. Among the 12 mild preeclampsia patients with LV dysfunction 8 patients had normal vaginal deliveries, 4 patients went in for LSCS. Among the patients with severe preeclampsia, 2 patients had a normal vaginal delivery [9]. None of the patients developed complications like pulmonary edema or cardiac failure [10]. Smith R, et.al. did not find significant differences in the functional status of the left ventricle, as evidenced by echocardiographically derived EF between normotensive and hypertensive pregnant patients [11]. Stouffer, et al. 4 reported that the left ventricular systolic function was well preserved in most of the Preeclamptic women. Only 7% of them showed depressed left ventricular performance as evidenced by percentage fractional shortening [12]. In our study it is found that in most of the preeclampsia patients the indices of left ventricular systolic function fell within normal range, these observations indicate good cardiac contractile function, even though the left ventricle operate on the ascending limb of the left ventricle function curve. Only 5 out of 50 patients of this group had depressed LV systolic function [13]. These findings correlate well with the Young P, et al study found that among the 25 preeclampsia women who developed pulmonary edema during Antepartum and Postpartum period 12 (48%) showed diastolic dysfunction evidenced by reversed E/A ratio with normal LV systolic function [14].

## Conclusion

LV systolic function was within normal limits in most of the Preeclampsia patients. A statistically insignificant number of patient 4/54 (7.4%) had LV systolic function p-value >0.05. Statistically significant LV diastolic function was seen in

17/54 (31.48%) of preeclampsia patients  $p < 0.001$ . LV hypertrophy was a rare finding occurring only in two patients of the study group. Appropriate management of the patients who showed LV dysfunction prevented pulmonary edema and cardiac failure.

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