Advances in Obstetrics and Gynecology Research, 2024, Volume 2, Issue 3
https://ojs.bbwpublisher.com/index.php/AOGR
Online ISSN: 2981-8060

Clinical Analysis of Serum Soluble Tyrosine Kinase Receptor-1 and Placental Growth Factor in Pre-eclampsia

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Abstract: *Objective:* To study the clinical application effect of using serum soluble tyrosine kinase receptor-1 (sFlt-1) and placental growth factor (PlGF) in pre-eclampsia. *Methods:* From September 2021 to September 2023, 58 cases of pre-eclampsia patients who underwent physical examination during pregnancy and eventually gave birth in Xinghua People's Hospital were the observation group of this study and 795 cases of healthy pregnant women who underwent pregnancy examination in this hospital during the same period of time were the control group of this study; 38 cases of mild pre-eclampsia in the observation group were treated as the mild group and 20 cases of severe pre-eclampsia patients were treated as the severe group and the serum sFlt-1 and PlGF were used to compare the results of the observation group and the control group. Compare the serum sFlt-1 and PlGF levels between the observation and control groups; compare the serum sFlt-1 and PlGF levels between the mild and severe groups. *Results:* The serum PlGF level of the observation group was lower than that of the control group, and the sFlt-1 level was higher than that of the control group, $P < 0.05$; the serum PlGF level of the mild group was higher than that of the severe group, and the sFlt-1 level was lower than that of the control group, $P < 0.05$; the results showed that the serum and urine sFlt-1 and PlGF levels of pregnant women of all the three groups were elevated with the aggravation of the condition of pre-eclampsia, and the sFlt-1/PlGF ratio also increased. The differences of sFlt-1/PlGF in serum and urine of the three groups were compared, with $P < 0.05$; the above ratios of the patients in the mild group were higher than those of the control group and those of the severe group were higher than those of the mild group, with $P < 0.05$. *Conclusion:* Serum sFlt-1 level was high in preeclamptic patients, while serum PlGF was low in preeclamptic patients.

Keywords: Pre-eclampsia; Serum soluble tyrosine kinase receptor-1; Placental growth factor

Online publication: July 22, 2024

1. Introduction

Pre-eclampsia is a common complication of pregnancy and its pathogenesis has not been fully clarified. In recent years, some studies have shown that serum soluble tyrosine kinase receptor-1 and placental growth factor are abnormally expressed in the serum of patients with pre-eclampsia. Soluble tyrosine kinase receptor-1 is an

important cell signaling molecule involved in the regulation of cell growth, differentiation and apoptosis. In patients with pre-eclampsia, its serum expression level may be affected by a variety of factors, such as vascular endothelial cell injury and inflammatory response [1]. The placental growth factor is a cytokine secreted by placental cells and is involved in placental vascularization and nutrient delivery [2]. Some studies have shown that the expression level of placental growth factor (PlGF) is reduced in patients with pre-eclampsia, which may affect placental function and lead to complications such as intrauterine fetal growth retardation. Therefore, the placental growth factor can be used as one of the indicators to assess placental function in patients with pre-eclampsia. Due to the important roles of sFlt-1 and PlGF in the pathogenesis of pre-eclampsia, the joint detection of the levels of these two biomarkers may contribute to a more comprehensive understanding of the pathophysiologic process of pre-eclampsia. Therefore, related scholars have suggested the joint detection of sFlt-1 and PlGF to assess the diagnosis of pre-eclampsia [3]. Specifically, an individualized treatment plan can be formulated by detecting the concentrations of these two factors in the patient's serum and combining them with the patient's clinical manifestations and signs.

2. Information and methods

2.1. General information

Fifty-eight patients with pre-eclampsia admitted to Xinghua People's Hospital were selected as the observation group of this study, while 795 healthy pregnant women were selected as the control group of this study, all of which were examined between 09/2021 and 09/2023. Age of observation group: 21–41 years old, mean 30.54 ± 3.27 years old. Age of control group: 22–40 years old, mean 30.29 ± 3.18 years old. The general data of the 2 groups satisfied the statistical difference ($p > 0.05$). The patients in the observation group were divided into a mild group and a severe group according to the severity of the disease, with 38 cases in the mild group and 20 cases in the severe group.

2.2. Methods

All subjects were collected with their fasting vein blood 3 mL, after blood coagulation, centrifuged at a rate of 3000 r/min for 10 min, separated serum, and placed in the environment of -70 ℃ to be examined. PlGF and sFlt-1 are determined through an electrochemiluminescence instrument (model: Shine i1910 Ningbo Ao Cheng Biotechnology Co., Ltd.). The corresponding procedures were carried out in strict accordance with the instructions, using the corresponding reagents; the coefficients of variation within and between batches were 4.3% and 5.2% for the PlGF kit and 4.5% and 5.5% for the sFlt-1 kit, respectively.

2.3. Observation indicators

(1) Serum PLGF and sFlt-1 levels in the observation and control groups.
(2) Serum PLGF and sFlt-1 levels in the mild and severe groups.
(3) Serum and urine sFlt-1/PLGF ratio of the three groups.

2.4. Statistical methods

SPSS 23.0 statistical software was used to process the data of this study. Mean ± standard deviation (SD) indicates measurement, *t*-test; (*n*, %) indicates counting, χ^2 test, $P < 0.05$ indicates that there is a statistical difference in data comparison.

3. Results

3.1. Serum PlGF and sFlt-1 levels in the observation group and control group

Compared with the control group, the serum PlGF level of the observation group was significantly lower, while the sFlt-1 level was significantly higher, as shown in **Table 1**.

Table 1 Comparison of serum PlGF and sFlt-1 levels between the observation group and the control group (Mean ± SD, pg/mL)

Group	Serum PlGF	Serum sFlt-1
Observation group (n = 58)	269.41 ± 68.73	4925.56 ± 1738.31
Controls group (n = 795)	518.36 ± 147.82	2236.78 ± 862.54
t	23.853	11.676
P	0.000	0.000

3.2. Serum PlGF and sFlt-1 levels in the mild and severe groups

Compared with the mild group, the serum PlGF level was significantly lower and the sFlt-1 level was significantly higher in the severe group, as shown in **Table 2**.

Table 2 Comparison table of serum PlGF and sFlt-1 levels in the mild and severe groups (Mean ± SD, pg/mL)

Group	Serum PlGF	Serum sFlt-1
Mild group (n = 20)	367.41 ± 165.45	3645.42 ± 1036.74
Severe group (n = 38)	158.76 ± 71.59	6438.78 ± 2315.68
t	5.381	6.328
P	0.000	0.000

3.3. Serum and urine sFlt-1/PlGF ratio in the three groups

The differences of sFlt-1/PlGF in serum and urine of the three groups were compared, with $P < 0.05$; the above ratios of the patients in the mild group were higher than those of the control group, and the above ratios of the severe group were higher than those of the mild group, with $P < 0.05$, as shown in **Table 3**.

Table 3 Serum and urine sFlt-1/PlGF ratios of the three groups

Group	Serum sFlt-1/PlGF	Urine sFlt-1/PlGF
Control group (n = 795)	5.12 ± 2.39	8.77 ± 4.03
Mild group (n = 20)	9.58 ± 4.35*	35.26 ± 12.78*
Severe group (n = 38)	45.17 ± 19.81†	132.54 ± 71.59†

Note: Comparing the mild group with the control group, *$P < 0.05$; comparing the severe group with the mild group, $^{\dagger}P < 0.05$.

4. Discussion

The main symptoms of pre-eclampsia include hypertension and proteinuria. Blood pressure is usually elevated and may exceed 140/90 mmHg. Proteinuria is an increase in protein in the urine and is a sign of hypertension [4]. Pre-eclampsia has serious implications for the health of the mother and child. For pregnant women, it can lead

to serious complications such as eclamptic seizures, heart failure, renal failure, placental abruption and even life-threatening. For fetuses and newborns, pre-eclampsia can increase the risk of adverse outcomes such as fetal growth restriction, preterm labor, fetal distress and neonatal asphyxia, which can seriously affect fetal growth and development and quality of survival. Therefore, timely diagnosis and treatment are very important. Currently, clinical diagnosis of pre-eclampsia mainly relies on symptoms, signs and imaging; however, these methods often have limitations. Therefore, finding new biomarkers is important to improve the accuracy of pre-eclampsia diagnosis [5].

Changes in the level of sFlt-1, a tyrosine kinase receptor on the surface of vascular endothelial cells, are closely related to the pathogenesis of pre-eclampsia. When the level of sFlt-1 is elevated, it may imply the exacerbation of the process of vascular endothelial cell injury and inflammatory response, which is an important part of the pathogenesis of pre-eclampsia [6,7]. On the other hand, PlGF is a growth factor that promotes angiogenesis, and its reduced levels may lead to insufficient angiogenesis and endothelial cell dysfunction. In patients with pre-eclampsia, PlGF levels tend to be lower than those of normal pregnant women. Therefore, by detecting the level of PlGF, it is possible to understand patients' angiogenesis and endothelial cell functional status. Combined detection of the two indicators, sFlt-1 and PlGF, can provide a more comprehensive understanding of the pathophysiological past of pre-eclampsia and develop a more personalized treatment plan [8]. For example, for patients with elevated sFlt-1, anti-inflammatory and vascular endothelial cell-protecting therapeutic measures can be taken; for patients with reduced PlGF levels, therapeutic methods to promote angiogenesis and improve endothelial cell function can be taken [9]. sFlt-1 and PlGF show specific changes in pre-eclampsia and this uniqueness makes the combined detection of the two a key tool to improve the diagnostic accuracy of pre-eclampsia. This uniqueness makes the combined detection of sFlt-1 and PlGF a key tool to improve the accuracy of pre-eclampsia diagnosis. Close monitoring of sFlt-1 and PlGF levels can also effectively assess the severity of pre-eclampsia and provide an important basis for the prediction of adverse pregnancy outcomes, thus supporting clinical treatment. In clinical practice, fully recognizing and utilizing these properties of sFlt-1 and PlGF in pre-eclampsia will bring great benefits to the diagnosis, condition assessment and subsequent treatment of patients and will help to protect the health and safety of mothers and infants [10]. This study used electrochemiluminescence to measure sFlt-1 and PlGF levels in serum samples from preeclamptic patients and normal pregnant women. By analyzing the data, the study compared the levels of these two indicators in the serum of preeclamptic patients and normal pregnant women. The findings showed that in patients with pre-eclampsia, sFlt-1 levels were significantly higher than in normal pregnant women ($p < 0.05$); serum PlGF levels were higher in patients with mild pre-eclampsia than in the severe group ($p < 0.05$), and sFlt-1 levels were lower than those of the severe group ($p < 0.05$); and serum sFlt-1 levels in patients with severe pre-eclampsia were generally higher than those of patients with mild pre-eclampsia. This finding suggests that the serum-soluble tyrosine kinase receptor-1 may play an important role in the development of pre-eclampsia. sFlt-1 is an important biomarker that may be closely related to the placenta's physiological function, the fetus's health status and the severity of the condition. Therefore, in patients with severe pre-eclampsia, changes in serum sFlt-1 levels may predict the severity and prognosis of the condition. On the other hand, serum PlGF levels were generally lower in patients with severe pre-eclampsia than in those with mild pre-eclampsia. PlGF is a growth factor closely related to fetal growth and development, and it may play a regulatory role in the development of pre-eclampsia. Therefore, doctors may develop appropriate treatment plans based on their serum PlGF levels to help improve their condition and promote fetal growth and development for this group of patients.

In recent years, it has been found that sFlt-1/PlGF levels are closely associated with the risk of developing pre-eclampsia and that the sFlt-1/PlGF ratio may predict the onset of pre-eclampsia earlier than the appearance

of clinical symptoms in terms of blood pressure, urinary protein. The results of this article showed that compared with normal pregnant women, the serum and urine sFlt-1/PlGF ratios were significantly higher in patients with mild pre-eclampsia, and the sFlt-1/PlGF ratios in patients with severe pre-eclampsia were significantly higher than those in patients with mild pre-eclampsia and the differences were statistically significant, which suggests that the degree of elevation in the sFlt-1/PlGF ratio correlates with the severity of the disease. This indicates that the elevated sFlt-1/PlGF ratio correlates with the severity of the disease and also suggests that the sFlt-1/PlGF ratio has some application value in identifying mild and severe pre-eclampsia. Because the etiology of pre-eclampsia is unclear and the disease progresses rapidly, there is no ideal laboratory indicator that can accurately predict the risk of pre-eclampsia. Therefore, the discovery of serum and urine PlGF and sFlt-1 and sFlt-1/PlGF ratio undoubtedly provides us with a new idea and method that has a broad application prospect. Meanwhile, the specimens of urine PlGF, sFlt-1 and sFlt-1/PlGF are easy to retain and non-invasive, which is more acceptable to patients. Therefore, the changes on serum sFlt-1 and PlGF in pre-eclampsia have clinical diagnostic value. Combined testing of these two indexes can help improve the diagnostic accuracy of pre-eclampsia and provide strong support for the evaluation of the condition and the prediction of adverse pregnancy outcomes. The monitoring of serum sFlt-1 and PlGF levels can provide guidance for the treatment strategy of pre-eclampsia. Future studies may further explore the specific mechanisms of sFlt-1 and PlGF in the pathogenesis of pre-eclampsia, as well as individualized treatment strategies for different patient groups.

In summary, serum sFlt-1 and PlGF levels play a role in the onset and development of pre-eclampsia and are closely related to the severity of the disease. These indicators may become effective tools for early diagnosis and condition assessment of pre-eclampsia and are expected to become predictive and monitoring indicators of pre-eclampsia.

Disclosure statement

The author declares no conflict of interest.

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