Analysis of the Correlation between the Alberta Stroke Program Early CT Score (Aspects) and The Clinical Degree of Acute Ischemic Stroke Patients

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Abstract. Ischemic stroke caused by middle cerebral artery occlusion is a clinical syndrome that often occurs due to the larger diameter of the middle cerebral artery and more cerebral blood flow. The clinical degree of ischemic stroke patients is influenced by the extent and location of the lesion. Alberta Stroke Program Early CT Score (ASPECTS) is a semi-quantitative calculation system to assess the extent and distribution of ischemic stroke images of the middle cerebral artery territory by CT scan. A quantitative study using cross-sectional design. The sample was from the medical record of ischemic stroke patients in the middle cerebral artery from June to August 2022 at Wahidin Sudirohusodo Hospital with a total of 32 patients. This study used the ASPECTS tool to determine the extent of ischemic lesions, while using the National Institute of Health Stroke Scale (NIHSS) scores to determine the clinical degree. An analysis of the correlation between ASPECTS and NIHSS was performed using the chi square test. There were 22 patients with better ASPECTS and 10 patients with worse ASPECTS. The highest NIHSS scores were for patients with moderate clinical degrees, then severe and mild. All patients with worse ASPECTS had severe NIHSS values, whereas most patients with better ASPECTS had moderate NIHSS values followed by mild. There is a significant correlation between ASPECTS and the clinical grade of ischemic stroke patients. The size and location of ischemic lesions can affect the clinical grade of ischemic stroke patients. ASPECTS is revealed to be applicable to determine the prognosis of the clinical grade of ischemic stroke patients.

Keywords: ischemic stroke, ASPECTS, clinical degree.

1 Introduction

The prevalence of stroke in the United States reached 87%, while in Indonesia it ranks first among non-communicable diseases that cause disability, where the majority of strokes are ischemic strokes. Ischemic stroke which cause by the middle cerebral artery (MCA) occlusion is a clinical syndrome that most often occurs because the middle cerebral artery has a larger diameter and receives a lot of cerebral blood flow

and therefore blood flow from extracranial blood vessels tends to enter the middle cerebral artery [1]. Clinical outcomes in the form of physiological changes, neurological deficits and recovery of brain function to improve patient's quality of life are important in assessing stroke patients. The National Institutes of Health Stroke Scale (NIHSS) is an instrument that measures the level of neurological deficits associated with acute stroke and has been widely used both in clinical and research settings [2].

Inflammation and immune responses are an important part of the pathophysiology of stroke and play a role in the extent of brain tissue damage. The extent of brain damage depends on the speed and duration of the lack of perfusion, the location and ability of collateral blood vessels to adequately perfuse the brain tissue at risk and the resistance of the brain structure to ischemic events. Assessment using a CT scan imaging of lesions resulting from ischemic stroke can identify the location and extent of the lesion. Alberta Stroke Program Early CT Score (ASPECTS) is a semiquantitative calculation system to assess the extent and distribution of acute ischemic stroke images in the middle cerebral artery territory as assessed by non-contrast CT scan. This study aims to analyze the correlation between ASPECT and the clinical degree of middle cerebral artery ischemic stroke patients [2-3].

2   Methods

This is a quantitative study using a cross-sectional analytical research design to analyze the correlation between the Alberta Stroke Program Early CT Score (ASPECTS) and the clinical degree of middle cerebral artery ischemic stroke patients. The sample we used are medical records of acute ischemic stroke patients in the middle cerebral artery region with symptom onset 1 to 3 days and received treatment from June to August 2022 at the Wahidin Sudirohusodo Hospital and other network hospitals, totaling 32 people. This study used ASPECT tool, which is assessed by the head CT Scan results when the patient is admitted to the hospital, to determine the extent of the ischemic lesion with an interpretation score of 8-10 which is included in better ASPECTS and a score of 0-7 which is included in worse ASPECTS. The patient's clinical degree is assessed when the patient is admitted to the hospital in onset symptoms day 1 to 3 using the National Institute of Health Stroke Scale (NIHSS), interpretations of 0-5 (mild clinical degree), 6-13 (moderate clinical degree) and ≥14 (severe clinical degree). An analysis of the correlation between ASPECTS and NIHSS was carried out using the chi-square test [3-4].

3   Results

This study was conducted on ischemic stroke patients with middle cerebral artery occlusion at Wahidin Sudirohusodo Hospital and other network hospitals from June - August 2022 with a total of 32 subjects. Data taken from medical records include gender, age and NIHSS score. ASPECT data is processed from the results of a non-contrast head CT scan. The subjects' characteristics are shown in Table 1.

3.1 Subject Characteristics

Table 1. Subject characteristics based on gender, NIHSS and ASPECTS score

		n	**%**
Gender	Male	16	50.0
	Female	16	50.0
NIHSS	Mild	6	18.8
	Moderate	16	50.0
	Severe	10	31.3
ASPECTS	Worse	10	31.3
	Better	22	68.8
Total		32	100.0

Based on Table 1, it can be seen that the number of male and female of middle cerebral artery ischemic stroke patients were 16 people, respectively. The highest category of NIHSS score in middle cerebral artery ischemic stroke patients was moderate degree, with 16 people, followed by severe degree, 10 people and mild degree, 6 people. There were 22 more middle cerebral artery ischemic stroke patients who had better ASPECTS than 10 people with worse ASPECTS.

3.2 Age, NIHSS and ASPECT Score Distribution

Table 2. Average age, NIHSS and ASPECTS score

	Mean	**SD**	**Median**	**Minimum**	**Maximum**
Age	57.78	9.81	58.00	34.00	75.00
NIHSS	10.00	4.81	9.00	2.00	18.00
ASPECTS	7.81	0.90	8.00	6.00	9.00

Based on Table 2, the average age of subjects who suffered middle cerebral artery ischemic stroke was 57.78 years old with the oldest patient's age in 75 years old and the youngest patient's age in 34 years old. The average NIHSS score is 10 (moderate degree) while the highest NIHSS score was 18 and the lowest NIHSS score was 2. The average ASPECT score was 7.81 (better ASPECTS) while the highest ASPECT score was 9 and the lowest was 6.

3.3 The Correlation between ASPECTS and Clinical Degree

Table 3. Cross-tabulation of ASPECTS and NIHSS in ischemic stroke patients with media cerebral artery occlusion

ASPECTS		NIHSS Mild	Moderate	Severe	Total	p value
Worse	n	0	0	10	10	
	%	0.0%	0.0%	100.0%	100.0%	
Better	n	6	16	0	22	0.000
	%	27.3%	72.7%	0.0%	100.0%	
Total	n	6	16	10	32	
	%	18.8%	50.0%	31.3%	100.0%	

Based on table 3, all ischemic stroke patients with middle cerebral artery occlusion who had worse ASPECTS also had a severe NIHSS score (100%). In patients with better ASPECTS (72.7%) there were 16 patients who had a moderate degree of NIHSS score, 6 people (27.3%) who had a mild degree, and none had a severe degree. These results were calculated using a chi-square test, the p value was 0.000 (<0.005). This means that there was a significant correlation between ASPECTS and the clinical degree of ischemic stroke patients with middle cerebral artery occlusion.

4   Discussion

This study aims to analyze the correlation of ASPECTS and the clinical degree of ischemic stroke patients with middle cerebral artery occlusion. The diagnosis of middle cerebral artery occlusion ischemic stroke was established based on a non-contrast head CT scan obtained when the patient was admitted to the hospital at the onset of symptoms 1 to 3 days. Author determined ASPECTS by taking the results of head CT scans from the radiologist. For imaging results that do not yet display an ASPECT score, author carried out an assessment to determine the ASPECT score. Data on the clinical degree of ischemic stroke patients was taken from medical records, where every patient who suffered a stroke when admitted to the hospital was assessed using the NIHSS score.

4.1 Alberta Stroke Program Early CT Score (ASPECTS)
According to the results, it showed that there were 22 subjects with middle cerebral artery ischemic stroke who had better ASPECTS, and only 10 people had worse ASPECTS. ASPECTS is a simple semiquantitative counting system to assess the extent and distribution of acute ischemic stroke images in the anterior circulation, which was the middle cerebral artery territory, as assessed by non-contrast CT scan. ASPECTS is stated to be applicable to determine the prognosis and type of therapeutic approach for acute ischemic stroke patients using both CT-Scan and MRI imaging. In the ASPECTS scoring system, the middle cerebral artery territory is divided into 10 sections, each section has a value of 1 point. Those 10 parts consist of 3 subcortical structures and 7 cortical structures. The total ASPECTS score is 10 points (normal), if an infarction was

found in 1 structure, reduce the ASPECTS score by 1 and so on. Patients with an ASPECTS score of 8-10 have better clinical outcomes than patients with a score of ≤ 7. The structures assessed on ASPECTS can be seen in Figure 1 [5].
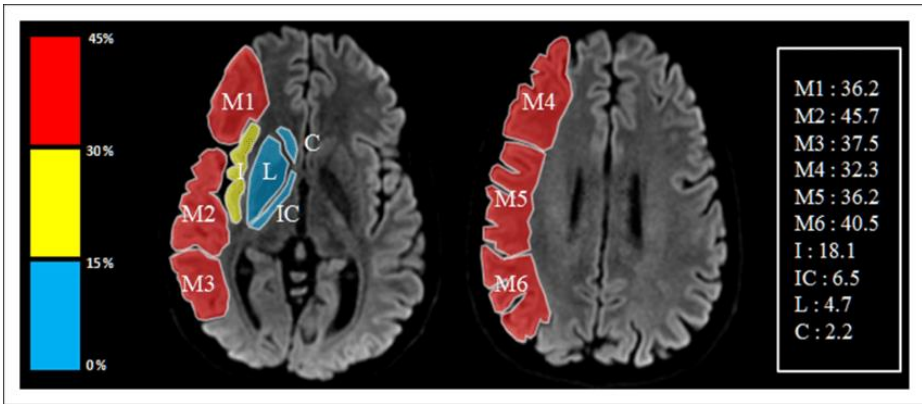
Figure 1. ASPECTS Score, Caudate Nucleus (C), Lentiform Nucleus (L), Internal capsule (CI), Insular ribbon (I), anterior MCA cortex (M1), lateral MCA cortex of the insular ribbon (M2), posterior MCA cortex (M3), anterior MCA cortex, superior to M1, rostral to basal ganglia (M4), lateral MCA cortex, superior to M2, rostral to basal ganglia (M5) and posterior MCA cortex, superior to M3, rostral to basal ganglia (M6) [6].

In its development, apart from using CT scan, ASPECTS can also be assessed using Magnetic Resonance Imaging (MRI), CT Angiography and CT Perfusion. Study conducted by Finlayson O et al., 2012 showed that the three modalities used, non-contrast CT, CT Angiography and CT Perfusion demonstrated equally good results with good internal consistency in assessing ASPECTS. The American Heart Association (AHA)/American Stroke Association (ASA) in 2018 still recommends using non-contrast CT as an ASPECT assessment because of its efficiency, availability, and affordability. ASPECTS is stated to be applicable to determine the prognosis and type of therapeutic approach for acute ischemic stroke patients using both CT scan and MRI imaging. Demaerschalk BM et al., 2006 revealed that ischemic involvement in an estimate of more than 1/3 of the MCA showed an ASPECT score <7 with a sensitivity of 94% and a specificity of 98% [7].

4.2 Clinical Degree
Based on this study, the highest NIHSS score for middle cerebral artery ischemic stroke patients was in moderate clinical degree, with 16 people, then 10 severe clinical degree, and 6 mild clinical degree. Ischemic stroke caused by middle cerebral artery occlusion is the most frequent clinical syndrome because the it has a larger diameter and receives a lot of cerebral blood flow and therefore blood flow from extracranial blood vessels or the heart tends to enter the middle cerebral artery. The clinical manifestations that appear depend on the location of the affected middle cerebral artery. The extent of brain damage depends on the speed and duration of the lack of perfusion,

the location and ability of collateral blood vessels to adequately perfuse the brain tissue at risk and the resistance of the brain structure to ischemic events. Larger lesions cause more severe deficits than small lesions in the same anatomic area [8].

The NIHSS is an instrument that measures the level of neurological deficits associated with acute stroke and has been widely used both in clinical and research settings. The NIHSS assessment is carried out at patient admission by providing scores on various neurological aspects of the patient. The NIHSS assessment includes an assessment of language, motor, sensory, consciousness, visual field, extraocular movements, coordination, neglect and speech functions. The NIHSS has good reliability and validity including its use prospectively and retrospectively. Baseline NIHSS scores correlate with early and long-term clinical outcomes, response to therapy, neurological worsening, and mortality [7].

4.3 The Correlation between ASPECTS and Clinical Degree

According to this study, all ischemic stroke patients with middle cerebral artery occlusion that had worse ASPECTS also had a severe NIHSS score (100%). There were 16 patients with better ASPECTS (72.7%) who had a moderate degree of NIHSS score, 6 people (27.3%) had a mild degree, and none had a severe degree. These results were calculated using a chi-square test, the p value was 0.000 (<0.005). This means that there was a significant correlation between ASPECTS and the clinical degree of ischemic stroke patients with middle cerebral artery occlusion [9-10].

The maximum ASPECTS score is 10 points, while the minimum score is 0 points. An ASPECTS score < 7, indicates that the ischemic area of the middle cerebral artery is reaching more than 1/3 of the Middle Cerebral Artery (MCA). The size and location of the ischemic lesion are anatomically related to the patient's clinical degree. Larger lesions cause more severe deficits than small lesions in the same anatomic area. ASPECTS shows the extent of ischemic lesions in the middle cerebral artery territory, and has been used as a basis for determining the prognosis of ischemic stroke patients. ASPECTS is revealed to be applicable to determine the prognosis and type of therapeutic approach for acute ischemic stroke patients through non-contrast CT scan imaging. This is in accordance as Esmail A et al., 2021 proposing that ASPECTS is a measurement scale that has reliability for identifying the extent of acute ischemic lesions and can play a role in assessing the clinical outcomes of ischemic stroke patients [9, 11].

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