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Transthoracic Echocardiography A Predictor of Complications in Patients with Severe Preeclampsia

Hamza A.A. Mahmoud*[1], Ahmed M.A. Ismail*[1], Eman I. Darweesh[1], Abd El Rahman H. Mohamed[1], Mohamed A.W. Ezaat[2]

Departments of [1]Anesthesia, Intensive Care and Pain Management and [2]Internal Medicine, Faculty of Medicine, Sohag University, Egypt

***Corresponding author:** Ahmed MA Ismail**, Mobile: (+20)** 01006774710**, E-Mail:** ahmed.aly25.aa@gmail.com

ABSTRACT

Background: Severe preeclampsia (PE) and eclampsia are a hypertensive disease of pregnancy associated with significant morbidity and mortality and require special monitoring. Lung ultrasonography and transthoracic echocardiography are a novel monitoring and diagnostic tools in intensive care and are widely used nowadays.

Objective: To detect the role and value of transthoracic echocardiography (TTE) in postoperative monitoring in patients with severe PE.

Patients and Methods: This was a cross sectional study of 55 patients with severe preeclampsia, 35 patients with eclampsia and 60 healthy controls. Transthoracic echocardiography was done to evaluate diastolic function using E/A ratio with continuous wave Doppler, ejection fraction using M mode in long axis parasternal view and inferior vena cava (IVC) diameter in subcostal view. All measurements were done postoperatively.

Results: There was significant difference between the 3 groups regarding diastolic function (p value 0.0001). Abnormal diastolic function in severe PE, eclampsia and controls was 81.2%, 94.3% and 5% respectively. There was no difference between the 3 groups of the study as regard IVC diameter. There was significant difference between the 3 groups as regards EF (P=0.007), the mean of EF in severe PE, eclampsia and controls was 66.89 ± 5.54, 63.029 ± 8.45 and 66.43 ± 4.16 respectively. **Conclusions:** The use of transthoracic echocardiography is mandatory in postoperative monitoring in patients with severe PE and eclampsia as they can adjust management and detect complications. Restricted fluid therapy policy is indicated with the higher grades of diastolic dysfunction and lower ejection fraction (EF).

Keywords: Echocardiography, Eclampsia, Lung Ultrasonography, Severe preeclampsia.

INTRODUCTION

Severe PE is characterized by systolic blood pressure ≥ 160 mm Hg and diastolic blood ≥ 110 mm Hg on two occasions 4 hours apart, proteinuria > 300 mg per 24 hours urine collection after 20 weeks of gestation with either thrombocytopenia (platelet count less than 100,000), impaired liver function as indicated by elevated liver enzymes (to twice normal level), epigastric pain not responding to medications, progressive renal impairment (double serum creatinine from baseline within 24 hours) pulmonary edema or new onset visual or cerebral disturbances [(1)].

In patients with severe PE accurate assessment of maternal hemodynamics is fundamental for appropriate fluid management. Inadequate intravascular volume results in decreased oxygen delivery to tissues and exacerbates organ dysfunction. Fluid excess can lead to fluid extravasation and pulmonary edema, the risk of fluid over-resuscitation is especially high in women with PE [(2)].

Transthoracic echocardiography (TTE) and lung ultrasonography are essential diagnostic tools for critical care physicians and are becoming incorporated into training curriculums. Basic TTE is used widely by intensivist for assessing and monitoring patients' cardiovascular state through assessment of myocardial contractility, diastolic function and volume status as guided by the American Society of Echocardiography recommendations [(3)].

The aim of the present study was to detect the role and value of TTE in postoperative monitoring in patients with severe PE.

PATIENTS AND METHODS

A cross sectional study was conducted on 90 female patients with severe preeclampsia (55 cases with severe preeclampsia and 35 cases with eclampsia) and 60 healthy parturient undergone caesarian section (for indications other than severe PE and eclampsia) as a control group attending for delivery in Sohag University Hospitals in the period from October 2018 to October 2019.

Inclusion criteria: Patients with severe preeclampsia (hypertension > 160 / 110, proteinuria up to 2-gram, severe persistent epigastric pain, elevated liver enzymes, thrombocytopenia < 100,000, visual and cerebral disturbances, and pulmonary edema) and patients with eclampsia (the same previous criteria plus eclamptic fits).

Exclusion criteria: Patient with known: Hypertension, Cardiac disorders, Pulmonary disorders and Renal disorders

After cases admission to ICU and controls admission to Obstetrics Department, anesthesia sheet was revised to check:

Age, diagnosis, BMI, gestational age, gestational history, parity, type of anesthesia, pulse, blood pressure,

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fluids, proteinuria and other criteria of severe PE and laboratory investigations were checked (CBC, urea and creatinine, liver function tests, urine analysis) and fluid intake and output were also revised.

Transthoracic echocardiography was performed to all cases and controls in this study *Transthoracic echocardiography:* While patients lying flat on left lateral position using transthoracic echocardiography probe of (SONOACE 8000 SE(Write the producing country)) ultrasonography device apical 4 chamber view was obtained then Pulsed Wave (PW) Doppler was used and its curser was directed to tips of mitral valve leaflets then diastolic function was assessed using E/A ratio as a marker of diastolic function and if diastolic dysfunction was present its grade was recorded [(4)]

- **Grade 1** diastolic dysfunction (impaired relaxation pattern) E/A< 0.8 or E<50cm/s.
- **Grade 2** diastolic dysfunction (pseudonormal) E/A 0.8-2 and E>50cm/s.
- **Grade 3** diastolic dysfunction (restrictive) E/A >2.

Then long axis parasternal view was obtained from the same position and M mode was used with Teichholz method to assess left ventricular systolic function and ejection fraction was recorded, normal EF was considered > 55%.

Then patient changed her position and lied flat again and probe was put in subcostal area and knob of the probe tilted toward right shoulder till inferior vena cava appear in its long axis view then its widest diameter was detected (usually just before its entrance in right atrium) and this diameter was recorded; normal diameter was 1.5 – 2.5 cm.

Ethical consent

An approval of the study was obtained from Sohag University Academic and Ethical Committee. Written informed consent was obtained from all the participants in the study after explanation of the nature of study.

Statistical analysis

After completion of data collection, data were revised, coded and fed to the computer and analyzed using MedCalc program version 17. Quantitative data were tested using Kolmogorov–Smirnov (K.S) test and described using mean and standard deviation for normally distributed data, while median and minimum and maximum for abnormally distributed data. Qualitative data were described using number and percent. Significance level for all statistical tests was set as $P < 0.05$.

RESULTS

There was highly statistical significance difference between 3 groups as pulse rate, systolic blood pressure (SBP), and diastolic blood pressure (DBP) were higher in cases group than controls (Table 1).

Table (1): Comparison between cases and controls as regards clinical data

	Cases		Controls (N=60)	P
	Preeclampsia (N=55)	Eclampsia (N=35)		
Pulse (Mean± SD)	94.8±10.5	104.85±13	85.98±7.02	**<0.0001***
SBP (mm/hg) Mean± SD	178 ±3.6	180 ±13	120.7± 7.1	**<0.0001***
DBP (mm/hg) Mean± SD	101.3 ±11.5	104.85±13	70.5±8.02	**<0.0001***

ECHO parameters (EF, IVC and Diastolic dysfunction) in cases and controls

There was statistically significant difference between severe PE patients and eclampsia patients as regard EF, as EF was lower in eclamptic patients than those with severe PE. EF was also lower in eclampsia patients than controls (Table 2).

Table (2): Comparison between cases and controls as regards ECHO parameter

	Cases		Controls (N=60)	P
	Preeclampsia (N=55)	Eclampsia (N=35)		
EF (Mean± SD)	**66.89±5.54**	**63.029 ±8.45**	**66.43± 4.16**	**0.007***
P1	**0.009***			
P2		**0.02***		
P3	**0.966**			
IVC (Mean± SD)	**1.48±0.34**	**1.32±0.46**	**1.46±0.32**	**0.131**

Cases has a higher incidence of diastolic dysfunction than control groups. As regard grades of diastolic dysfunction grade 1 was detected in severe PE group in higher percentage, while Diastolic dysfunction grade 2 was detected in eclampsia group in higher percentage that difference was statistically significant as (Table 3).

Table (3): Comparison between cases and controls as regards Diastolic dysfunction grades

	Cases				Controls (N=60)		P
	Preeclampsia (N=55)		Eclampsia (N=35)				
	No.	%	No.	%	No.	%	
Diastolic dysfunction							
Normal	**10**	**18.2**	**2**	**5.7**	**51**	**85**	**<0 .0001***
Abnormal	**45**	**81.2**	**33**	**94.3**	**9**	**15**	
Diastolic dysfunction grades							
Normal diastolic function	**10**	**18.2**	**2**	**5.7**	**51**	**85**	
Diastolic dysfunction grade 1	**28**	**50.9**	**3**	**8.6**	**6**	**10**	
Diastolic dysfunction grade 2	**17**	**30.9**	**26**	**74.3**	**3**	**5**	**<0 .0001***
Diastolic dysfunction 3	**0**	**0**	**4**	**11.4**	**0**	**0**	

Postoperative complications were detected in cases in 10 patients with higher percentage in eclampsia group than severe PE group (8 cases vs 2 cases respectively) (Table 4).

Table (4): Postoperative complications detected in cases group

Postoperative complications	Cases (No=90)	
	No	%
No complications	80	88.9
Pulmonary edema	3	3.3
Acute respiratory distress syndrome	1	1.1
Cardiac arrest	2	1.1
Mild pericardial effusion	2	2.2
Subarachnoid hemorrhage and PRESS (same patient)	1	1.1
Peripartum cardiomyopathy and pulmonary embolism (same patient)	1	1.1

As regard common complications occurred in cases group, pulmonary edema constituted highest percentage within complication in percentage, followed by (cardiac arrest and mild pericardial effusion) which constituted the same percentage, other complications percentage illustrated in details in (Figure 1).

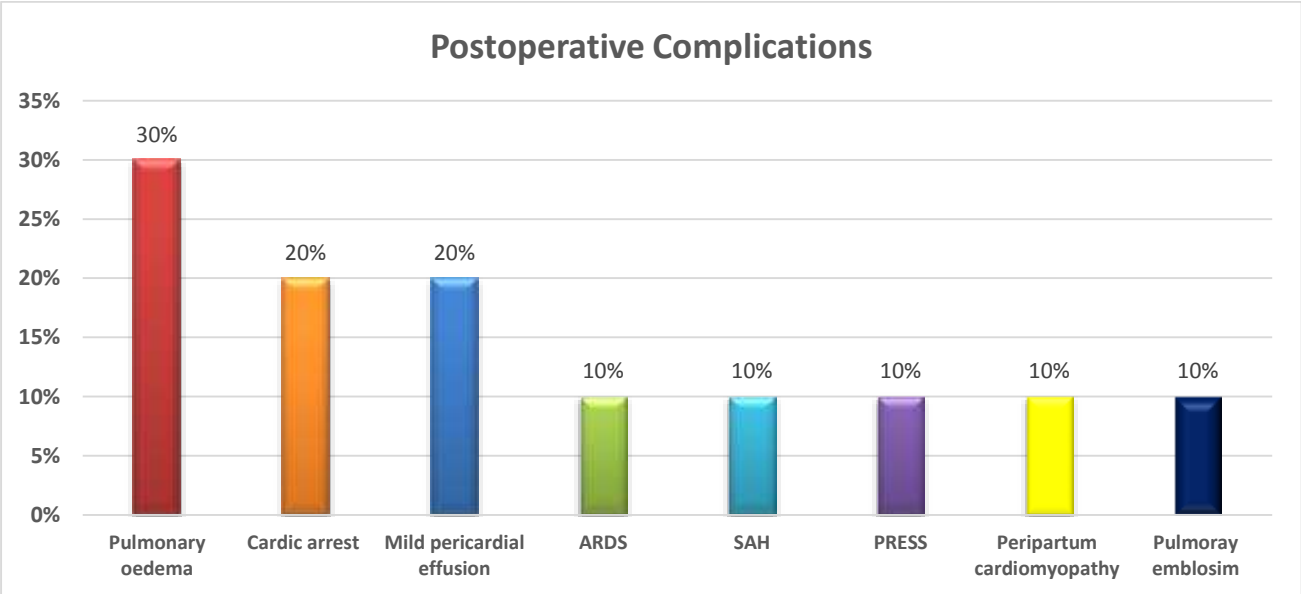

Figure (1): Percentage of complications in complicated cases.

Table (5) shows factors that affect occurrence of complications, while (Table 6) shows predicting ability of lung ultrasound scores (LUS) and TTE in predicting complications.

Table (5): Factors affecting occurrence of postoperative complications in cases groups

Factors affecting	Postoperative complications		P
	Complicated (N=10)	Non complicated (N=80)	
Age (Years)			
Median (Min –Max)	24.5 (23- 43)	23 (19-40)	0.014*
Pulse (Beats/minutes)			
Median (Min –Max)	115 (110-150)	95 (75-115)	<0.0001*
Diastolic dysfunction grades			
Median (Min –Max)	2 (1-3)	1(0-3)	0.004*
EF			
Median (Min –Max)	57.5(40-73)	68(50-78)	0.003*

Table (6): Predicting ability of TTE in predicting complications

	AUC (95%CI)	P value	cut off point	Sensitivity (95%CI)	Specificity (95%CI)	PPV (95%CI)	NPV (95%CI)
EF	**0.78 (0.69 - 0.87)**	**0.005***	**<58**	70 (34.8 - 93.3)	90 (81.2 - 95.6)	46.7 (20.5 - 74.3)	**96 (88.8 - 99.2)**
Diastolic dysfunction grades	**0.75 (0.65 to 0.84)**	**<0.0001***	**>1**	90 (55.5 - 99.7)	52.5 (41 - 63.8)	19.1 (9.1 - 33.3)	**97.7 (87.5 - 99.9)**
Pulse rate	**0.92 (0.85 - 0.97)**	**<0.0001***	**>100**	90 (55.5 - 99.7)	81.25 (71 - 89.1)	37.5 (18.8 - 59.4)	**98.5 (91.8 – 100)**

DISCUSSION

There was highly statistically significant difference between the 3 groups as mean value of pulse rate was higher in severe PE and eclampsia cases than control, which was in line with **Anthony and Schoeman**[5] who found that tachycardia commonly complicates severe preeclampsia and eclampsia.

There was no statistically significant difference between the 3 groups of the study as regard IVC diameter.

In the current study as regards EF, there was significant difference between preeclampsia vs eclampsia, controls vs eclampsia, while between controls vs preeclampsia no significant difference was detected. The low mean of EF in eclamptic patients according to **Melchiorre *et al.*** [6] was that the myocardial contractility showed to be significantly impaired in the more severe preeclampsia cases.

In the current study there was statistically significant difference between the 3 groups as regard diastolic function. Abnormal diastolic function in severe PE, eclampsia and controls was 81.2%, 94.3% and 5% respectively, which was in line with **Ambrozic *et al.*** [7] who found that the incidence of diastolic dysfunction was higher in cases with severe PE than in controls. **Pàez *et al.*** [8] explained this by the changes in both arterial and venous systems seen in preeclampsia.

In the current study, pulmonary edema was presented in 3.3% of cases (preeclampsia and eclampsia) representing 30% of complications in complicated cases (10 cases), which was in agreement with **Jantasing and Tanawattanacharoen** [9] who found that pulmonary edema was in 3.4% of cases. **Norwitz *et al.*** [10] reported that pulmonary edema may occur in up to 2.9% of women with severe preeclampsia with mainly postpartum presentation.

In the current study, cardiac arrest was in 2.2% of cases, representing 20 % of complicated cases, which was in agreement with **Campbell and Sanson** [11] who reported that PE accounts for 16% of cases of postoperative cardiac arrest.

In the present study, acute respiratory distress syndrome (ARDS) was in 1.1% of cases, representing 10 % of complicated cases, which was in line with **Terrone *et al.*** [12] who found that ARDS was in 1.03% of cases in a study conducted on 193 female patients with severe PE.

In the current study, pericardial effusion was present in 2.2% of cases representing 20 % of complicated cases. This was in line with **Matsuki *et al.***

[13] who reported that PE is an etiological factor of pericardial effusion although the presence of such effusions is generally asymptomatic and no treatment is required. It could be caused by hypoalbuminemia and an increase in peripheral vascular permeability, which are associated with preeclampsia together with excessive volume of fluid transfusion.

In the present study, subarachnoid hemorrhage (SAH) was present in 1.1% of case representing 10 % of complicated cases. **Bateman *et al.*** [14] reported that PE was present in 40% of peripartum SAH cases and it increased the risk of SAH seven-fold, likely secondary to a combination of hypertension-induced aneurysm rupture and, more commonly, pial vessel rupture.

In the present study, posterior reversible encephalopathy syndrome (PRES) was present in 1.1% of cases that represent 10 % of complicated cases, which was in line with **Hinchey *et al.*** [2] who report that (PRES), that is a vasogenic and parieto-occipital cerebral edema that is typically reversible, may be diagnosed in women with preeclampsia-eclampsia.

In the current study, peripartum cardiomyopathy (PPCM) was present in 1.1% of cases representing 10 % of complicated cases. This was in line with **Bello *et al.*** [15] who reported in a meta-analysis of 22 studies a 22% prevalence of preeclampsia among women with PPCM, more than four times the estimated global prevalence. Additionally, **Goland and Elkayam** [16] reported that preeclampsia and eclampsia are associated with PPCM, which may reflect shared pathophysiology.

In the current study, pulmonary embolism was present in 1.1% of cases representing 10 % of complicated cases. This was in line with **Olié *et al.*** [17] who found that preeclampsia was associated with a significantly increased risk of pulmonary embolism during postpartum but not during pregnancy.

CONCLUSIONS

The use of transthoracic echocardiography is mandatory in postoperative monitoring in patients with severe PE and eclampsia as they can adjust management and detect complications. Restricted fluid therapy policy is indicated with the higher grades of diastolic dysfunction and lower ejection fraction (EF).

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