Article published online: 2022-09-27

ORIGINAL ARTICLE

Prognostic factors in acute stroke, regarding to stroke severity by Canadian Neurological Stroke Scale: A hospital-based study

Fardin Faraji, Keyvan Ghasami, Afsoon Talaie-Zanjani[1], Abolfazl Mohammadbeigi[2]

Department of Neurology, Valiasr Hospital, Arak University of Medical Science, [1]Department of Health, Islamic Azad University of Arak, Arak, [2]Clinical Research Development Center, Faculty of Medicine,Qom University of Medical Sciences, Qom, Iran

ABSTRACT

Introduction: Stroke is an acute vascular disease and the second leading cause of death in the world. We have assessed the patients on hospital admission with some other prognostic factors besides the preliminary neurological examinations in order to estimate their clinical status in the future.

Materials and Methods: The present study was performed on the patients admitted to Valiasr Hospital of Arak within 72 h of stroke onset from April to October 2011. Diagnosis of stroke in the suspected patients was done by a neurologist and verified by the findings of the computed tomography scans. For each patient, a specific questionnaire, which described its stroke severity according to canadian neurological scale of stroke (CNSS), was prepared in order to define the severity of the stroke. Systolic as well as diastolic blood pressure of the patients was measured at the admission and their level of blood sugar, cholesterol, and triglyceride was also determined.

Results: Out of 62 patients under study (mean age, 66.14 ± 10.9 years), 36 (58.1%) were males and 26 (41.9%) were females. Overall, 66.1% of the patients were diagnosed with the ischemic stroke, while 33.9% were diagnosed with the hemorrhagic stroke. Regression analysis showed that cholesterol and diastolic blood pressure were the most important prognostic factors of the severity of stroke (CNSS).

Conclusion: Diastolic blood pressure and serum cholesterol level have the potential to be used for assessing the stroke outcome as well as to improve the stroke rehabilitation.

Key words: Blood pressure, blood sugar, Canadian Neurological Scale of stroke, cholesterol, stroke, triglyceride

Introduction

Stroke is the third leading cause of death after cancer and cardiovascular diseases and is responsible for the long-term disability worldwide.[1] All over the world, the annual number of deaths due to stroke has been estimated as 5.54 millions.[2] Moreover, due to the rapid rise in the world elderly population, it is even predicted that the burden of stroke will increase in future.[3] Also the burden of stroke is high and has a growing manner in economically developing countries.[1]

There are two distinct types of stroke including ischemic (which is further divided into thrombotic and embolic and occurs as a result of an obstruction within a blood vessel feeding a part or parts of the brain) and hemorrhagic (which results from the rupture of weakened cerebral arteries).[4] Hypertension, diabetes mellitus, hyper-lipidemia, smoking, coronary artery diseases, and particularly old age are the most recognized risk factors of stroke.[3,5-7] Although stroke incidence rates in younger and older ages have been reported to be greater in females and males, respectively, some authors have stated that it occurs equally in both genders.[4,8] However, stroke severity is one of the most important determinants of prognosis of the outcome. Besides, due to the lack of quantitative data on the initial neurological status in retrospective studies, Canadian Neurological Scale of Stroke (CNSS) is a useful method for quantifying the severity of stroke.[9,10] This scoring system can predict the long-term outcomes of acute stroke with a simple mathematical model based on the patients' age and the initial CNSS score.[11]

Access this article online	
Quick Response Code:	Website: www.asianjns.org
	DOI: 10.4103/1793-5482.116378

Address for correspondence:
Dr. Abolfazl Mohammadbeigi, Department of Public Health, Health Faculty, Qom University of Medical Sciences, Qom, Iran.
E-mail: beigi60@gmail.com

Considering the long-term neurological disabilities which may result from acute stroke[1] and differences in the extent of recovery among stroke survivors, predicting the outcomes of stroke is a very important issue. Therefore, we have assessed the patients at the time of hospitalization with some other prognostic factors besides the preliminary physical and neurological examinations in order to investigate their neurological status in relation to these factors. The present study was conducted in order to determine the relationship between the stroke severity based on the CNSS criteria and the clinical symptoms, such as the patients' blood pressure, sugar, cholesterol, and triglyceride levels, as well as some other factors and also to compare these symptoms in two main types of stroke patients.

Materials and Methods

The present study is a cross-sectional one which was conducted on 62 acute brain stroke patients who were admitted to Valiasr Hospital of Arak, Iran, within 72 h from the onset of neurological symptoms between April and October 2011.

The patients with neurologic symptoms who had been referred to the hospital and were diagnosed by a neurologist and the imaging techniques with stroke are included in the present study. If the neurologic symptoms had occurred due to myocardial infarction, brain abscess, subarachnoid hemorrhage, and electrolyte disorders, such as hypoglycemic coma, these patients were excluded from the study. On admission, the suspected patients were examined by a neurologist and the stroke was verified by computed tomography (CT) scans as well as the magnetic resonance imaging (MRI). The patients' systolic and diastolic blood pressure was measured by a trained nurse. Then, blood samples were taken at the time of hospitalization and transferred to the hospital laboratory in order to determine the sugar, cholesterol, and triglyceride levels. Therefore, the blood sugar sample was obtained from the patients before taking the glucose serum.

For each patient, a specific questionnaire describing a patient's neurological status was prepared and, according to CNSS, an appropriate score was given to the questionnaire. According to this instrument, the patients with higher scores have a good prognosis. The reliability and validity of this scale have been confirmed in other studies.[10,11] For validation of the CNSS in the current study, in the first stage, two independent neurologists assigned scores to ten patients. Then, the Kappa coefficient was calculated and the high Kappa indicated the validation of instrument. Moreover, the neurologic exam was conducted by a neurologist for all the subjects and, according to the CNSS criteria, a score was assigned to each patient. Demographic characteristics of brain stroke patients were also recorded.

It should be noted that a written informed consent was obtained from the patients or their relatives at the admission. Also the protocol of the study was approved by the ethical committee of Arak University of Medical Sciences. In the present study, all the statistical analyses were performed through the SPSS statistical software (v. 11.5). Moreover, the Spearman correlation coefficient, Mann–Whitney *U* test, and *t* test were used in order to analyze the data. In addition, the adjustment for the related factors in univariate analysis was carried out through the linear regression model.

Results

Out of the 62 patients studied whose age ranged from 40 to 85 years (mean age, 66.46 ± 9.85 years), 36 (58.1%) were males and 26 (41.9%) were females. The mean values of systolic and diastolic blood pressure, blood sugar, and cholesterol as well as triglyceride levels were 164.2 ± 26.8 mmHg, 102.6 ± 21.13 mmHg, 208.04.90 ± 81.5 mg/dl, 215.9 ± 64.8 mg/dl, and 213.23 ± 52.83 mg/dl, respectively. Out of all the studied patients, 37.1% were detected as ischemic type, 33.9% as hemorrhagic, and the rest (29%) as transient ischemic attack (TIA). Therefore, 66.1% (41 patients) were diagnosed with the ischemic stroke.

As Table 1 depicts, in our study, the mean values of systolic and diastolic blood pressure, mean arterial pressure (MAP), and cholesterol level showed a significant difference between the two types of ischemic and hemorrhagic stroke ($P < 0.05$). Based on the results, the mean of systolic and diastolic blood pressure, mean arterial pressure, and cholesterol was higher in the hemorrhagic patients. Nevertheless, the mean of the triglyceride level and blood sugar was not statistically different between the two groups of patients ($P > 0.05$). Also the table shows that the mean of CNSS score is statistically higher in the ischemic patients ($P < 0.05$).

The results provided in Table 2 were showed that history

Table 1: Comparison of the quantitative characteristic of the two types of stroke patients

	Type of stroke		*P* value
	Ischemic *n*=41 Mean±SD (median)	Hemorrhagic *n*=21 Mean±SD (median)	
Age	66.8±10.9 (67)	65.8±7.6 (65)	0.730[a]
Systolic blood pressure	154.75±18.2 (160)	182.6±31.4 (190)	<0.001[a]
Diastolic blood pressure	96.37±12.9 (100)	114.5±28.1 (120)	0.002[b]
Mean arterial pressure	115.4±12.44 (116.7)	137.22±28.05 (143.3)	0.002[a]
Blood sugar	197.8±77.1 (200)	228.09±87.9 (220)	<0.168[a]
Triglyceride	185.1±58.6 (180)	205.9±66.7 (200)	<0.216[a]
Cholesterol	193.6±57.4 (180)	257.3±57.8 (240)	<0.001[a]
CNSS score	11.94±4.33 (14.5)	7.57±2.79 (7)	<0.001[b]

[a]Independent sample *t*-test, [b]Mann-Whitney *U* test; CNSS – Canadian Neurological Scale of stroke; SD – Standard deviation

of HTN and HLP were significantly associated with type of stroke.

Spearman's correlation coefficient [Table 3] showed an inverse significant correlation between systolic and diastolic blood pressure, MAP, and blood lipidemia factors by CNSS. However, the correlation between CNSS and blood sugar was not statistically significant. After the adjustment for age, blood sugar, and all lipidemia factors in the linear regression model with the stepwise method, only two significant variables remained as the prognostic determinants of CNSS. The standardized coefficients of beta for cholesterol level and diastolic blood pressure were −0.505 and −0.342, respectively, which were statistically significant in the regression model at the 0.001 level. These results indicate that as the cholesterol level and diastolic blood pressure increase, the CNSS decreases and the prognosis of the patient would be worse.

Discussion

From all the studied patients, 66.1% were diagnosed with the ischemic stroke and 33.9% with hemorrhagic stroke. In the United States, however, about 83% of strokes are ischemic and 17% are hemorrhagic.[12] Since the hemorrhagic type has worse outcomes and the percentage of this type in our study was higher than the USA, the medical treatment and the burden of the disease increase.

According to our results, there was a significant inverse correlation between the stroke severity according to the CNSS and the level of the patients' blood pressure. Other researchers have also showed the relationship between blood pressure and stroke.[1,5,6,13,14] These studies indicated that the increased systolic and diastolic blood pressure was significantly and positively associated with death and disability among the patients with the acute hemorrhagic stroke, but not those with the acute ischemic stroke.[1] Although the mechanisms underlying hypertension in stroke are complex,[15] it is suggested that high blood pressure can increase the risk of hemorrhagic transformation; of course, this has not been demonstrated in the clinical ischemic stroke.[14] Moreover, based on our results in the regression model, diastolic blood pressure is a more important prognostic factor.

Univariate results of the present study showed significant correlation between the stroke severity and systolic, MAP, and especially diastolic blood pressure. However, contrary to our results, Semplicini *et al*.[16] found a good prognosis in the patients with normal blood pressure in spite of a significant relationship between hypertension and adverse outcomes of stroke. On the other hand, both high and low systolic and diastolic blood pressures have been reported to correlate with poor prognosis.[16] But, based on the multivariate analysis, diastolic blood pressure was a more important prognostic factor for predicting the prognosis and the severity of stroke. Moreover, another study demonstrated that in North American and Western European populations, a 5 mmHg decrease in diastolic blood pressure can decrease the stroke risk by 30% to 40%.[17]

In this study, the stroke severity was significantly correlated with the blood cholesterol and triglyceride levels. In another study, however, the lower levels of blood triglyceride contributed to the poor prognosis in the patients with hemorrhagic stroke.[18] Dziedzic *et al*. also showed that a lower level of triglyceride is associated with a more severe stroke.[19] However, after adjusting for age and lipidemia factors of serum, triglyceride did not remain in the model. It seems that among the lipidemia variables, cholesterol is a more important factor for predicting the severity and future

Table 2: Comparison of the qualitative characteristic of the two types of stroke patients

	Type of stroke		*P* value
	Ischemic *n* (%)	Hemorrhagic *n* (%)	
Sex			0.178
Male	26 (63.4)	10 (47.6)	
Female	15 (36.6)	11 (52.4)	
Having smoking habit			0.436
Yes	23 (56.1)	13 (61.9)	
No	18 (43.9)	8 (38.1)	
Family history of CVA			0.213
Yes	19 (52.8)	8 (38.1)	
No	17 (47.2)	13 (61.9)	
History of DM			0.089
Yes	11 (26.8)	10 (47.6)	
No	30 (73.2)	11 (52.4)	
History HTN			0.009
Yes	17 (41.5)	16 (76.2)	
No	24 (58.5)	5 (23.8)	
History of HLP			0.018
Yes	26 (63.4)	6 (28.6)	
No	12 (29.3)	14 (66.7)	

CVA – Cerebral vascular accident; DM - Diabetes mellitus; HTN – Hypertension; HLP – Hyperkeratosis lenticularis perstans

Table 3: Correlation of CNSS with age and clinical symptoms

	Age	Systolic blood pressure	Diastolic blood pressure	Mean arterial pressure	Blood sugar	Triglyceride	Cholesterol
R	0.082	−0.498**	−0.518**	−0.538**	−0.229	−0.412**	−0.616**
P value	0.524	<0.001	<0.001	<0.001	0.073	0.001	<0.001

**Correlation is significant at the 0.01 level (two-tailed), *Correlation is significant at the 0.05 level (two-tailed); CNSS – Canadian Neurological Scale of stroke

outcomes of stroke. The results of another study showed that low levels of serum TC, TG, and HDL-C are strong independent predictors of 3-months poor outcome in the patients with the acute ischemic stroke.[20] In addition, the findings of a recent study showed that amongst the lipid determinations, only an inverse relationship was found between cholesterol and stroke outcomes. Since the mechanism of this apparently paradoxical situation remains unexplained, further research is needed to be conducted on the issue.[21]

Comparing two types of stroke patients showed that clinical characteristics such as blood pressure and lipidemia determinants in the hemorrhagic patients were higher than the ischemic ones. Also our results also showed this reverse correlation. In the present study, the patients with a higher level of triglyceride have a lower CNSS score and, consequently, a more severe disease. Based on the CNSS criteria, the patients with lower scores have a poor prognosis and a more severe stroke. Zhang *et al*.'s study showed that in-hospital case-fatality rate for acute hemorrhagic stroke was more than threefold higher compared to the acute ischemic stroke.[1]

The results of the present study did not show any significant correlation between blood sugar and CNSS. Nevertheless, controversies are observed in the findings of other studies. Askiel and Williams,[8] for example, reported that the stroke patients with high levels of blood sugar at the time of hospitalization were at a higher risk of death within the first 30 days. Accordingly, the effect of hyperglycemia on hospital admission was known to be responsible for the worse outcome than euglycemia in patients with thromboembolic stroke.[13] Sarah *et al*.[22] also mentioned that hyperglycemia can caused a higher rate of mortality and a lower ability of functional recovery.

In the present study, we used the CNSS score as an instrument for predicting the outcomes as well as the severity of stroke. Moreover, other studies have mentioned that today CNSS is a valid and reliable instrument for the stroke scoring system, which can be used in order to measure the initial stroke severity retrospectively. It can also be applied for discharging the patients.[11] This algorithm could be useful for predicting the long-term outcomes of the acute stroke for the patients through a simple mathematical model based on the patients' age and the initial items.[11,23]

However, since other recent studies showed the effect of the severity of stroke on the outcome of the disease, we did not follow the patients in future.

Conclusion

Based on the results of the present investigation, the stroke severity is correlated with diastolic blood pressure and serum cholesterol level in a way that as the diastolic blood pressure and the serum cholesterol level increased, the severity of stoke increased as well. Therefore, measurement and control of these important prognostic factors help us assess the outcomes of stroke and, at the same time, improve the stroke rehabilitation.

Acknowledgments

The present work was financially supported by the research department of Arak University of Medical Sciences. The authors would like to thank all the engaged staff of Valiasr Hospital who cooperated in the process of data collection. The authors are also grateful for Ms. A. Keivanshekouh for her cooperation in improving the use of English in the manuscript.

References

1. Zhang Y, Reilly KH, Tong W, Xu T, Chen J, Bazzano LA, *et al*. Blood pressure and clinical outcome among patients with acute stroke in Inner Mongolia, China. J Hypertens. 2008;26:1446-52.
2. World Health Organization (WHO). The world health report Geneva: WHO; 2000.
3. Rothwell PM, Coull AJ, Giles MF, Howard SC, Silver LE, Bull LM, *et al*. Change in stroke incidence, mortality, case-fatality, severity, and risk factors in Oxfordshire, UK from 1981 to 2004 (Oxford Vascular Study). Lancet. 2004;363:1925-33.
4. Rowland LP, TA. P. Merritt's neurology. Philadelphia: Lippncott Williams and Wilkins; 2010.
5. Abboud H, Labreuche J, Plouin F, Amarenco P. High blood pressure in early acute stroke: A sign of a poor outcome? J Hypertens. 2006;24: 381-6.
6. Geeganage CM, Bath PM. Relationship between therapeutic changes in blood pressure and outcomes in acute stroke: A metaregression. Hypertension. 2009;54:775-81.
7. Grau AJ, Weimar C, Buggle F, Heinrich A, Goertler M, Neumaier S, *et al*. Risk factors, outcome, and treatment in subtypes of ischemic stroke. Stroke. 2001;32:2559-66.
8. Askiel MD, Williams L. Another reason to avoid a sugar high: Study links high blood sugar to mortality after stroke. Stroke. 2003;69:842-56.
9. Bushnell CD, Johnston DCC, Goldstein LB. Retrospective assessment of initial stroke severity: Comparison of the NIH Stroke Scale and the Canadian Neurological Scale. Stroke. 2001;32:656-60.
10. Stavem K, Lossius M, Rønning OM. Reliability and validity of the Canadian Neurological Scale in retrospective assessment of initial stroke severity. Cerebrovascular Diseases. 2003;16:286-91.
11. Goldstein LB, Chilukuri V. Retrospective assessment of initial stroke severity with the Canadian Neurological Scale. Stroke. 1997;28: 1181-4.
12. Rosamond WD, Folsom AR, Chambless LE, Wang CH, McGovern PG, Howard G, *et al*. Stroke incidence and survival among middle-aged adults: 9-year follow-up of the Atherosclerosis Risk in Communities (ARIC) cohort. Stroke. 1999;30:736-43.
13. Gentile NT, Seftchick MW, Huynh T, Kruus LK, J. G. Decreased mortality by normalizing blood glucose after acute ischemic stroke. Acad emerg Med. 2006;13:174-80.
14. Sare GM, Geeganage C, Bath PM. High blood pressure in acute ischaemic stroke–broadening therapeutic horizons. Cerebrovasc Dis. 2009;27:156-61.
15. Chamila MG, Philip MWB. Relationship Between Therapeutic Changes in Blood Pressure and Outcomes in Acute Stroke A Metaregression. Hypertension 2009;54:775-81.
16. Semplicini A, Benetton V, Calo L, *et al*. Hypertension in acute ischemic stroke. Cardiovasc Rev Rep. 2004;25:51-7.
17. Lawes CMM, Bennett DA, Feigin VL, Rodgers A. Blood pressure and stroke. Stroke. 2004;35:776-85.
18. Mihalko V, Smolanka VI, Bulesta BA, Fekete I, al. e. serum cholesterol and triglyceride levels in patients with acute stroke. Stroke. 2001; 16:37-51.
19. Dziedzic T, Slowik A, Gryz EA, Szczudlik A. Lower serum triglyceride

level is associated with increased stroke severity. Stroke. 2004; 35:e151-2.
20. Li W, Liu M, Wu B, Liu H, Wang LC, Tan S. Serum lipid levels and 3-month prognosis in Chinese patients with acute stroke. Adv Ther. 2008;25:329-41.
21. Roquer J, Cuadrado-Godia E, Rodriguez-Campello A, Jimenez-Conde J, Martinez-Rodriguez JE, Giralt E, *et al*. Serum cholesterol levels and survival after rtPA treatment in acute stroke. Eur J Neurol. 2011.
22. Sarah E, Capes D, Klas M, Parbeen P, Hertzel CG. Stress hyperglycemia and prognosis of stroke in Nondiabetic and diabetic patients. Stroke. 2001;32:24-6.
23. Cote R, Battista R, Wolfson C, Boucher J, Adams J, Hachinski V. The Canadian Neurological Scale: Validation and reliability assessment. Neurology. 1989;39:638-43.

How to cite this article: Faraji F, Ghasami K, Talaie-Zanjani A, Mohammadbeigi A. Prognostic factors in acute stroke, regarding to stroke severity by Canadian Neurological Stroke Scale: A hospital-based study. Asian J Neurosurg 2013;8:78-82.

Source of Support: Nil**, Conflict of Interest:** None declared.