Clinical Significance Of Alberta Stroke Programme Early Computed Tomography (Aspect) Score And Infarct Volume With National Institute Of Health Stroke Scale (NIHSS) In Acute Ischemic Stroke

L Amalia

Citation

L Amalia. *Clinical Significance Of Alberta Stroke Programme Early Computed Tomography (Aspect) Score And Infarct Volume With National Institute Of Health Stroke Scale (NIHSS) In Acute Ischemic Stroke*. The Internet Journal of Neurology. 2022 Volume 23 Number 1.

DOI: 10.5580/IJN.56350

Abstract

Background: Imaging plays an essential role in diagnosing ischemic stroke, and Computed tomography scanning (CT-scan) was the most imaging to assess early ischemic changes. Alberta Stroke Programme Early Computed Tomography (ASPECT) score was a tool for assessing CT-scan in ischemic stroke, and we confirmed with infarct volume to predict outcomes and severity of stroke compared with NIHSS.

Objective: We hypothesize that the ASPECT score negatively correlated and infarct volume positively correlated with neurological deficit in acute ischemic stroke patients.

Methods: This was an analytic-descriptive cross-sectional study on first-acute onset ischemic stroke patients in the Neurology Ward of Hasan Sadikin General Hospital. We divided into two groups, small vessel disease and extensive vessel disease, based on a non-contrast head CT scan. ASPECTS and infarct volume were calculated from CT-scan of ischemic stroke patients involving medial cerebral artery and compared to NIHSS.

Results: A total of 37 subjects (51.35% male and 48.65% female), with mean age 56.21 ± 12.53 years, there were 56.75% small vessel diseases and 43.25% large vessel diseases. Subjects with small vessel disease had higher ASPECT score (8.21±3.83 vs. 6.94±3.86), smaller infarct volume (0.21±0.86 vs. 1.04±1.83 cc), and had lower NIHSS (4.78±3.86 vs. 11.50±3.83) than subjects with large vessel diseases. Spearman's correlation test show a significance correlation between ASPECT ($r=-0.94$, $p<0.001$), infarct volume ($r=0.77$, $p<0.001$) and NIHSS.

Conclusion: There was a strong correlation between ASPECT score, infarct volume, and NIHSS score in acute ischemic stroke. The higher the value of the ASPECT score, the lower the value of infarct volume, the lower the value for NIHSS.

INTRODUCTION

Stroke is still the leading cause of disability worldwide, and ischemic stroke is more common than intracerebral hemorrhage stroke. After narrowing or blocking the artery, it causes a reduction of cerebral blood flow resulting in brain ischemia. Early management will minimize infarct volume and neuronal damage and prevent the severity of neurological deficit.[1,2]

We can assess neuronal damage and infarct volume non-contrast brain CT scan on acute ischemic stroke patients.[1-4]

The Alberta Stroke Program Early Computed Tomography (ASPECT) is a simple tool to evaluate early ischemic changes using non-contrast brain CT for anterior circulation, and we can predict clinical outcomes before intravenous thrombolysis or mechanical thrombectomy procedure.[1,5-7]

National Institute of Health Stroke Score (NIHSS) was a tool that can assess neurological deficit and severity of stroke patients to predict clinical outcomes after the stroke event. Increasing one point of NIHSS can decrease about 28% of clinical outcomes of acute ischemic stroke, but still had

limitations for assessing metabolic problems that can cause a decreased level of consciousness.[5,6]

We hypothesize that ASPECT score and infarct volume non-contrast head CT scan correlated with neurological deficit in acute ischemic stroke patients.

METHODS

This study was a retrospective from the medical record of hospitalized acute ischemic stroke patients confirmed by non-contrast brain computerized tomography (CT) less than 72 hours of onset. We assessed the neurological deficit using the National Institute of Health Stroke Scale (NIHSS) on the acute phase. We classified acute ischemic stroke patients into two groups: extensive vessel disease and small-vessel disease based on non-contrast head CT scan. We excluded patients with a decreased level of consciousness due to metabolic problems, history of stroke, CT scan > 5 mm slices. A neuroradiologist assessed the ASPECT score and infarct volume-statistical analysis using Spearman rank and Kruskal Wallis test, considered significant if p<0.001.

The Research Ethics Committee Universitas Padjadjaran Bandung (No.27/UN6.KEP/EC/2020) had approved this study. This study had complied with all relevant ethical regulations (including The Declaration of Helsinki). All patients were informed about the purpose of the study and had obtained written consent.

RESULTS

A total of 37 patients were eligible in this study, with the mean age of our subjects (mean ± SD) 56.21± 12.53, 51.35% were male, and 48.65% were female. We collected data about stroke subtype (small vessel and major vessel diseases), onset, ASPECT score, infarct volume, and NIHSS (table 1).

Table 1

Characteristic of stroke patients

Variable		N	%
Age (years)	Mean ± Std	56.21±12.53	
	Range	45-68	
Gender	Male	19	51.35%
	Female	18	48.65%
Stroke subtype	Large vessel diseases	18	43.25%
	Small vessel diseases	19	56.75%
ASPECTS	Mean±Std	7.81±2.11	
Infarct volume (cc)	Mean±Std	0.83±2.11	
NIHSS	Mean±Std	8.40±9.04	
NIHSS	Mild deficit (0-4)	7	18.91%
	Moderate deficit (5-14)	26	70.27%
	Severe deficit (15-25)	4	10.81%
	Very severe deficit (>25)	0	0

ASPECT score in this study (mean ± SD) was 7.81±2.11 and NIHSS in this study (mean ± SD) was 8.40±9.04 (table 1)

ASPECTS score according to stroke subtype

We found that the enormous vessel diseases stroke subtype had an ASPECT score lower than minor vessel diseases and was statistically significant (p<0.001) using the Kruskal Wallis test. (table 2)

Table 2

ASPECT score according stroke subtype

Stroke subtype	n	ASPECTS		
		Mean	Median(min-maks)	p value
Large vessel disease	18	6.94±3.86	6(4-7)	
Small vessel disease	19	8.21±3.83	9(8-9)	<0.001*

Note : * statistically significant

NIHSS score according to stroke subtype

We found that the enormous vessel diseases stroke subtype had NIHSS score higher than minor vessel diseases and was statistically significant (p<0.001) using the Kruskal Wallis test. (table 3)

Table 3

NIHSS score according stroke subtype

Stroke subtype	n	NIHSS		
		Mean	Median(min-max)	p value
Large vessel disease	18	11.50±3.83	10.50(8-19)	
Small vessel disease	19	4.78±3.86	4(3-8)	<0.001*

Note : * statistically significant

Infarct volume according to stroke subtype

We found that the enormous vessel diseases stroke subtype had larger infarct volume than small vessel disease and was statistically significant (p<0.001) using the Kruskal Wallis test. (table 4)

Table 4

Infarct volume according stroke subtype

Stroke subtype	n	ASPECTS		
		Mean	Median(min-max)	p value
Large vessel disease	18	1.04±1.83	2.15(0.34-3.55)	
Small vessel disease	19	0.21±0.86	0.42(0.02-1.41)	<0.001*

Note : * statistically significant

Correlation ASPECT, infarct volume, and NIHSS score

We found that ASPECT score and NIHSS had a strong negative correlation (r=-0.94, p<0.001) and also had a strong positive correlation between infarct volume and NIHSS (r=0.77,p<0.001). This study also showed a strong positive correlation between ASPECT score and infarct volume (table 5).

Table 5

Correlation between ASPECT, infarct volume and NIHSS score

Variable	Correlation	r	P value
ASPECTS and NIHSS	Spearman	**-0.94**	**<0.001***
Infarct volume and NIHSS	Spearman	**0.77**	**<0.001***
ASPECT and NIHSS	Spearman	**-0.77**	**<0.001***

Note : * statistically significant; r = coefficient correlation.

DISCUSSION

The subjects in this study had a mean age of 56.21 ± 12.53, with 51.35% male and 48.65% female. This result is the same with the incidence of stroke, which states that stroke is more common in men than women.[8,9]

The distribution of stroke types in this study is suitable with the prevalence of ischemic stroke from another study that small vessel occlusion or lacunar type stroke has a higher prevalence in Asian countries than large vessel occlusion.[12]

ASPECTS and infarct volume according to stroke subtype

This study found that large vessel disease strokes had a lower ASPECT score (6.94±3.86) and larger infarct volume (1.04±1.83 cc) than minor vessel diseases, which is in accordance with the previous study. The study stated that large vessel disease strokes had more expansive infarct lesions than minor vessel diseases.[12] Emboli originating from the heart and artery-to-artery emboli tends to be larger than emboli originating from the cervicobrachial artery. The embolism can clog the arteries in a more proximal location cause larger ischemic lesions.[10-12]

The size and extent of ischemic lesions of minor vessel diseases are usually less than 1.5mm and tend to be in the territory of the small branch artery of the medial cerebral artery. Artery-to-artery emboli block ischemic lesions in large vessel occlusion from broken fibrous plaque. The size of the emboli is smaller than the artery-to-artery emboli, so the blockage occurs in the distal region of arteries, and the extent of the resulting infarct volume is smaller than large vessel occlusion.[10,12]

NIHSS score according to Stroke subtype

Major vessel diseases had a higher NIHSS average (11.50±3.83) than minor vessel diseases (4.78±3.86). The extent of ischemic changes will influence neurological deficit and severity of stroke.[15] Ischemic lesions with more minor ischemic changes in the subcortical region will provide lower NIHSS than large vessel occlusion.[13,14] The results of this study suit the previous study that major vessel diseases have a higher NIHSS value.[12] Proximal or bifurcation blockages of the cerebral artery media more often occur in large vessel occlusion, resulting in extensive ischemic changes and providing severity of neurological deficit compared with small vessel occlusion.[10,13] Small vessel diseases or lacunar stroke is located in the subcortical region (basal ganglia) and has smaller lesions than major vessel diseases.[15,16] Previous studies found that proximal blockage had a higher NIHSS value than distal blockages or without blockages.[17] Proximal blockages occur in strokes caused by large emboli like emboli which comes from the heart or artery to artery emboli resulting in large vessel occlusion.[17]

Correlation between ASPECT score, infarct volume, and NIHSS

The correlation coefficient between ASPECTS and NIHSS is -0.94 (p value<0.001) which means there is a strong negative correlation between ASPECTS and NIHSS in acute ischemic stroke. A lower ASPECT score will provide higher NIHSS and increase the severity level of stroke. The correlation coefficient between infarct volume and NIHSS is r=0.77 (p value<0.001) which means there is a strong positive correlation between infarct volume and NIHSS in acute ischemic stroke. The correlation coefficient between ASPECTS and infarct volume is r=-0.77 (p value<0.001) which means there is a strong negative correlation between ASPECTS and NIHSS in acute ischemic stroke. A larger infarct volume will provide a lower ASPECT score. The

higher the value of ASPECTS, the lower the value of infarct core, the lower the value for NIHSS. ASPECT score and infarct core correlated with stroke severity. This result is the same as the Canadian Alteplase for Stroke Effectiveness Study (CASES) study in Canada, which states that subjects with ASPECTS 6-10 grades have a higher likelihood of independent living.[8]

LIMITATION OF STUDY

We did not perform CT perfusion or Magnetic Resonance Imaging Diffuse Weighted Imaging (MRI-DWI) to compare infarct volume from infarct core with non-contrast brain CT.

CONCLUSION

There was a strong correlation between ASPECT score, infarct volume, and NIHSS score in acute ischemic stroke. The higher the value of the ASPECT score, the lower the value of the infarct core, the lower the value will be for NIHSS. ASPECT score and infarct volume correlated with stroke severity.

References

1. Alfa AY. Penatalaksanaan Stroke Fase Akut. In: Basuki A, Dian S, editors. Neurology in Daily Practice. 1 ed. Bandung: Bagian/UPF Ilmu Penyakit Saraf Fakultas Kedokteran UNPAD/RS. Hasan Sadikin; 2010. p. 67-84.
2. Hacke W, Donnan G, Fieschi C, Kaste M, von Kummer R, Broderick JP, et al. Association of outcome with early stroke treatment: pooled analysis of ATLANTIS, ECASS, and NINDS rt-PA stroke trials. Lancet (London, England). 2004;363(9411):768-74.
3. Menon BK, Puetz V, Kochar P, Demchuk AM. ASPECTS and Other Neuroimaging Scores in the Triage and Prediction of Outcome in Acute Stroke Patients. Neuroimaging Clinics of North America. 2011;21(2):407-23.
4. Hill MD, Buchan AM. Thrombolysis for acute ischemic stroke: results of the Canadian Alteplase for Stroke Effectiveness Study. Canadian Medical Association Journal. 2005;172(10):1307-12.
5. Puetz V, Dzialowski I, Hill MD, Demchuk AM. The Alberta Stroke Program Early CT Score in Clinical Practice: What have We Learned? International Journal of Stroke. 2009;4(5):354-64.
6. Meschia JF, Bushnell C, Boden-Albala B, Braun LT, Bravata DM, Chaturvedi S, et al. Guidelines for the Primary Prevention of Stroke. A Statement for Healthcare Professionals From the American Heart Association/American Stroke Association. 2014;45(12):3754-832.
7. Mansour OY, Megahed MM, Abd Elghany EHS. Acute ischemic stroke prognostication, comparison between Glasgow Coma Score, NIHS Scale and Full Outline of UnResponsiveness Score in intensive care unit. Alexandria Journal of Medicine. 2015;51(3):247-53.
8. Hill MD, Buchan AM. Thrombolysis for acute ischemic stroke: results of the Canadian Alteplase for Stroke Effectiveness Study. Canadian Medical Association Journal. 2005;172(10):1307-12.
9. Boehme AK, Esenwa C, Elkind MSV. Stroke Risk Factors, Genetics, and Prevention. 2017;120(3):472-95.
10. Misbach J, Ali W. Stroke in Indonesia: A first large prospective hospital-based study of acute stroke in 28 hospitals in Indonesia. Journal of Clinical Neuroscience. 2000;8(3):245-9.
11. Caplan LR. Caplan's Stroke A Clinical Approach. 4th ed. Philadelphia, PA: Saunders Elsevier; 2009
12. Kim BJ, Kim JS. Ischemic stroke subtype classification: an asian viewpoint. Journal of stroke. 2014;16(1):8-17.
13. Horie N, Tateishi Y, Morikawa M, Morofuji Y, Hayashi K, Izumo T, et al. Acute stroke with major intracranial vessel occlusion: Characteristics of cardioembolism and atherosclerosis-related in situ stenosis/occlusion. Journal of Clinical Neuroscience. 2016;32:24-9.
14. Arboix A, Alió J. Large vessel diseases stroke: clinical features, specific cardiac disorders and prognosis. Current cardiology reviews. 2010;6(3):150-61.
15. Glymour MM, Berkman LF, Ertel KA, Fay ME, Glass TA, Furie KL. Lesion Characteristics, NIH Stroke Scale, and Functional Recovery After Stroke. American Journal of Physical Medicine & Rehabilitation. 2007;86(9):725-33.
16. Chung JW, Park SH, Kim N, Kim WJ, Park JH, Ko Y, et al. Trial of ORG 10172 in Acute Stroke Treatment (TOAST) Classification and Vascular Territory of Ischemic Stroke Lesions Diagnosed by Diffusion□Weighted Imaging. 2014;3(4):e001119.
17. Heldner MR, Zubler C, Mattle HP, Schroth G, Weck A, Mono M-L, et al. National Institutes of Health Stroke Scale Score and Vessel Occlusion in 2152 Patients With Acute Ischemic Stroke. 2013;44(4):1153-7.

Author Information

Lisda Amalia
Department of Neurology, Medical Faculty, Universitas Padjadjaran/RSUP Hasan Sadikin
Bandung, Indonesia