ORIGINAL ARTICLE

Use of ABCD2 risk scoring system to determine the short-term stroke risk in patients presenting to emergency department with transient ischaemic attack

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Abstract

Objective: To determine the 3-day stroke risk of patients presenting to emergency department with transient ischaemic attack, and to evaluate the predictive value of ABCD^2 (Age, Blood pressure, Clinical features, Duration of symptoms and Diabetes) score for these patients.

Methods: The prospective study was conducted on patients with diagnosis of transient ischaemic attack who were divided into low (0-3 points), medium (4-5 points) and high (6-7 points) risk groups according to their ABCD^2 scores. The sensitivity of the scoring system on estimation of the risk of stroke in 3 days was evaluated through receiver operating characteristic curve. SPSS 15 was used for data analysis.

Results: Of the 64 patients in the study, none of the low-risk group had stroke. Stroke was present in 4 of 33 (12.12%) medium-risk patients, while there were 4 in 18 (22.22%) in the high-risk group. Sensitivity and specificity of each ABCD^2 score for 3rd day stroke risk was calculated. In the receiver operating curve generated by these calculations, the c statistics was determined as 0.76 (95% CI: 0.64, 0.86; $p<0.01$) and the most appropriate cut-off score to dichotomise the study group was determined as 4.

Conclusions: In transient ischaemic attack patients with an ABCD^2 score of four or higher had a markedly increased short-term stroke risk, while those with a lower score were quite safe. It is appropriate to hospitalise patients with a score of four or more and investigate for underlying cause and initiate treatment.

Keywords: ABCD^2, Emergency department, Risk scoring system, Stroke risk, Transient ischaemic attack. (JPMA 63: 1142; 2013)

Introduction

Transient ischaemic attack (TIA) is a brief episode of neurological dysfunction with symptoms lasting less than 24 hours and resulting from focal cerebral ischaemia not associated with permanent cerebral infarction.[1] Patients who have had a TIA are at increased risk of stroke, myocardial infarction and vascular deaths. For this reason, emergency physicians have a significant role in the management of these patients.[2]

A recent survey suggested that in the population older than 65 years, 1 in 15 reported a history of TIA. About 15% of patients experiencing stroke have reported a history of TIA.[3] Ten per cent of patients with TIA experienced a stroke within 3 months, and half of these strokes occurred within 48 hours of the initial TIA.[4]

Clinical prediction scores such as the California Index, Age, Blood pressure, Clinical features, and Duration of Symptoms (ABCD) and Age, Blood pressure, Clinical features, Duration of symptoms and Diabetes (ABCD2) scores have been developed with the aim of improving identification of TIA sub-groups at higher or lower early stroke risk. 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.[5]

The ABCD2 system is a prognostic system based on clinical data designed to predict stroke risk after a TIA, to guide triage to specialist care, target secondary prevention, and to inform public education. Use of the score has been recommended in national guidelines in North America, Europe and Australia.[6,7]

The ABCD2 score has been proposed as a useful clinical tool for risk stratification after TIA. This model combines 5 clinical variables into a 7-point scale: age, blood pressure, clinical features, duration of symptoms and history of diabetes. International guidelines have recommended that patients with low ABCD2 scores (3 or less) be triaged for non-specialist care or less urgent specialist care (up to 1 week or longer).[8] Emergency evaluation and hospital admission for patients with a score of $\geq$4 on these scales have been recommended.[9] Existing prognostic scores for stroke risk after TIA validate well on multiple independent

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cohorts, but the unified ABCD2 score is likely to be most predictive.[10,11] Patients at high risk need immediate evaluation to optimise stroke prevention.

The aim of this study was to determine the 3rd day stroke risk of patients presenting to an emergency department (ED) with TIA and to evaluate the predictive value of the ABCD2 score for these patients.

Patients and Methods

The prospective, cross-sectional study comprised all patients presenting with an ED diagnosis of TIA from May to July 2010, at the Haydarpasa Numune Research and Training Hospital, Istanbul. The study was approved by the Ethics Committee of Marmara University. TIA is defined as acute onset of focal cerebral or monocular symptoms lasting less than 24 hours and thought to be attributable to a vascular cause in the opinion of neurologist evaluating the patient. All patients who were older than 18 years and had sufficient clinical suspicion to justify diagnostic testing for a neurovascular cause were eligible for inclusion. On enrollment, a standardised case report form was completed, collecting data on clinical features of the TIA, medical history, and findings of clinical examination. Subsequently, all relevant diagnostic testing was recorded.

Exclusion criteria included: patients <18, diagnosis of any kind of haemorrhage, a computed tomography (CT) scan or other investigation that revealed a primary cause of the symptoms other than TIA, lack of informed consent, or lack of specification of time of symptom onset. Patients with a clinical diagnosis of stroke were also excluded. All patients who were suspected of having a TIA were consulted by an expert neurologist blinded for the study, and those patients who were diagnosed as having a TIA by the neurologist, were included.

Data evaluated included demographic information, medical history, presenting symptoms, location of admission (hospital or observation unit), vital signs, and results of diagnostic testing.

The ED physician noted the patient's age, blood pressure, clinical symptoms, duration of symptoms and history of diabetes mellitus, and, using these parameters, the ABCD2 score was calculated in the range of 1 to 7 (Table-1).

The five potential risk factors were age, blood pressure, clinical features (motor weakness and speech disturbance), duration of symptoms and diabetes. These risk factors were defined and chosen according to previous studies. Age was dichotomised at 60 years. Clinical features were classified as follows: motor weakness (focal, usually unilateral, weakness of one or more of the face, arm, hand or leg); speech disturbance (defined as either dysarthria or dysphasia or both) without weakness. Other neurological symptoms were excluded for this criterion. Limb weakness required a clear description of loss of power as opposed to more vague terms, such as "clumsiness" or "heaviness," in the absence of definite weakness. Symptom durations were divided as less than 10 min, 10-59 min, and 60 min or longer. In patients with more than one TIA in the past month, the duration of the longest event was used. Diabetes was defined as requiring either oral medication or insulin. Hypertension was coded as elevated blood pressure on first recording after the TIA (cut-off points of 140mmHg systolic and 90mmHg diastolic were used).

Table-1: ABCD2 Scoring Criteria.

A	Age	≥60 years	1 point
B	Blood pressure	≥140/90 mm Hg	1 point
C	Clinical features	Unilateral weakness	2 points
Speech impairment without weakness			1 point
D	Duration	≥60 minutes	2 points
		10-59 minutes	1 point
D	Diabetes	Presence of diabetes mellitus	1 point

Patients were categorised into 3 groups according the ABCD2 score as low risk (0-3 points), medium risk (4-5 points), and high risk (6-7 points).

After the initial evaluation; the patients were either discharged with the medical advices of the neurologist, or admitted to the neurology ward according to decision of the neurologist. Follow-up was performed at 3rd day, either by a centralised telephone interview or by consultation with the neurologist. Death, stroke, and further vascular events, as well as hospital admissions, were recorded.

The primary outcome was stroke occurring within 3 days of TIA presentation. Stroke was defined as a rapidly developed focal or global disturbance of cerebral function, with no apparent non-vascular cause, lasting more than 24 hours or until death, and distinguishable from the event leading to the initial TIA diagnosis.

To find a clinically and statistically significant difference between the mean ABCD2 scores of patients with and without stroke (difference between independent means, one-tailed). With a type 1 error of 0.05, a power of 0.80, and allocation ratio of 7, the minimum sample size that was required was 56. Using convenience sampling, a total of 64 patients were enrolled during the 3-month period. The power of the study with these 64 patients at the end

of the study to statistically distinguish between the ABCD2 scores of patient with and without stroke was 0.85.

Normally distributed variables were reported as means and standard deviation with 95% confidence interval (CI) and were compared using Student's t-test for independent variables. To test for normal distribution, which is the main assumption for a Student's t-test to be done, we used Kolmogorov-Smirnov and Levene's tests. Also, normal distribution was assessed using normal quantile plot and histograms. Categorical variables were presented as frequencies and percentages with ranges and were assessed using Fisher's exact test. The level of significance was taken as $p<0.05$. The stroke risks of the patients were expressed with their 95% CI on the basis of a linear regression. A receiver operating characteristic curve (ROC) analysis was conducted to identify the threshold that maximised the sensitivity and specificity for discriminating between high and low-risk patients for stroke according to their ABCD2 scores.

Statistical analyses were performed using SPSS 15. The G*Power version 3.1.2. (Franz Faul, Universitat Kiel, Germany) was used for power and sample size analysis. MedCalc Software v11.3 was used for ROC analysis.

Results

The mean age of the 64 patients was 68.4±11.79 years, and there were 36 (56.3%) males. The mean time from symptom onset to enrollment was 4.96±3.87 hours. Of the 64 patients, 22 (34.4%) presented with speech disturbances, 30 (46.9%) with unilateral weakness and 12 (18.8%) with unilateral numbness. In 12 (18.8%) patients, symptoms lasted for less than 10 minutes; in 24 (37.5%) between 10-60 minutes; and in 28 (43.8) more than an hour. Nineteen (29.7%) patients had a history of diabetes mellitus; 51 (79.7%) presented with high blood pressure; 46 (71.9%) had a history of hypertension; 15 (23.4%) had a history of coronary artery disease (CAD); 10 (15.6%) had a history of atrial fibrillation; 5 (7.8%) had a history of peripheral arterial disease; 8 (12.5%) had a history of stroke; 11 (17.2%) had a history of TIA; and 8 (12.5%) had a history of hyperlipidaemia. Besides, 14 (21.9) patients were smokers/ex-smokers; 16 (25.0%) were on acetylsalicylate; 6 (9.4%) were using clopidogrel and 10 (15.6%) were using warfarin. Patient characteristics were noted according to the components of the ABCD2 score (Table-2).

Table-2: Distribution of the ABCD2 score parameters of the patients.

Variables	Subgroup	n	%
Hypertension	present	51	79.7
	absent	13	20.3
Clinical features	Speech disturbance	22	34.4
	Unilateral weakness	30	46.9
	Numbness	12	18.8
Duration of symptoms	<10 minutes	12	18.8
	10-60 minutes	24	37.5
	>60 minutes	28	43.8
Diabetes	present	19	29.7
	absent	45	70.3
Age	≥60 years	47	73.4
	<60 years	17	26.6

Table-3: Diagnostic risk ratios and cross-tabulation of presence of stroke on the 3rd day compared to ABCD2 risk groups.

	ABCD2 Risk Groups			
	Low n (%)	Medium n (%)	High n (%)	Total Row n (%)
Stroke Not Present	13 (20.3)	29 (45.3)	14 (21.8)	56 (87.4)
Stroke Present	0 (0)	4 (6.3)	4 (6.3)	8 (12.6)
Total Column n (%)	13 (20.3)	33(51.6)	18 (28.1)	64 (100)
%Risk (CI)	0	12.1 (4-20)	22.2 (8-36)	

(n=Number of cases, CI=Confidence Interval).
ABCD: Age, Blood pressure, Clinical features, Duration of symptoms and Diabetes.

Table-4: The sensitivity and specificity of ABCD2 to predict stroke on the 3rd day for every score.

ABCD^2 score	Sensitivity (%95 CI)	Specificity (%95 CI)	+ LR (%95 CI)	- LR (%95 CI)
>=1	100,00 (63.1-100)	0,00 (0.0-6.4)	1,00	
>3	100,00 (63.1-100)	23,21 (13.0-36.4)	1,30 (0.8-2.1)	0,00
>4*	75,00 (34.9-96.8)	62,50 (48.5-75.1)	2,00 (1.3-3.1)	0,40 (0.1-1.4)
>5	50,00 (15.7-84.3)	75,00 (61.6-85.6)	2,00 (1.0-4.1)	0,67 (0.3-1.5)
>6	37,50 (8.5-75.5)	98,218 (90.4-100)	21,00 (8.6-51.4)	0,64 (0.08-4.8)
>7	0,00 (0.0-36.9)	100,00 (93.6-100)		1,00

(*:the highest sensitivity and specificity; CI: confidence interval; LR: likelihood ratio).
ABCD: Age, Blood pressure, Clinical features, Duration of symptoms and Diabetes.

The scores were then grouped to create strata for low, moderate and high risk to identify patients who could be managed non-urgently and those who probably needed priority for evaluation, treatment and observation. Overall, 13 (20.3%) were classified as low risk, defined as a score of less than 4 (stroke risk 0% at 3 days); 33 (51.6%) as moderate risk with a score of 4 or 5 (stroke risk 12.1% at 3 days); and 18 (28.1%) as high risk with a score of greater than 5 (stroke risk 22.2% at 3 days) (Table-3).

The sensitivity and specificity of ABCD2 to predict stroke on the 3rd day was calculated for every score (Table-4). The ROC curve of ABCD2 Risk Score vs. presence of stroke on 3rd day was drawn (Figure) and accuracy of each score and level were compared as described by Hanley & McNeil

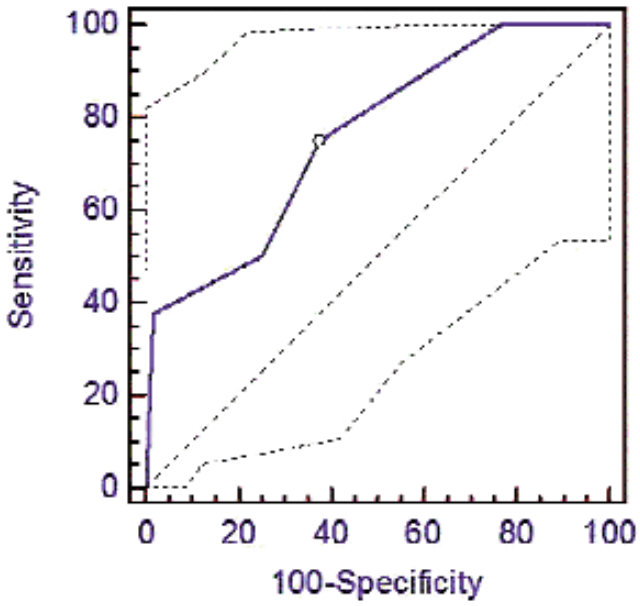

Figure: Receiver operating characteristic (ROC) curve of the ABCD2 Risk Score vs. presence of stroke on the 3rd day.

(Area Under the Curve [AUC]: 0.76; SE: 0.09; 95% CI 0.64, 0.86).[12] The ABCD2 Risk Score discriminated patients with a high risk of developing stroke on the 3rd day from patients with TIA but a low risk successfully.

Discussion

TIA is a cerebrovascular disease characterised by sudden focal neurologic or monocular symptoms lasting less than 24 hours.[2,13,14] Most cases of TIA last less than 1 hour and usually less than 30 minutes.[14,15]

While most patients easily recover from symptoms of TIA, some progress to stroke, which is life-threatening or causes a permanent neurological deficit. It is crucial to distinguish these patients in an ED. There is a variety of clinical and radiological methods for making that distinction and the ABCD2 scoring system is the easiest and most commonly used among these methods.

The current study tried to define the value of the ABCD2 scoring system for predicting risk among TIA patients. Many recent studies have also researched the predictive value of the ABCD2 system; though the results varied, they all concluded that the scoring system is valid for risk stratification.[4,16-19] These studies have defined different risk groups and clinical end-points. The predictive value of the ABCD2 scoring system needs to be clarified before widespread clinical use.[20]

The results suggest that ABCD2 scoring clearly distinguishes TIA patients who had stroke on the third day from those who did not.

When we look through the literature, a study including 2893 patients evaluated the predictive value of ABCD2 scoring on the 2nd, 7th and 90th days for stroke risk, and demonstrated that it is significant for all end-points (C statistics were between 0.62 and 0.83).[10] Another study with 470 patients has shown that ABCD2 successfully predicted stroke risk on days 2, 7, 30 and 90.[21]

Although the current study divided patients into three risk groups, when the sensitivity and specificity of each ABCD2 score for third day stroke risk was calculated, the highest sensitivity and specificity was shown to be ≥4, so the cutoff value was defined as 4.

Another study investigated the sensitivity, specificity, positive and negative predictive values of the ABCD2 score using different cutoff levels, and the associated admission rates for the score. Sensitivity was calculated as 86.4% and the negative predictive value as 91.7% for the cutoff of an ABCD2 score of 4; the sensitivity was calculated as 96.6% and the negative predictive value as 96.1% for the cutoff of an ABCD2 score of 3. Hospitalisation ratios, according to these values, were 69.1% vs. 83.6% respectively.[21]

In another study, all 121 TIA patients were hospitalised for investigation of etiology and medical intervention. The ABCD2 scores of patients who had arterial revascularisation or anti-coagulant treatment were investigated retrospectively and no difference was detected between those whose score was ≥3 and those with a score >3 concerning the need for medical intervention.[22] The current study found that stroke risk was low for a score ≥4. Although these patients do not require hospitalisation, but it should be kept in mind that they may still require medical treatment or intervention.

In the current study, none of the 13 low-risk patients had a stroke on the third day; 4 of the 33 medium-risk (12.1%) and 4 of the 18 high-risk (22.2%) patients had a stroke. In other words, while none of the patients with a score <4 had stroke; 8 (15.9%) of those with an ABCD2 score of ≥4 had stroke. In a multi-centered study held with large patient population, patients were classified as low (<4), medium (4-5) and high (6-7) risk groups according to their ABCD2 scores. Among the low-risk group comprising 1628 patients, the stroke risk was calculated as 1% on the 2nd day and 1.7% on the 7th day, while it was 4.1% to 5.9% for the medium-risk group of 2169 patients, and 8.1% to 11.7% for the high-risk group of 1012 patients on the corresponding days. Although these risk values were different for each centre, it has been demonstrated that there is a correlation between ABCD2

scores and stroke risk throughout the study.[10] In spite of our limited patient population, a similar concordance was presented in our study.

Data reported in the study revealed that when patients presenting to an ED with a diagnosis of TIA were evaluated with the ABCD2 scoring system, patients with a score of ≥4 increased short-term stroke risk, whereas those with a score <4 had a quite low risk. However, the limited sample size of this study and presence of other studies prevent a brave decision regarding out patient follow up for low-risk patients. Nevertheless, similar results of more comprehensive studies support the view that ABCD2 scoring is valuable for risk stratification among TIA patients.[10]

Conclusion

The ABCD2 scoring system is instructive regarding decisions on the follow-up and treatment of patients. Those with a score of ≥4 should be hospitalised for investigation of etiology and appropriate treatment. ED doctors especially should use ABCD2 scoring since it is easier and faster compared to other diagnostic methods. The clinical situation of the patient, other risk factors, cost-effectiveness and facilities should also be considered while deciding on treatment and follow-up.

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