Review Article

Prediction of stroke risk in patients with transient ischemic attack: ABCD score and its derived scores

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ABSTRACT

Transient Ischemic Attack (TIA) is a high-risk signal of acute ischemic cerebrovascular disease, indicates a significant increase in the risk of ischemic stroke, especially within 7 days. Risk assessment and stratification are important in patient with TIA. A variety of simple prediction scales were developed based on the risk factors for stroke in patients with TIA, such as the California scale, ABCD scale, and ABCD2 scale. Among them, the ABCD scale score is used most commonly, but as its application becomes more and more common, the defects of this scale are also increasingly apparent. In recent years, some derived scales of ABCD score were introduced in order to improve the sensitivity and specificity of prediction. This article reviews the evolution, contents, characteristics, and predictive value of the ABCD score and its derived scales in the prediction of the stroke risk in patients with TIA.

Keywords: Predictive value, Risk assessment, Risk factors, Stroke, Transient ischemic attack

INTRODUCTION

Transient Ischemic Attack (TIA)is kind of ischemic cerebrovascular disease that affects the brain, retina, and spinal cord; TIA is caused by transient focal and reversible neurological dysfunction with no imaging evidence of acute pathological changes; It is also the most important independent risk factors of cerebral infarction.[1] To date, increased incidence of TIA is observed from 18% of people aged 45 and above and who at least experienced at least one TIA.[2] Reports suggested that percentages of other TIAs occurring within 7 d after cerebral infarction rate reach as high as 8.0% to 10.5%, whereas the incidence of 90 d is 10.5% - 14.6%, and the possibility of serious incidence (such as death and asymptomatic cerebral infarction, etc.) totals 25.1%, and 15-20% in patients before onset of ischemic stroke in TIA history.[3,4] Therefore, for patients with TIA etiology examination, risk stratification, risk prediction, and promptly taking effective treatment measures to reduce the occurrence of cerebral infarction are particularly important in the clinical work. Update, evaluation methods used for forecasting TIA include the California scale, the ABCD score series, Canada forecasting scale, and Recurrence Risk Estimator-90 score.[2] The most commonly used is the ABCD score scale.[5] In recent years, studies not only affirmed the predictive value, but also observed limitations of the ABCD rating scale. Simple and effective screening of high-risk groups TIA back stroke assessment system, and timely and effective treatment for reducing the incidence of stroke and save medical resources are thus significant. This review summarizes grading of the ABCD score and its derivatives in TIA prognostic application development, content and characteristics and evaluation and so on.

DEFINITION OF TIA AND RISK PREDICTION OF SCALE

TIA is a common type of cerebrovascular disease characterized by repeated attacks; recent and frequent

incidence of TIA is cerebral apoplexy in the early warning signal.[2] In 1958, for the first time, TIA became recurrent for a few minutes to several hours, with most attacks spanning 5-10 min; in 1961, TIA was defined as single or multiple brain dysfunction with no any residual symptoms usually lasting less than 1h; in 1965, TIA was defined as the sudden emergence of focal or full cranial nerve dysfunction at a duration of not more than 24 hours, and with the exclusion of vascular origin; In 2002, the new concept of TIA was proposed because of local brain or retinal ischemic caused by transient neurologic deficit attack with typical clinical symptoms lasting less than 1h, and without evidence of acute cerebral infarction imaging; In 2009, the American Heart Association(AHA) and the American Stroke Association (ASA) suggested the new concept of TIA, stating that the disease is caused by focal brain, spinal cord, or retinal ischemic but is not accompanied by acute infarction and transient nerve dysfunction.[1,2,6]

Based on the concept of TIA, the attention to TIA from clinical symptoms to histology change and new concept depends on imaging studies. In recent years, studies showed extremely high short-term risk of stroke after TIA and clinical significance of early risk stratification and intervention in patients with TIA.[2]

ABCD SCORE

To date, ABCD score, which was suggested in 2005, is the most commonly applied method used in clinical setting.[5] The ABCD score is simple, fast and is suitable for screening the beginning of outpatient emergency patients, and includes age, blood pressure, clinical characteristics, and symptoms duration; ABCD score also focuses on the importance of unilateral limb weakness and duration of symptoms, obtaining good application.[7] ABCD score is used to predict TIA risk within 7d after stroke, and it can also be used to conduct health education to the public while allowing clinicians to rapidly screen increased risk in patients, thus guiding further treatment.

Researchers suggested that ABCD score of 4 or less points generally do not require hospitalization because of limited early risk of stroke (has not occurred in 1 case in the study of its stroke).[8] ABCD score of 6points (approximately 30% within 7d stroke incidence) in the acute phase must be observed in hospital settings. In the event of stroke, clinicians can timely apply thrombolysis therapy.

In recent years, increasing effective studies became available on application of ABCD score in different people and various situations. Researchers also conducted retrospective studies among hospitalized patients with TIA using emergency treatment and used hospitalization medical records to extract the ABCD score and prospective follow-up on patients with stroke outcome within 30d. Such studies aimed to verify the ABCD score

in hospitalized TIA patients within 30d stroke-prediction ability. Results showed that high ABCD score indicates high incidence of stroke within 30 d. ABCD score reached 0-2, 3, 4, 5, and 6 with risks of stroke reaching 0%, 3.5%, 7.6%, 21.3% and 31.3% respectively; at the same time, ABCD score of 5-6 points within 30 d stroke risk is eight times higher than that of ABCD score of 4 points or less.[8,9]

The study suggests good clinical use of this score to predict reliability of the risk of stroke after TIA. ABCD score can identify high risk of stroke patients at an early period. Another study in the northern region investigated TIA patients in the emergency department within 24h of stroke onset. Results showed that high ABCD score is associated with high incidence of stroke within 7d and 30 d (at each 1min, odds ratio (OR) value increases to 2.55 within 7d, and to 2.62 within 30d). At the same time, compared with the ABCD score of less than 4 points, ABCD score of 5-6 points indicates increased risk of stroke by six times, confirming the predictive value of ABCD score.[10]

In one retrospective study, according to the ABCD score, TIA patients were divided into high-stroke-risk (ABCD score of 5 points or above) and low-risk groups (ABCD score of 4 or less) and evaluated prediction ability at 7 d and 90 d. Results showed that in the high-risk group (ABCD score of 5 points or above), sensitivity of stroke risk prediction within the 7 d totals 100%, whereas that within 90d is 86%. Dividing patients into high-risk group standards according to the ABCD score 5 or more points may be unreasonable. However, after using the scoring system to identify TIA patients with high risk of stroke in the short term, a good predictive value was still observed.[11,12]

The advantage of ABCD score is its simple construction, and clinicians can assess patient scores immediately. At the same time, as ABCD score can be easily remembered, it is readily available to public health education. However, as this parameter does not include other important risk factors, such as history of diabetes and intracranial or extracranial artery stenosis, prediction accuracy is reduced.[2,13]

ABCD2 SCORE

Along with continuous understanding of TIA, many researchers observed in clinical work that ABCD score <4 points also indicate an extremely high risk for cerebral infarction patients. Therefore, we suggest combining the ABCD2 rating scale with diabetes-risk stratification prediction assessment, that is ABCD2 score scale.[14] ABCD2 score scale includes five clinical factors as follows: age 60 years or above (1 point); BP 140/90 MM Hg or above (1 MMHG = 0.133kPa) (1 point), unilateral muscle weakness (2 points) or speech disorder not associated with muscle weakness (1 point), more than 60 min (2 points) or 10-59 min (1 point) duration of

symptoms, diabetes (1 point) with a score of 0-7 points. At the same time, according to score, TIA patients were divided into high-risk group (6-7 points), moderate-risk group (4-5 points) and low-risk group (0-3 points). Scholars, in a timely manner and after testing scale, using ABCD2 score scale to a large number of patients with TIA, retrospectively studied and analyzed incidence of stroke within 2 d after TIA attack. Their results showed that incidence of stroke in low-risk, moderate-risk, and high-risk groups reached 1.0%, 4.1%, and 8.1%, respectively. Incidence of stroke in the high-risk group is 2-8 times higher than that of the low-risk and moderate group; incidence of secondary stroke in low-risk, moderate-risk and high-risk groups reached 3.1%, 9.8%, 17.8%, respectively, within 90 d. incidence of secondary stroke in medium and high-risk groups accounting for about 90%, are higher than that of the low-risk group.[2,14,15]

Other studies demonstrated that TIA patients in low-risk (0-3 points), moderate-risk (4-5 points), high-risk groups (6-7 points) presented incidence of cerebral infarction of 3%, 31% and 3%, respectively (P<0.05) within 7 d. TIA patients with secondary to cerebral infarction within 7 d probability and linear correlation between ABCD2 score showed that high score indicates high incidence of cerebral infarction; ABCD2 score >6 displays highest incidence in patients, and risk of recurrence of cerebral infarction is seven times higher than that of other patients.[16,17] To date, numerous studies proved that efficiency of ABCD2 score for early prediction of cerebral infarction after TIA value is higher than that of ABCD score method, with recommendations of AHA/ASA for clinical evaluation of the prognosis of patients with TIA risk method.[2]

In recent years, a growing number of studies have shown that ABCD2 score for prediction of stroke after TIA features more limitations because of lack of etiology assessment, making ABCD2 score prediction value questionable.[2,15,17]

CIP RATINGS

Most studies have shown that cerebral MRI (magnetic resonance imaging, MRI) on patients with TIA suggests that rate of incidence of brain ischemic changes is around 80%, which are in correspondence with TIA symptoms reaches 31-39% in tissue ischemic probability.[18,19] Given the pathogenicity of the focal ischemic, scholars put forward a kind of based on clinical and radiographic prediction rating scale (clinical and imaging-based predictive algorithm, CIP), the ABCD2 rating scale and DWI high signal combination can improve prediction neural function in the aftermath of the TIA missing and the risk of cerebral infarction progress. The rating scale TIA patients can be divided into: the low-risk group (ABCD2 score <4+DWI negative, can ABCD2 score 4+ DWI negative can or higher) and high risk group (ABCD2 score <4+DWI, ABCD2 score of 4 or more points can +DWI positive can), clinical trials confirmed that, CIP risk score predicts 7 d after TIA cerebral infarction of accuracy is higher than ABCD2 score, the difference is statistically significant.[2] But because the brain lesions in MRI for early pawn sensitivity is low, DWI high signal can help to find TIA patients with recent cerebral ischemic change, but DWI abnormal signal changes whether can be proved cerebral infarction is controversial, and is also difficult to distinguish them from changes in short-term and recurrent ischemic lesions.[18] CIP score is a kind of method for TIA patients to predict value , but which still need further research.

ABCD2I SCORE

Although ABCD2 score based on the ABCD score increased diabetes, the risk factors, making the sensitivity of the ABCD score has improved to some extent, but because the ABCD2 score lack the etiology assessment on TIA, obviously there are some shortcomings. At present, the cause of TIA including hemodynamic theory, theory of microemboli (source sex cardiac and artery embolism etc.).

Most of the studies confirm that the relationship between ischemic cerebrovascular disease and carotid atherosclerosis plaque is very close.[1,3,20,21] In recent years, with the development of imaging, radiographic abnormality in evaluating the risk of stroke after TIA is more and more important significance.

In recent years, studies have shown that magnetic resonance Imaging (coursing together Weighted Imaging, DWI) abnormality and artery stenosis is the independent risk factors of cerebral apoplexy, and found that they can be combined with ABCD2 score to improve predictive value on the risk of stroke after TIA. Based on the above evidence, the researchers make supplement and revision to ABCD2 score, and founded ABCD2I grading system in 2010 which on the basis of ABCD2 score is added the presence of acute or chronic ischemic lesions on DWI ischemic lesions or on CT scan grading project (3 points), total score of 10 points.[5,17-19]

Researchers have confirmed that DWI, ABCD2 score has predictive value to TIA within 7 d after stroke risk, DWI positive, ABCD2 score results and can artery atherosclerosis be within 90 d after TIA independent risk factor for stroke, abnormal DWI results and patients with TIA etiology, warning its future increased risk for cerebral infarction. Scholars can estimate of risk for stroke after TIA based on ABCD2 score and whether there are infarcts in and CT and DWI, the result shows: the TIA within 7 d and 30 d after cerebral infarction predicted rate increased by 18%.[15,20,22] Due to the lack of appreciation of ABCD2I on the artery stenosis, so affected its predictive value, resulting in limitations in clinical practice.

ABCD3 AND ABCD3I SCORE

In the initial years after the establishment of ABCD2 score, the relationship about ABCD2 carotid stenosis recurrent TIA and DWI positive lesions with early stroke events with TIA patients is paying attention seriously, and demand to establish a set of risk rating scale suitable for the emergence of the secondary medical institutions is emerging.[2,8,9,11,22] In 2010, researchers established ABCD3 and ABCD3I score.[15] Which on the basis of the ABCD2 added an index in ABCD3: double TIA (TIA attack 2 times or more within 7 days, 2points), the total score nine points; ABCD3I score increased three indicators (double TIA, ipsilateral carotid stenosis, positive DWI), a total of eight items: age 60 years or more (1 point), blood pressure >140/90 MMHG (1 point), clinical symptoms (words damaged 1 points; partial side limb weakness 2 points), duration of symptoms (10-59 minutes 1point; 2 minutes and 60 minutes or higher), diabetes (1 point), double TIA, carotid stenosis and positive DWI (2 points), and all score of 13 points.

Research shows ABCD3 score and ABCD3I score in the prediction of statistics of the risk of stroke after TIA within 2 d, 7 d, 28 d and 90 d, the latter is significantly higher than the former, the difference was statistically significant. Results shows that compared with the score does not include the imaging findings, ABCD3I has more predictive value on early stroke after TIA, and ABCD3 and ABCD2 have no obvious difference in the early prediction of stroke. Later, many experts make verification on the results of ABCD3 and corresponding ABCD3I.[2,15,17,23,24]

Researchers at home and abroad have carried out in accordance with the ABCD3I score validation grouping amount samples of TIA patients into low-risk group (0-3), moderate group (4-7), high-risk group (8 to 13 points) for investigation and study analysis , the results show that the incidence of stroke after TIA within 7 d is: low-risk group < moderate group < high-risk group (differences are statistically significant); Incidence of stroke within 90 d, low-risk group of < moderate group < high-risk groups (the difference had statistical significance), compared with low risk and moderate group, Incidence of stroke within 7 d and 90 d after TIA in high-risk groups were significantly higher, incidence of cerebral infarction within 90 d after TIA in the intermediate risk category is higher than lower dangerous group, the difference was statistically significant.

ABCD3I score 8 or more, incidence of stroke within the 7 d after TIA became significantly higher, and when ABCD3I score 4 or more the incidence of stroke points within 90 d after TIA became significantly higher, when ABCD3I score 3 points or less, cerebral infarction was not be found within 7 d, 90 d. It indicates with ABCD3 score higher, there will be possible to become cerebral infarction, indirectly suggest most patients whose ABCD3I score <3 with TIA don't need observation in

hospitable, they was medically treated mainly with antiplatelet aggregation of secondary prevention; due to patients with TIA scored 4 to 7 points is the largest number and account for large proportion, they need to be alert to the occurrence of cerebral infarction and if conditions allowed they can be in hospital; Patients scored 8 points or more should be treated as first priority, and should be admitted to hospital as soon as possible and improve the imaging, serology and related inspection and then key intervention and treatment. There are foreign scholars scored the large sample TIA patients according to ABCD2, ABCD3, ABCD3I ratings, and were followed up for 3 years, using COX regression model risk proportion to make the comparison to the scoring system, the results also suggest that ABCD3 and ABCD3I scoring system is superior than ABCD2 score on the predictive value of stroke after TIA.[23]

Similarly, domestic researchers make a comparison to the moderate amount of samples of TIA patients according to ABCD2, ABCD2I, ABCD3, ABCD3I scoring methods, found that predicting stroke risk within 7 d after TIA, ABCD2, ABCD2I, ABCD3, ABCD3I scoring area under the curve (area under the receiver operating characteristics curve, AUC) are 0.733, 0.898, 0.830 and 0.733 respectively; Predict TIA within 90d after stroke risk was 0.699, 0.857, 0.788 and 0.699respectively, so the study says ABCD3I scoring method is more accurate than ABCD2 and ABCD2I scoring method in predicting TIA back stroke risk, coming with higher clinical value.[25]

ABCD, ABCD2and ABCD3 score mainly based on clinical characteristics and are simple, easy, and have a good effect on prediction, but the lack of a TIA etiology, risk factors, imaging and laboratory test, and other auxiliary examination joining, resulting in lacking specificity. Therefore, there are certain risk in the prediction of risk of stroke.[25] For ABCD3I rating scale, needing to rely on auxiliary examination results, and when evaluating also need a certain amount of time with high medical dependence and trust from patients, which can't quickly assess the risk stratification.

ABCD3 OTHER IMPROVEMENTS SCALE (D, C/I, NEW---V-F, L)

Although the class rating scale has certain prediction value on risk of stroke occurrence in patients with TIA within in a certain period, but they all don't bring into the intracranial vascular imaging as evaluation criteria. When some scholars of cerebral angiography making cerebral infarction (Digital Subtraction Angiography, DSA) inspection on patients, they found that 60.5% of patients having intracranial vascular acuity 50% narrow lesions and the incidence of intracranial stenosis is higher than of extracranial vessels.[18,19,26] At present, the studies of cervical artery stenosis is not yet clear, studies have shown that internal carotid artery stenosis is the independent risk factors of stroke after TIA within 7 d.[2,18] ABCD3-V grading method brings into the lesion

ipsilateral carotid stenosis 50% + lesions or ipsilateral intracranial artery stenosis 50% or greater as rated items on the basis of ABCD3 evaluation method, assignment 2 points.[25-27] A multicenter study brings into a large number of samples of TIA patients and evaluate TIA patients according to ABCD2, ABCD3 and ABCD3-V three evaluation method, according to the area under the receiver-operating characteristic curve (ROC) concluded that ABCD3-V scoring method of area under the ROC curve is greater than the ABCD2 area under the ROC curve and ABCD3 evaluation method, which suggests that the ABCD3-V scoring method for value of prediction of cerebral infarction within seven days after TIA is better than that of the ABCD2 and ABCD3 grading method and compared with ABCD2 score method, predicted value of cerebral infarction occurrence after TIA within 7 days according to ABCD3 score is higher, at the same time, the higher the ABCD3-v score is, the greater the risk of secondary cerebral infarction after TIA is.[28]

In 2014, Japanese researchers put forward ABCD3I (d, c/I) score through a multicenter study, adding DWI high signal in imaging and internal carotid artery stenosis, the statistics results indicate that ABCD3I (d, c/I) score has good predictive value on the short-term risk of stroke after TIA, but the long-term predictive value is not good enough.[23]

On the basis of this when we can remove DWI high signal, namely ABCD3I (c/I) score the rating scale not only can predict short-term stroke but also can predict the long-term risk of stroke within three years, due to the low incidence of intracranial artery stenosis patients, the prediction value is low.[23,28] In ABCD3I and modified score above, exist in patients with TIA recurrent recall bias and different research background, putting forward the new-ABCD3I score, and adding a double DWI high signal (2 points), which can suggests occurrence of prompt brain tissue ischemic, dynamic changes of clinical symptoms replacing the histological steady state change to reduce the error, the researchers identified the score to further improve the predictive value of early risk of stroke after TIA through model research, but that still needs further clinical practice research to prove.

As the domestic medical level configuration various widely, some domestic scholars adding into biochemical test results on the basis of ABCD3 grading method to make up of a ABCD3-F (join fibrinogen index), ABCD3-l (such as adding low density index) scoring tool, the above method is the simplicity of operator, convenient for observation and also has obtained the good clinical use value.[2,25,29,30] Some scholars adopt ABCD3 -I grading combining homocysteine (HcY), fibrinogen (FIB), and D-dimer to predict risk of stroke after TIA to explore practical value of predicting risk of stroke after TIA according to ABCD3-I grading combined with of HcY, FIB, D-dimer , the study found that the patients with TIA HcY and FIB level significantly increased risk

for the development of cerebral infarction, TIA patients was divided into low-risk group (0-3), moderate group (4 to 7 points) and the high-risk group (8 to 13 points), results showed that as the increase of grading, risk of stroke after TIA also increased, compared with high-risk group and moderate, low-risk group, the incidence of stroke in high-risk group of 7 d increased significantly.[23] Whether ABCD3 rating scale joint biomarkers predictive value can increase the risk of stroke still need large-scale clinical trials to verify.

DISCUSSION

Of all the ABCD score scales, the most commonly used is ABCD2 score scale, which has extremely high predictive value of the differential diagnosis and early assessment after TIA, but because of its own shortcomings, its accuracy to predict is affected by this. Neurologist in clinical and scientific research need to master using of relevant scale, but clinical scale is mainly used as the tools for diagnosis, curative effect evaluation, and functional assessment, while we need to be aware of is the scale does not replace clinical diagnosis in the clinical work and scientific research. In numerous prediction scoring system, from the initial score tool based on the clinical characteristics to now the score method combing imaging, laboratory examination and clinical characteristics, because the researchers according to different methods with different evaluation factors and different emphasis, there has not been formed a generally accepted and perfect prediction scoring system, which needs further research.

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