Stroke
Journal of the American Heart Association

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Stroke. 2014;45:92-100; originally published online November 21, 2013;
doi: 10.1161/STROKEAHA.113.003085
Stroke is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231

Print ISSN: 0039-2499. Online ISSN: 1524-4628

A Prospective Cohort Study of Patients With Transient Ischemic Attack to Identify High-Risk Clinical Characteristics

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Background and Purpose—The occurrence of a transient ischemic attack (TIA) increases an individual's risk for subsequent stroke. The objectives of this study were to determine clinical features of patients with TIA associated with impending (≤7 days) stroke and to develop a clinical prediction score for impending stroke.

Methods—We conducted a prospective cohort study at 8 Canadian emergency departments for 5 years. We enrolled patients with a new TIA. Our outcome was subsequent stroke within 7 days of TIA diagnosis.

Results—We prospectively enrolled 3906 patients, of which 86 (2.2%) experienced a stroke within 7 days. Clinical features strongly correlated with having an impending stroke included first-ever TIA, language disturbance, longer duration, weakness, gait disturbance, elevated blood pressure, atrial fibrillation on ECG, infarction on computed tomography, and elevated blood glucose. Variables less associated with having an impending stroke included vertigo, lightheadedness, and visual loss. From this cohort, we derived the Canadian TIA Score which identifies the risk of subsequent stroke ≤7 days and consists of 13 variables. This model has good discrimination with a c-statistic of 0.77 (95% confidence interval, 0.73–0.82).

Conclusions—Patients with TIA with their first TIA, language disturbance, duration of symptoms ≥10 minutes, gait disturbance, atrial fibrillation, infarction on computed tomography, elevated platelets or glucose, unilateral weakness, history of carotid stenosis, and elevated diastolic blood pressure are at higher risk for an impending stroke. Patients with vertigo and no high-risk features are at low risk. The Canadian TIA Score quantifies the impending stroke risk following TIA. **(*Stroke*. 2014;45:92-100.)**

Key Words: emergency medicine ■ stroke ■ transient ischemic attack

The World Health Organization defines transient ischemic attack (TIA) as a sudden, focal neurological deficit lasting for <24 hours, presumed to be of vascular origin, and confined to an area of the brain or eye perfused by a specific artery.[1,2] TIAs are relatively common, having an annual incidence of 68 per 100 000.[3] By definition, patients with TIA do not experience permanent neurological deficits. Instead, a TIA identifies individuals who are at increased risk of a subsequent stroke, especially in the week following the attack. Prior studies have estimated this risk to be within 7 days of TIA, increasing to 8% to 12% by 90 days.[3–11] At the time of these studies, the management of TIAs was suboptimal.[6,12–15] These studies prompted many improvements in care to prevent impending strokes. Subsequent small studies with concerted efforts to optimize care concluded that reduced stroke rates were attainable with timely and efficient interventions.[6–11]

Received August 2, 2013; final revision received October 3, 2013; accepted October 9, 2013.

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Presented at the Canadian Association of Emergency Physicians Annual Scientific Meeting, Niagara Falls, Ontario, Canada, June 2012, and published in abstract form (*Can J Emerg Med.* 2012;14:314) and at International Stroke Conference 2013, Honolulu, HI, February 6, 2013, and published in abstract form (*Stroke*. 2013;44:A132).

The online-only Data Supplement is available with this article at http://stroke.ahajournals.org/lookup/suppl/doi:10.1161/STROKEAHA.113.003085/-/DC1.

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***Stroke* is available at http://stroke.ahajournals.org** **DOI: 10.1161/STROKEAHA.113.003085**

Interventions proven to prevent impending strokes include antiplatelet therapies, statins (cholesterol-lowering agents), antihypertensives, carotid endarterectomy, and anticoagulation, which when implemented quickly result in greatly improved outcomes.[16–18] The American Heart Association TIA guidelines recommend admitting all patients with TIA, but there is no evidence that admission alone is beneficial.[19] Hence, admission rates are highly variable across North America.[6,15] Many centers instead have implemented specialized outpatient rapid access Stroke Prevention Clinics to expedite assessment and management of patients with TIA.[20] Because of the heterogeneity of patients presenting with transient neurological complaints, prioritizing investigation and specialty consultation for patients at highest risk of impending stroke remains an essential first step in optimizing stroke prevention.

The objectives of our study were to determine clinical features associated with impending (within 7 days) stroke in a modern cohort of emergency department patients diagnosed with TIA and to develop a highly sensitive clinical stratification score for impending stroke to guide testing and resource allocation.

Methods

Study Design

We conducted a prospective multicenter cohort study at 8 university-affiliated Canadian tertiary care teaching emergency departments. We enrolled patients for a 5-year period from October 2006 to October 2011.

Study Population

We prospectively enrolled adult patients (aged >18 years), assessed by an emergency physician or neurologist, diagnosed as having a TIA in the emergency department.

We excluded patients who were diagnosed with a confirmed stroke (ie, neurological deficit was already present for >24 hours), had a decreased level of consciousness (ie, Glasgow Coma Scale score of <15), had a documented other cause for their deficit which was not a TIA (eg, hypoglycemia, seizure, electrolyte imbalance, migraine, etc), presented to enrolling emergency department >7 days following onset of most recent TIA, and were treated with tissue plasminogen activator for an acute stroke.

Our study was approved by the Research Ethics Board at each center without the need for written informed consent as patients received usual care. Participants were informed that they might be contacted in 1 week and at 3 months, and verbal consent was obtained at the time of each telephone call.

Data Collection

Attending emergency physicians, neurologists, or supervised residents in emergency medicine or neurology completed all assessments. Physicians were oriented to the study and the standardized data collection forms by means of a formal 1-hour teaching session as well as individual orientation by local study staff. Physicians completed data forms to identify the presence or absence of 49 clinical findings in consecutive patients with TIA. Variables included characteristics of the current event, physical examination findings, and medical history provided by the patient. When feasible, we requested that the first physician ask another on-duty physician to complete a second data collection form independently to assess interobserver agreement.

Study nurses collected data forms, verified data, confirmed eligibility, and recorded nonsubjective data from physician, nursing, consultant, triage, ambulance, follow-up neurological consultations, and radiology reports. Information was sought from the study hospital's electronic medical records to identify subsequent emergency visits, stroke/neurology clinic visits, and diagnostic imaging. We conducted telephone follow-up calls at 7 and 90 days to assess for subsequent stroke or subsequent TIAs. We used a previously validated tool, the Questionnaire for Verifying Stroke Free Status.[21,22] In addition to the Questionnaire for Verifying Stroke Free Status, patients were asked whether they were admitted subsequent to their initial emergency department visit for stroke and whether they experienced neurological deficits, whereupon they were asked the duration of the symptoms, date of onset, and side affected (if applicable). Verbal informed consent was obtained at the start of telephone follow-up. We have successfully used such proxy outcomes in previous prospective cohort studies.[23–25]

Study nurses reviewed emergency department census reports to identify any possible missed patients. If patients with TIA were not clearly excluded by the eligibility criteria, they were deemed to be a possible missed patient. Information including age, sex, and investigations performed were recorded on a standardized possible missed patient data collection form. Data were entered into a computerized database using Statistical Analysis System (SAS) software. Data management and study coordination were conducted at the Ottawa Hospital Research Institute, Clinical Epidemiology Unit at The Ottawa Hospital.

Outcome Measures

The primary outcome was stroke within 7 days of emergency department diagnosis of TIA, termed impending stroke. Stroke was defined as a rapidly developing clinical symptom(s) of focal (or occasionally global) disturbance of cerebral function lasting >24 hours or until death with no apparent nonvascular cause.[1]

Outcome Assessment

The primary outcome was assessed for all patients from a composite of sources including site hospital records for stroke occurrence, admission or mortality, autopsy report at site hospital, or patients answering yes to ≥1 of the telephone follow-up questions. An Adjudication Committee blinded to the initial emergency department visit for TIA reviewed all of these possible events. The Adjudication Committees reviewed local cases and were composed of 3 members, usually 2 stroke neurologists and 1 experienced emergency physician (1 site used 2 experienced emergency physicians and 1 stroke neurologist). These assessors independently assessed each possible outcome and required agreement of 2 of the 3 physicians to be considered an event (the site using 2 emergency physicians had a fourth, external stroke neurologist adjudicate whenever the third adjudicator was an emergency physician who disagreed with the local stroke neurologist).

Secondary Outcomes

Stroke within 2, 30, and 90 days was also assessed. These time points were used so that our results could be compared with previous work by other investigators. The outcome assessment for these secondary outcomes used the same methods as for our primary outcome.

Data Analysis

The interobserver agreement for each variable was measured using the κ coefficient, which measures the proportion of potential agreement beyond chance. Individual predictor variables with a κ value of >0.6 were considered to have substantial interobserver agreement.[26] For variables with ≥3 ordered categories, a weighted κ measure of interobserver agreement was calculated.[27,28] The c-statistic with 95% confidence bands was calculated by the coordinating center based on the data entered on the physician data forms and documentation available.

Univariate analysis was used to determine the strength of the association between each variable and the primary outcome. Pearson χ^2 test was used for nominal variables and the unpaired 2-tailed t test for continuous variables, using either a pooled or separate variance estimate as appropriate. Variables with a P value of <0.2 or variables previously deemed important were used in the subsequent multivariate analysis. Given the large number of variables contained within

our data set, it was necessary to decrease the number of candidate variables to generate a stable model.

A logistic regression analysis using stepwise selection was conducted for those variables found to be associated with stroke on univariate analysis as well as for clinically sensible interaction terms. Using accepted approaches, a risk scale was created by rounding up the lowest logistic regression β-coefficient to 1 and then multiplying the other coefficients by the same factor and then rounding to the nearest whole number.[29] The logistic regression analysis used SAS. We estimated that we would need between 60 and 100 cases positive for the primary outcome to conduct stable and valid multivariate analyses.

Results

We enrolled 3906 patients representing 78.1% of all potentially eligible patients seen at the participating emergency departments during the study period. Follow-up was complete for all but 14 (0.4%) patients at 7 days (Appendix I in the online-only Data Supplement). There were 86 (2.2%) patients who had a subsequent stroke within 7 days of their index visit. This number increased to 132 (3.4%) at 90 days. Possible missed patients who were not enrolled were similar to enrolled patients, but had a slightly lower investigation rate (age, 69.3 years; 52.2% female; 92.9% had a computed tomography scan; and 82.1% had an ECG).

Table 1 displays the clinical features of our cohort. Our patients had a mean age of 68.0 years with equal sex distribution. The most common symptoms were sensory deficits, weakness, and speech difficulties. A history of hypertension was present in 3 of every 5 patients. About 1 in 3 had a history of elevated lipids, and 1 of every 5 patients had a history of diabetes mellitus. On physical examination, weakness was the most common deficit followed by language disturbances and sensory deficits. Almost all patients underwent computed tomography of the head (97.1%) and electrocardiography (92.5%). Most patients were administered an antithrombotic agent (92.0%) with most patients either left on or started on acetylsalicylic acid. Patients with atrial fibrillation (either history or ECG evidence) were managed with warfarin in 212 (52.7%) of 402 cases. The cumulative recurrent TIA rate was 2.9% and 6.8% at 7 and 90 days, respectively.

We present the univariate analyses in Table 2. Clinical features strongly correlated with having an impending stroke included initial TIA, dysarthria, longer duration, weakness, gait disturbance, elevated blood pressure, and atrial fibrillation on ECG. Variables found to be significantly less associated with an impending stroke included vertigo, lightheadedness, and visual loss.

Our multivariate analysis (Table 3) calculated adjusted odds ratios for clinical variables thought to be clinically significant and strongly associated with an impending stroke on univariate analysis and used the optimal cut points for continuous variables (eg, diastolic blood pressure, serum glucose, systolic blood pressure, platelet count, etc). We found 12 variables independently associated with an impending stroke within 7 days. Vertigo was negatively associated with having an impending stroke. This model has a c-statistic of 0.77 (95% confidence interval [CI], 0.73–0.82; Figure). The model had a good fit with a Hosmer-Lemeshow goodness-of-fit *P* value of 0.963. When this model was applied using our secondary outcomes of subsequent stroke at 2, 30, and 90 days, the c-statistic with 95% CIs were 0.78 (95% CI, 0.73–0.84), 0.75 (95% CI, 0.71–0.80), and 0.74 (95% CI, 0.69–0.78), respectively. The ABCD2 Score had a c-statistic of 0.64 (95% CI, 0.59–0.70) for subsequent stroke at 7 days when calculated by the coordinating center.

Table 4 lists the 9 components of the Canadian TIA Score obtained from the clinical history and examination and the 4 components obtained from investigations. The total score ranges from −3 to 23. The probability of a subsequent stroke within 7 days ranges from 0.01% to >27.6% (no patient in our cohort had a total score of >14; Table 5).

Discussion

We observed a 7-day stroke rate of 2.2%, which increased to 3.4% by 90 days, following an emergency department diagnosis of TIA. This subsequent stroke rate is less than many previous studies that reported 7-day rates of 4% to 10% and 8% to 12% by 90 days.[3–11] This rate, however, is consistent with more recent studies with 90-day subsequent stroke rates of 1.2% to 2.1%,[16,18] presumably attributable to immediate investigation and aggressive management of modifiable risk factors. Of note, only 1 in 10 patients in our cohort were admitted to hospital on the index presentation to the emergency department. Moreover, of the patients discharged from the emergency department, a small but important number developed a stroke within the week, demonstrating the importance of prioritizing follow-up based on accurate risk stratification. This population represents a key target for efforts to further improve stroke prevention without inflating admission rates for lower risk patients. We have identified clinical characteristics that are associated with an impending stroke: first diagnosis of TIA, increased age, deficits lasting >10 minutes, history of gait disturbance, dysarthria, increased blood pressure, atrial fibrillation on ECG, and infarction on computed tomography. Clinical findings indicating a decreased chance of an impending stroke included symptoms lasting <1 minute, lightheadedness, vertigo, and visual loss. Using these findings and considering variables previously known to be associated with an impending stroke, we developed a TIA risk score. This score includes 13 variables with a total score ranging from −3 to 23. Each point level is associated with an assessment of an individual patient's risk for a subsequent stroke in the following 7 days. This will allow physicians to assess more accurately the need for prompt aggressive investigations, specialist assessment, and interventions to maximize the chances for stroke prevention.

Physicians have become more aggressive in investigating and treating patients with TIA during the past 10 years. Among previous studies assessing for subsequent stroke rates following TIA, Gladstone et al's[6] administrative database study of 271 emergency department patients found that 4.2% had a subsequent stroke within 7 days (9.4% at 90 days). In their study, 42.9% underwent neuroimaging, 84.9% had an ECG, and 62.9% were treated with antithrombotic medication, all rates significantly lower compared with that of our cohort.

Johnston et al[30] developed the ABCD2 Score to predict risk of stroke after TIA. The methodologies of this study did not follow the standards for clinical decision rule/score development, including prospective derivation, explicitly

Table 1. Clinical Characteristics and Outcomes for ED Patients With TIA

Characteristic	Patients (n=3906)
Demographics	
Mean age, y (SD)	68.0 (14.4)
Female (%)	1976 (50.6)
Clinical features	
History (%)	
Arrival by ambulance	1521 (38.9)
First-ever TIA	2531 (64.8)
Duration of symptoms, min	
<1	91 (2.3)
1–4	260 (6.7)
5–9	163 (4.2)
10–29	601 (15.4)
30–59	468 (12.0)
≥60	2305 (59.0)
History of altered sensation	1796 (46.0)
History of weakness	1699 (43.5)
Language disturbance	1496 (38.3)
Lightheadedness	829 (21.2)
Vertigo	429 (11.0)
Gait disturbance	863 (22.1)
Visual loss	465 (11.9)
Diplopia	173 (4.5)
Examination	
Mean initial systolic blood pressure (SD)	154.3 (26.0)
Mean initial diastolic blood pressure (SD)	81.7 (14.3)
Mean initial heart rate (SD)	77.2 (15.1)
Weakness (%)	760 (19.5)
Any speech difficulty (%)	561 (14.4)
Altered sensation (%)	528 (13.5)
Gait abnormality (%)	442 (11.3)
Abnormal finger-nose test (%)	329 (8.4)
Dysarthria (%)	321 (8.2)
Pronator drift (%)	280 (7.2)
Aphasia (%)	159 (4.1)
Medical history (%)	
Hypertension	2308 (59.1)
High cholesterol	1295 (33.2)
Diabetes mellitus	746 (19.1)
Coronary artery disease	725 (18.6)
Known prior stroke	509 (13.0)
Current smoker	506 (13.0)
Atrial fibrillation	349 (9.2)
Carotid stenosis	154 (3.9)
Peripheral vascular disease	155 (3.9)
Diagnostic tests in ED (%)	
Computed tomography of head	3792 (97.1)
Evidence of acute or old infarction	1101 (28.2)
ECG	3613 (92.5)
Evidence of atrial fibrillation	195 (5.0)
MRI head	54 (1.4)
Carotid Doppler	273 (7.0)
Computed tomography neck angiography	337 (8.6)
Routine medications before index TIA (%)	
Antihypertensive	1823 (46.7)
Any antithrombotic	1647 (42.2)
ASA	1435 (36.7)
Statin	1231 (31.5)
Clopidogrel	322 (8.2)
Warfarin	267 (6.8)
Dipyridamole/ASA	112 (2.8)
Medications on discharge (%)	
Any antithrombotic	3595 (92.0)
ASA	2511 (64.2)
Antihypertensive	1918 (49.1)
Statin	1330 (34.1)
Clopidogrel	702 (18.0)
Dipyridamole/ASA	494 (12.7)
Warfarin	301 (7.7)
Disposition and outcomes (%)	
Admitted to hospital	389 (10.0)
Carotid revascularization ≤90 d from index visit	103 (2.6)
Cumulative stroke ≤2 d from index visit	56 (1.4)
Cumulative stroke ≤7 d from index visit	86 (2.2)
Cumulative stroke ≤30 d from index visit	109 (2.8)
Cumulative stroke ≤90 d from index visit	132 (3.4)
Cumulative repeat TIA ≤2 d from index visit	59 (1.5)
Cumulative repeat TIA ≤7 d from index visit	113 (2.9)
Cumulative repeat TIA ≤30 d from index visit	185 (4.7)
Cumulative repeat TIA ≤90 d from index visit	265 (6.8)
Myocardial infarction ≤90 d from index visit	16 (0.4)

ASA indicates acetylsalicylic acid; ED, emergency department; and TIA, transient ischemic attack.

defining variables, measuring interobserver agreement, and they did not validate the rule as a whole as part of validation. This score has not performed well during prospective validation, with an accuracy (0.56; 95% CI, 0.47–0.65) when interpreted by physician users.[30–32] Within this study, we found the sensitivity to be 0.65 (95% CI, 0.59–0.70) when assessed by the coordinating center and assumed to be interpreted perfectly. Notwithstanding the relatively low discrimination of the ABCD2 Score, clinical practice for TIA has evolved rapidly during the past few years. Hence, there is a continued need to risk stratify patients with TIA within the context of current imaging, pharmacotherapy, and surgical approaches to stroke prevention.

Hippisley-Cox et al[33] developed and validated a score for the general population without a history of previous stroke or TIA to determine their absolute risk of stroke. This tool is for

Table 2. Univariate Correlation of Variables for Stroke Within 7 days of TIA—Phase I

Clinical Features, %	No Stroke ≤7 d (n=3820)	Stroke ≤7 d (n=86)	*P* Value	κ (n=59)
Mean age, y (SD)	67.9 (14.5)	70.7 (12.8)	0.082	n/a
Female, %	50.7	47.7	0.585	n/a
Arrival by ambulance, %	38.9	48.8	0.062	n/a
Admitted to hospital at index visit, %	9.8	15.1	0.107	n/a
First-ever TIA, %	66.0	80.0	0.007	0.69
Duration of symptoms,* min				
<1	2.4	0.0	0.032	0.88*
1–4	6.8	2.3		
5–9	4.2	2.3		
10–29	15.5	11.6		
30–59	11.9	17.4		
≥60	59.1	66.3		
History of altered sensation, %	47.4	37.3	0.069	0.77
History of weakness, %	43.9	65.1	<0.001	0.75
Language disturbance, %	40.3	50.0	0.078	0.78
Lightheadedness, %	23.7	16.5	0.133	0.33
Vertigo, %	12.4	3.8	0.021	0.17
Gait disturbance, %	24.5	39.0	0.004	0.53
Visual loss, %	13.4	3.8	0.012	0.87
Examination, %				
Any weakness	19.4	29.1	0.025	0.59
Face	7.9	18.6	<0.001	1.0
Arm	12.4	14.0	0.673	1.0
Leg	7.8	10.5	0.364	1.0
Pronator drift	7.3	11.9	0.112	0.45
Any speech difficulty	14.2	28.2	<0.001	0.56
Aphasia	4.5	5.8	0.595	1.0
Dysarthria	8.5	19.8	<0.001	1.0
Altered sensation	13.7	15.3	0.683	0.83
Gait abnormality	12.0	9.9	0.557	0.56
Abnormal finger-nose test	9.1	11.1	0.532	0.53
Mean systolic blood pressure	154.1	161.9	0.006	n/a
Mean diastolic blood pressure	81.6	87.0	0.002	n/a
Mean initial heart rate	77.2	78.5	0.430	n/a
Diagnostic testing, %				
Platelet count >400×10^9/L	4.0	7.0	0.158	n/a
Glucose >15 mmol/L	2.0	9.3	<0.001	n/a
CT evidence of acute infarction	4.4	10.5	0.014	n/a
CT evidence of old infarction	24.8	36.0	0.017	n/a
CT evidence of any infarct	27.9	41.9	0.004	n/a
ECG evidence of atrial fibrillation	4.9	10.5	0.038	n/a
Medical history, %				
Hypertension	60.5	66.3	0.290	0.76
High cholesterol	34.2	28.9	0.319	0.75
Diabetes mellitus	19.6	19.3	0.939	1.0
Coronary artery disease	18.9	25.3	0.143	0.94
Known prior stroke	13.3	15.7	0.536	0.79
Current smoker	13.2	15.7	0.521	0.81
Atrial fibrillation	9.1	12.0	0.359	1.0

(*Continued*)

Table 2. Continued

Clinical Features, %	No Stroke ≤7 d (n=3820)	Stroke ≤7 d (n=86)	*P* Value	κ (n=59)
Peripheral vascular disease	4.1	3.6	1.000	n/a
Carotid stenosis	4.0	7.2	0.149	1.0
Valvular heart disease	3.6	4.8	0.546	0.81
Congestive heart failure	3.0	2.4	1.000	0.79

CT indicates computed tomography; n/a, not applicable; and TIA, transient ischemic attack.
*Correlation coefficient used for duration of symptoms.

general practice and was not created to risk stratify patients with a warning TIA to determine the risk of a subsequent stroke. We have therefore not attempted to compare our results with this study.

The 2009 American Heart Association recommendations for managing TIA include the following: (1) neuroimaging within 24 hours, preferably MRI, plus noninvasive imaging of the cervical vessels; (2) electrocardiography as soon as possible after TIA, with prolonged cardiac monitoring and echocardiography in patients in whom the cause is not identified; (3) routine blood tests; and (4) hospitalization for patients presenting within 72 hours of TIA with an ABCD2 Score >2.[19] The ABCD2 Score assigns a point value from 0 to 7 based on clinical findings, duration, blood pressure, diabetes mellitus, and patient age.[30]

An alternative definition of TIA has been proposed in which the deficits last <1 hour and MRI demonstrates no infarction.[2] This definition does provide greater diagnostic accuracy by eliminating many of the nonischemic causes that mimic TIA or stroke. However, this definition is not practical in many American centers, most Canadian centers, and indeed most of the world, given the requirement for immediate MRI. This classification is also of limited clinical usefulness because both patients with deficits lasting <1 hour and patients with deficits lasting >1 hour are both at increased risk for an impending stroke, and both groups will benefit from the proposed Canadian TIA Score.[11]

Strengths

We conducted a large prospective multicenter cohort study of patients with TIA. This study prospectively assessed historical, examination, and investigation findings to identify patients at highest risk for an impending stroke. We also followed the methodological standards recommended for derivation studies for clinical decision rules.[34–37] Our score used variables available to the clinician at the bedside, which is where the score is intended to be used. Our study primarily enrolled patients diagnosed by frontline emergency physicians with TIA. Although some TIA mimics may have been enrolled, it allows our results to be highly generalizable. All physicians enrolling patients were well-trained, certified emergency medicine specialists or neurologists, reducing classification bias. Our use of blinded Adjudication Committees to assess subsequent strokes provided a highly rigorous event classification.

Limitations

We used the traditional definition of TIA, which is a clinical diagnosis based largely on history and without the benefit of MRI to exclude small infarcts, consistent with current practice in most emergency departments.[38] We expect that we enrolled some patients with neurological symptoms attributable to nonischemic causes (eg, postural hypotension, migraine, psychogenic). Nevertheless, the treating physician's diagnosis at the moment of first hospital contact is the most relevant entry for risk stratification of such patients.

Table 3. Prediction Model for Subsequent Stroke ≤7 Days

				95% CI	
Variable	β	SE	Odds Ratio	Lower	Upper
Atrial fibrillation on ECG	1.08	0.39	3.0	1.4	6.3
Already on antiplatelet therapy	1.33	0.49	3.8	1.4	10.0
Initial triage DBP ≥110 mm Hg	1.35	0.37	3.8	1.9	7.9
Dysarthria or aphasia	0.53	0.23	1.7	1.1	2.6
History of gait disturbance	0.65	0.24	2.0	1.2	3.1
History of unilateral weakness	0.64	0.24	1.9	1.2	3.0
Glucose ≥15 mmol/L	1.51	0.41	4.5	2.0	10.0
First TIA (in lifetime)	0.84	0.28	2.3	1.3	4.0
Symptoms ≥10 min	1.03	0.52	2.8	1.0	7.8
Platelet count ≥400×10^9/L	0.92	0.45	2.5	1.0	6.0
History of carotid stenosis	0.82	0.45	2.3	0.9	5.5
History of vertigo	−1.20	0.61	0.3	0.09	0.98
Infarction (new or old) on CT	0.48	0.23	1.6	1.0	2.5

Hosmer-Lemeshow goodness-of-fit *P* value=0.963. CI indicates confidence interval; CT, computed tomography; DBP, diastolic blood pressure; and TIA, transient ischemic attack.

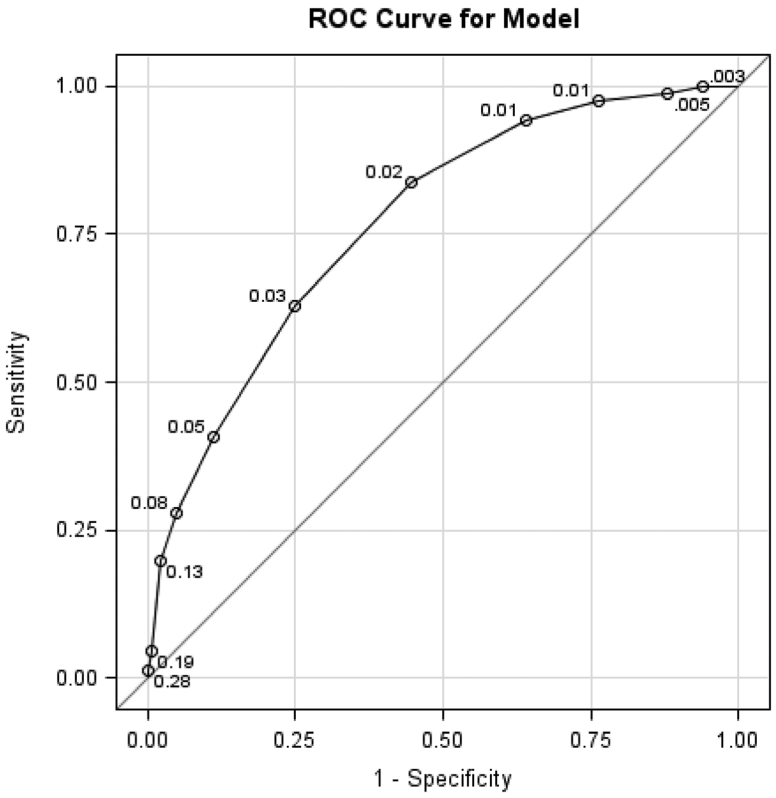

Figure. Receiver operating characteristic (ROC) curve analysis using the stroke score based on stroke prediction logistic regression model. CI indicates confidence interval.

Area under ROC curve = 0.77; 95%CI (0.73,0.82)

The ABCD2 Score calculation in this study was the coordinating center's assessment rather than the treating physician at the bedside. This result is similar to that found in the previous prospective validation, which was a prospective study done during a portion of this study. Because physicians were not asked to total the scores and interpret the total scores for the entire period for this study, we only used the coordinating center's calculation of the ABCD2 Score which provides an interpretation assuming that physicians will always correctly calculate and interpret the ABCD2 Score.

Table 4. Canadian TIA Score

Items	Points
Clinical findings	
First TIA (in lifetime)	2
Symptoms ≥10 min	2
History of carotid stenosis	2
Already on antiplatelet therapy	3
History of gait disturbance	1
History of unilateral weakness	1
History of vertigo	−3
Initial triage diastolic blood pressure ≥110 mm Hg	3
Dysarthria or aphasia (history or examination)	1
Investigations in emergency department	
Atrial fibrillation on ECG	2
Infarction (new or old) on CT	1
Platelet count ≥400×10^9/L	2
Glucose ≥15 mmol/L	3
Total score (−3 to 23)	_____

CT indicates computed tomography; and TIA, transient ischemic attack.

Not all eligible patients were enrolled. We do not suspect any systematic reason for this, other than the realities of conducting research in busy, tertiary care emergency departments. The potentially eligible patients who were not enrolled seem to be if anything less sick based on the somewhat lower rates of computed tomography and ECG use in this group compared with enrolled patients. This suggests that this group would likely have a lower subsequent stroke rate than the enrolled patients.

Clinical Implications

Clinicians need to continue to be concerned about patients with clinical features previously known to be correlated with an impending stroke including longer duration, weakness, elevated blood pressure, and atrial fibrillation. Clinicians may now also consider the presence of vertigo, lightheadedness, or visual loss as lowering the likelihood of subsequent early stroke, if patients do not have other concerning clinical findings. Clinicians must also consider other less well-established high-risk variables such as initial TIA, dysarthria, and gait disturbance.

Physicians may now also use the Canadian TIA Score to identify high-risk features for an impending stroke and identify the impending stroke risk, which in turn may help guide the urgency of further investigations. It is likely that this score can be categorized into strata that dictate a course of action. This may include outpatient management with a primary care provider for ultralow-risk patients (eg, <0.5% for subsequent

Table 5. Probability of a Subsequent Stroke Within 7 Days of Diagnosis of TIA Based on Canadian TIA Score

Score	No. of Patients (n=3899)	Sensitivity (95% CI)	Specificity (95% CI)	Estimated Probability of Having Outcome, %
–3	1	1.0	0.0	0.01
–1	3	1.0	0.0 (0.0–0.0)	0.03
0	15	1.0	0.0 (0.0–0.0)	0.04
1	20	1.0	0.01 (0.0–0.01)	0.07
2	65	1.0	0.01 (0.01–0.01)	0.11
3	127	1.0	0.03 (0.02–0.03)	0.2
4	226	1.0	0.06 (0.05–0.07)	0.3
5	449	0.99 (0.97–1.0)	0.12 (0.11–0.13)	0.5
6	473	0.98 (0.94–1.0)	0.24 (0.22–0.25)	0.8
7	742	0.94 (0.89–0.99)	0.36 (0.35–0.38)	1.2
8	772	0.84 (0.76–0.92)	0.55 (0.54–0.57)	2.0
9	544	0.63 (0.53–0.73)	0.75 (0.74–0.76)	3.2
10	253	0.41 (0.30–0.51)	0.89 (0.88–0.90)	5.1
11	114	0.28 (0.18–0.37)	0.95 (0.95–0.96)	8.1
12	62	0.20 (0.11–0.28)	0.98 (0.98–0.98)	12.6
13	24	0.05 (0.0–0.09)	0.99 (0.99–1.0)	19.0
14	9	0.01 (0.0–0.03)	1.0 (1.0–1.0)	27.6

CI indicates confidence interval; and TIA, transient ischemic attack.

stroke within 7 days), prompt investigations for moderate risk (eg, 0.6%–5%) with follow-up within 2 days including all work-up for the cause of the TIA, and same-visit consultation and investigations for patients with high risk (eg, >5%).

Research Implications

A prospective multicenter validation study following the established guidelines to develop a clinical decision rule is now required. Additional research is also required to define the cut points for low-, moderate-, high- and critical-risk groups and to determine optimal interventions for each stratum to prevent stroke in high-risk patients, while minimizing the impact on resources.

Conclusions

Clinicians should be most concerned about the increased risk for an impending stroke among TIA patients with these high-risk criteria: first TIA, language disturbance, duration of symptoms beyond 10 minutes, gait disturbance, atrial fibrillation on ECG, infarction on computed tomography, elevated platelets or glucose, unilateral weakness, history of carotid stenosis, and elevated diastolic blood pressure. Clinicians can be less concerned for a subsequent early stroke in patients with isolated vertigo. The Canadian TIA Score identifies the risk of an impending stroke after a TIA and can assist physicians in selectively expediting investigations and specialist assessment.

Acknowledgments

We thank the hundreds of physicians who completed our data collection forms and all the emergency department nurses, and clerks at the 8 study sites for their cooperation with the study. We also thank the following research personnel at the study hospitals: Ottawa Hospital—Civic Campus and General Campus, Ottawa, Ontario (Rebecca Briscoe, Renée Labreche, Natalie Bilodeau, Tara Leach, Sarai Cohn-Kalter, and Malaika Mvungi); Kingston General Hospital and Hotel Dieu Hospital, Kingston, Ontario (Kathy Bowes, Jane Reid, and Deb Emerton); Hôpital de L'Enfant-Jésus, Quebec City, Quebec (Marilyne Dufresne). We thank our colleagues at the Ottawa Hospital Research Institute (Cheryl Symington, Sheryl Domingo, My-Linh Tran, and Angela Marcantonio) and Lily Chen at the University of Ottawa Heart Institute Methods Centre for their assistance with this project. The guarantor, Dr Perry, accepts full responsibility for the work and the conduct of the study, had access to the data, and controlled the decision to publish. The author contributions were as follows: Dr Perry conceived the idea and prepared the manuscript; J. Sutherland coordinated the study, collected the data, and contributed to the writing of the manuscript; Dr Wells provided considerable statistical assistance and revised the manuscript. Drs Sivilotti, Émond, Worster, Sharma, Stotts, Jin, Oczkowski, Sahlas, Murray, MacKey, Verreault, and Stiell assisted with study design, oversaw study conduct at their respective sites, and revised the manuscript.

Sources of Funding

We acknowledge peer-reviewed funding from the Canadian Institutes of Health Research (Grant No. 84372). Dr Perry was funded as a Career Scientist by the Ontario Ministry of Health and is now funded by a Canadian Institutes of Health Research New Investigator Award, and Dr Stiell is a University Health Research Chair, University of Ottawa.

Disclosures

None.

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SUPPLEMENTAL DATA

Appendix I: Study Enrolment