

# Inter-Rater Reliability Of Alberta Stroke Program Early Computed Tomography Score (ASPECTS) In Acute Ischemic Stroke

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## Abstract

Computed-tomography scanning (CT-scan) is as a gold standard for diagnosing stroke and deciding for subsequent stroke management inspite had several difficulty to evaluate early ischemic changes. CT-scan assessment with ASPECTS has a similarity in interpretation among neurologists, radiologist and neuroradiologist. We hypothesize that there were good inter-rater reliability of ASPECT score between stroke neurologist and neuroradiologist. This study was an analytic-descriptive cross-sectional on first-time ischemic stroke patient in Neurology Department of Dr. Hasan Sadikin Central General Hospital from October 2017 – February 2018. Classification were done using the Trial of Org 10172 in Acute Stroke Treatment (TOAST) criteria. ASPECTS was calculated from CT-scan of patients by stroke neurologist and neuroradiologist. Cohen's kappa test were used to analyze inter-rater agreement from two experts. A total of the 46 subjects were enrolled, with 13 cases of cardioembolic stroke, 10 cases of large arteries (LAA) stroke, 22 cases of lacunar stroke, and 1 other stroke cause. Mean onset of stroke was  $13.6 \pm 7.1$  hours with 10 (21.7%) cases was hyperacute stroke and 36 (78.3%) was acute stroke. Mean score of ASPECTS was  $7.54 \pm 2.11$  and there was very good agreement between 2 experts assessment of ASPECT score (Cohen kappa=86.95%). There was a very good inter-rater reliability between stroke neurologist and neuroradiologist in assessing ASPECT score on acute ischemic stroke patients.

## INTRODUCTION

Computed-tomography scanning (CT-scan) is as a gold standard for diagnosing stroke, deciding for subsequent stroke management inspite had several difficulty to evaluate early ischemic changes. For the presence of early ischemic changes on CT brain of acute ischemic stroke patients, neurologists and neuroradiologists are still in the way of carefully evaluating at stroke centers. The CT-scan ability to predict risk of bleeding quickly allows thrombolysis treatment to be done in acute ischemic stroke (Glymour MM, et al. 2007; Hacke et al. 2004 ; Demaerschuk B et al. 2006), however, in assessing a hyperacute ischemic stroke setting (with onset less than 3 hours), 31-53% cases CT-scan can only find a hypodensity in the brain parenchym and we found normal CT-scan in another cases. (Hill, 2005; Horie et al, 2016). Risk of bleeding is exist in an extensive ischemic lesions after a thrombolysis procedure in acute ischemic stroke patients. (Glymour MM, et al. 2007; Hacke et al. 2004)

The Alberta Stroke Early Computed Tomography Score (ASPECTS) program was developed as a systematic, easy and reliable method to evaluate the severity of ischemic lesions on non contrast brain CT in the media cerebral arteries territory of acute ischemic stroke.(Puetz et al, 2009; Meschia J et al, 2014). CT-scan assessment in acute ischemic stroke using ASPECTS has good common interpretation among neurologists, radiologist and neuroradiologist. (Meschia J et al, 2014) and can help in determining ischemic stroke severity on the area on CT-scan images. Previous study concluded that ASPECT had strong correlation with National Institute of Health Stroke Scale (NIHSS) score. (Puetz et al, 2009 ; Amalia et al, 2020)

The Alberta Stroke Program Early CT Score (ASPECTS) is a simple and reproducible grading system developed to assess early ischemic changes in noncontrast computed tomography (NCCT). (Alfa 2010 ; Puetz et al 2009 ; Meschia J et al. 2014) and is currently used to prevent bleeding for thrombolysis treatment and mechanical

thrombectomy in anterior circulation territories acute ischemic stroke. (Mansour OY et al. 2015).

Alberta Stroke Program Early Computed Tomography (ASPECT) score is a 10 point scale that's grades early ischemic changes within middle cerebral artery (MCA) territory seen on brain CT. ASPECT has demonstrated reliability between real time and expert ratings, which means that this method is a reproducible clinical scale for rating early ischemic changes on CT.(Mansour OY et al. 2015).

We hypothesize that there were good agreement of ASPECT score between stroke neurologist and neuroradiologist .

**MATERIAL AND METHODS**

This was a cross sectional study that all anterior ischemic stroke patients from October 2017 until February 2018 which had perform expertised non contrast head CT scan by radiologist. We excluded ischemic stroke patients with underlying systemic disease that involved level of consciousness and recurrent stroke event.

Stroke classification using Trial of Org 10172 in Acute Stroke Treatment (TOAST) which are large artery atherosclerotic stroke (LAA), lacunar stroke, cardioembolic stroke, other demonstrated cause stroke, and undetermined cause stroke.

ASPECTS was calculated from non contrast head CT-scan of patients with ischemic stroke involving medial cerebral artery by stroke neurologist (LA) and neuroradiologist (FA) on admission. Statistics was calculated with Cohen's Kappa test using IBM SPSS Statistics for Windows, version 25.0 (IBM Corp., Armonk, N.Y., USA) with set criteria was : less than 0% no agreement, 0-20% poor agreement, 20-40% fair, 40-60% moderate, 60-80% good, >80% very good.

**RESULTS**

A total of the 46 subjects were enrolled, with 13 cases of cardioembolic stroke, 10 cases of large arteries (LAA) stroke, 22 cases of lacunar stroke, and 1 other stroke cause.. Mean onset of stroke was 13.6±7.1 hours with 10 (21.7%) cases was hyperacute stroke and 36 (78.3%) was acute stroke (table 1).

Mean score of ASPECTS was 7.54±2.11 and LAA and lacunar stroke subtype have higher ASPECT (table 2). There was very good agreement between 2 experts assessment of ASPECT score (Cohen kappa=86.95%). There was a very good inter-rater reliability between stroke neurologist and

neurologist in assessing ASPECT score on acute ischemic stroke patients (table 3).

**Table 1**  
Characteristic research subject

Variable	N	%	
Age (years)	Mean ± SD Range	57.2±10.5 37-84	
Gender	Male Female	19 27	41.3% 58.7%
Stroke subtype	LAA Lacunar Cardioembolic Others	10 22 13 1	21.7% 47.8% 28.3% 2.2%
Onset	Early hyperacute (<3 hours) hyperacute (3-6 hours) Acute (6-24 hours)	0 10 36	0 21.7% 78.3%
Risk Factor	Hypertension Dyslipidemia DM type 2 Artery disease AF CAD Valve disease Smoking Hypercoagulation	35 22 11 9 8 6 1 6 1	76.1% 47.8% 23.9% 19.6% 17.4% 13.0% 2.2% 13.0% 2.2%
ASPECTS	Mean±SD Range	7.5±2.1 0-10	

Note : SD = standard deviation; LAA = large artery atherosclerosis; DM = diabetes melitus; AF = atrial fibrillation; CAD = coronary artery disease.

**Table 2**  
ASPECTS score according Stroke Subtype

Stroke subtype	n	ASPECTS		P value
		Mean±SD	Median(min-max)	
LAA	10	7,9±0,8	8(3-6)	0,001*
Lacunar	22	8,5±0,9	9(6-10)	
Cardioembolic	13	5,4±2,7	6(0-9)	
Others	1	8	8	

Note : LAA = Large Artery Atherosclerosis; SD = standard deviation

**Table 3**  
ASPECT score Neurologist (FA) and ASPECT Stroke Neurologist (LA)

Variable	N=46
ASPECT FA	
Mean±Std	7.54±2.115
Median	8.00
Range (min-max)	0.00-10.00
ASPECT LA	
Mean±Std	7.32±2.357
Median	8.00
Range (min-max)	0.0-10.00

**DISCUSSION**

Imaging of the brain is a key in managing patient with acute

ischemic stroke (AIS) that occurs as a result of an obstruction within a blood vessel supplying blood to the brain and early treatment can reduce brain damage and prevent more complications after stroke event. For the evaluation of patients with AIS, computed tomography (CT) is the imaging modality of choice. (Alfa 2010; Hacke W, et al. 2004 ; Menon BK et al. 2011; Hill MD et al. 2005)

The Alberta Stroke Program Early CT Score (ASPECTS) is a simple, easy-to-do and reproducible grading system developed to assess early ischemic changes in noncontrast computed tomography (NCCT), (Alfa 2010 ; Puetz et al 2009 ; Meschia J et al. 2014) and is currently used worldwide in the decision algorithm to prevent bleeding in thrombolysis treatment and mechanical thrombectomy in anterior circulation acute ischemic stroke.

From our research, we found that LAA and lacunar stroke subtype have higher ASPECT. The ischemic stroke severity is determined by the ischemic location and the extent of the lesions, and also by the patient's metabolic condition. (Misbach J, Ali W. 2000; Glymour MM, et al. 2007)

Glymour et al. showed that stroke with ischemic lesions located in the subcortical region had a NIHSS value lower than strokes with cortical lesion. (Arboix A, Alió J. 2010) This is supported by Horie et al., who mentioned higher NIHSS following a cardioembolic strokes (Kim BJ, Kim JS. 2014). An emboli blockage usually occur in branching of arteries such as bifurcations from carotid internal to cerebral media and anterior arteries. The lenticulostriate artery is almost perpendicular in a way to the source artery, emboli rarely clogs because this artery is the penetrating artery in the media cerebral artery (Kim BJ, Kim JS. 2014). Lacunar stroke located in the subcortical region (basal ganglia) and the lesions are much smaller than cardioembolic or LAA. (Arboix A, Alió J. 2010; Glymour MM, et al. 2007). The study by Heldner et al in 2013 showed a higher NIHSS stated in a strokes with embolic blockages in the proximal region than strokes with distal blockages or without blockages caused by large emboli which comes from the heart. (Arboix A, Alió J. 2010).

Most neurologists treating acute stroke still depend mostheavily on noncontrast brain CT because it is more readily available than MRI. Computed tomography methods for estimating the middle cerebral artery territories involved have been developed and The ASPECTS Study Group reported a kappa statistic for ASPECTS from 5 stroke

neurologists had a good agreement (Cohen's kappa 69%) (Demaerschuk B et al, 2006). The inter-rater reliability of ASPECTS from 2 experts have a very good agreement with Cohen's Kappa 86.95% in this study. The conclusion of this statistical analysis, there was a very good inter-rater reliability between stroke neurologist and neuroradiologist in assessing ASPECT score on acute ischemic stroke patients. This is in agreement with the results of study by Puetz et al., which states that CT-scan assessment using ASPECTS has good inter-rater reliability among neurologists, radiologist and neuroradiology specialist. (Hill MD, Buchan AM. 2005; Mansor et al 2015)

As a study limitation, CT perfusion or Magnetic Resonance Imaging Diffusion Weighted Imaging to compare infarct volume from infarct core were not done due to policy. According this study, we hope that ASPECT can be used by more neurologist to predict infarct core on acute ischemic stroke patient whenever CT perfusion or Magnetic Resonance Imaging Difusion Weighted Imaging are not available especially for thrombolysis treatment to prevent bleeding.

## CONCLUSION

There was a very good inter-rater reliability between stroke neurologist and neuroradiologist in assessing ASPECT score on acute ischemic stroke patients. ASPECT is a reproducible clinical scale for rating an early ischemic changes on CT that has demonstrated reliability between real time and expert ratings.

## References

- Alfa AY. 2010. 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 : p. 67-84.
- Arboix A, Alió J. 2010. Cardioembolic stroke: clinical features, specific cardiac disorders and prognosis. *Current cardiology reviews* 6(3):150-61.
- Demaerschuk B, Silver B, Wang E, Merino JG, Tamayo A, Hachinski V. 2006. ASPECT scoring to Estimate Middle Cerebral Artery Territory Infarction. *Can J Neurosci.*33:200-204.
- Glymour MM, Berkman LF, Ertel KA, Fay ME, Glass TA, Furie KL. 2007. Lesion Characteristics, NIH Stroke Scale, and Functional Recovery After Stroke. *American Journal of Physical Medicine & Rehabilitation* 86(9):725-33.
- Hacke W, Donnan G, Fieschi C, Kaste M, von Kummer R, Broderick JP, et al. 2004. Association of outcome with early stroke treatment: pooled analysis of ATLANTIS, ECASS, and NINDS rt-PA stroke trials. *Lancet (London, England)* 363(9411):768-74.
- Hill MD, Buchan AM. 2005. Thrombolysis for acute ischemic stroke: results of the Canadian Alteplase for Stroke Effectiveness Study. *Canadian Medical Association Journal*

172(10):1307-12.

Horie N, Tateishi Y, Morikawa M, Morofuji Y, Hayashi K, Izumo T, et al. 2016. Acute stroke with major intracranial vessel occlusion: Characteristics of cardioembolism and atherosclerosis-related in situ stenosis/occlusion. *Journal of Clinical Neuroscience* 32:24-9.

Kim BJ, Kim JS. 2014. Ischemic stroke subtype classification: an asian viewpoint. *Journal of stroke* 16(1):8-17.

L Amalia, I Parwati, A Rizal, R Panigoro. Correlation Between Alberta Stroke Program Early Computed Tomography Score (ASPECTS) and National Institute of Health Stroke Score (NIHSS) in Ischemic Stroke. *Sains Malaysiana* 2020.vol 49 (5),p 1115-1120.

Mansour OY, Megahed MM, Abd Elghany EHS. 2015. Acute ischemic stroke prognostication, comparison between Glasgow Coma Score, NIHSS Scale and Full Outline of UnResponsiveness Score in intensive care unit. *Alexandria*

*Journal of Medicine* 51(3):247-53.

Menon BK, Puetz V, Kochar P, Demchuk AM. 2011. ASPECTS and Other Neuroimaging Scores in the Triage and Prediction of Outcome in Acute Stroke Patients.

*Neuroimaging Clinics of North America* 21(2):407-23.

Meschia JF, Bushnell C, Boden-Albala B, Braun LT, Bravata DM, Chaturvedi S, et al. 2014. Guidelines for the Primary Prevention of Stroke. A Statement for Healthcare Professionals From the American Heart

Association/American Stroke Association 45(12):3754-832.

Misbach J, Ali W. 2000. Stroke in Indonesia: A first large prospective hospital-based study of acute stroke in 28 hospitals in Indonesia. *Journal of Clinical Neuroscience* 8(3):245-9.

Puetz V, Dzialowski I, Hill MD, Demchuk AM. 2009. The Alberta Stroke Program Early CT Score in Clinical Practice: What have We Learned? *International Journal of Stroke* (5):354-64.

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