

## Value of ABCD<sup>2</sup> in Predicting Early Ischemic Stroke in Patients Diagnosed with Transient Ischemic Attack

Mojtaba Chardoli, Alireza Khajavi, Mohsen Nouri, and Vafa Rahimi-Movaghar

*Sina Trauma and Surgery Research Center, Tehran University Medical Sciences, Tehran, Iran*

*Received: 22 Nov. 2012; Received in revised form: 30 Dec. 2012 ; Accepted: 22 Feb. 2013*

**Abstract-** As a significant number of patients diagnosed with transient ischemic attack (TIA) at emergency department are at risk to develop TIA or cerebral vascular accident (CVA), several attempts have been made to figure out a predictive method to detect those at higher risk of such attacks. We aimed to evaluate the role of ABCD<sup>2</sup> scoring which includes age, blood pressure, clinical symptoms, diabetes mellitus, and duration of symptoms in predicting short term outcome of the patients presenting with TIA. One hundred consecutive patients visited between 2009 and 2010 in Hazrat Rasoul Akram Hospital and diagnosed with TIA were enrolled and their ABCD<sup>2</sup> scores were registered. The incidence of death, CVA, or TIA during the first week after the attack was recorded. Eleven patients suffered new TIA/CVA after 1 week. Sensitivity and specificity of ABCD<sup>2</sup> score for predicting CVA/TIA at cut-off point of 4 were 72.7% and 52.8%, respectively. At the same cut-off point for ABCD<sup>2</sup>, positive and negative predictive values were 16% and 94 %, respectively. Our results show that although patients with ABCD<sup>2</sup> score greater than 4 were more likely to develop recurrent TIA/CVA in short term, those with lesser score still harbour a considerable risk for TIA/CVA. Though ABCD<sup>2</sup> as an easily applicable tool is very helpful in management of TIA patients at emergency department, but it should not be the only measure to rely on in our decision making.

© 2013 Tehran University of Medical Sciences. All rights reserved.

*Acta Medica Iranica*, 2013; 51(9): 611-614.

**Keywords:** ABCD<sup>2</sup>; Stroke; Transient ischemic attack

### Introduction

Cerebral vascular accidents (CVA) are a major cause of morbidity and mortality worldwide (1,2). In the last decade, a great deal of attention has been paid to detect patients with transient ischemic attack (TIA) who are at higher risk of developing CVA since up to 20% of ischemic strokes have been preceded by TIA (3). As there is no general consensus over indications and timing of hospitalization and evaluations in patients with TIA, such a risk stratifying guideline may help with clinical decision making to prevent on one hand unnecessary exhaustive work-ups and on the other, preventable morbidity from a future CVA/TIA. Among the current classifications, easy and rapid application of ABCD<sup>2</sup> -which stands for age, blood pressure, clinical status, diabetes mellitus, and duration of symptoms- and its accuracy in predicting the outcome have made it one of the most favourable scoring systems (4,5).

Several population based studies from the four corners of the globe have examined the accuracy of the

ABCD<sup>2</sup> scoring system in detecting high and low risk patients for developing early or late CVA/TIA after the initial event (6-11). In this study, we aimed to evaluate the ABCD<sup>2</sup> in our emergency department to find out how it may help us with clinical decision making in patients diagnosed with TIA.

### Materials and Methods

The study was approved by the Ethics Committee of Tehran University of Medical Sciences. In a prospective cohort study, 100 consecutive patients visited in Hazrat Rasoul Akram Hospital and diagnosed clinically with TIA were enrolled between 2009 and 2010 after giving informed consent. The diagnosis was made by a neurologist based on any clinical neurologic deficit lasting less than 24 hours which had no findings on brain CT-scan correlated with the signs and symptoms. Patients not meeting these criteria and those with a past medical history of CVA would be excluded. Patients' demographic data besides ABCD<sup>2</sup> score were registered

**Corresponding Author:** Vafa Rahimi-Movaghar

Research Vice Chancellor of Sina Trauma and Surgery Research Center, Tehran University of Medical Sciences, Tehran, Iran  
Tel: +98 21 66757010, +98 915 3422682, Fax: +98 21 66757009 , E-mail: v\_rahimi@sina.tums.ac.ir, v\_rahimi@yahoo.com

## ABCD predictor of brain ischemic attack

on data sheets upon their hospitalization. Indices of ABCD<sup>2</sup> were scored as follow: 1 point for age > 60, 1 point for systolic blood pressure > 140 mmHg and/or diastolic blood pressure > 90 mmHg, 1 point for any clinical symptoms, 1 point for isolated speech disturbance or 2 points for unilateral weakness, 1 point for history of diabetes, 1 point for duration of symptoms between 10-59 minutes or 2 points for longer duration. Final ABCD<sup>2</sup> score of 4 or less was considered low risk and higher scores were nominated high risk group. Patients were called by telephone after 1 week from their initial symptoms to be asked for signs or symptoms of new neurologic deficits and were visited clinically in suspicious cases and any new TIA/CVA was registered. Collected data were entered in SPSS version 13.0 for statistical analysis. To evaluate normal distribution of the data, Kolmogorov-Smirnov Z test was used. The non-parametric Mann-Whitney U test was used for data analysis in case of abnormal distribution. When nominal or ordinal variables were compared, Chi-square test was utilized. Data are showed as mean ± SEM throughout the manuscript. A *P*-value less than 0.05 was considered statistically significant.

## Results

Collected data from our patients are summarized in table 1. Eleven patients (11.0%) in our series developed TIA or CVA within 1 week from the initial attack. Of 50 patients with ABCD<sup>2</sup> score ≤4, 47 patients did not experience TIA/CVA (negative predictive value of 94%). On the other hand, positive predictive value for an ABCD<sup>2</sup> score >4 was 16.0%. Sensitivity and specificity of ABCD<sup>2</sup> score for predicting CVA/TIA at cut-off point of 4 were 72.7% and 52.8%, respectively. Relative risk for patients with ABCD<sup>2</sup> score >4 to develop TIA/CVA was 2.66 compared with those with ABCD<sup>2</sup> score equal or less than 4.

Duration of symptoms, ABCD<sup>2</sup>, and diastolic blood pressure did not follow a normal distribution (*P*<0.01); so, non-parametric tests were utilized for their analysis. Though age, systolic or diastolic blood pressures, and

duration of symptoms were not statistically different between those who developed or not TIA/CVA within 1 week, ABCD<sup>2</sup> was significantly higher in the patients who suffered a second TIA/CVA (*P*<0.05). When patients categorized on the ABCD<sup>2</sup> (higher or lower than 4), age (older or younger than 60), systolic and diastolic blood pressure (higher or lower than 140 or 90 mmHg, respectively), clinical symptoms, and diabetes (diabetic or non-diabetic) were evaluated with 1 week development of TIA/CVA, only presence of DM and higher ABCD<sup>2</sup> scores were associated with higher rate of TIA/CVA (*P*<0.05).

## Discussion

The scoring system to predict early ischemic stroke in patients diagnosed with TIA introduced by Johnston *et al.* first as ABCD (4) and later completed as ABCD<sup>2</sup> (5), has become the subject of extensive investigations (6-19). As any other newly introduced scoring or classification system, several authors have tested ABCD<sup>2</sup>'s validity and very different results have been obtained which should be interpreted cautiously. The growing body of evidence has failed to show such a pivotal role for ABCD<sup>2</sup> in detecting high or low risk patients for CVA/TIA (6-8) and the recent publications are not as promising as the earlier reports (4,5).

In their prospective study to find any incremental value for addition of ABCD<sup>2</sup> to carotid artery and central nervous system imaging, Stead *et al.* reported no additional benefit and the risk of stroke was independent of ABCD<sup>2</sup> stratification in their study (6). Also, data from a multicentre prospective study which included 1667 patients, demonstrated ABCD<sup>2</sup> as a poor predictor of the early ischemic stroke (7).

Another multicentre prospective study from Canada with 2056 patients enrolled, indicated that ABCD<sup>2</sup> is an inaccurate predictor of early stroke (8). Cut-points of 2 and 5 were both used for data analysis and in either case the test was insensitive or nonspecific to predict the desirable outcome.

**Table 1.** Summary of the collected data from one hundred patients diagnosed with transient ischemic attack.

Variable	ABCD 4 or below	ABCD above 4	Total
Age (year)	59.54 ± 1.25	62.04 ± 1.12	60.79 ± 0.84
Systolic blood pressure (mm-Hg)	160.10 ± 3.00	180.80 ± 2.74	170.45 ± 2.27
Diastolic blood pressure (mm-Hg)	88.00 ± 1.17	96.70 ± 1.14	92.35 ± 0.92
Duration of symptoms (minutes)	39.40 ± 5.64	177.56 ± 23.69	108.48 ± 13.96
Positive history of diabetes (%)	26	28	27

A recent publication from Oxford Vascular Study considered a role for ABCD<sup>2</sup> in predicting severity of the early vascular events, but its results showed this scoring system should not outline a low risk population who is unlikely to develop early vascular accident as a significant number of patients in low-risk group experienced early cerebral attacks (9). Another report from Australia demonstrated poor predictive value for ABCD<sup>2</sup> in guiding clinicians for evaluation of TIA (10).

On the other hand, a population based study from Italy showed no occurrence of stroke in 90 day follow up of low risk patients with ABCD<sup>2</sup> score < 4 (11). Some studies have showed that ABCD<sup>2</sup> score of higher than 4 or 3 is associated with increased mid- to long-term risk of ischemic stroke or death (12,13). Although, risk ratio for patients designated as high risk by ABCD<sup>2</sup> indicates a higher chance of ischemic event in the future, its accuracy in stratifying high or low risk groups for decision making at emergency department is under question. ABCD<sup>2</sup> is a constellation of some previously well-known risk factors for developing ischemic brain attacks and its association with higher risk of CVA is not surprising but, what is important to the practitioners is the accuracy of this or any other scoring system in identifying a low risk group which requires no further work-up and can be discharged safely or delineating a high risk group which should undergo extensive costly and sometimes invasive evaluations. As showed in a population based study from Ireland, CVA may happen in a number of patients with low score of ABCD<sup>2</sup> and this underscores the fact that this scoring system should not be relied too much in clinical decision making (14). Some attempts are made to improve predictability of ABCD<sup>2</sup> by adding some other predictive factors but they have not generally been accepted and require further investigations (15-18).

Our results show that although patients with ABCD<sup>2</sup> score greater than 4 were more likely to develop recurrent TIA/CVA in short term, those with lesser score still harbour a considerable risk for TIA/CVA. This puts a safe discharge of the latter patients in doubt and precautions should be taken regarding their management. However, this simple classification helps us with identifying the high risk group readily (19) who will most likely benefit from early diagnostic and therapeutic measures. Apart from ABCD<sup>2</sup>'s application for hospitalization, further studies to address the effect of its application on outcome measures such as recurrent TIA/CVA or mortality are warranted. In conclusion, when dealing with a phenomenon whose occurrence may lead to devastating results, a highly sensitive test to

diagnose or a test with high negative predictive value to clear the situation is required. We believe that ABCD<sup>2</sup> does not have the potential to become a corner stone in predicting a repeated TIA/CVA after the initial TIA. However, its easy application makes it a helpful predictive tool for every physician treating these patients in the emergency department.

## References

1. Menken M, Munsat TL, Toole JF. The global burden of disease study: implications for neurology. *Arch Neurol* 2000;57(3):418-20.
2. Lopez AD, Mathers CD, Ezzati M, Jamison DT, Murray CJ. Global and regional burden of disease and risk factors, 2001: systematic analysis of population health data. *Lancet* 2006;367(9524):1747-57.
3. Hackam DG, Kapral MK, Wang JT, Fang J, Hachinski V. Most stroke patients do not get a warning: a population-based cohort study. *Neurology* 2009;73:1074-6.
4. Johnston SC, Gress DR, Browner WS, Sidney S. Short-term prognosis after emergency department diagnosis of TIA. *JAMA* 2000;284(22):2901-6.
5. Johnston SC, Rothwell PM, Nguyen-Huynh MN, Giles MF, Elkins JS, Bernstein AL, Sidney S. Validation and refinement of scores to predict very early stroke risk after transient ischaemic attack. *Lancet* 2007 369:283-92.
6. Stead LG, Suravaram S, Bellolio MF, Enduri S, Rabinstein A, Gilmore RM, Bhagra A, Manivannan V, Decker WW. An assessment of the incremental value of the ABCD2 score in the emergency department evaluation of transient ischemic attack. *Ann Emerg Med* 2011;57(1):46-51.
7. Asimos AW, Johnson AM, Rosamond WD, Price MF, Rose KM, Catellier D, Murphy CV, Singh S, Tegeler CH, Felix A. A multicenter evaluation of the ABCD2 score's accuracy for predicting early ischemic stroke in admitted patients with transient ischemic attack. *Ann Emerg Med* 2010;55(2):201-10.e5.
8. Perry JJ, Sharma M, Sivilotti ML, Sutherland J, Symington C, Worster A, Émond M, Stotts G, Jin AY, Oczkowski WJ, Sahlas DJ, Murray HE, MacKey A, Verreault S, Wells GA, Stiell IG. Prospective validation of the ABCD2 score for patients in the emergency department with transient ischemic attack. *CMAJ* 2011;183(10):1137-45.
9. Chandratheva A, Geraghty OC, Luengo-Fernandez R, Rothwell PM; Oxford Vascular Study. ABCD2 score predicts severity rather than risk of early recurrent events after transient ischemic attack. *Stroke* 2010;41(5):851-6.

## ABCD predictor of brain ischemic attack

10. Sanders LM, Srikanth VK, Psihogios H, Wong KK, Ramsay D, Phan TG. Clinical predictive value of the ABCD2 score for early risk of stroke in patients who have had transient ischaemic attack and who present to an Australian tertiary hospital. *Med J Aust* 2011;194(3):135-8.
11. Cancelli I, Janes F, Gigli GL, Perelli A, Zanchettin B, Canal G, D'Anna L, Russo V, Barbone F, Valente M. Incidence of Transient Ischemic Attack and Early Stroke Risk: Validation of the ABCD2 Score in an Italian Population-Based Study. *Stroke* 2011;42(10):2751-7.
12. Yang J, Fu JH, Chen XY, Chen YK, Leung TW, Mok V, Soo Y, Wong KS. Validation of the ABCD2 score to identify the patients with high risk of late stroke after a transient ischemic attack or minor ischemic stroke. *Stroke* 2010;41(6):1298-300.
13. Holzer K, Feurer R, Sadikovic S, Esposito L, Bockelbrink A, Sander D, Hemmer B, Poppert H. Prognostic value of the ABCD2 score beyond short-term follow-up after transient ischemic attack (TIA)--a cohort study. *BMC Neurol* 2010;10:50.
14. Sheehan OC, Kyne L, Kelly LA, Hannon N, Marnane M, Merwick A, McCormack PM, Duggan J, Moore A, Moroney J, Daly L, Harris D, Horgan G, Williams EB, Kelly PJ. Population-based study of ABCD2 score, carotid stenosis, and atrial fibrillation for early stroke prediction after transient ischemic attack: the North Dublin TIA study. *Stroke* 2010;41(5):844-50.
15. Cucchiara BL, Messe SR, Sansing L, MacKenzie L, Taylor RA, Pacelli J, Shah Q, Pollak ES, Kasner SE. D-dimer, magnetic resonance imaging diffusion-weighted imaging, and ABCD2 score for transient ischemic attack risk stratification. *J Stroke Cerebrovasc Dis* 2009;18(5):367-73.
16. Giles MF, Albers GW, Amarenco P, Arsava MM, Asimos A, Ay H, Calvet D, Coutts S, Cucchiara BL, Demchuk AM, Johnston SC, Kelly PJ, Kim AS, Labreuche J, Lavallee PC, Mas JL, Merwick A, Olivot JM, Purroy F, Rosamond WD, Sciolla R, Rothwell PM. Addition of brain infarction to the ABCD2 Score (ABCD2I): a collaborative analysis of unpublished data on 4574 patients. *Stroke* 2010;41(9):1907-13.
17. Fothergill A, Christianson TJ, Brown RD Jr, Rabinstein AA. Validation and refinement of the ABCD2 score: a population-based analysis. *Stroke* 2009;40(8):2669-73.
18. Asimos AW, Rosamond WD, Johnson AM, Price MF, Rose KM, Murphy CV, Tegeler CH, Felix A. Early diffusion weighted MRI as a negative predictor for disabling stroke after ABCD2 score risk categorization in transient ischemic attack patients. *Stroke* 2009;40(10):3252-7.
19. Giles MF, Rothwell PM. Systematic review and pooled analysis of published and unpublished validations of the ABCD and ABCD2 transient ischemic attack risk scores. *Stroke* 2010;41(4):667-73.