Assessment of cerebral infarction after transient cerebral ischemic attack by ABCD² score combined with the position of intracranial vascular stenosis

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Abstract

This study aims to investigate the value of the ABCD² score combined with the position of the offending vessel stenosis in predicting the risk of transient ischemic attack (TIA) to develop into cerebral infarction.

The ABCD² score and head magnetic resonance imaging + magnetic resonance angiography (MRA) results of 192 patients with TIA were retrospectively analyzed. With the 7th day as the endpoint time, these patients were divided into 3 groups, according to ABCD² scores: low-risk group (n = 105), moderate-risk group (n = 60), and high-risk group (n = 27). Blood vessels were screened using head MRA results, and patients were accordingly divided into 2 groups: proximal vascular stenosis group (n = 71) and nonproximal vascular stenosis group (n = 171). Then, the association of the position of the intracranial vascular stenosis and ABCD² score with short-term prognosis was analyzed.

Based on the ABCD² score, the incidence of cerebral infarction after 1 week was significantly higher in the high-risk group (85.7%) than in the moderate-risk group (16.7%) and low-risk group (1.9%), and the differences were statistically significant (P < .05). When the ABCD² score was ≥4 points, the incidence of cerebral infarction after 1 week was significantly higher in the proximal vascular stenosis group (59.1%) than in the nonproximal vascular stenosis group (30.8%), and the difference was statistically significant (P < .05). When the ABCD² score was <4 points, the incidence of cerebral infarction after 1 week in the proximal stenosis group (2%) was not significantly different from that in the nonproximal stenosis group (1.9%, P > .05).

The ABCD² score combined with proximal offending vessel stenosis can improve the short-term prediction of cerebral infarction in patients with TIA.

Abbreviations: CT = computed tomography, MRA = magnetic resonance angiography, MRI = magnetic resonance imaging, TIA = transient ischemic attack.

Keywords: ABCD² score, cerebral infarction, head magnetic resonance angiography imaging, prediction, proximal vascular stenosis, transient cerebral ischemic attack

1. Introduction

Transient ischemic attack (TIA) is a recoverable and transient neurological deficit attack caused by focal cerebral ischemia in the brain, spinal cord, and retina, and is a common clinical ischemic cerebrovascular disease.[1] Furthermore, it is the most important risk factor for acute ischemic cerebrovascular disease, a super early warning signal for cerebral infarction.[2] Clinically, secondary cerebral infarction occurs in one-third of TIA patients, two-third of these occur within 1 week, and the incidence of cerebral infarction in 30 days is 8.2% to 16.3% in TIA patients.[3,4] Therefore, the rapid and accurate risk stratification of TIA patients is critical. Furthermore, assessment based on the combination of clinical features and imaging data is of great significance. The ABCD² score is the most common risk assessment tool for stroke after TIA in clinic, which has good predictive value for the occurrence of cerebral infarction within 1 week after TIA.[5,6] However, this scoring system does not include imaging. Therefore, the efficacy of clinical application is not high. Previous studies have revealed that the ABCD² score combined with carotid artery stenosis and other indicators can better predict the risk of early stroke in TIA patients.[7] Endothelial dysfunction is the key to the pathogenesis of atherosclerosis. Atherosclerosis can cause vascular stenosis, and the occurrence of TIA is closely related to atherosclerosis. The study conducted by Ottaviani et al[8] also confirmed that angiostegnosis is an independent risk factor for ischemic stroke. The present study aims to investigate the value of the ABCD² score combined with proximal stenosis of the offending vessel in predicting cerebral infarction within 1 week after TIA.
2. Data and methods

2.1. Subjects of study

A total of 192 TIA patients diagnosed in the Department of Neurology of Hengshui Halison International Peace Hospital in Hengshui City, Hebei province, from June 2015 to January 2017 were enrolled into this study. Among these patients, 108 patients were male and 84 patients were females, and the age of these patients ranged from 30 to 82 years old, with an average age of 57.2 ± 13.6 years old. The diagnoses of all patients were in accordance with the criteria developed by the Fourth National Conference of Cerebrovascular Disease in 1996, and stenosis of the offending vessel in all patients was screened by head magnetic resonance imaging angiography (MRA) examination. All patients underwent head computed tomography (CT) at admission in the hospital, and no corresponding focal lesions were detected by CT in any of the patients. All patients underwent head magnetic resonance imaging (MRI) examination within 24 hours. The neurology specialist judged whether the cerebral infarction occurred based on the clinical manifestations of the patient, and the MRI diffusion-weighted examination of the head showed a new acute infarction. This study was conducted in accordance with the declaration of Helsinki and approved by the Ethics Committee of Hengshui Halison International Peace Hospital. Written informed consent was obtained from all participants.

2.2. Research methods

2.2.1. The ABCD² scoring method. All TIA patients were scored according to the ABCD² scoring method, which mainly included 5 items: age, blood pressure, clinical characteristics, duration of symptoms, and the presence of diabetes (Table 1). Patients were scored based on the above indicators, which were detected during the attack of TIA with the longest duration. According to the score, these patients were divided into 3 groups: low-risk group (0–3 points), moderate-risk group (4–5 points), and high-risk group (6–7 points).

2.2.2. Clinical treatment. All patients were routinely given dual antiplatelet aggregation therapy immediately after diagnosis of TIA. Treatment plan: Aspirin ( Bayer HealthCare, Beijing, China, National Pharmaceutical Standard JZ20130078) 100mg/d, combined with clopidogrel hydrochloride (Shenzhen Xinli Thai Pharmaceutical Co., Ltd., Shenzhen, China, national medicine quasi-word H20000542) 75mg/d, and at the same time using statin drugs to stabilize the plaque treatment.

2.2.3. Head MRI+MRA scan. A 3.0 dual gradient superconducting MRI system (Sigma Twin-Speed, GE Medical Systems, Boston) was adopted, in which the spatial resolution of the brain MRI examination was high, and the diffusion weighted imaging (DWI) sequence could display the ischemic brain tissue at the early stage of the disease. When the DWI image presented with focal hyperintense signals and these signals were located in the blood supplying area correlated to the clinical symptoms, it is considered as a DWI abnormality. Head MRA examination was performed in all patients. The degree of intracranial stenosis was determined by Three-dimensional time of flight-MRA imaging method using the Warfarin–Aspirin symptomatic intracranial disease test criteria,[10] and the arteries were calculated as follows. Stenosis rate: stenosis rate = (1 – AS/AN) × 100%. AS is the narrowest diameter of the stenosis, and AN is the normal vessel diameter of the same artery. And the evaluated blood vessels in the head and neck included the following: the anterior cerebral artery, middle cerebral artery, posterior cerebral artery, siphon of the internal carotid artery, and basilar artery. The proximal vessels included: A1 segment of the anterior cerebral artery, M1 segment of the middle cerebral artery, P1 segment of the posterior cerebral artery, V4 segment of the vertebral artery, end of the internal carotid artery, and basilar artery.

2.2.4. Determination of cerebral infarction. In the present study, among these 192 TIA patients, 35 patients progressed into cerebral infarction within 1 week. The diagnosis of cerebral infarction was based on head CT and MRI results and clinical features, which were in line with the diagnostic criteria developed by the Fourth Academic Conference of Cerebrovascular Disease. All TIA patients underwent head MRI examinations. The clinical signs of all patients with cerebral infarction were in accordance with the head MRI results, and the cerebral infarction lesions were all new lesions. The observation time point of the endpoint event for all patients was the 7th day.

2.3. Statistical analysis

Data were statistically analyzed using statistical software SPSS 18.0, Chicago. Measurement data were expressed as mean ± standard deviation (x ± SD). Intergroup comparison was conducted using t test. Count data were evaluated using chi-squared test. P < .05 was considered statistically significant.

3. Results

3.1. The association of ABCD² scores and the progression into cerebral infarction within 1 week in TIA patients

The ABCD² scoring was performed in 192 TIA patients. Among these patients, the incidence of cerebral infarction was 1.9% in the low-risk group, 16.7% in the moderate-risk group, and 85.2% in the high-risk group. The incidence was significantly higher in the high-risk groups than in the moderate-risk group and low-risk group, and the differences were statistically significant (P < .05, Table 2).

Table 1

| Risk factor                  | Criterion                | Score |
|------------------------------|--------------------------|-------|
| Age                          | ≥60                      | 1     |
| Blood pressure               | ≥140/90 mm Hg            | 1     |
| Clinical symptoms            | Unilateral weakness      | 2     |
|                             | Atrialia without limb weakness | 1     |
| Duration                     | ≥60 min                  | 2     |
|                             | 10–59 min                | 1     |
| Diabetes                     |                          | 1     |

Table 2

| Group                | TIA | 7 day incidence of cerebral infarction (%) |
|----------------------|-----|------------------------------------------|
| Low-risk group       | 105 | 2 (1.9)‡                                  |
| Moderate-risk group  | 60  | 10 (16.7)§                                |
| High-risk group      | 27  | 23 (85.2)¶                                |

TIA = transient ischemic attack.

‡ Compared with the low-risk group, P < .05.
§ Compared with the low-risk group, P < .05.
¶ Compared with the moderate-risk group, P < .05.
3.2. Association of ABCD² scores with the position of the stenosis and the incidence of cerebral infarction within 1 week in TIA patients

When the ABCD² score was ≥4 points, the incidence of cerebral infarction within 1 week was significantly higher in the proximal vascular stenosis group (59.1%) than in the nonproximal vascular stenosis group (30.8%), and the difference was statistically significant (P < 0.05). When the ABCD² score was <4 points, the incidence of cerebral infarction within 1 week in the proximal stenosis group (2%) was not significantly different from that in the nonproximal stenosis group (1.9%, P > 0.05; Table 3).

4. Discussion

TIA is a common clinical ischemic cerebrovascular disease, and is an independent risk factor for cerebral infarction. Studies have revealed that the incidence of cerebral infarction in 1 week in TIA patients was up to 8% to 10.5%. In the present study, among these 192 patients, 35 patients (18.2%) progressed into cerebral infarction within 1 week. This was far higher than that reported in foreign studies. In terms of the reasons, first, it may be correlated to human race. Second, the patients included in the present study were all hospitalized patients, and their conditions were relatively severe, since patients with mild diseases do not visit the hospital. Therefore, the incidence of cerebral infarction increased.

TIA is an important and dangerous early warning event of ischemic stroke. Therefore, emergency clinical assessment and treatment after TIA can reduce the risk of stroke after TIA. How to quickly identify high-risk patients is crucial. Studies have revealed that the ABCD² score has good predictive value. The ABCD² score was proposed by Johnston et al. in the United States, which is mainly used for the risk assessment of stroke after TIA. This has been verified by many studies at home and abroad, in which positive results have been achieved. The score includes 5 aspects (age, blood pressure, clinical characteristics, duration of symptoms, and the presence of diabetes) with a total of 7 points. In the present study, 192 patients were included, and these patients were divided into 3 groups, according to ABCD² scores: low-risk group, moderate-risk group, and high-risk group. These results revealed that the ABCD² score was positively correlated with the incidence of cerebral infarction within 1 week after TIA. The difference in the incidence of cerebral infarction within 1 week after TIA between the moderate-risk group and high-risk group was statistically significant. The difference in the incidence of cerebral infarction within 1 week after TIA between the high-risk group and moderate-risk group was statistically significant. These results reveal that the higher the ABCD² score of TIA patients, the higher the incidence of cerebral infarction in the short term. This further confirms that the ABCD² score has predictive significance for early stroke in TIA patients. A study conducted by Si-Yan-Kai et al. revealed that intracranial arteriostenosis, especially proximal vascular lesions, can increase the risk of cerebral infarction from TIA within 1 week. In the present study, when the ABCD² score was ≥4 points, the incidence of cerebral infarction within 1 week was significantly higher in the proximal vascular stenosis group (59.1%) than in the nonproximal vascular stenosis group (30.8%), and the difference was statistically significant. After TIA, patients with proximal stenosis of the offending vessel were prone to cerebral infarction. Therefore, intracranial vascular stenosis has a significant correlation with the occurrence and development of cerebral infarction. Furthermore, there was a strong correlation between the ABCD² score and MRA results. The combination of the ABCD² score and MRA results can further improve the accuracy of the prediction. In summary, the ABCD² score improved the predictive value for the risk of cerebral infarction after TIA, and the combination of the ABCD² score and proximal stenosis of intracranial offending vessel is of great significance for predicting the incidence of cerebral infarction within 1 week in TIA patients, which can significantly improve the accuracy of prediction. This is worthy of clinical popularization and application. There are some limitations in this study. The relationship between internal carotid artery and cerebral infarction has not been analyzed in detail. The degree of stenosis of the proximal intracranial vessels and the progression of TIA to cerebral infarction has not been analyzed. This is also the focus of future research.

Author contributions

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