Can the ABCD² Risk Score Predict Positive Diagnostic Testing for Emergency Department Patients Admitted for Transient Ischemic Attack?

Jon W. Schrock, MD; Aaron Victor, BS; Theodore Losey, MD

Background and Purpose—We sought to determine if the ABCD² score, typically used for risk stratification, could predict having a positive diagnostic test in patients evaluated acutely for transient ischemic attack.

Methods—We performed a retrospective cohort study for patients admitted from our emergency department with a new diagnosis of transient ischemic attack confirmed by a neurologist. ABCD² scores were calculated and patients with a score of ≥4 were placed in the high-risk cohort. Tests evaluated included electrocardiogram, CT, MRI, MR angiography, carotid ultrasonography, and echocardiography. Specific test findings considered to signify positive diagnostic tests were created a priori.

Results—We identified 256 patients with transient ischemic attack for inclusion; 167 (61%) were female, the median age was 60 years (interquartile range, 50 to 72), and 162 (63%) patients had an ABCD² score of ≥4. Rates of completion of diagnostic testing were electrocardiogram, 270 (100%); CT, 224 (88%); MRI, 89 (35%); MR angiography, 68 (27%); carotid ultrasonography, 125 (49%); and echocardiography, 135 (53%). Univariate analysis found a significant association only with elevated ABCD² score and carotid duplex testing (P<0.05).

Conclusion—An elevated ABCD² score may help predict patients with severe carotid occlusive disease but does not predict positive outcome in other commonly ordered tests for patients being evaluated for transient ischemic attack. An elevated ABCD² score cannot be recommended as a tool to guide diagnostic testing in patients presenting acutely with transient ischemic attack. (Stroke. 2009;40:3202-3205.)

Key Words: ABCD² score ■ carotid stenosis ■ stroke ■ transient ischemic attack

Patients who have a transient ischemic attack (TIA) have a significant risk of stroke in the next week.¹,² Risk scores have been developed to assist in short-term risk stratification of patients with TIA. The ABCD² score uses clinical features, medical history, and blood pressure to generate a number that can be used to determine the patient’s short-term risk of stroke.³

Patients who are evaluated and treated for TIA in an urgent fashion have a lower risk of short-term stroke.⁴ This knowledge has led to more aggressive evaluations of patients presenting with TIA. Unfortunately, the recommendations for diagnostic testing for TIA are based on limited evidence, the majority of which is category 3 or 4.⁵ The decision of which test to perform on which patient can become confusing and can expose patients to excessive testing, radiation, and medical costs.

The evaluation of patients with TIA may occur as an outpatient or in a hospital or observation unit setting.⁶ Testing may be ordered by physicians, including neurologists, hospitalists, or emergency physicians with various degrees of expertise in the management of TIA. Although the ABCD² score was not designed to assist in predicting possible pathological conditions for acute stroke, it would be helpful if such an association existed. Previous research evaluating the ABCD² score in patients with TIA found no relationship between an elevated score and carotid stenosis or atrial fibrillation.⁷ Currently, it is unknown if the ABCD² score is predictive of significant pathology using other diagnostic tests routinely used in patients with TIA. We sought to evaluate the ability of the ABCD² score to predict positive diagnostic test results in patients being acutely evaluated for TIA.

Methods

We conducted a retrospective observational cohort study of all patients presenting with an emergency department (ED) diagnosis of TIA from January 2004 through December 2007. Our facility is a large urban ED with approximately 90,000 visits annually. The research protocol was approved by our institution’s Internal Review Board, which allowed for an exemption for informed consent. Patients were recruited using the International Classification of Diseases, Ninth Revision, Clinical Modification for TIA. All patients

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From the Department of Emergency Medicine (J.W.S.), MetroHealth Medical Center, Case Western Reserve University School of Medicine, Cleveland, Ohio; Case Western Reserve University (A.V.), Cleveland, Ohio; and the Department of Emergency Medicine (T.L.), MetroHealth Medical Center, Case Western Reserve University School of Medicine, Cleveland, Ohio.

Correspondence to Jon W. Schrock, MD, MetroHealth Medical Center, Department of Emergency Medicine, 2500 MetroHealth Drive, Cleveland, OH 44109-1998. E-mail jwschrock@metrohealth.org

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with an ED diagnosis of TIA were screened. Patients who had a subsequent neurologist diagnosis of TIA were included for analysis. Patients who had an ED diagnosis of TIA and returned to baseline while in the ED but later in the hospitalization either developed a new focal neurological deficit or were diagnosed with cerebral infarction based on radiological imaging were included for analysis. Patients subsequently diagnosed with cerebral infarction were included because this diagnosis may be made on the basis of diagnostic testing. For example, patients with an initial diagnosis of TIA but with a positive diffusion-weighted imaging MRI or subacute infarct on CT may receive a discharge diagnosis of cerebral infarction. Patients presenting with new focal neurological deficits in the ED which were still present at the time of neurology evaluation were felt to be an acute cerebral infarction and not a TIA. These patients were excluded from final analysis. These patients were considered a misdiagnosis during the ED evaluation.

If the diagnosis of TIA was uncertain, the staff neurologist who evaluated that patient was queried for clarification. Patients who left the hospital against medical advice or were transferred to another hospital facility were excluded. Patients were enrolled only for their initial TIA during the study period. Subsequent TIAs during the study period were excluded. Data were collected by 2 trained researchers (A.V., S.L.) using a structured instrument. Data evaluated included demographic information, medical history, presenting symptoms, location of admission (hospital or observation unit), vital signs, and results of diagnostic testing. Because we were evaluating only emergent or urgent testing for TIA, any testing performed after hospital discharge was not used in our analysis.

Lists of criteria were created a priori to represent a positive diagnostic test and are included in Table 1. All right to left cardiac shunts, including patent foramen ovale, atrial septal defect, and ventricular septal defects, were included. Any intracranial cerebral vascular stenosis was included as a positive examination if present. Our neuroradiologists do not quantify degrees of stenosis; therefore, we choose to include all patients with visible stenosis. Dilated cardiomyopathy defined as an ejection fraction ≤35% were included as a positive finding on echocardiography.

The ABCD² score is a cumulative point scoring system with the following items: age ≥60 years or <60 years, 1, elevated blood pressure (systolic ≥140 mm Hg or diastolic ≥90 mm Hg) or 2, clinical features (unilateral weakness = 1, speech disturbance without weakness = 1), duration of symptoms in minutes (<10 minutes = 0, 10 to 59 minutes = 1, and ≤60 minutes = 2), and the presence of diabetes = 1.

All data were entered into a structured database using Panorama 4.0, (Prove Development, Huntington Beach, Calif). Statistical analysis was performed using STATA 9.2 (College Station, Texas). Results are reported as frequencies and percentages with interquartile ranges and 95% CIs where appropriate. Patients were dichotomized into low risk (score 0 to 3) and high risk (score 4 to 7) a priori with a high-risk cohort used as the referent group. A score of ≥4 representing high risk of subsequent TIA was conceived before study inception and has been used in prior studies. Univariate analysis was performed providing ORs using the χ² test with probability values <0.05 considered significant.

### Results

During the study period, 436 patients received an ED diagnosis of TIA. Of those, 146 (33%) were given an alternative diagnosis not related to TIA or cerebral vascular disease. Of the ED patients diagnosed with TIA, 58 (13%) were given a neurology diagnosis of acute cerebral infarction. Of the patients diagnosed with a neurology diagnosis of cerebral infarction, 24 (9%) had no new neurological deficit at the time of admission and developed a cerebral infarction at some point during hospitalization. This allowed 256 patients for analysis. The length of stay for the patients diagnosed with TIA and cerebral infarction was 1 day (interquartile range, 1 to 3 days) and 2.5 days (interquartile range, 1 to 5 days), respectively. Of the patients diagnosed with cerebral infarction, 5 (21%) were admitted for ≥7 days. Patient demographic information can be seen in Table 2. The majority of patients, 165 (64%), were admitted to the hospital; 82 (32%) were admitted to our ED observation unit and 9 (4%) were discharged directly from the ED. The distributions of ABCD² scores can be seen in the Figure. The low-risk group included 100 (39%) patients. Univariate logistic regression found a significant association with elevated ABCD² score and carotid duplex testing only (P<0.05). The results of the regression for all the diagnostic tests studied can be seen in Table 3. At ED arrival, 14 (5.5%) of patients were currently taking antiplatelet and lipid-lowering agents, respectively.

### Discussion

TIA is estimated to be diagnosed at a rate of 240,000 cases each year. The use of diagnostic testing for patients with TIA

### Table 1. Criteria for Positive Diagnostic Testing

<table>
<thead>
<tr>
<th>Test Evaluated</th>
<th>Criteria for Positive Diagnostic Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrocardiogram</td>
<td>Atrial fibrillation, atrial flutter, ST segment elevation</td>
</tr>
<tr>
<td>Brain CT</td>
<td>Acute infarct, subacute infarct, acute bleed or hemorrhage</td>
</tr>
<tr>
<td>Brain MRI</td>
<td>Positive diffusion-weighted images, acute stroke, subacute stroke</td>
</tr>
<tr>
<td>Brain MRI* angiography</td>
<td>Vascular stenosis, basilar artery stenosis, carotid stenosis, dissection</td>
</tr>
<tr>
<td>Carotid duplex ultrasound*</td>
<td>Vascular stenosis, carotid stenosis, dissection</td>
</tr>
<tr>
<td>Echocardiography</td>
<td>Patent foramen ovale, positive shunt, thrombus, intramural thrombus, ejection fraction ≤35%</td>
</tr>
</tbody>
</table>

*Any carotid stenosis >50% considered significant.

### Table 2. Demographic Information

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>157 (61%)</td>
</tr>
<tr>
<td>Age, years</td>
<td>60 (interquartile range, 50–71)</td>
</tr>
<tr>
<td>Systolic blood pressure, mm Hg</td>
<td>148 (SD, 129–172)</td>
</tr>
<tr>
<td>Diastolic blood pressure, mm Hg</td>
<td>77 (SD, 65–89)</td>
</tr>
<tr>
<td>Heart rate, beats/min</td>
<td>99 (SD, 79–119)</td>
</tr>
<tr>
<td>Race</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>130 (51%)</td>
</tr>
<tr>
<td>Black</td>
<td>101 (39%)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>15 (6%)</td>
</tr>
<tr>
<td>Risk factors</td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td>90 (35%)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>198 (77%)</td>
</tr>
<tr>
<td>Atrial fibrillation</td>
<td>12 (5%)</td>
</tr>
<tr>
<td>Smoker</td>
<td>105 (41%)</td>
</tr>
<tr>
<td>Hyperlipidemia</td>
<td>104 (41%)</td>
</tr>
<tr>
<td>Prior TIA</td>
<td>46 (18%)</td>
</tr>
</tbody>
</table>
often follows the potential clinical stroke subtype they presented with: large vessel occlusive, small vessel occlusive, or embolic. Over 250 unique guideline documents have been published on the management of patients with TIA and 36% of these were judged by experts to be incorrect, impractical, unclear, outdated, or biased. These patients often are managed by nonneurologists who may be unaware of the need for specific diagnostic testing.

We sought to determine if the ABCD² score could assist in guiding diagnostic testing in these patients with the premise that a higher score could predict a positive test result. Unlike previously published research, we found a statistical association with an elevated score and the presence of carotid stenosis. This should not be too surprising because many of the elements of the score—hypertension, diabetes, and age—are independent risk factors for carotid stenosis. Positive results for other diagnostic testing were not influenced by an elevated ABCD² score. Although we did not specifically look at stroke subtypes, previous work has shown that an elevated ABCD² score was not associated with a particular stroke subtype.

The rates of positive diagnostic testing varied significantly with a positive electrocardiogram occurring in <2% and a positive MRI finding occurring in over half of the patients tested. It should be expected that inexpensive noninvasive tests such as an electrocardiogram would be used more frequently than more costly invasive testing and therefore have a lower percentage of positive findings. A recent publication by Quinn et al evaluated if a low ABCD² score could predict a noncerebrovascular diagnosis in patients referred to a neurology clinic for TIA. They used a lower ABCD² score (0 to 1) to define low risk. Their population included inpatients and outpatients and did not define the timing of the diagnostic brain imaging. Similar to our results, they found a high score was significantly associated with carotid vascular disease. Unlike our results, they found a high score was significantly associated with vascular lesions on brain imaging. The different rates of brain imaging among populations, 46.4% and 36.7% for the Quinn study and ours, respectively, suggest that they were more selective on who received brain imaging. The differences in study objectives, in rate of testing, and the different cutoffs used to determine low versus high risk make comparisons of the results of the 2 studies problematic.

It would be helpful to have an instrument that could direct diagnostic testing of patients with TIA. Currently, such a tool does not exist. Physicians will need to continue to use their judgment in directing diagnostic testing for these patients.

Our study was conducted at a single center so our findings may be different than other centers with significantly different populations. Not every patient received every test. This would not be practical and is not possible with the retrospective nature of the study. Our rates of testing were much higher than a published Canadian study on patients with TIA. Despite our higher rates of testing, it is possible that limited testing could introduce selection bias. We did not study how this diagnostic testing affected patient outcomes, which would require a prospective analysis. We did not use imaging criteria as part of the diagnostic criteria for TIA because it would confound the results. We did not evaluate outpatient workups for TIA. This would be difficult because very few patients with the acute presentation of TIA were discharged (4%).

### Summary

We found a high ABCD² score, of ≥4, was associated with a significantly increased likelihood of carotid stenosis in patients presenting with TIA. If the score was used as a means of determining which patient gets testing, 15% of patients with significant carotid stenosis would have been missed. Although a high ABCD² score is suggestive of significant carotid disease, we cannot recommend it as a screening tool for deciding in which patients to obtain carotid imaging. A high score was not associated with positive diagnostic testing for patients undergoing brain MRI, MR angiography, CT, echocardiography, or electrocardiography and the ABCD² score should not be used to influence diagnostic testing for these modalities.

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### Disclosures

None.
References


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