Diagnostic value of CT perfusion imaging parameters combined with D-dimer and lipoprotein-associated phospholipase A2 in ischemic stroke

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Introduction. To analyze the clinical value of combined detection of lipoprotein-associated phospholipase A2 (Lp-PLA2) and D-dimer (D-D) in the diagnosis of ischemic stroke.
Methods. 50 patients with ischemic stroke were selected as the observation organize and 50 healthy subjects as the control organize. Lp-PLA2 and D-D standardss were compared between the two organizes. ROC curve was drawn to analyze the diagnostic efficacy of Lp-PLA2, D-D and their combination in ischemic stroke.
Results. The standardss of Lp-PLA2 and D-D in observation organize were higher than those in control organize ($P < 0.05$). ROC curve showed that the area under the curve of Lp-PLA2, D-D and the combination of the two in the diagnosis of ischemic stroke were 0.833, 0.784 and 0.948, respectively, and the combined detection had the highest diagnostic efficiency.
Conclusion. Lp-PLA2 and D-D combined detection can improve the diagnostic sensitivity and specificity of ischemic stroke, and has high application value.
Keywords. ischemic stroke; Lipoprotein-associated phospholipase A2; D-dimer; Diagnostic value; Combined detection

INTRODUCTION

Acute ischemic stroke refers to a series of nerve tissue functional deficit syndrome caused by cerebral artery thrombosis, embolus shedding or hemodynamic change, which leads to cerebral tissue ischemic anoxic necrosis. Therefore, early active vascular opening, restoration of corresponding blood supply and treatment of ischemic penumbra are the keys to the diagnosis and treatment of acute cerebral infarction. At present, intravenous thrombolysis and intravascular therapy are the proven standard treatments for saving ischemic penumbra. It is pointed out that the intensity of endovascular therapy has increased compared with the past. In the randomized large controlled clinical trial Liming Study and the Disul-3 study, it is pointed out that patients with anterior circulation large vessel occlusion whose treatment time window is extended to 6 to 24 hours can be treated after rigorous imaging screening such as CT and MRI. The patients received endovascular therapy and benefited from it. With the continuous development of endovascular therapy technology, the vascular revascularization rate is higher than before [1-2], but in clinical treatment, there are still patients who have failed to achieve vascular opening. In order to evaluate the improvement degree and therapeutic effect of cerebral ischemia and hypoxia after endovascular therapy for patients, and predict the prognosis of AIS endovascular therapy... It is a hot topic of research. Mile et al. first proposed the

definition of CTP in 1991 using computed tomography (CT). CTP can reflect the information of brain tissue blood perfusion, cerebral hemodynamic changes, cerebral ischemia degree and other aspects of brain function. CTP technology refers to intravenous injection of iodine contrast agent, and carry out continuous scanning on the selected layer to obtain the inch of each pixel in the layer. The commonly used CT perfusion parameters are as follows: BF, BV, MTT, peak time of ij (TTP), etc., and CTP is used to analyze parameters CBF and CBV The changes of MTT and TTP in the disease can reflect the location and scope of ischemic lesions in the very early stage of ischemic stroke. It is of great value to evaluate the ischemic penumbra of acute ischemic stroke, reflect the blood perfusion of ischemic brain tissue, evaluate collateral circulation and guide the best personalized diagnosis and treatment plan, and can also predict the hemorrhage transformation after cerebral infarction CT perfusion imaging can evaluate the reperfusion status of patients with thrombolysis or intravascular therapy, and predict the degree of cerebral ischemia in patients with acute cerebral infarction and the improvement of postoperative ischemia, which has important clinical significance for judging the postoperative efficacy.

Plasma D-dimer (D-D) is a degradation product with specificity, which is produced by cross-linking Fibrinogen (FIB) after activation and then hydrolysis by fibrinolytic enzyme [3]. Studies have shown that increased plasma D-D standards is associated with increased risk of adverse prognosis and death, and is also associated with infarct size and progressive cerebral infarction in AIS patients [4]. Fibrin(ogen) degradation products (FDP) are degradation products of FIB and fibrin. When the primary and secondary fibrinolytic system is hyperactive, FDP will also specifically increase. It is commonly used as an index to detect the blood fibrinolytic coagulation balance in patients. A retrospective study of 266 patients with AIS showed that persistently elevated plasma FIB standardss were associated with poor prognosis. Some studies have shown that plasma D-D and D-D/FIB are used as indicators to judge thrombosis when AIS, acute pulmonary embolism and deep vein thrombosis occur [5]. However, whether the ratio of plasma D-D to FDP (D-D/FDP) can also be used as an indicator of AIS needs to be explored through a large number of basic studies and clinical trials.

The main purpose of using intravenous thrombolytic drugs is to make the narrow or occlusive blood vessels unobstructed, so as to improve cerebral ischemia and save the ischemic penumbra around the core infarction area of AIS. A domestic prospective randomized controlled study showed that the effective rate of intravenous thrombolysis in AIS patients was 81.67%. Although most AIS patients with intravenous thrombolytic drugs can achieve good functional outcomes, there are still a small number of patients whose symptoms have not been significantly improved, resulting in poor short-term prognosis and reduced quality of life. Plasma D-D is a specific degradation product of fibrinolytic cross-linked fibrin. Studies have shown that changes in plasma D-D standards in human body can directly reflect the hypercoagulability and fibrinolysis degree in human body, and it is the most valuable indicator for observing fibrinolysis after intravascular thrombosis, with high

sensitivity and specific prediction value [6]. In a retrospective cohort study of 22 AIS patients treated with warfarin, plasma D-D standardss were positively associated with infarct volume, severity, and functional outcome. Another study included 90 AIS patients in the observation organize and 65 healthy subjects in the control organize [7]. In a prospective cohort study of 191 patients suspected of acute pulmonary thrombosis (85 positive and 96 negative), plasma D-D and D-D/FIB standardss were significantly higher in patients with acute pulmonary embolism. Moreover, further studies found that the positive rate of D-D/FIB diagnosed with acute pulmonary embolism was 2 times higher than that of plasma D-D. Plasma D-D has been a commonly used index for detecting coagulation and fibrolysis function in clinical practice, which is of great value in judging thrombosis. More and more studies have shown the relationship between plasma D-D and functional outcomes in AIS patients.

Ischemic stroke is a common clinical cerebrovascular disease with rapid onset and rapid progression. If not treated in time, it can seriously damage the neurological function of patients and even threaten the life safety of patients. Therefore, in order to effectively improve the prognosis of patients with ischemic stroke, it is of great clinical significance to take effective measures to diagnose patients with such diseases as soon as possible. Lipoprotein-associated phospholipase A2 (Lp-PLA2) is a phospholipase, which has the function of hydrolyzing and oxidizing phospholipids, and is closely related to the body's inflammatory response. Relevant studies [8-9] have shown that plasma Lp-PLA2 standards or activity can be used as an independent predictor of ischemic stroke risk. D-dimer (D-D) is a degradation product of fibrin, which can reflect the hypercoagulability and hyperfibrinolysis of the body. Relevant studies [10-11] have shown that the standards of D-D in peripheral blood of patients with ischemic stroke is significantly increased, and is closely related to the severity of stroke. In view of this, this study analyzed the clinical value of Lp-PLA2 and D-D combined detection in the diagnosis of ischemic stroke, as reported below.

1. DATA AND METHODS

1.1 General Information

Fifty patients with ischemic stroke admitted to our hospital from January 2021 to December 2022 were selected as the observation organize. Inclusion criteria: Met the diagnostic criteria for ischemic stroke and confirmed by MRI, CT and other examinations; First onset; Hospital admission within 48 hours of onset; Patients and their families gave informed consent to the study. Exclusion criteria: accompanied by severe extracerebral injury; Those with mental illness; The presence of severe malnutrition; Poor cardiopulmonary function; Accompanied by malignant tumor; The blood clotting system is deficient. Another 50 healthy subjects who underwent physical examination in our hospital during the same period were selected as the control organize.

1.2 Detection Methods

All subjects collected 5mL of fasting venous blood in the morning, centrifuged the serum and placed it in a -80℃ refrigerator to be measured. Lp-PLA2 was determined by continuous monitoring method, the instrument was Abbott C16000 biochemical analyzer, and the reagent was Suzhou Boyuan Lp-PLA2 detection kit. D-D was determined by immunoturbidimetry, and the instrument was selected by Wulfen ACL-TOP750 automatic coagulation analyzer with supporting reagents. All operations are carried out in strict accordance with laboratory requirements and kit instructions.

1.3 Observation Indicators

Serum Lp-PLA2 and D-D standardss were compared between the two organizes, and ROC curves were drawn to analyze the diagnostic efficiency of Lp-PLA2, D-D and their combination.

1.4 Statistical Processing

SPSS22.0 was used to analyze the data. Measurement data were expressed as x±s and t test was adopted. The ROC curve was drawn and the area under the curve (AUC) was calculated. AUC value > 0.9 indicated high diagnostic efficiency, 0.71 ~ 0.9 indicated good diagnostic efficiency, and 0.5 ~ 0.7 indicated poor diagnostic efficiency. $P < 0.05$ was considered statistically significant.

2 RESULTS

2.1Lp-PLA2 and D-D standardss

The standardss of Lp-PLA2 and D-D in observation organize were higher than those in control organize ($P < 0.05$). See Table 1.

Table 1 Comparison of Lp-PLA2 and D-D standardss between the two organizes (x±s)

organize	Number of cases	Lp-PLA2（ng/mL）	D-D（mg/L）
Observation organize	50	235.74±18.88	1.22±0.22
Control organize	50	111.14±10.36	0.33±0.03
T-value		49.221	60.060
p-value		0.000	0.000

2.2 Diagnostic value

ROC curve showed that the area under the curve of Lp-PLA2, D-D and their combination in diagnosing ischemic stroke were 0.833, 0.784 and 0.948, respectively, and the combined detection had the highest diagnostic efficiency. See Table 2 and Figure 1.

Table 2Diagnostic value of LP-PLA2, D-D and their combination in ischemic stroke

index	AUC	95%CI	Optimum cutoff value	specificity	sensitivity
Combination of the two	0.948	0.877~0.977	/	0.866	0.933
Lp-PLA2	0.833	0.755~0.912	171.44	0.766	0.866
D-D	0.784	0.717~0.871	0.722	0.755	0.815

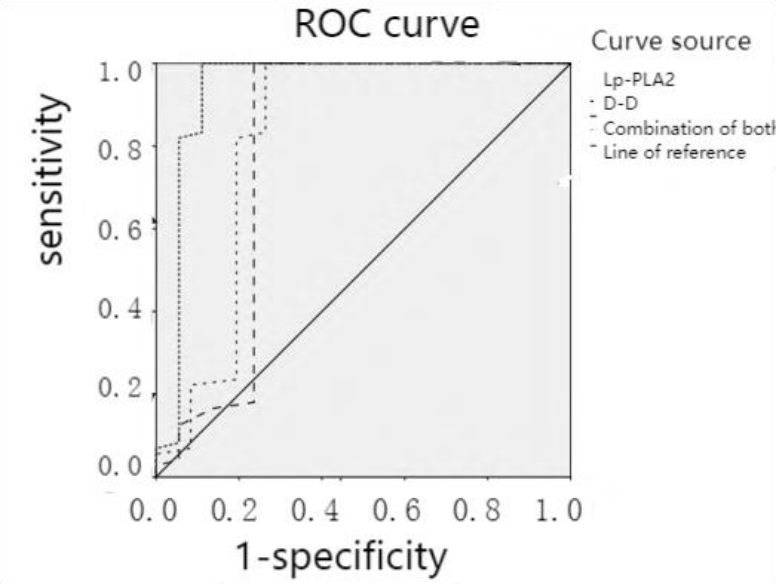

Figure 1 ROC curve of LP-PLA2, D-D and their combination in the diagnosis of ischemic stroke

3 DISCUSSION

3.1 AIS and D-dimer (D-Dimer, D-D)

Plasma D-D is the final degradation product rich in fibrin produced by crosslinked fibrin under the action of plasminase. It has become a simple method to detect the dynamic equilibrium state of coagulation and anticoagulation mechanism, and can be used to rule out the diagnosis of venous thromboembolism. The study on the relationship between AIS acute stage and D-D standards has been a hot topic for doctors and scholars. In a foreign prospective cohort study, there were 30 patients with cerebral infarction in the observation organize and 10 healthy people in the control organize. The results showed that plasma D-D concentration standardss in the acute stage of AIS in the observation organize and the control organize were 372.53±114.69 ng/mL and 142±17.81 ng/mL, respectively, $P < 0.05$. The plasma D-D concentration standards was significantly increased in the acute stage of AIS [12]. A domestic study showed that plasma D-D concentration in AIS was significantly higher than that in control organize in acute stage. This indicates that in the acute stage of AIS, blood flow in the local vascular stenosis is slow, coagulation factors are activated, and blood is in a state of hypercoagulation and low fibrinolysis, which is more likely to form thrombus.

In a foreign study that evaluated the relationship between plasma D-D standards and infarction volume in 59 AIS patients upon admission, the results showed that the mean plasma D-D concentration standards was 215.3μg/L (77-497μg/L) in patients with focal infarction and 385.7μg/L (161-819μg/L) in patients with multiple embolic infarction at admission. The infarct volume was 566.2μg/L (96-2098μg/L) in patients with 1-19cc, (668.8-4752μg/L) in patients with 20-49cc, and 702.5μg/L

(248-1991µg/L) in patients with 50-199cc. Patients with 5200cc infarct volume had 844.0µg/L, $P < 0.05$, indicating that plasma D-D standards was positively correlated with infarction volume, and plasma D-D concentration standards could be used to predict AIS infarction volume. Another foreign study showed that in 124 AIS patients with nonvalvular atrial fibrillation (NVAF), infarction volume measured by CT 3±1 day after onset was significantly correlated with admission plasma D-D standardss. A domestic study showed that plasma D-D standardss increased with the increase in infarct volume. The infarct size in the acute stage of AIS is closely related to the plasma D-D concentration standards, and the higher the plasma D-D concentration standards, the larger the infarct volume may be. However, contrary results were found in another prospective study abroad. The reasons for the different research results may be as follows: 1. There are differences in the detection methods of plasma D-D standards in the studies; 2. Lack of dynamic monitoring of the relationship between plasma D-D standards and infarct size; 3. There was no detailed organizeing of plasma D-D standards and infarct size in the AIS organize, and further correlation analysis between plasma DD standards and infarct size in the AIS organize was lacking.

In several studies, elevated plasma D-D standardss have also been shown to be associated with early clinical progression and poor prognosis. Another foreign study showed that plasma D-D standardss at admission in 124 AIS patients were significantly correlated with functional outcomes after cardiogenic stroke in patients with nonvalvular AF. A foreign study showed that plasma DD standardss were higher in the organize of cardiogenic cerebral embolism than in the organize of large atherosclerosis and lacunar infarction.

These results indicate that the incidence of cardiogenic cerebral embolism is significantly related to the increase of plasma D-D standards. In combination with the above literature, it is suggested that plasma D-D standards may increase in the acute stage of AIS, among which the increase of plasma D-D standards is more obvious in cardiogenic cerebral embolism, and the increase standards is positively correlated with the volume and area of AIS infarction. Detection of plasma D-D standards is of guiding significance in the diagnosis, treatment and secondary prevention of AIS.

Acute ischemicstroke (acuteischemicstroke AIS) refers to tissue necrosis due to insufficient blood supply to the brain caused by a variety of diseases, which is manifested by a series of symptoms of impaired nerve tissue function. The incidence of acute ischemic stroke is high, accounting for more than 69% of cerebral stroke, and its morbidity and disability rate, complications and mortality are extremely high. Therefore, it is the core focus of research to make clear diagnosis early in clinical practice, strive for timely and effective treatment, and minimize the scope of ischemic necrosis. In clinical diagnosis and treatment, computed tomography is the first step in the diagnosis of acute stroke, and CT plain scan first excludes hemorrhagic stroke in the diagnosis of acute cerebral infarction, and reflects the initial signs of ischemic stroke, but the degree of ischemic anoxic necrosis of ischemic brain tissue and the patency of blood supply arteries cannot be judged. Station CT imaging can better

evaluate the condition of patients and provide better diagnosis and treatment plan, thus providing help for the diagnosis and treatment and prognosis assessment of acute ischemic stroke.

3.2 Cerebral CT perfusion imaging scan

CT perfusion imaging was first proposed by Mi et al., 1991, using computed tomography (CT) and computer software imaging processing, mainly as functional imaging indicators. In the early stage,CT perfusion imaging was mostly used in functional imaging of myocardial perfusion and tumor efficacy detection, and its cost was lower than that of magnetic resonance perfusion weighted imaging (perfusion weighted imaging, early warning indicator) Fast tracing, can not use reflective isotopes and other characteristics. CT perfusion imaging technology refers to intravenous injection of contrast agents. At the same time, multiple scans are carried out on the selected layer to obtain the time-density curve of each pixel in the layer, and various perfusion parameter values are calculated using mathematical models. Commonly used parameters are as follows: mean time of contrast agent (MTT), time of peak of contrast agent (TTP), and cerebral blood volume are not specified [13] There is blood volume in the vascular structure of brain tissue per unit time, and cerebral blood flow (CBF) refers to the blood flow flowing through a certain vascular structure of brain tissue per unit time. With the progress of computer technology,CT perfusion imaging has gradually been widely used in clinical work and research, and is often used in cerebral ischemia and tumor diseases, especially in ischemic cerebrovascular diseases.

3.3 Application of CT perfusion imaging in acute ischemic stroke

Evaluation of ischemic penumbra: Acute ischemic stroke is a cerebral nerve function defect caused by cerebral tissue ischemia and hypoxia due to various reasons. The main focus of acute ischemic stroke is to save the ischemic penumbra of ischemia and hypoxia within a super time window, narrow the infarct and save reversible brain tissue. Acute cerebral infarction includes ischemic penumbra and central necrotic area, whose ischemic penumbra is a dynamic process that changes with the ischemia and hypoxia of brain tissue. HakimM interpreted the ischemic penumbra (IP) as indicating that the ischemic hypoxia of brain tissue is reversible. If the blood supply of ischemic penumbra can be restored in a short time, the damaged nerve cells may survive and restore the function of nerve cells The focus of cerebral ischemia treatment is to save the ischemic penumbra as soon as possible, then the focus of the problem is the determination of the ischemic penumbra. ct perfusion imaging can assist in determining the ischemic penumbra in the central area of necrosis and surrounding necrosis. Early and accurate determination of the location and scope of the necrotic central area and ischemic penumbra area is helpful to identify the patients who may benefit from restoring ischemic penumbra blood supply, assist in guiding individual thrombolysis or intravascular therapy, improve the treatment rate of patients and improve the prognosis.

The key point of acute cerebral infarction treatment is to save ischemic penumbra, and the key of early thrombolytic therapy is to judge the existence of

penumbra. Studies have shown that mismatch and contrast are often used as two methods to determine ischemic penumbra. The unmatched method refers to the penumbra area in which the CBF decreased significantly but the CBV did not maintain normal or abnormal slight increase in the brain. The contrast method was to compare the abnormal CTP areas with MRI. The areas with reduced perfusion but not final infarction were penumbra areas. In theory, the latter can judge penumbra more accurately. However, because the penumbra threshold is not recognized by the comparison method, the current mismatch method has more practical application value. Mmphy et al. studied 30 patients with 7-h ischemic stroke and proposed that the mismatched method to determine the penumbra was highly sensitive and accurate. Hot spots of CT perfusion imaging in acute ischemic stroke..... It is a reference threshold measurement for penumbra evaluation, and the absolute values of CBV and CBF vary greatly due to the differences in mathematical operation models and imaging related technologies in the study. Scholars Bivard et al. found that different deconvolution techniques used by different software packages differ significantly in calculating volume. According to the study of scholars Campbell et al., cbv0 is not the best predictor for predicting the core volume of cerebral infarction, and delay time (DT) can also be used to calculate the core volume of cerebral infarction. The ischemic penumbra was evaluated using CTP parameter peak time > 6 s in a randomized large trial resolution 3 Studies have shown that the free threshold method can be used to predict the volume of infarction and the prediction of cerebral infarction in the core area of infarction. Clinical studies have shown that whether there is reversible brain tissue around the infarct lesion in patients with acute cerebral infarction confirmed by examination can make up for the limitations of thrombolysis within 6 hours by identifying the "thrombolytic time window" to guide patients' thrombolytic therapy In this study, 30 cases with ischemic penumbra were examined by CT perfusion imaging and compared with intravenous thrombolysis in the time window h) 30 patients can still benefit from intravenous thrombolysis [14]. Scholar Henry et al. [15] under the guidance of CT perfusion imaging, the therapeutic window of alteplase thrombolysis can be extended to patients with cerebral tissue showing ischemia at the time of imaging but not yet infarcted (9 hours after stroke). Under the guidance of CT perfusion imaging,CT perfusion imaging is currently an important examination method for diagnosing ischemic penumbra blood supply in patients with acute cerebral infarction, which can detect reversible ischemic brain tissue in the early stage of ischemic changes. It is particularly important to guide early venous thrombolysis or vascular opening, so as to restore ischemic penumbra blood supply as soon as possible and improve the functional symptoms of damaged nerve cells. Relevant studies have confirmed [16] that guided reperfusion therapy improves the functional prognosis of AIS patients and increases the benefits for patients undergoing intravascular thrombectomy.

Evaluation of collateral circulation: The collateral circulation of the brain varies greatly between individuals due to factors such as development. There are many imaging examinations to evaluate collateral circulation, which are generally judged

clinically by CT angiography, magnetic resonance angiography, cerebrovascular angiography and other methods. For patients with acute cerebral infarction, early successful reperfusion and good collateral circulation are closely related to the clinical outcome after intravenous thrombolysis and intravascular therapy. Studies have suggested that whether the collateral circulation of the brain is well compensated and whether there is ischemic penumbra in acute ischemic stroke and the size of the infarct core are very important. The collateral circulation of the brain refers to when the supplying artery is narrow or blocked. Other cerebral blood vessels can reach the ischemic area through the anastomotic pathway between blood vessels, so that the ischemic brain tissue can get the corresponding perfusion. The collateral circulation mainly consists of three standardss: the first standards is Willis ring, the second standards is ocular artery, the first standards is pia collateral branch, and the third standards is new capillaries. At present, the gold imaging standard in clinical evaluation of collateral circulation is digital cerebrovascular angiography, but clinical improvement may prolong the treatment time of acute ischemic stroke, and it can also quantitatively reflect the condition of collateral circulation in CT perfusion imaging under certain circumstances [17]. Due to the long return of compensatory blood flow in the collateral circulation and changes in blood flow factors, studies have found that cerebral blood perfusion An important parameter of "mean delay time MTT" is an independent risk factor for predicting acute ischemic stroke. Burton's views are consistent with Kheradmand et al., both of which indicate that TTP prolongation has high sensitivity. Related clinical studies [18] have shown that there is a correlation between the circulation of the lateral branches of the brain evaluated by the regional pilimeningeal collateral branch (rLMC-M) in CTP imaging There is a clear correlation between the volume of progressive infarction and the clinical prognosis of patients with acute anterior circulation great artery occlusion before and after thrombectomy, and its independent influencing factor is the small ninth volume of progressive core infarction with good collateral circulation. Therefore, the evaluation of collateral circulation is helpful to guide the screening of patients with acute ischemic stroke who may benefit from endovascular therapy. No relevant studies have found that CBV is one of the indicators to evaluate the collateral circulation compensation of patients in non-perfusion CT imaging, and the low perfusion intensity ratio of automated cranial CTP can also better evaluate the collateral circulation compensation [19],Arenillas et al Studies have shown that CBV is currently a good indicator for evaluating collateral circulation compensation, and CBV with a number less than 0.7 indicates good collateral circulation, slow progression of ischemic core infarction area, and greater possibility of recovery of ischemic penumbra around the infarction core.

Application in the diagnosis of transient ischemic attack (TIA) : TIA is a sudden, transient and reversible neurological impairment. Attacks usually complete recovery within half an hour, the duration is short, but rarely can be abnormal on CT and MRI. The diagnosis of TIA often lacks relevant imaging evidence, so neuroimaging techniques are crucial for the evaluation of TIA patients. CTP examination can detect

ischemic changes in patients at an early stage, and CT perfusion imaging combined with CT angiography can look for symptomatic stenosis/occlusion associated with an increased risk of stroke. Siebert et al. used CT perfusion imaging to study 10 patients with TIA, and believed that whole brain CT perfusion imaging was easier to find small areas of abnormal ischemic penumbra damage, which was more meaningful than plane tomography. The abnormal changes of blood flow detected by CT perfusion imaging in ischemic stroke can indicate the corresponding vascular lesions to a certain extent, and further search for the cause combined with CT angiography or cerebrovascular angiography has high clinical value for the diagnosis and treatment of TIA and the determination of its severity.

Evaluation of hemorrhage transformation after cerebral infarction: Hemorrhagic transformation after cerebral infarction refers to the hemorrhage caused by changes in the cerebral blood flow barrier caused by a series of reactions triggered by tissue ischemia and hypoxia after the disturbance of cerebral blood flow supply. The specific pathophysiology of hemorrhage is still not fully understood[20]. Functional imaging used to predict hemorrhagic transformation includes functional MRI images,CT perfusion images, angiography and other indicators. Currently, more and more scholars have studied various perfusion CT parameters and shown good results in predicting hemorrhagic transformation. However, for the specific indicators of CTP parameters which can best predict HT, researchers' opinions are not unanimous at present. According to Jain et al.,CTP parameters are relatively higher than CBF Langel et al. found that rCBF had a higher value in predicting intracerebral hemorrhage transformation, similar to the Jain view. The volume of infarct area using MTT image and rCBV value at admission has been reported to be closely related to HT, and Horsch et al. studied that CTP can also assess penetration The rate at which surface products (PS) percolate through the disrupted blood-brain barrier from the intravascular to the extravascular space indirectly reflects the permeability of the blood-brain barrier involved in the HT pathophysiology of ischemic stroke, suggesting that high PS increases the risk of HT after AIS intravascular therapy. A review has concluded [21] that the imaging appearance of CTP indicates high blood-brain barrier permeability and acute severe hypoperfusion (CBV < 0.5 ml / 100 g; CBF < 0.48; Compared with MTT1.3), it is highly sensitive and predictive to HT risk. In a recent meta-analysis, six (40%) of the 15 studies used conventional perfusion CT parameters, three (20%) used no CBV in cerebral blood volume, and one used relative cerebral blood flow (CBF). The highest temperature was used for 1 item, and TTP chart was used for l item. These studies showed that the hemorrhagic transformation CBV organize was lower, the CBF was lower, and the peak time was longer than that of the non-hemorrhagic transformation organize.

CT perfusion imaging reflects acute cerebral infarction in the early stage of cerebral ischemia, finds ischemic penumbra, evaluates peripheral hemodynamics, collateral circulation, guides thrombolysis, vascular opening and other treatments, and evaluates prognosis. It has the advantages of short imaging time and simple operation, and is widely used in central nervous system diseases, such as Moyamoya disease and

cerebral blood perfusion before and after intracranial vascular stent surgery However, there are still many problems worth studying in the clinical application of glioma. For example, due to the current imaging technology, the threshold of CTP parameters is still controversial, and the patient's activities are prone to produce artifacts during scanning. At present, prospective studies on the threshold of CTP parameters during the occurrence of acute cerebral infarction are needed to further improve the clinical application value of CT perfusion imaging.

3.4 Formation and influencing factors of D-dimer

D-dimer (DD) is a specific cross-linked molecular marker of fibrin degradation produced by fibrinogen in human body under the action of fibrinase produced after activation of fibrinolytic system, and its standards change may be affected by many factors. Previous studies have found that the standards of D-dimer in the body will increase with the increase of age, the overall standards of D-dimer in women > 40 years old will be higher than that of men of the same age, and the standards of D-dimer in high-fat diet (or drinkers) will be higher than that in low-fat diet (or non-drinkers). The standards of D-dimer in pregnant women also increased with the prolongation of pregnancy. Some studies have also found that the collection time of D-dimer specimens may affect the results, for example, if the tourniquet restraint time is too long, the D-dimer may show false positive results, and the plasma hemoglobin, blood lipids, rheumatoid factors and other substances in the subject's plasma may also interfere with the detection results of D-dimer. In addition, the linear range and reference range of D-dimer detection reagents and instruments are also different from each other.

Clinical significance of 3.5 D-dimer detection

D-dimer exists in the early stage of plasma clot formation, can reflect the hypercoagulability, hyperfibrinolysis and tissue damage in the body, and can also express the pre-thrombotic state, which is the main sensitive indicator of hyperfibrinolysis and hypercoagulability in the body [22]. In addition, D-dimer has high stability and can avoid the influence of hemolysis, bilirubin and other related factors. Previous studies have found that D-dimer, as a pathological sign of hypercoagulability in the body, has a very low standards in healthy people. Therefore, if the standards of D-dimer increases in the body, it may be one of the manifestations of human dysregulation, suggesting that the body may be in the initial stage of disease occurrence. Most previous studies on cancer and thrombotic diseases have also shown that D-dimer can be used for diagnosis or prognosis of diseases [23]. Previous studies have pointed out that D-dimer can be used to assist in the diagnosis of DIC diseases, and can be used as one of the laboratory indicators for screening and diagnosis of pulmonary embolism and deep vein thrombosis diseases, and can also be used to predict the occurrence and development of vascular lesions in diabetic patients. In addition, D-dimer can be used in malignant tumors, acute myocardial infarction, hypertension, systemic lupus erythematosus, viral hepatitis and other diseases. The D-dimer standards also changes to varying degrees, so the analysis of D-dimer in the above diseases can also be used as a reference index to evaluate the severity of

disease development, treatment effect and prognosis.

In recent years, in the relevant studies on D-dimer and acute ischemic stroke, some scholars have found that fibrin degradation products can be continuously deposited on the vascular wall during the process of vascular endothelial injury and thrombosis, indicating that fibrin degradation products may play an important role in the pathophysiological process of atherosclerosis. D-dimer may be one of the independent risk factors for acute ischemic stroke, and its elevated standards may increase the risk of acute ischemic stroke [24]. It has also been reported in relevant literature that in the course of acute ischemic stroke, the injury of the blood vessel wall in the patient activates the blood clotting system in the body, which easily forms thrombus in the circulating blood and partially or completely blocks the blood vessel lumen, and then activates the fibrinolytic system in the body and breaks down the thrombus to partially or completely reopen the blood vessel. In other words, patients with acute ischemic stroke have both increased tendency of blood coagulation and secondary hyperfibrinolysis. Therefore, the D-dimer content of patients with acute ischemic stroke will change correspondingly, and the change standards can reflect the hypercoagulation state, hyperfibrinolysis state and tissue damage in the body. Moreover, relevant research data also show that D-dimer (DD) may have a positive correlation with the occurrence and development of ischemic stroke, as well as the evolution of the disease course. It can be used as an auxiliary diagnostic laboratory indicator of ischemic stroke with certain accuracy. Dynamic monitoring of D-dimer standards changes can predict whether the disease of patients with ischemic stroke is progressing or not, and can also evaluate the prognosis of patients with coma, nerve damage, etc. Therefore, clinicians can refer to the changes of D-dimer standards to guide the relevant clinical diagnosis and treatment and prognosis assessment of patients with acute ischemic stroke.

3.6 Summary

The etiology of ischemic stroke is complex, and atherosclerosis is considered to be the main cause. After the onset of ischemic stroke patients, there are still a lot of dying nerve cells around the ischemic lesion. If blood perfusion can be obtained in time, it can help these nerve cells to restore normal metabolism, reduce nerve function damage, and improve the prognosis of patients. Therefore, early clinical diagnosis of ischemic stroke is very important.

At present, there are many diagnostic methods for ischemic stroke, and imaging examination and serological index detection are relatively common. Among them, imaging examination can clearly show the situation around the ischemic lesion and provide an important reference for the formulation of treatment plan. However, imaging examination takes a long time, and more convenient methods are still needed to assist the early diagnosis of ischemic stroke in clinic. The detection of serological indicators has the advantages of simple, quick and rapid results. By detecting serological indicators closely related to the occurrence and development of ischemic stroke, it can help clinical diagnosis of such diseases as early as possible, so as to formulate targeted treatment plans.

Lp-PLA2 is a novel inflammatory response marker, secreted mostly by endovascular T cells, macrophages, mast cells, etc., which has a pro-inflammatory effect, can stimulate the inflammatory response of the body, and induce the formation of atherosclerotic plaque. Once the standards of LP-PLA2 increases, it can accelerate the progression of ischemic stroke [25]. At the same time, Lp-PLA2 has the function of hydrolyzing and oxidizing low-density lipoprotein lecithin, which can accelerate the release of pro-inflammatory substances, cause a large number of cell adhesion molecules to accumulate, thus phagically oxidizing low-density lipoprotein, and reduce plaque stability. Therefore, Lp-PLA2 standards will increase significantly after the onset of ischemic stroke patients [26]. D-D is a specific degradation product. During the normal formation of thrombosis, fibrin monomer will be cross-linked into a network through a series of reactions in the body to form fibrin polymer. In this state, the body can self-regulate and activate the fibrinolysis process to promote the continuous degradation of fibrin polymer, and D-D will be generated during the degradation process. Therefore, D-D standards can better reflect secondary fibrinolytic activity and blood hypercoagulability in vivo [27-28]. Ischemic stroke is closely related to the formation of cerebral artery thrombosis, which may be accompanied by a hypercoagulable state in the body after the onset, and compensatory fibrinolytic activity will be enhanced in the body to adjust this state, resulting in a relatively high standards of D-D, and the more obvious the coagulation/fibrinolytic imbalance is, the more serious the condition of ischemic stroke, and the D-D standards will remain at a high standards for a long time [29-31]. The combined detection can improve the diagnostic sensitivity and specificity of ischemic stroke. The reason for the analysis is that the occurrence and development of ischemic stroke are closely related to blood hypercoagulability and inflammatory response in the body, so the standardss of Lp-PLA2 and D-D can be significantly increased after the onset of the disease, but the detection process of a single indicator is susceptible to multiple factors, making it difficult to independently diagnose, while the combined detection can complement each other's advantages and minimize the influence of external factors. Avoid the limitation of single indicator detection, thereby improving the diagnostic value.

In summary, the combined detection of Lp-PLA2 and D-D can improve the diagnostic sensitivity and specificity of ischemic stroke, and is of high value in the diagnosis of ischemic stroke.

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