How useful is the ABCD2 TIA score in predicting and preventing stroke?

¿Sirve la escala ABCD2 del AIT para predecir y prevenir Ictus?

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Abstract

Background and objectives: Independent validations of the ABCD2 score used to predict stroke development have reported conflicting results, and besides expert opinion as to proper diagnostic approach and best treatment differs widely. A model predictive power can be modified by the concomitant use of effective diagnostic and pharmacological treatments. We aimed to determine the predictive power of the ABCD2 score while simultaneously providing patients with current urgent recommended treatments and recording their early and long term health outcomes.

Methods: Data were retrospectively collected from all the patients presenting with a TIA for a whole year and were followed for another whole year. Physicians completed data forms with the ABCD2 score when patients arrived at the emergency department (ED).We calculated sensitivity, specificity for predicting stroke at 7 and 30 days after visiting the ED using the high-risk cutpoint of an ABCD2 score ≥ 4.Univariate Cox proportional hazards regression modelling was performed for ABCD2 score to estimate the hazard ratios relative to the low-risk category and to assess the effect of the individual components of the ABCD2 score and other potential risk factors to predict stroke development.

Results: We enrolled 172 patients (mean age 71 yr, 51 % women) with a new incident diagnosis of TIA. The mean (SD) ABCD2 score was 4.2 (1.4). There were 7 new TIA, 17 non fatal strokes and 3 fatal strokes. Intrahospital mortality was 1.7% and 8.7% during the 1 year follow up. An ABCD2 score of ≥ 4 had a sensitivity of 88% and 82 % for a stroke at 7 and 30 days respectively, a poor specificity of 30%. Negative predictive value at 7 days was 98%. ABCD2 score ≥ 4 had no significant predictive value for stroke within 7 days (hazard ratio [HR], 3.49; 95%CI, 0.42 to 27.93) and 30 days (HR, 1.97; 95%CI, 0.43 to 9.13) of the event. Only diabetes predicted an increased likelihood of stroke over the first week (HR, 5.47; 95%IC 1.43 to 20.95) and over the first month (HR, 3.60; 95%IC 1.08 to 12).

Conclusions: An ABCD2 score of < 4 has a good negative predictive value (98%) for stroke development within the first 7 days. However, the low positive predictive value of the ABCD2 score fails to predict with a high level of confidence the future occurrence of a stroke. It was only being diabetic that was significantly related to the probability of stroke development. TIA probably justifies early accurate identification of the underlying TIA etiology for nearly all presentations. We recommend adding a systematic Brain CT, carotid ultrasound and ECG within 24 hours while concomitantly starting urgent treatment.

Key words. Transient ischemic attack. Stroke. ABCD2 score. Emergency management

Resumen

Introducción y objetivo: Las validaciones de la escala ABCD2 para predecir un Ictus después de un AIT han sido contradictorias y la opinión de los expertos sobre cual es mejor método de diagnóstico y tratamiento son muy variables. Además el poder predictivo de las escalas puede variar mucho si al mismo tiempo se usan procesos diagnósticos y terapéuticos efectivos en variar el curso de la enfermedad. Nuestro objetivo es evaluar el poder predictivo real de la escala ABCD2 cuando al mismo tiempo a los pacientes se les somete a métodos diagnósticos adecuados y tratamientos efectivos urgentes.

Metodología: Se recogieron de manera retrospectiva todos los pacientes con diagnóstico de AIT que acudieron a un hospital terciario durante un año y fueron seguidos prospectivamente durante 1 año. Los datos de la escala ABCD2 fueron los que presentaban al momento de llegada a urgencias. Calculamos cual era la sensibilidad, especificidad y poder discriminatorio de una puntuación ≥ 4 para predecir la aparición de un Ictus a los 7 y 30 días. Se aplicó un modelo de regresión univariante de Cox a la escala ABCD2 para estimar el cociente de riesgo relativo a la categoría de bajo riesgo y valorar la capacidad predictiva de ictus de sus componentes individuales y de otros potenciales predictores de riesgo.

Resultados: Incluimos 172 pacientes (edad media 71 años, 51% mujeres) con un nuevo diagnóstico de AIT. La puntuación media de la escala ABCD2 fue de 4.2 ± 1.4. Se produjeron 7 nuevos AIT, 17 Ictus no fatales y 3 ictus fatales durante el seguimiento. La mortalidad intrahospitalaria fue del 1.7% y la total durante el seguimiento de 1 año del 8.7 %. Una puntuación en la escala de ABCD2 de ≥ 4 tenía una sensibilidad del 88% y del 82% para predecir un ictus a los 7 y 30 días respectivamente, con una pobre especificidad del 30%.El valor predictivo negativo a 7 dias fue del 98%. Una puntuación ABCD2 ≥ 4 no tuvo valor predictivo significativo de ictus a los 7 días (hazard ratio [HR], 3.49; 95%CI, 0.42 to 27.93) ni a 30 días (HR, 1.97; 95%CI, 0.43 to 9.13). Como componente individual, solo la diabetes predijo la probabilidad de desarrollar un ictus en la primera semana (HR, 5.47; 95%IC 1.43 to 20.95) y durante el primer mes (HR, 3.60; 95%IC 1.08 to 12).

Conclusiones: Un ABCD2 < 4 tiene un buen valor predictivo negativo (98%) para descartar el desarrollo de un ictus en los próximos 7 días. Sin embargo, su bajo valor predictivo positivo no permite predecir con seguridad el desarrollo de un ictus. Solo la variable diabetes de la escala se asoció con una probabilidad relevante de tener un ictus. Probablemente cualquier tipo de presentación de AIT justifica la búsqueda rápida de la etiología subyacente. Consideramos que en el AIT, independientemente de la escala ABCD2, se debe realizar en menos de 24 horas un TAC cerebral, ECG, e imagen de carótida, mientras al mismo tiempo se inicia tratamiento preventivo urgente.

Palabras clave. Ataque isquémico transitorio. Ictus. Escala ABCD2. Manejo urgente.

Introduction

When a stroke develops it is necessary to administer treatment within the first few hours in order to prevent catastrophic consequences. The majority of strokes develop without previous warning. However, up to 20% of strokes can be preceded by the occurrence of a warning TIA[1].

When a TIA occurs, in most cases it does not develop into a stroke, however 1 in 10 TIA will develop a stroke within the first 90 days. Fifty percent of these subsequent strokes occur in the first 7 days and 50% of those strokes develop within the first 48 hours.

The ability to predict that a TIA will develop into a stroke would

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Table 1. ABCD2 score

	Value	Score
Age	≥ 60 years	1
Blood pressure	Systolic blood pressure > 140 mm Hg or diastolic blood pressure > 90 mm Hg	1
Clinical symptoms	Unilateral weakness	2
	Speech disturbance without weakness	1
Duration of symptoms	60 minutes	2
	10-59 minutes	1
Diabetes	Oral medication or insulin	1

Table 2. Characteristics of the 172 patients enrolled in the study

Characteristic	No. (%) of patients*
Age, yr, mean (SD)	71.5 (13.8)
Male	84 (48.8)
Current smoking	18 (11.3)
Hypertension	105 (61)
Diabetes	40 (23.3)
Hypercholesterolemia	58 (33.9)
Known atrial fibrillation	21 (12.2)
Coronary heart disease	13 (7.8)
Peripheral artery disease	9 (5.3)
Previous TIA (> 15 days)	9 (5.2)
Previous ischemic stroke	28 (16.4)

*Unless otherwise indicated.

Table 3. Individual components of the ABCD2 score

Components of ABCD2 score	No. (%) of patients
Age ≥ 60 years	143 (83)
SBP ≥ 140 or DBP ≥ 90	133 (77)
Unilateral weakness	90(52)
Speech disturbance without weakness	36 (21)
Duration of symptoms:	
≥ 60 min	67 (39)
10-59 min	37 (21)
< 10 min	47 (27)
History of diabetes	40 (23)

Abbreviations: DBP, diastolic blood pressure; SBP, systolic blood pressure.

Table 4. Seven-day, 30-day and 365-day cumulative incidence of ischemic stroke, stratified by ABCD2 score

ABCD2	No. (%) of patients	7d Rate* No. (%)	30d Rate* No. (%)	365d Rate* No. (%)
0	–-	–-	–-	–-
1	5 (2,9)	0	1 (20)	1 (20)
2	13 (7,6)	0	0	0
3	33 (19,2)	1 (3)	1 (3)	2 (6)
4	39 (22,7)	4 (10)	4 (10)	5 (12,8)
5	53 (30,8)	2 (3,8)	3 (5,7)	8 (15,1)
6	19 (11)	1 (5,3)	1 (5,3)	2 (10,5)
7	10 (5,8)	1 (10)	1 (10)	2 (20)
Total	172 (100)	9 (5,2)	11 (6,4)	20 (11,6)

*Rate: cumulative incidence rate

allow detailed diagnostic studies to find its etiology, administer intense treatment in order to prevent a stroke, or to keep the patient under close observation so that immediate treatment can be provided in case of stroke development[2].

Of the various scales used to predict the transformation of a TIA into a stroke, the most frequently used is the ABCD2. According to the score obtained from this scale, some medical societies recommend either admitting the patient to the hospital or directing them to an out-patient clinic as well as types of diagnostic methods and treatments to be used[3-7].

However, in the last few years, multiple studies have been published that contradict the validity of the ABCD2 scale[8-11]. It is possible that the conclusions obtained from large populations of patients cannot be used for the individual management of the approximately one hundred of patients that come yearly to the general hospital with TIA. Furthermore, model predictive power can be modified by the concomitant use of effective diagnostic and pharmacological treatments.

We aimed to determine the predictive power of the ABCD2 score while simultaneously providing them with current urgent recommended treatments recording their early and long term health outcomes. We studied clinical, imaging and treatment variables in all TIA admitted patients during one year at a general hospital which serves to a population of about 500, 000 inhabitants.

Material and methods

A retrospective longitudinal cohort study was performed. All patients who were admitted at A Coruña University Hospital with a TIA diagnosis during the year 2008 were included. TIA was defined by the WHO time-based criteria. Patient follow-up was carried out until June 2010 by means of electronic medical history and phone calls to register new stroke episodes and death.

The following variables were recorded: age, sex, smoking history, arterial hypertension, diabetes mellitus, dyslipidemia, previous cardiac disease, previous cerebrovascular disease, and diagnostic delay time (or the amount of time between the appearance symptoms until arrival to the emergency department [ED]).

ABCD2 score (Table 1) was calculated in all patients upon arrival at the ED using data collected on electronic and paper medical records. Additional potential risk predictors were collected: hemiparesis (weakness of the entire left or right side of the body), crescendo TIA (≥ 2 TIA episodes in the last 15 days), suspected cardioembolic stroke at the ED (when previously unknown arrhythmia and/ or heart murmur was detected or if the patient had an already known cardioembolic source) and symptomatic carotid artery stenosis (CAS) ≥ 70%.

Statistical analyses. Patients were stratified into 2 groups according to their ABCD2 score. Risk categories were defined based on the distribution of end points in our population. Sensitivities and specificities of prediction were determined at the cutoff of the score. Kaplan-Meier analysis was used to estimate the stroke-free survival. Univariate Cox proportional

Tabla 5. Accuracy parameters for predicting the 7-day, 30-day and 365-day risk of stroke after a TIA using a cutoff of 4 for dichotomization

	Sensitivity %(95% CI)	Specificity %(95% CI)	PPV %(95% CI)	NPV %(95% CI)
7-day	88.89 (50.67-99.42)	30.86 (23.98-38.67)	6.67 (3.13-13.13)	98.04 (88.21-99.90)
30-day	81.82 (47.75-96.79)	30.63 (23.72-38.48)	7.5 (3.70-14.15)	96.08 (85.41-99.32)
365-day	85 (61.14-96.04)	31.79 (24.59-39.93)	14.17 (8.71-21.99)	94.12 (82.77-98.47)

Abbreviations: NPV, negative predictive value; PPV, positive predictive value.

hazards regression modelling was performed for ABCD2 score to estimate the hazard ratios relative to the low-risk category and to assess the effect of the individual components of the ABCD2 score and other potential risk factors during 7 days, 30 days, and 365 days after TIA. A sample size ≥ 158 will make it possible to detect as significant, in a Cox regression model, a relative risk of 3.5 or more with a prevalence of exposure to an ABDC2 score ≥ 4 of 70% and a censored data percentage of 85% (Security: 95%; Statistical power: 80%). Statistical Package for the Social Sciences software (SPSS 18.0, Chicago, Illinois, USA) was used for statistical analysis.

Results

During the study period, 172 patients diagnosed with TIA were admitted to our hospital. Characteristics of these patients are shown in table 2. Diagnostic delay time was 6.3 (0.1 – 48) hours. Thirty patients (17%) had crescendo TIA. Forty-seven patients (28%) were suspected of having cardioembolism. Atrial fibrillation or flutter was detected at the ED in 38 patients (22%). Carotid duplex ultrasonography was performed on 139 patients (81%) with the following results: 43 no alterations, 89 carotid atherosclerosis without stenosis or stenosis < 70%, and 9 carotid atherosclerosis with stenosis ≥ 70%.

At the end of the follow-up period, 24 patients (14%) had an ischemic stroke (3 fatal strokes), 12 (7%) experienced a recurrent TIA, and 21 (12%) died (4 deaths from cardiovascular diseases). Hospital mortality rate was 1.7%. Nine patients had an ischemic stroke within 7 days of the index TIA, 2 more within 30 days and 9 more within 365 days. There was no hemorrhagic stroke.
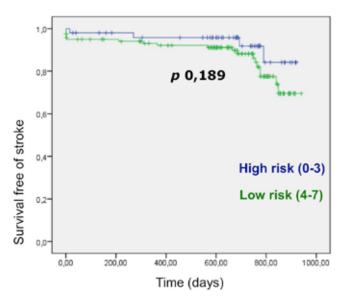
Individual components of the ABCD2 score are indicated in Table 3. Mean score (SD) was 4.2 (1.4). Table 4 shows the 7-day, 30-day and 365-day cumulative incidence of ischemic stroke, stratified by ABCD2 score. Patients were stratified into 2 groups: low risk (0-3) and high risk (4-7). There were no statistically significant differences in stroke-free survival between the two groups (p 0.189) (Figure 1). Accuracy parameters for predicting the 7-day, 30-day and 365-day stroke risk using cutoff of 4 are depicted in Table 5. ABCD2 score ≥ 4 had no significant predictive value for stroke within 7 days (hazard ratio [HR], 3.49; 95%CI, 0.42 to 27.93), 30 days (HR, 1.97; 95%CI, 0.43 to 9.13) and 365 days (HR, 2.29; 95%CI, 0.67 to 7.86) of the event (Table 6). Thirteen percent of all

strokes within 7 days (1 of 9 patients), 18% of strokes within 30 days (2 of 11 patients), and 15% of strokes within 1 year (3 of 20 patients) occurred in patients with ABCD2 scores < 4. Individual components of the ABCD2 score and other potential risk factors were then analysed to assess if they could help identify patients with TIA who had strokes (Table 7). Only diabetes predicted an increased likelihood of stroke over the first week (HR, 5.47; 95%IC 1.43 to 20.95) and over the first month (HR, 3.60; 95%IC 1.08 to 12).

Discussion

In general, the use of a score ≥ 4 to predict stroke development and adjust the treatment of patients with TIA during the first hours was not useful. It was only being diabetic that was significantly related to the probability of stroke development. After our study was done a post hoc analysis of the SOS_TIA registry showed that patients with TIA with ABCD2 < 4 have similar 90-day stroke risk as patients with TIA with ABCD2 ≥ 4[12].

The addition of diabetes to the ABCD2 score is justified because it is an independent risk factor with high predictive power and in our study it was the only factor associated

Figure 1. Kaplan-Meier curves of patients surviving free from stroke from time of presenting TIA stratified according to ABCD2 score

Tabla 6. Survival free of subsequent stroke after incident TIA stratified by ABCD2 score (0-3 vs 4-7)

Variable	Total (n)	7 Days			30 Days			365 Days		
		Events (n)	Rate* (%)	HR (95%CI)	Events (n)	Rate* (%)	HR (95%CI)	Events (n)	Rate* (%)	HR (95%CI)
ABCD2 1-3	51	1	2	1.0 (reference)	2	3,9	1.0 (reference)	3	5.9	1.0
ABCD2 ≥ 4	121	8	6.6	3,49 (0.42-7.93)	9	7,4	1,97 (0.43-9.13)	17	14,1	2.29 (0.67-7.86)

with the risk of stroke development within 7 or 30 days. The presence of significant carotid stenosis as well as a possible cardioembolic etiology were also measured as factors that could produce a stroke, but neither was associated with the risk of a stroke within 7 or 30 days in our cohort.

A relevant finding of our study is that an ABCD2 score of < 4 has a good negative predictive value (98%) for stroke development within the first 7 days. In this study, only 2% of the patients with an ABCD2 score of < 4 developed a stroke within the first 7 days.

One limitation of our study was that the patients were included retrospectively, however a large part of the follow-up was prospective. Although the study was retrospective, the variables included, age, blood pressure, and diabetes, are objective in nature and not susceptible to error of adjudication. However, clinical symptoms being subjective can be a source of bias.

The low number of stroke recurrences in our study could be a limitation to its statistical power. The stroke recurrence within 30 days and one year (6.4% y 11.6% respectively) in this study is less than that described in other studies. In the Rochester Registry, the accumulated risk of stroke within 30 days was 14% and 23% within one year 3. In other inter-national studies, the stroke recurrence within 7 days varies between 4% and 12%. The early stroke rate within 7 days in our population is 5% which is similar to that described in other Spanish cohort studies[13].

The low risk of stroke development from TIA in our study could be due to the fact that the majority of patients received early treatment with anti-platelets/anticoagulation and vascular risk factor control[14]. In fact, medical literature shows that the lowest risks were seen in emergency department studies and the highest risks were seen in population-based studies without urgent treatment (0.9% vs 11%) at 7 days after admission to the hospital[15].

One strength of our study is that it represents the real world progression of all of the TIA patients who came to the general hospital within one year as it is modified by the simultaneous and immediate decisions the internist on call has to apply.

In medical literature there are as many studies in favor of the predictive value of the ABCD2 as there are against it. It is important to know that when the ABCD2 scale was used prospectively to validate its usefulness with 2056 patients with TIA, it was also inaccurate at any cut-point as a predictor of an imminent stroke. Furthermore, an ABCD2 score cut-point

Tabla 7. Survival free of subsequent stroke after incident TIA stratified by components of the ABCD2 score and other potential risk factors.

Variable	Total (n)	7 Days			30 Days			365 Days		
		Events (n)	Rate* (%)	HR (95%CI)	Events (n)	Rate* (%)	HR (95%CI)	Events (n)	Rate* (%)	HR (95%CI)
Age ≥60 years	143	7	4.9	0.81 (0.17-3.94)	8	5.6	0.62 (0.16-2.36)	17	11,9	1.26 (0,36-4,33)
SBP ≥140 or DBP ≥90	133	7	5.3	0.97 (0.20-4.69)	9	6.8	1.25 (0.27-5.78)	18	13.5	2.3 (0.53-9.97)
Unilateral weakness	90	4	4.4	1.68 (0.31-9.15)	5	5.6	1.39 (0.33-5.84)	11	12.2	1.66 (0.57-4.87)
Duration ≥ 60 min	67	2	3	0.35 (0.07-1.67)	2	3	0.35 (0.07-1.67)	4	6	0.40 (1.13-1.23)
Diabetes	40	5	12.5	5.47 (1.43-0.95)	5	12.5	3.60 (1.08-12)	7	17.5	1.97 (0.74-5.21)
Crescendo TIA	30	3	10	2.56 (0.64-0.27)	3	10	1.99 (0.53-7.51)	5	16.7	1.87 (0.67-5.21)
Hemiparesis	35	3	8.6	2.37 (0.57-9.9)	3	8.6	1.7 (0.44-6.56)	8	22.9	2.51 (0.97-6.47)
Cardioembolic stroke	47	0	0	0.03 (0-24.94)	0	0	0.03 (0.00-2.86)	3	6.4	0.37 (0.09-1.6)
CAS ≥ 70%	9	1	11.1	0.29 (0.34-2.57)	1	11.1	0.36 (0.04-3.04)			

*Cumulative incidence rate. Abbreviations: CAS, symptomatic carotid artery stenosis

of more than 2 that is recommended by the American Heart Association was also nonspecific[10].

Years later, researchers added MRI data concerning DWI lesions to the ABCD2 scale. If the patient scores low on the ABCD2 scale but there are DWI lesions present in the MRI, the patients` real stroke risk will be high. Vice versa, if the patient scores high on the ABCD2 scale but there are no DWI lesions present in the MRI, the patients` real stroke risk will be low[16]. The scale does not include the presence of atrial fibrillation, which is the cause of 25% of strokes. In these patients, anticoagulants and heart rate control are necessary and atrial fibrillation itself will determine the type of treatment.

The scale does not correlate with the presence of CAS, thus it is necessary to determine the presence or lack thereof of CAS with imaging techniques, such as ultrasound and CT angiography. In fact a recent study shows that advanced age is the best predictor of the presence of CAS, suggesting that age should be the criteria for performing a carotid ultrasound[17]. Since the presence of atrial fibrillation and CAS are important risk factors for the development of a stroke, their absence from the ABCD2 scale may diminish its predictive power.

From the point of view of the internist attending to these patients during the first days, the current application of the ABCD2 scale does not change the diagnostic process nor the way the patient should be treated. These risk factors are very prevalent in the population of patients presenting with TIA. In fact, in our case 22% of the patients had atrial fibrillation and 5% had significant carotid artery stenosis.

Some medical societies recommend hospital admission in the case of high ABCD2 scores. The decision of hospital admission in a patient with TIA based on an ABCD2 score is not justified in our population since it was not a good predictor of early stroke development. Patients with motor weakness and language dysfunction most likely have an ischemic etiology and thus may have a higher risk. In accordance with the results of our study, we believe it is important to perform an early clinical evaluation that includes a brain CT scan, arrhythmia detection and carotid ultrasound. Such an evaluation does not warrant patient admission to a standard ward as it can be performed in Acute Observation Units or in ambulatory clinics.

Although the scale does not change the acute management of a patient having suffered from TIA, it does warrant that the patient is made aware of the increased possibility of a stroke in the future. Thus, a TIA diagnosis should serve to educate the patient to return to the hospital immediately should the symptoms recur. Those patients diagnosed with recurring TIA in the form of a stroke, should be admitted directly to the CT scan room upon arrival at the hospital so that they can be immediately treated with a catheter or tPA [18].

It is always difficult to make prognoses in medicine. It continues to be difficult to predict which TIA will develop into a stroke. However, it is possible to prevent many TIA from developing into strokes. Assuming we could diagnose and treat patients very soon after TIA has occurred, data in the EXPRESS study suggest that we might prevent 80 % of strokes. In our study, with inmediate treatment of TIA with antiplaquelets/anticoagulants, blood presure control, and statins, 90% did not develop a stroke. However, for the 10% of patients who do return with a stroke, the knowledge of previously having a TIA enables them to be immediately treated with the new techniques of catheter intervention which have recently been demonstrated to be very effective.

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