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Diagnostic Accuracy of Cincinnati Pre-Hospital Stroke Scale

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Abstract

Introduction: Stroke is recognized as the third cause of mortality after cardiovascular and cancer diseases, so that lead to death of about 5 million people, annually. There are several scales to early prediction of at risk patients and decreasing the rate of mortality by transferring them to the stroke center. In the present study, the accuracy of Cincinnati pre-hospital stroke scale was assessed. **Methods:** This was a retrospective cross-sectional study done to assess accuracy of Cincinnati scale in prediction of stroke probability in patients referred to the emergency department of Poursina Hospital, Rasht, Iran, 2013 with neurologic symptoms. Three criteria of Cincinnati scale including facial droop, dysarthria, and upper extremity weakness as well as the final diagnosis of patients were gathered. Sensitivity, specificity, predictive values, and likelihood ratios of Cincinnati scale were calculated using SPSS version 20. **Results:** 448 patients were assessed. The agreement rate of Cincinnati scale and final diagnosis was 0.483 ± 0.055 (p<0.0001). The sensitivity of 93.19% (95% Cl: 90.11-95.54), specificity of 51.85% (95% Cl: 40.47-63.10), positive predictive value of 89.76% (95% Cl: 86.27-92.62), negative predictive value of 62.69% (95% Cl: 55.52-72.45), positive likelihood ratio of 1.94% (95% Cl: 1.54-2.43), and negative likelihood ratio of 0.13% (95% Cl: 0.09-0.20) were calculated. **Conclusion:** It seems that pre-hospital Cincinnati scale can be an appropriate screening tool in prediction of stroke in patients with acute neurologic syndromes.

Key words: Stroke; decision support techniques; facial paralysis; dysarthria; early diagnosis

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Introduction:

Stroke is recognized as the third cause of mortality after cardiovascular and cancer diseases, so that lead to death of about 5 million people, annually (1). Only in United States about 700,000 people each year suffer from stroke or recurrence of it (2). Also in Iran the rate of stroke in people older than 45 year-old is nearly 338 per 100,000 cases (3, 4). Delay in diagnosis may lead to irreversible complications, while with appropriate and timely treatments such outcomes can be decreased, significantly (5). There are different scales to early prediction of stroke events such as Cincinnati Pre-hospital Stroke Scale (CPSS), Melbourne Ambulance Stroke Screen (MASS), Medic Pre-hospital Assessment for Code Stroke (Medic PACS), and Los Angeles Pre-hospital Stroke Screen (LAPSS), (6-11). In Cincinnati scale, becoming positive of facial droop, dysarthria, or weakness in the upper extremities is considered as a sign of stroke (12). In Frendl et al. study in 2009, the sensitivity and specificity of Cincinnati scale were reported 94% and 20%, respectively (13). Another study in North Carolina for comparison of two pre-hospital scales showed higher sensitivity of Cincinnati scale than Med PACS (about 79%)(11). Consequently, using above-mentioned scales can be useful in timely prediction of patients at risk for development of cerebrovascular attacks. So, in this study the accuracy of Cincinnati scale was assessed in prediction of stroke among patients hospitalized with neurologic symptoms.

Methods:

Study design and setting

This retrospective cross-sectional study done to assess the accuracy of Cincinnati stroke scale in patients with acute neurologic symptoms referred to the emergency department of Poursina Hospital, Rasht, Iran, from April to August 2013. Cincinnati scale is a pre-hospital scale to assess the stroke probability with three variables included facial droop, dysarthria, and upper extremity weakness. Becoming positive of each variable leads to the positive result of Cincinnati scale. This project was

Table 1: The initial assessment of patients by using pre-hospital Cincinnati stroke scale

Variables	Normal status	Abnormal status
Facial droop	Both sides of the face move equally	One side of the face does not move
Upper extremity weakness	Both sides of the upper extremity move equally	One side of the upper extremity does not move
Dysarthria	The patient produces speech without any problem	The patient has dysarthria

Table 2: The rate of agreement between Cincinnati scale and final diagnosis of patients in prediction of stroke probability

Variables	Stroke			Kappa	p
	Yes (%)	No (%)	Total (%)		
Facial droop					
Yes	184 (41.1)	13 (2.9)	197 (44)		
No	183 (40.8)	68 (15.2)	251 (56)	0.188 ± 0.32	0.0001
Upper extremity weakness					
Yes	268 (59.8)	30 (6.7)	298 (66)		
No	99 (22.1)	51 (11.4)	150 (34)	0.270 ± 0.046	0.0001
Dysarthria					
Yes	189 (42.2)	9 (2)	198 (44)		
No	178 (39.7)	72 (16.1)	250 (56)	0.223 ± 0.031	0.0001
Cincinnati					
Positive	342 (76.3)	39 (8.7)	381 (85)		
Negative	25 (6.5)	42 (9.4)	67 (15)	0.483 ± 0.055	0.0001

confirmed by Ethical Committee of Guilan University of Medical Sciences. All researchers observed the declaration of Helsinki during the study. Hospitalized patients with at least one acute neurologic symptom on arrival such as weakness or numbness in limbs, facial numbness, dizziness, dysarthria, aphasia, severe headache with unknown cause, visual impairment, gait abnormality, and ataxia, etc. were entered. Data regarding three criteria of Cincinnati scale including facial droop, dysarthria, and upper extremity weakness as well as the final diagnosis of patients were gathered (Table 1). According to recorded clinical information, the results of brain computed tomography (CT) scan, and responsible neurologist's view, the probability of stroke was finally diagnosed. Subsequently, the accuracy of Cincinnati scale in estimation of stroke compare to the final diagnosis was assessed. For detecting the agreement rate between Cincinnati scale and final diagnosis of the neurologist, kappa coefficient was applied. The rate of agreement was considered as very weak (0-0.2), weak (0.21-0.4), average (0.41-0.6), good (0.61-0.8), and excellent (0.8-1) (14). There was no limitation of age and gender in the present study.

Statistical analysis

Data was analyzed by SPSS version 20 and Chi-square test. The total sample volume was estimated as 422 cases with considering 88.77% sensitivity, 10% accuracy, and 95% confidence interval. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), positive likelihood ration (LR+), and negative likelihood ratio (LR-) were calculated. Qualitative variables were reported as percentage and quantitative ones as mean and standard deviation. $P<0.05$ was considered statistically significant.

Results:

448 patients who referred to the emergency department with at least one neurologic symptom were assessed. 197 (44%) cases had facial droop, 298 (66.5%) upper extremity weakness, and 198 (44%) dysarthria. Among Cincinnati variables, facial droop had 0.188 ± 0.032 ($p<0.0001$), upper extremity weakness 0.270 ± 0.046 ($p<0.0001$), and dysarthria 0.223 ± 0.031 ($p<0.0001$) agreement rate with final diagnosis, (Table 2).

The accuracy of facial droop, upper extremity weakness, and dysarthria were 56.3%, 71.2%, and 58.3%, respectively. In addition, the agreement rate of Cincinnati scale and final diagnosis in prediction of stroke was 0.483 ± 0.055 ($p<0.0001$). Finally, the sensitivity of 93.19% (95% CI: 90.11-95.54), specificity of 51.85% (95% CI: 40.47-63.10), PPV of 89.76% (95% CI: 86.27-92.62),

Table 3: Screening prformance characteristics of Cincinnati stroke scale in prediction of stroke probability (95% confidence interval)

Variables	Facial droop	Weakness	Dysarthria	Cincinnati
Sensitivity	50.1 (55.4-44.9)	73.0 (68.2-77.0)	51.5 (46.2-56.7)	93.2 (90.1-95.5)
Specificity	84.0 (74.1- 1.2)	63.0 (51.5-73.4)	88.9 (80.0-94.8)	51.8 (40.5-63.1)
PPV	93.4 (89.0-96.4)	83.9 (85.9-93.1)	95.4 (91.5-97.9)	89.8 (86.3-92.6)
NPV	27.1 (21.7-33.0)	34 (26.5-42.2)	28.8 (23.3-34.8)	62.7 (55.5-72.4)
LR+	3.10 (1.9-5.2)	2.0 (1.5-2.6)	4.60 (2.5-8.6)	1.90 (1.5-2.4)
LR-	0.60 (0.5-0.7)	0.40 (0.3-0.5)	0.55 (0.5-0.6)	0.13 (0.09-0.2)

PPV: positive predictive value, NPV: negative predictive value, LR+: positive likelihood ratio, LR-: negative likelihood ration

NPV of 62.69% (95% CI: 55.52-72.45), LR+ of 1.94% (95% CI: 1.54-2.43), and LR- of 0.13% (95% CI: 0.09-0.20) were calculated for Cincinnati scale in prediction of stroke probability (Table 3).

Discussion:

The results of this study showed high sensitivity of Cincinnati scale for using as an appropriate screening tool in pre-hospital prediction of stroke. In Frendl et al. study on sensitivity of Cincinnati scale in 2009 the similar results was achieved, but with lesser PPV and specificity as well as higher NPV (13). In comparison with Studnek et al. study, Cincinnati scale had higher sensitivity and specificity in the present study (11). Also, in Chen et al. study regarding comparison of Cincinnati and LAPSS scales, it was shown that Cincinnati has significantly higher sensitivity and lower specificity (6). In the study of Mingfeng and colleagues, the pre-hospital scale of ROSIER had significantly higher specificity and lower sensitivity than Cincinnati (15). Bray et al. also showed that MASS and Cincinnati scales have the same sensitivity (7). It seems that Cincinnati scale because of high sensitivity can be an appropriate screening tool to rapid and early prediction of stroke in patients with acute neurologic symptoms. Thus, by using this scale, these patients can be transferred to hospitals equipped with stroke center and decrease the rate of mortality through this way. Performing other studies with more sample volume was suggested to do more accurate assessment.

Conclusion:

Based on the findings of present study, it is concluded that pre-hospital Cincinnati scale can be an appropriate screening tool in prediction of stroke in patients with acute neurologic syndromes.

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Authors' contributions:

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References:

1. Luengo-Fernandez R, Gray AM, Rothwell PM. Effect of urgent treatment for transient ischaemic attack and minor stroke on disability and hospital costs (EXPRESS study): a prospective population-based sequential comparison. Lancet Neurol. 2009;8(3):235-43.
2. Lloyd-Jones D, Adams R, Carnethon M, et al. Heart disease and stroke statistics—2009 update a report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Circulation. 2009;119(3):e21-e181.
3. Delbari A, Salman Roghani R, Tabatabaei SS, Lökk J. A stroke study of an urban area of Iran: risk factors, length of stay, case fatality, and discharge destination. J Stroke Cerebrovasc Dis. 2010;19(2):104-9.
4. Kasmaei HD, Baratloo A, Nasiri Z, Soleymani M, Yazdani MO. Recombinant Tissue Plasminogen Activator Administration in Patients With Cerebrovascular Accident; A Case Series. Archives of Neuroscience. 2015;2(2).
5. Savitz SI, Caplan LR, Edlow JA. Pitfalls in the diagnosis of cerebellar infarction. Acad Emerg Med. 2007;14(1):63-8.
6. Chen S, Sun H, Lei Y, et al. Validation of the Los Angeles Pre-Hospital Stroke Screen (LAPSS) in a Chinese Urban Emergency Medical Service Population. PLoS One. 2013;8(8):e70742.
7. Bray JE, Coughlan K, Barger B, Bladin C. Paramedic diagnosis of stroke examining long-term use of the Melbourne Ambulance Stroke Screen (MASS) in the field. Stroke. 2010;41(7):1363-6.
8. Kidwell CS, Saver JL, Schubert GB, Eckstein M, Starkman S. Design and retrospective analysis of the Los Angeles prehospital stroke screen (LAPSS). Prehosp Emerg Care. 1998;2(4):267-73.
9. Kidwell CS, Starkman S, Eckstein M, Weems K, Saver JL. Identifying Stroke in the Field Prospective Validation of the Los Angeles Prehospital Stroke Screen (LAPSS). Stroke. 2000;31(1):71-6.
10. Kothari RU, Pancioli A, Liu T, Brott T, Broderick J. Cincinnati prehospital stroke scale: reproducibility and validity. Ann Emerg Med. 1999;33(4):373-8.
11. Studnek JR, Asimos A, Dodds J, Swanson D. Assessing the validity of the Cincinnati Prehospital Stroke Scale and the Medic Prehospital Assessment for Code Stroke in an urban emergency medical services agency. Prehosp Emerg Care. 2013;17(3):348-53.

12. Kothari RU, Pancioli A, Liu T, Brott T, Broderick J. Cincinnati Prehospital Stroke Scale: Reproducibility and Validity. Ann Emerg Med.33(4):373-8.
13. Frendl DM, Strauss DG, Underhill BK, Goldstein LB. Lack of impact of paramedic training and use of the cincinnati prehospital stroke scale on stroke patient identification and on-scene time. Stroke. 2009;40(3):754-6.
14. Donner A, Shoukri MM, Klar N, Bartfay E. Testing the equality of two dependent kappa statistics. Stat Med. 2000;19(3):373-87.
15. Mingfeng H, Zhixin W, Qihong G, Lianda L, Yanbin Y, Jinfang F. Validation of the use of the ROSIER scale in prehospital assessment of stroke. Ann Indian Acad Neurol. 2012;15(3):191-5.