The Clinical Value of Predicting Heart Failure Through Changes in the Relevant Indicators of Severe Preeclampsia (With 3 Cases Reported)

Zhou H[1], Qing Y[2], Zhou C[1] and Wei J[3*]

[1]Dalian Medical University, Dalian, Liaoning, China

[2]Bengbu Medical College, Bengbu, Anhui, China

[3]The Affiliated Changzhou No.2 People's Hospital of Nanjing Medical University, Changzhou, Jiangsu, China

*Corresponding author:

Jinhua Wei,
The Affiliated Changzhou No.2 People's Hospital of Nanjing Medical University, Changzhou, Jiangsu, China, Tel: 13651508915;
E-mail: czweijh@126.com

Citation:

Wei J et.al. The Clinical Value of Predicting Heart Failure Through Changes in the Relevant Indicators of Severe Preeclampsia (With 3 Cases Reported). J Clin Med Img. 2021; V5(15): 1-6

1. Abstract

Severe preeclampsia is common, seriously threatening the health of mothers and children. It often damages to the heart, liver, kidney, brain and other important organs, causing maternal dysfunction. Among them, severe preeclampsia combined with heart failure is the main cause of the increase in maternal and perinatal mortality, and its treatment is a difficult point in the clinical obstetrics and gynecology. This paper retrospectively analyzes the changes in clinical and laboratory examination indicators of blood, digestion, urinary, circulation and other systems in 3 patients with severe preeclampsia combined with heart failure before and after delivery, and then to identify potential trends in these indicators. Thus, the clinical value of predicting heart failure in patients with severe preeclampsia is explored.

Hypertensive Disorders of Pregnancy (HDP) are one of the major causes of maternal and perinatal mortality worldwide, with a global incidence of 2%-8%, including gestational hypertension, preeclampsia, eclampsia, chronic hypertension with superimposed preeclampsia and chronic hypertension. According to "the 2019 edition of the Guidelines for Hypertension and Preeclampsia in Pregnancy" which published by "the American College of Obstetricians and Gynecologists (ACOG)", the diagnostic criteria for preeclampsia are:

Blood Pressure: Pre-pregnancy blood pressure is normal, after 20 weeks of pregnancy systolic blood pressure ≥ 140mmHg or diastolic pressure ≥ 90mmHg, 2 blood pressure measurement interval of at least 4 hours; systolic blood pressure ≥ 160mmHg or diastolic pressure ≥ 110mmHg.

Urine Protein: 24-hour urine protein quantification is greater than 300mg; Protein/creatinine ≥0.3; Routine urine protein ++ or above.

Urinary Protein-Negative Conditions are Consistent with the Following New Manifestations:

Thrombocytopenia: platelet count $< 100×10^9$/L; Renal insufficiency: serum creatinine $> 97\mu mol$/L or 2 times higher than the upper limit of normal, excluding other kidney diseases; Impaired liver function: transaminase is 2 times higher than the upper limit of normal; Pulmonary edema; New headache was not relieved by common drug treatment, excluding other causes or blurred vision [1]. Severe preeclampsia is a serious type of preeclampsia, which threatens the health of mother and child. As the disease progresses, severe preeclampsia can lead to terminal organ failure, such as heart and kidney failure. Among them, severe preeclampsia combined with heart failure is the main cause of maternal and perinatal mortality. Studies have found that early clinical and laboratory examination indicators could predict the occurrence of heart failure in the patients with severe preeclampsia. It found that the elevation

of Brain Natriuretic Peptide (BNP), myocardial enzyme spectrum, Neutrophil-Lymphocyte Ratio (NLR) and C-Reactive Protein (CRP) were associated with severe preeclampsia combined with acute left heart failure, and the diagnosis value of four indicators was better than that of each single indicator [2]. Studies have also shown that low serum albumin increases the occurrence of early severe preeclampsia combined with heart failure [3].

However, the current research on the indicators related to severe preeclampsia with heart failure at home and abroad is limited to the heart failure indicators and some infectious indicators, and the multi-system indicators are not observed. In addition, these studies did not explore the Potential trends of the indicators furtherly. In this paper, the indicators of relevant clinical and laboratory examination indicators before and after delivery in 3 patients with pre-severe eclampsia combined with heart failure are analyzed retrospectively, and BNP, Troponin I (TnI), mesh red blood cells, D-dimer, lactic acid dehydrogenase (LDH), 24-hour urine protein quantification, Hemoglobin (Hb), Hematocrit (HCT), serum total protein, serum albumin, Alanine Transaminase(ALT), Aspartate Transaminase (AST), Blood Urea Nitrogen (BUN), Creatinine (CR), Potassium ions (K+) and other clinical and laboratory examination indicators has a potential trend in patients with severe preeclampsia combined with heart failure. Thus, their clinical value of predicting heart failure in patients with severe preeclampsia is explored.

2. Clinical Data

Pregnant woman 1, female, 25 years old, was admitted to the hospital because of "pregnancy for 32+2 weeks, dizziness for 2 days, high blood pressure for 5 hours". She gained 10Kg in the first half month before admission. Upon admission, the blood pressure was 140/90mmHg, urine protein (+), and edema of both lower limbs (++). The diagnosis of "preeclampsia" was admitted. MgSO4 was used to relieve spasmodic and Labetalol was used to relieve blood pressure. On the 3rd day of admission, she developed dyspnea, sat breathing, coughed pink foamy sputum, heart rate reached 75 beats/min, blood pressure reached 175/85mmHg, and breathing reached 35 beats/min. Severe preeclampsia combined with early heart failure was diagnosed, and her pregnancy was terminated by emergency cesarean section. After the operation, the patient was transferred to ICU for observation and treatment for 4 days, and the patient was discharged after stable improvement. The relevant indicators were improved, and the condition of the pregnant woman was stable within 1 month of postoperative follow-up.

Pregnant woman 2, female, 34 years old, was admitted to hospital due to " pregnancy for 39+6 weeks, high blood pressure, chest tightness and shortness of breath for more than 5 hours". Upon admission, the blood pressure was 182/124mmHg, the heart rate was 104 beats/min, and the respiration was 22 beats/min. The patient was admitted with the diagnosis of "severe preeclampsia

combined with acute left heart failure". The pregnant woman did not have a perinatal health card during her pregnancy and did not have regular prenatal examination. After admission, she was treated with MgSO4 for spasmodic treatment, Labetalol combined with Adulate for antihypertensive and anti-heart failure treatment. On the day of admission, her pregnancy was terminated by emergency cesarean section. After the operation, the patient was transferred to ICU for observation and treatment for 3 days, and the patient was discharged after stable improvement.

Pregnant woman 3, female, 30 years old, was admitted to hospital for " pregnancy for 28+6 weeks, dizziness for 5 days and edema for 2 days". Her blood pressure was 170/92 mmHg and her urine protein was (+++). She was admitted to hospital with "severe preeclampsia". MgSO4 was given as antispasmodic therapy, and Labetalol was given as antihypertensive therapy. On the 5th day of admission, the 24-hour urinary protein quantitation was 22g, the urinary protein was 3+, the liver enzymes were increased: ALT was 93.0U/L, AST was 87.0 U/L, mesh red blood cell count was 4.07%, and the plasma albumin was rapidly decreased: serum albumin was 27.3g/L and serum total protein was 47.3 g/L. The diagnosis of early-onset severe preeclampsia was confirmed. On the 5th day of admission, the pregnant woman suddenly had chest distress. The examination showed that bilateral pleural effusion increased compared with the previous one, and liver and kidney functions deteriorated progressively. Therefore, the pregnancy was terminated by cesarean section. After the operation, the patient was transferred to ICU for observation and treatment for 2 days. The postoperative follow-up was 2 months. Among them, the mesh red blood cell count and 24-hour urinary protein quantitation returned to normal after one month of operation. Liver and kidney function returned to normal after two months of operation, and the condition recovered well.

3. Discussion

Severe preeclampsia combined with heart failure is one of the most serious complications of hypertension during pregnancy and is the main cause of the increase in maternal and perinatal mortality. It is not possible to predict whether patients with severe preeclampsia will combine heart failure correctly and timely. It makes the treatment of severe preeclampsia combined with heart failure one of the difficult problems in clinical obstetrics and gynecology [4]. Currently, treatment of pre-severe eclampsia combined heart failure focuses on rapid treatment when heart failure occurs rather than prevention before heart failure occurs. Studies have found a variety of triggers for preeclampsia combined heart failure. Pregnant women did not carry out formal birth tests, so that it makes pregnancy hypertension not timely detection and treatment in early pregnancy. Pregnant women combined anemia and low-proteinemia increases the burden of the heart and hypoxia of the heart muscle. In addition, inappropriate treatment can increase

the burden of the heart. Respiratory infections increase resistance to pulmonary circulation [5]. Studies had confirmed that clinical and laboratory examination indicators can help predict the occurrence of pre-severe eclampsia combined heart failure, but many factors can interfere with the clinical and laboratory examination indicators of patients with severe preeclampsia, such as the degree of damage to various systems before severe preeclampsia, individual differences and relatively imperfect test results. Based on the analysis of the clinical and laboratory examination indicators in 3 patients with severe preeclampsia combined with heart failure, this study finds its potential trends (Figure 1, Table 1). This study explores whether this can be used to predict the occurrence of heart failure in patients with pre-severe eclampsia, and then human intervention is made as early as possible to reduce the mortality rate of maternal and perinatal babies.
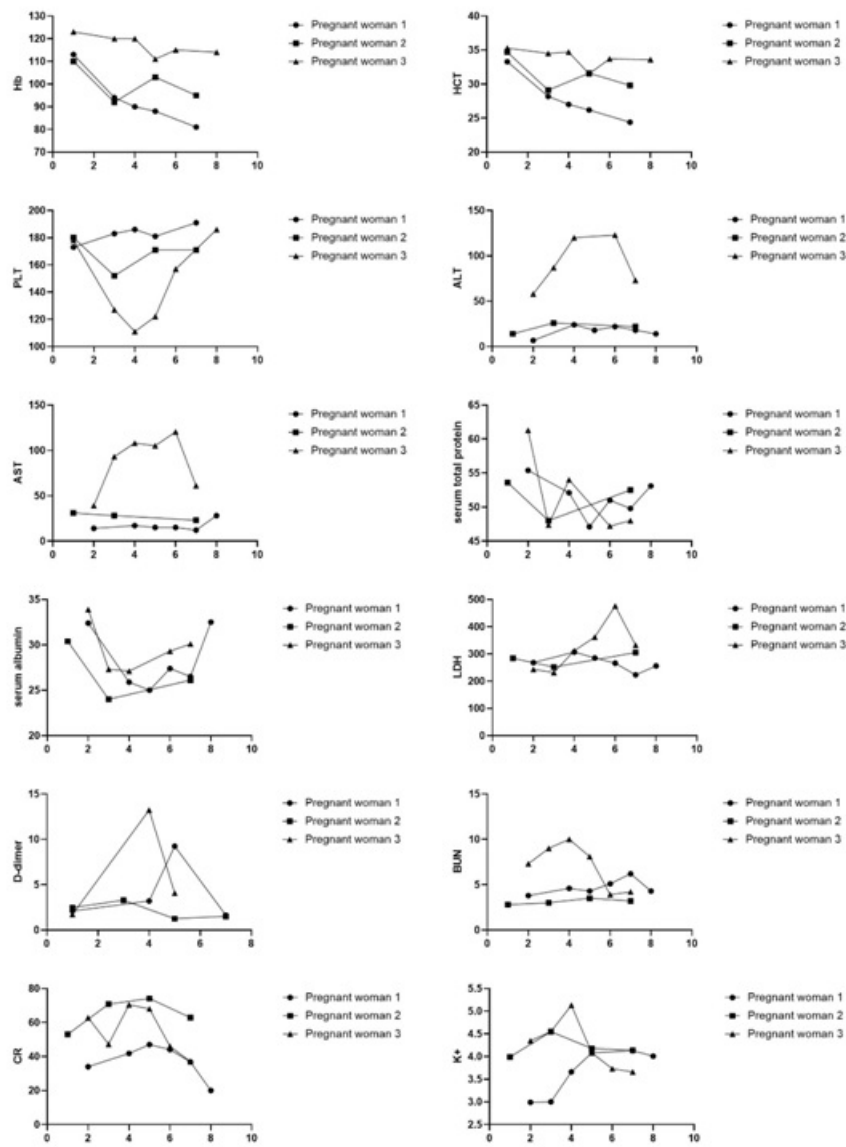

Figure 1: Scatter chart of the examination indicators on 3 pregnant women (horizontal coordinates: time; ordinates: test indicators).

Table 1: General information on 3 pregnant women

serial number	Age (years)	Weight (kg)	Pregnancy Week (Week)	The manner in which the pregnancy is terminated	Termination of pregnancy week (week)	Follow-up or not
Pregnant women 1	25	93	32+2	Cesarean	32+5	be
Pregnant women 2	34	76	39+6	Cesarean	39+6	be
Pregnant women 3	30	60	28+6	Cesarean	29+5	be

3.1. Blood System

Both pregnant women 1 and 2 had anemia. Although pregnant woman 3 did not have anemia before delivery, she still had anemia 2 days after delivery. Hb was found to decline before and after delivery and began to decline before delivery, extending until one week after delivery (Figure 1). HCT also showed a downward trend. The reasons for the decrease of Hb and HCT are as follows: anemia leads to myocardial hypoxia, which leads to the acceleration of the compensate heart rate, which leads to the increase of the pumping function of the heart and the occurrence of high-volume blood circulation of the heart. Thus, it aggravates the cardiac load and induces the occurrence of severe preeclampsia combined with heart failure [6, 7]. Therefore, we speculate whether we could predict the occurrence of severe preeclampsia combined with heart failure before the delivery when Hb of the patients with severe preeclampsia was decreasing. And at this time intervention and treatment of anemia could prevent the occurrence and development of heart failure timely and effectively.

3.2. Digestive System

The analysis of serum total protein and albumin of 3 pregnant women showed that serum total protein and albumin decreased before delivery and gradually increased after delivery. However, we specifically found that both serum total protein and albumin were lower than normal average before and after delivery (Figure 1), which confirms that serum total protein and albumin had been different from normal average before the symptoms of heart failure. The main reason for this phenomenon is that low protein leads to myocardial edema, increases cardiac load, and causes cardiac enlargement and hypertrophy, which leads to hypoxia of cardiac cells. It decreases cardiac compensatory function, and heart failure, which in turn leads to heart failure [8]. In addition, studies have shown that severe preeclampsia patients with hypoalbuminemia can edema through decidua, resulting in increased pressure between the uterine wall and placenta, accelerating the induction of placental abruption, and further increasing maternal and perinatal mortality. ALT and AST were opposite to the changes of serum total protein and albumin. ALT and AST in pregnant women 1 and 2 were in normal range, while ALT and AST in pregnant woman 3 were higher than normal average. ALT and AST of pregnant woman 3 were even more than twice the normal value during delivery (Figure 1). The analysis of the trend of three patients showed that ALT and AST both showed an upward trend before delivery, reached the peak value during delivery, and decreased one week after delivery. It proves that patients with severe preeclampsia had progressive liver function damage before heart failure occurred, and the damage reached the maximum during delivery. The change of LDH did not find a clear trend.

3.3. Urinary System

BUN and CR peaked during delivery. It means that they showed an upward trend before delivery, peaked during delivery, and showed a downward trend after delivery (Figure 1). This phenomenon indicates that kidney function is most damaged during delivery. Delivery increases blood volume throughout the body, and most of the excess metabolites are excreted by the kidneys under normal circumstances. When kidney failure occurs, the high blood volume leads to increased blood flow back to the heart and a heavier load on the heart, leading to heart failure and pulmonary edema. The changes of relevant indicators about liver and renal function before and after delivery remind that other systems throughout the body may be at risk of varying degrees of damage in the process of severe preeclampsia combined with heart failure.

D-dimer was found to be much higher than normal before and after delivery. It increased before delivery, peaked at delivery, and decreased one week after delivery (Figure 1). Elevated D-dimer levels indicate hypercoagulability or secondary hyperfibrinolysis. The elevation of D-dimer proves the presence of high coagulation or secondary fibrin dissolution of the euphoria. In the third trimester of pregnancy, the body is in a state of hyper coagulation, and the simple slight increase of D-dimer may be a physiological phenomenon. However, the D-dimer of the three patients all reached the peak during delivery, which proved that when D-dimer and fibrinolytic increased, the blood of patients with severe preeclampsia was in a state of continuous hyper coagulation, increasing the resistance of blood vessels. It aggravates myocardial ischemia and hypoxia, and also accelerates the process of heart failure. No significant changes were observed in Platelet Indicators (PLT).

3.4. Circulation System

Results of blood gas of the three patients showed that K+ peaked during delivery and gradually returned to normal after delivery (Figure 1). Severe preeclampsia can indirectly lead to intracellular K+ transfer to extracellular, affecting normal ion exchange in the heart. After the health function is impaired, blood stasis will con-

tinue to add the burden of the heart, thus triggering heart failure.

BNP and TnI were observed in three pregnant women except that both were far higher than the normal range (Figure 1). BNP is an indicator to evaluate atrial filling and ventricular function, while TnI is a combination of multiple markers of myocardial injury. Clinically, BNP and TnI are often used to assist in the diagnosis of heart failure, and to judge the severity and prognosis of the disease. It has been reported that there is little change on the left ventricular diastolic diameter of heart failure patients with retained ejection fraction, and the ejection fraction and cardiac function deterioration rate are higher with the increase of BNP. This conclusion suggests whether the change of ejection fraction could be combined to predict the possibility of heart failure in patients with severe preeclampsia [9].

Results of blood gas of the three patients with severe preeclampsia combined with heart failure after delivery were all in the normal range, and it did not find obvious trend. However, it has been reported that blood oxygen saturation (SpO2), CRP, NLR and other indicators in patients with severe preeclampsia combined with acute left heart failure were significantly different from those in the control group [2].

At the same time, through the strict measurement of the daily total amount of the three pregnant women on the operation day, the first day after the operation and the second day after the operation, we found that the output amount of the three pregnant women on the second day after the operation was far more than the input amount (Table 2). Water and sodium are stored in pregnant women before delivery due to the action of estrogen and aldosterone, but the reason for the obvious increase in the amount of water and sodium after delivery is still unclear. Through literature review and clinical experience, we reasonably indicate that the reasons for the significant increase in postpartum production were as follows: placenta delivery, uterine shrinkage, and there is a large amount of blood going into the systemic circulation; Placental hormones retreated, aldosterone and cortisol decreased, and the amount of inter-tissue fluid reabsorbing into systemic circulation increased. Circulating blood volume increases, the glomerular filtration rate increases, and sodium reabsorption decreases, as stored water and sodium during pregnancy are excreted through the kidneys.

Table 2: The daily total amount on 3 pregnant women on the operation day, the first day after the operation and the second day after the operation

serial number	date	Total incoming (ml).	Total out (ml).				out (ml).
			urine	lochia	feces	total	
Pregnant women 1	On the day of the operation	1740	1120	650	--	1770	30
	First day after the operation	2240	3760	531	--	4219	2051
	The day after the operation	3920	3850	68	70	3988	68
Pregnant women 2	On the day of the operation	1691	3130	460	c--	3590	1899
	First day after the operation	1999	3680	330	--	4010	2011
Pregnant women 3	On the day of the operation	1050	1700	200	--	1900	850
	First day after the operation	32.5	1000	80	--	1080	1047.5
	The day after the operation	30	500	--	--	500	470

In this study, three patients with severe preeclampsia combined heart failure were transferred to ICU after delivery. Thereby, their clinical and laboratory examination indicators were relatively systematic and comprehensive, and all three followed up to the various indicators returned to normal. However, there are still some limitations in this study, such as the limitation of the number of cases, individual differences among patients and the interaction between these indicators. Therefore, expanding the number of cases, reducing individual differences and interaction between samples are the main research objectives of the next step.

In summary, through retrospective analysis of the changes of the relevant clinical and laboratory examination indicators in three patients with severe preeclampsia combined with heart failure before and after delivery, this study found that Hb and HCT had always shown a downward trend before and after delivery. It had also been found that ALT, AST, BUN, CR, K+ and D- dimer are on the rise before delivery, peaking during delivery and decreasing after delivery. Furthermore, TnI, LDH, 24-hour urine protein quantification and mesh red blood cell count were significantly higher than normal. Therefore, we speculate that clinical and laboratory exam-ination indicators in patients with severe preeclampsia sometimes precede the appearance of signs and symptoms of heart failure, and have a clear trend. Timely detection of changes in the relevant clinical and laboratory examination indicators can effectively and timely predicts the decline of heart function, and then to avoid the occurrence of heart failure in pregnant women with severe pre-eclampsia.

References

1. Yang Yike QH. Key points of American Society of Obstetricians and Gynaecologists (ACOG) "Guidelines for Gestational Hypertension and Preeclampsia, 2019 edition" (Part I). Chinese Journal of Practical Gynecology and Obstetrics. 2019; 35: 895-9.

2. Liqun W, Qun X, Rui Y, Jie G, Pingsheng C. Changes of related indicators in severe preeclampsia complicating acute left heart failure. Journal of Wenzhou Medical College. 2019; 49: 533-7.

3. Wei Z. Pregnancy outcome in patients with early onset severe pre-eclampsia combined with low serum albumin. Hainan Medical Journal. 2020; 31: 1269-71.

4. Cui M. Clinical analysis of maternal and neonatal outcomes of dif-

ferent types of hypertensive disorder complicating pregnancy. Chinese Journal of Medicine. 2018; 53: 415-9.

5. Xuesu H. On 48 Cases of Severe Preeclampsia Combined With Heart Failure. Journal of Occupational Health And Damage. 2011; 26: 223-4.

6. Shaoqin L. Severe preeclampsia complicated with heart failure: a case report and literature review. World Health Digest. 2011; 8: 235-6.

7. Jianhua L. Obstetric management of pregnancy complicated with heart failure. Chinese Journal of Obstetric Emergency. 2017; 6: 65-9.

8. Qing L. Correlation between severe preeclampsia and hypoproteinemia. The Journal of Practical Medicine. 2007; 23: 2732-3.

9. Xu Zhijun WY, Zhao Xue. Study on the relationship between B-type natriuretic peptide and severe preeclampsia in hypertensive pregnant women. Chinese Journal of Emergency Medicine. 2013; 22: 1417-20.