Clinical Significance Alberta Stroke Program Early Computed Tomography Score (ASPECTS) And National Institute Of Health Stroke Score (NIHSS) On First Ever Acute Ischemic Stroke Patients

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Citation

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Abstract

Background The Alberta Stroke Program Early CT Score (ASPECTS) is used to quantify the extent of ischemic lesion in acute ischemic stroke on middle cerebral artery territory. Stroke severity is determined by the extent of ischemic lesion among other factors, which can be quantified using National Institute of Health Stroke Score (NIHSS). NIHSS is a subjective tool with many biases. Knowing the correlation between ASPECTS and NIHSS, clinician could use ASPECTS as secondary method for measuring the severity of acute ischemic stroke.

Objectives To find correlation between ASPECTS and NIHSS on acute ischemic stroke patients.

Method This was an analytic-descriptive cross-sectional study on first-onset ischemic stroke patient in Neurology Ward of Hasan Sadikin General Hospital admitted from October 2017 – February 2018. Ischemic stroke patients classified using the Trial of Org 10172 in Acute Stroke Treatment (TOAST) criteria. ASPECTS is calculated from CT-scan of patients with ischemic stroke involving middle cerebral artery and compared to NIHSS. Statistical significances were calculated with Spearman rank and Kruskal Wallis test with significance if p value < 0.001.

Results The total of the 46 subjects, consisting of 10 cases of stroke atherosclerosis of the large arteries (LAA), 22 cases of lacunar stroke, 13 cases of cardioembolic stroke and 1 another cause of stroke were included in this study. ASPECTS in this study (mean ± SD) was 7.54±2.11 and NIHSS in this study (mean ± SD) was 10.47±6.04. We found that cardioembolic stroke subtype had ASPECT score lower than another type of stroke (LAA, lacunar, and undetermined causes) and statistically significant (p<0.001) and had higher NIHSS than another type of stroke (p<0.001) Spearman's correlation test between ASPECTS and NIHSS show a strong correlation between ASPECTS and NIHSS (r=- 0.821,p < 0.001)

Conclusion There is a strong inverse correlation between ASPECTS and NIHSS score on acute ischemic stroke. The higher the value ASPECTS, it will be the lower value of the NIHSS and ASPECT score had correlation with stroke severity.

INTRODUCTION

Stroke is the third leading causes of mortality and severe disability worldwide. Ischemic stroke is responsible for around 80% of strokes. It occurs as the arteries narrow or become blocked, leading to severe reduction in the blood flow or ischemia. It is a medical emergency and timely management is crucial to minimize neuronal damage and potential complications.[1,2]

Imaging plays a key role in the management of acute ischemic stroke (AIS). Computed tomography (CT) is presently the imaging modality of choice for the evaluation of patients with AIS.[1-4] The Alberta Stroke Program Early CT Score (ASPECTS) is a simple and reproducible grading system developed to assess early ischemic changes in non-contrast computed tomography (NCCT),[1,5,6] and is currently used worldwide in the decision algorithm for thrombolysis and mechanical thrombectomy in anterior circulation of

AIS.[7]

The Alberta Stroke Program Early Computed Tomography (ASPECT) score is a 10-point scale that grades early ischemic changes within middle cerebral artery (MCA) territory seen on head CT in patients with acute ischemic stroke. ASPECT is reproducible clinical scale for rating early ischemic changes on CT that has demonstrated reliability between real-time and expert ratings.[7]

National Institute of Health Stroke Score (NIHSS) is a tool that can examine neurological deficit in patients with acute stroke. NIHSS can predict clinical outcome on stroke patients. Increasing 1 point of NIHSS can decrease about 28% of clinical outcome in patients with acute stroke, but we had problem to assess NIHSS in metabolic problem that can cause decrease level of conciousness.[6,7]

We hypothesize that ASPECT score had correlation with neurological deficit in patient with acute ischemic stroke compared with non-contrast head CT scan.

METHODS

This was a retrospective cross-sectional study from medical record of acute ischemic stroke patients which was confirmed by non-contrast brain computerized tomography (CT) less than 24 hours onset. We assessed the neurological deficit using the National Institute of Health Stroke Scale (NIHSS) on admission. Ischemic stroke classification was established using Trial of Org 10172 in Acute Stroke Treatment (TOAST) criteria. We classified acute ischemic stroke patients into two groups according to TOAST stroke classification: large vessel disease (large atherosclerosis and cardioembolic stroke) or LVD and small vessel disease (lacunar stroke) or SVD and undetermined stroke. We excluded patients with metabolic problem that could influenced consciousness, history of stroke, CT scan > 5 mm slices. ASPECT score was assessed by neuroradiologist. To determine statistical significances, Spearman rank and Kruskall Wallis test were performed. P value (p) below 0.001 is considered significant. R coefficient was calculated to establish the correlation.

RESULTS

A total of 46 patients were eligible in this study (figure 1). The mean age of our subjects (mean ± SD) 57.23±10.534 years. 41.3% were male and 58.7% were female. We collected data about stroke classification, onset, ASPECTS and NIHSS (table 1).

ASPECTS in this study (mean ± SD) was 7.54±2.11 and NIHSS in this study (mean ± SD) was 10.47±6.04 (table 1)

Figure 1

Recruitment process for eligible patients

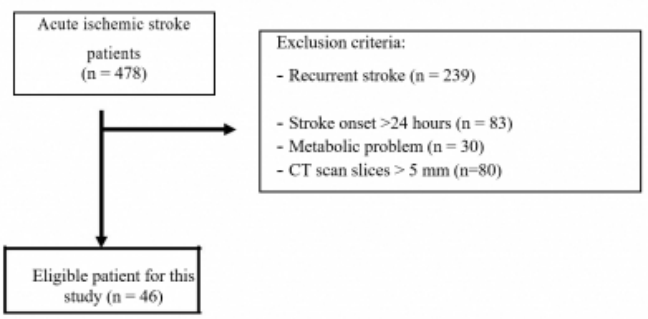

Table 1

Characteristic of stroke patients

Variable		N	%
Age (years)	Mean ± Std	57.23±10.53	
	Range	37-84	
Gender	Male	19	41.3%
	Female	27	58.7%
Stroke subtype	LAA	10	21.7%
	Lacunar	22	47.8%
	Cardioembolic	13	28.3%
	Undetermined	1	2.2%
Onset	*Early hyperacute* (<3 hours)	0	0
	hyperacute (3-6 hours)	10	21.7%
	Acute (6-24 hours)	36	78.3%
ASPECTS	Mean±Std	7.54±2.11	
	Score	0-10	
NIHSS	Mean±Std	10.47±6.04	
	Score	1-23	
NIHSS criteria	Mild deficit (0-4)	8	17.4%
	Moderate deficit (5-14)	24	52.2%
	Severe deficit (15-25	14	30.4%
	Very severe deficit (>25)	0	0

Note: LAA: Large Atherosclerosis Artery

ASPECTS score according stroke subtype

We found that cardioembolic stroke had a lower ASPECT score than another type of stroke (LAA, lacunar, and undetermined causes) and that this 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)	Nilai p
LAA	10	7.90±0.88	8(3-6)	
Lacunar	22	8.59±0.96	9(6-10)	0.001*
Cardioembolic	13	5.46±2.79	18(6-23)	
Undetermined	1	8	8	

Note : LAA : Large Atherosclerosis Artery

NIHSS score according stroke subtype

We found that cardioembolic stroke had a higher NIHSS score than another subtype of stroke (LAA, lacunar, and undetermined causes) and that this was statistically significant (p<0.001) using the Kruskal Wallis test. (table 3)

Table 3

NIHSS score according stroke subtype

Stroke subtype	n	ASPECTS		
		Mean	Median(min-max)	P value
LAA	10	10.60±3.83	10.50(6-16)	
Lacunar	22	6.68±3.86	6(1-18)	0,000*
Cardioembolic	13	16.85±5.44	18(6-23)	
Undetermined	1	10	10	

Note : LAA : Large Atherosclerosis Artery

Correlation ASPECT and NIHSS score

We found strong negative correlation between ASPECT and NIHSS score (r=-0.821, p<0.001). This study showed that correlation between ASPECT and NIHSS score was statistically significant (table 4).

Table 4

Correlation between ASPECT dan NIHSS score

Variable	Correlation	r	P value
ASPECTS dan NIHSS	Spearman	**-0.821**	**0.000****

Note: * statistically significant; r = coefficient correlation.

DISCUSSION

The subjects in this study had an average age of 57.23 ± 10.53 with an age of at least 37 years and a maximum age of 84 years. This is not in accordance with the epidemiology of stroke which states that strokes most often occur at the age of 75 years. This difference can be caused by age is one of the non-modifiable risk factors for recurrent stroke.[8,9] The majority of elderly subjects were excluded from this study because they had suffered strokes twice or more.

The study subjects consisted of 19 people (41.3%) men and 27 women (58.7%). This is not in accordance with the incidence of stroke which states that stroke is more common in men than women.[8] This difference can be caused by the method of sampling by consecutive sampling.

The most common types of ischemic strokes in this study were 22 stroke cases (47.8%) followed by cardioembolic stroke in 13 cases (28.3%), 10 cases of LAA stroke (21.7%), and causes of stroke. Another, in this case is hyperfibrinogenemia, in 1 case (2.2%). The distribution of stroke subtypes in this study is in accordance with the prevalence of ischemic stroke reported by Bum Joon Kim et al in his 2013 study, which states that lacunar stroke has a higher prevalence in Asian countries than other types of stroke.[11]

ASPECTS according stroke subtype

This study found that cardioembolic strokes had lower ASPECTS values (5.46 ± 2.79) than LAA strokes (7.90 ± 0.88), lacquers (8.59 ± 0.96) and strokes due to other causes (8). This is in accordance with a study conducted by Horie et al in 2016. The study stated that on MRI-DWI examination cardioembolic strokes had wider infarct lesions compared to LAA strokes and lacunar stroke.[12] Embolic originating from the heart tends to have a larger size than embolic originating from the cervico-cranial artery, so that the embolic can occlude the arteries in a more proximal location and cause wider ischemic lesions.[10,11,12]

The extent of ischemic lesions caused by lacunar strokes is usually less than 1.5 mm in size and tends to be in the territory of the transverse artery of the middle cerebral artery, the basal ganglia.[10,14] Ischemic lesions in stroke LAA is blocked by artery-to-artery embolic from ruptured fibrous plaque. The size of the embolic is smaller than the embolic of the heart so that the blockage that occurs in the distal arteries and the extent of the resulting ischemic lesions is smaller.[12]

NIHSS score according Stroke subtype

Cardioembolic stroke had a higher NIHSS average (16.85 ± 5.44) than LAA strokes (10.60 ± 3.83), lacunar (6.68 ± 3.86) and strokes due to other causes (10). The severity of an ischemic stroke is determined by the ischemic location and the extent of the ischemic lesions that occur, but it is also determined by the patient's metabolic condition during a stroke.[10,15] Glymour et al. mentioned in their study that stroke with ischemic lesions located in the subcortical region had a NIHSS value lower than strokes with ischemic lesions in the cortical region.[14] The results of this study are supported by Horie et al., who also mentioned cardioembolic strokes have a higher NIHSS value.[12] Blockages due to embolic usually occur in branching of arteries such as bifurcations from carotid internal arteries to cerebral arteries middle and anterior sebaceous arteries, or at the bifurcation of the middle cerebral artery. Emboli rarely cause blockages of the penetrating artery in the middle cerebral artery such as the

lenticulostriate artery because this artery is almost perpendicular to the source artery.10 Lacunar stroke has a location in the subcortical region (basal ganglia) and has lesions that are much smaller than cardioembolic or stroke strokes LAA.[14,15] The study by Heldner et al in 2013 stated that strokes with embolic blockages in the proximal region had a higher NIHSS value than strokes with distal blockages or strokes without blockages.[16] Proximal blockages occur in strokes caused by large embolic from the heart.

Correlation between ASPECT and NIHSS

The correlation coefficient between ASPECTS and NIHSS is -0.821 with a value of $p>0.001$ which means there is a strong negative correlation between ASPECTS and NIHSS in acute ischemic stroke. The conclusion of this statistical analysis is that the high ASPECTS score in acute ischemic stroke has a low NIHSS value, and vice versa. This is in accordance with the results of the Canadian Alteplase for Stroke Effectiveness Study (CASES) study in Canada by Hill et al., which states that subjects with ASPECTS 6-10 grades have a higher likelihood of independent living.[8]

Limitation of this 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 is a strong negative correlation between ASPECTS and NIHSS score on acute ischemic stroke. The higher the value ASPECTS, it will be the lower value of the NIHSS and ASPECT score had correlation with stroke severity.

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