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# Evaluation of Early Acute Cerebral Infarction with Transcranial Doppler

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**Abstract:** ***Objective:*** For patients with early acute cerebral infarction (ACI), transcranial Doppler ultrasound was used in the clinical examination, and its application effect was observed and analyzed. ***Methods:*** This study was carried out between October 2018 and October 2019. 50 patients with ACI included as the research object was evaluated by transcranial Doppler and CT examination, and the application of the two examination methods was compared. ***Results:*** The results of transcranial Doppler examination showed that the abnormal rate of blood flow velocity and the ratio of both sides (VACA) in patients with early ACI was higher than that of CT examination. ***Conclusion:*** With the impact on the location and area of vascular occlusion in patients, VACA can effectively reflect the status and effectiveness of the collateral circulation function of the patient's pia vessels during cerebral infarction.

**Keywords:** Transcranial Doppler; Acute cerebral infarction (ACI); Early

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Due to the relatively thick human skull hinders the penetration of ultrasound to a certain extent, the conventional application of Doppler ultrasound can only be used to test the hemodynamic changes of the patient's extracranial artery[1]. Transcranial Doppler ultrasound can penetrate through the natural hole or the thin position of the skull to obtain the Doppler echo signal of the main artery of the skull base of the patient. The incidence rate of ACI, a disease with rapid onset, rapid development, and relatively high mortality and disability rate, continues to rise in recent years, and the patients also become younger. To avoid further deterioration of the condition of patients with ACI, it is necessary to research related examination methods[2]. In this study, 50 patients with ACI were selected as the research object, and the effect of the evaluation of early ACI with transcranial Doppler was analyzed and reported as follows.

## 1 Data & Methods

### 1.1 General data

This study in our hospital has informed the Ethics Committee and the family members of the patients, and obtained their consent. Research time: October 2018 to October 2019; Research subjects: Patients with ACI; Number of subjects: 100 cases; Male patients: 30 cases; Female patients: 20 cases; Minimum age: 19 years old; Maximum Age: 67 years old; Average age: (52.7 ± 4.6) years old.

### 1.2 Inclusion Standards

(1) Those patients who meet the clinical diagnostic criteria of middle cerebral artery flexion and cerebral infarction in our hospital; (2) Those patients who are within 48 hours of onset; (3) Those patients have no previous history of cerebrovascular disease.

### 1.3 Examination Methods

The Domestic Delica-9PB transcranial Doppler diagnostic instrument of China with the probe frequency of 1.6MHz was used to detect the patients and their anterior cerebral artery (ACA) through the bilateral temporal window. After the patients were instructed to keep a supine position and stay still, a 1.6MHz probe was used to detect the terminal carotid

artery (TICA), middle cerebral artery (MCA), anterior cerebral artery (ACA), and posterior cerebral artery (PCA) through the temporal window; Then, the probe frequency was set to 4.0MHz, and the common carotid artery (CCA) and internal carotid artery extracranial segment (EICA) on the patients' neck were detected; The patients were instructed to keep the side sitting position, and the lateral vertebral artery (VA) and basilar artery (BA) were detected separately through the pillow window; The middle cerebral artery (MCA), anterior cerebral artery (ACA), posterior cerebral artery (PCA), internal carotid artery (ICA), vertebral artery (VA), basilar artery (BA), and blood flow velocity in the same segment of the posterior cerebellar artery trunk were detected through the temporal window.

### 1.4 Diagnostic standards(Table 1)

**Table 1.** Normal reference value of intracranial main artery transcranial Doppler detection (cm/s)

| Blood vessel name | Pulsatility index | Peak systolic velocity | Average flow rate |
|---|---|---|---|
| MCA | 0.65——1.10 | 70——140 | 70——82 |
| ACA | 0.65——1.10 | 70——140 | 65——80 |
| ICA | 0.70——1.10 | 72——98 | 41——67 |
| PCA | 0.65——1.10 | 30——100 | 33——55 |
| VA | 0.60——1.24 | 30——80 | 27——45 |
| BA | 0.65——1.10 | 30——80 | 30——48 |

#### 1.4.1 Diagnostic standards for intracranial arterial stenosis

(1)Those patients with the average blood flow velocity higher than the normal reference value by 120%; (2) Those patients with an increase in low-frequency components; (3)The presence of vascular murmur or eddy murmur, turbulence murmur.

#### 1.4.2 Diagnostic standards for vascular occlusion

(1)Those patients with the signal that disappears from the main blood vessel, and exists in the nearby blood vessel; (2)Those patients with the decreased blood flow at the distal end of the blood vessel, and the significantly decreased pulsation index, and the relatively blunt waveform; (3)High resistance and low flow rate occurred at the proximal end of the vessel; (4) There is the establishment of collateral circulation; (5) The compensation of adjacent great vessels increased rapidly.

#### 1.4.3 Diagnostic standards for insufficient blood supply

The patient's average blood flow velocity is below the normal reference value.

## 2 Results

### 2.1 Transcranial Doppler detection results

MCA blood flow velocity (VMCA): 90 ± 4; ACA blood flow velocity (VACA): 70 ± 6; PCA blood flow velocity (VPCA): 45 ± 9; Ratio of both sides (VACA) is 1.03 ± 0.16.

### 2.2 CT detection results

There were 20 patients with cortical infarction, 18 patients with extensive infarction, and 12 patients with deep infarction.

The patients were grouped according to the CT detection results. The VACA ratio of both sides was 1.41 ± 0.33 for extensive infarction and 1.29 ± 0.22 for cortical infarction, both of which were above the normal value; And the comparison was significantly different ($P$<0.05); And it was 1.07 ± 0.12 for deep infarction, equivalent to the normal value, and there is no significant difference ($P$>0.05).

For comparison of the VACA ratio on both sides, the ratio of patients with extensive embolism was the largest, followed by patients with cortical infarction, and the ratio of patients with deep infarction was the smallest.

## 3 Discussion

Generally, hypertensive arteriosclerosis, infectious encephalitis and embolism caused by loose embolus can lead to ACI in patients, in which hypertensive arteriosclerosis is mainly caused by long-term heavy smoking and alcohol consumption and the increase of the internal alcohol content can damage the blood vessel wall, and then produce hematocrit, which may lead to platelet dysfunction, and further result in reduced red blood cell flexibility and blood flow; The infectious encephalitis is mainly for the enhanced activity of

fibrinogen, which leads to an increased possibility of infarction.

According to related research, the patient's age, vascular obstruction site and collateral circulation play an important role in the prognosis level of the patient's middle cerebral artery infarction. In the process of patients with cerebral infarction, to establish the collateral circulation quickly and effectively have an important impact on the treatment of patients[3]. Under normal circumstances, the cerebral fundus circulation, intracranial and external vascular anastomosis, and pia mater vascular anastomosis all belong to collateral pathways. Moreover, due to the small number of MCA and PCA, it was often considered that when MCA was blocked, the ACA collateral circulation path was the main path.

The application of transcranial Doppler in the clinic has been widely recognized in judging the related functions of the cerebral artery ring. It can provide an important basis for judging the treatment of patients with ACI. When the circulating supply capacity is insufficient, surgical treatment can be considered for the patient.

According to the comparison in the research results, in the extensive infarction and cortical infarction, the patient's VACA rate in the detected site was higher, while in the deep infarction, the patient's VACA rate was not significantly different. Therefore, it can be seen that, for patients with early cerebral infarction, there were different degrees of collateral blood flow increase; and for patients with a large area of infarction, the degree of blood flow compensation for a large area of infarction was large compared with a deep small area of infarction. The main reason lies in that there is no extensive vascular anastomosis at the end of the deep-penetrating branch artery. So, for patients with deep infarction, the VACA on the affected side has not increased significantly[4]. For patients with the two types of main infarction, the VAC ratio of the affected side was higher than that of the healthy side, the normal level and the branch obstruction, but there is no difference between them. It can be considered that, in the process of obstruction of the two types of trunks, through comparing the blood flow velocity of patients with extensive obstruction and non-extensive obstruction, the increase in the VACA ratio between the healthy side and the affected side is not significant, but the VACA ratio of patients with non-extensive infarction increased more obviously[5]. Meanwhile, the VACA ratio on both sides was also higher than that of patients with extensive infarction. It can be seen that for patients with non-extensive infarction, the degree of compensation for collateral circulation was higher than that of patients with extensive infarction, but the scope of their location was different. Therefore, the clinical prognosis of patients of different types must be varied[6-7].

According to this study, the results of transcranial Doppler detection showed that the abnormal rate of the blood flow velocity and bilateral (VACA) ratio in patients with early ACI was higher than that of CT detection, which had a more precise and effective prediction of the patient's condition and prognosis.

In conclusion, VACA can affect the areas of vascular obstruction in patients and the infarction area, and can effectively reflect the status and effectiveness of the collateral circulation function of the patient's pia vessels during cerebral infarction. Also, VACA can be used as an important indicator to judge the function and prognosis of the collateral circulation pathway from the ACA to the MCA area.

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