Role of Alberta Stroke Program Early CT-scan (ASPECT) Score On Acute Ischemic Stroke

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Citation

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Abstract

The Alberta Stroke Early Computed Tomography Score (ASPECTS) program was developed as a systematic, easy-to-do and reliable method of assessing the extent of ischemic lesions on CT scans without contrast in patients with acute ischemic stroke in the media cerebral arteries. ASPECTS is calculated by looking at the number and extent of ischemic lesions found in the cerebral artery vascular territories, namely the basal ganglia and most brain hemispheres. CT-scan assessment using this ASPECTS has good interpretation in common among neurologists, radiology trainees and neuroradiology specialist. ASPECTS can be used to determine the severity of stroke indirectly based on the area of ischemic lesions found on CT-scan images.

INTRODUCTION

Computed-tomography scanning (CT-scan) is one of the brain imaging modalities for establishing a diagnosis of ischemic stroke and bleeding stroke, so that it can be a reference for subsequent stroke management. CT scans are easy to do and can be found all over Indonesia, making CT scans as a mainstay diagnostic tool in diagnosing a stroke. The ability of CT-scan to get rid of bleeding lesions quickly allows thrombolysis to be done in acute ischemic stroke[3,4], but in diagnosing a hyperacute ischemic stroke (stroke with onset of less than 3 hours), CT-scan can only find hypodensity in the brain parenchyma in 31-53% of cases.[5,6] The extent of ischemic lesions is important to know because extensive ischemic lesions are at risk of bleeding after thrombolysis.[3,4]

The Alberta Stroke Early Computed Tomography Score (ASPECTS) program was developed as a systematic, easy-to-do and reliable method of assessing the extent of ischemic lesions on CT scans without contrast in patients with acute ischemic stroke in the media cerebral arteries. ASPECTS is calculated by looking at the number and extent of ischemic lesions found in the cerebral artery vascular territories, namely the basal ganglia and most brain hemispheres.[5,7,8] CT-scan assessment using this ASPECTS has good interpretation in common among neurologists, radiology trainees and neuroradiology specialist.[9]

ASPECTS can be used to determine the severity of stroke indirectly based on the area of ischemic lesions found on CT-scan images.[7]

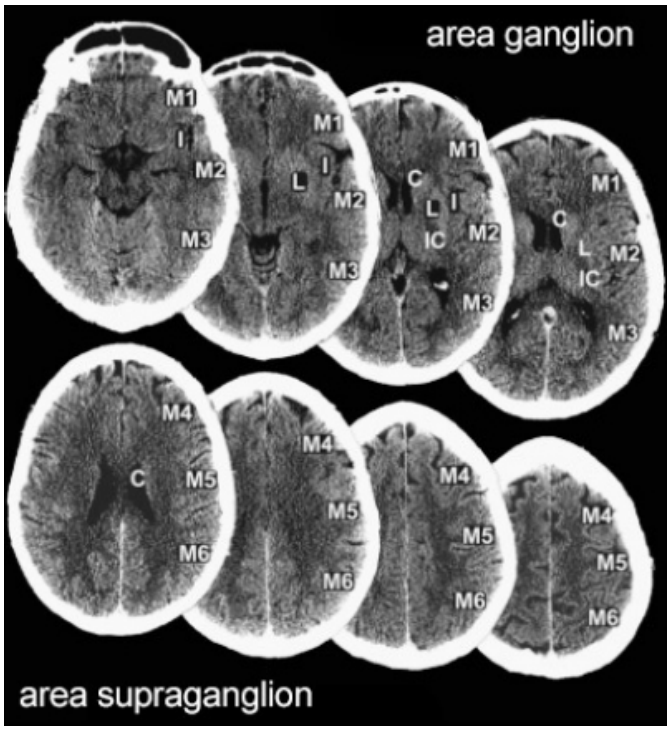
ALBERTA STROKE EARLY CT-SCAN PROGRAM (ASPECTS)

Barber et al proposed the Alberta Stroke Early CT-scan Program (ASPECT) in 2000 as a method to replace the rules of one-third of the MCA area for assessing early ischemic changes. ASPECTS is a simple, reliable and systematic method for assessing ischemic initial changes in CT-scan images without contrast. ASPECTS is devoted to assessing the area of ischemic lesions in the area of the media cerebral artery.[7,34,38]

ASPECT scores consist of 10 points, each of which represents the anatomical area of the brain. 4 points for subcortical structures, namely caudate nucleus (C), lentiform (L,) internal capsule (IC), and insular ribbon (I), and 6 points for cortical structure in the territory of the media cerebral artery. Cortical points (M1-M6) are divided into 2 areas, namely the ganglion area and the supraganglion area. The boundary of these two areas is the head of the caudate nucleus. All ischemic lesions that are as high or below the head of the caudate nucleus are counted as ganglion areas, and above the head of the caudate nucleus are counted as supraganglion areas (Figure 1) .[7,13,34,38]

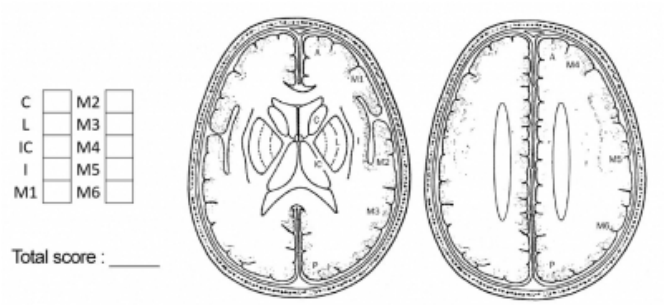
The initial ischemic change to ASPECTS is defined as follows:
(1). Parenchymal hypodensity, which is the loss of a firm boundary between the cortex and subcortex or lower brain parenchymal density relative to the same structure in the contralateral hemisphere,
(2). Focal swelling without parenchymal hypodensity on CT-scan images without contrast is not calculated in ASPECTS.[9,38]

Figure 1



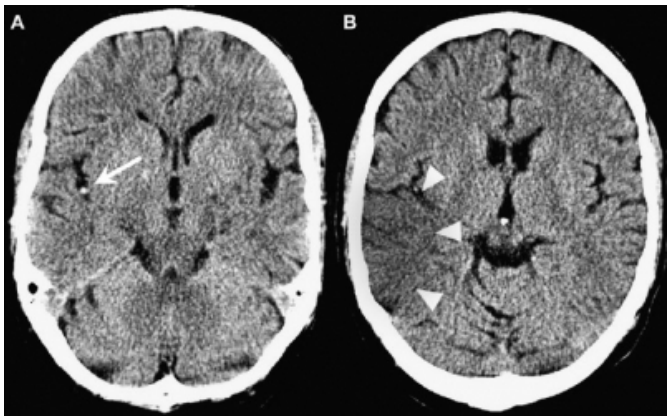
ASPECTS is calculated by subtracting one point from a total of 10 initial points if evidence of initial ischemic change is found. A score of 10 on the ASPECT represents a normal CT-scan result marked by a picture of an intact brain parenchyma in the area of vascularity of the cerebral artery media, and a score of 0 depicts global ischemia in all areas of the media of cerebral arteries. To be able to see all areas of ASPECTS, axial pieces of the entire brain are needed with a thickness of 4-5 mm, and the initial ischemic sign changes must be seen on 2 sequential CT-scan pieces to ensure that the lesions are ischemic lesions, not artifacts. Accuracy is needed in comparing the right and left hemispheres, especially if the patient is not well positioned when a CT scan is performed. Tilted head, motion artifacts and bone artifacts are common causes of false-negative assessment in ASPECTS. The ASPECTS assessment form as shown in Figure 2.[8,34,38]

Figure 2



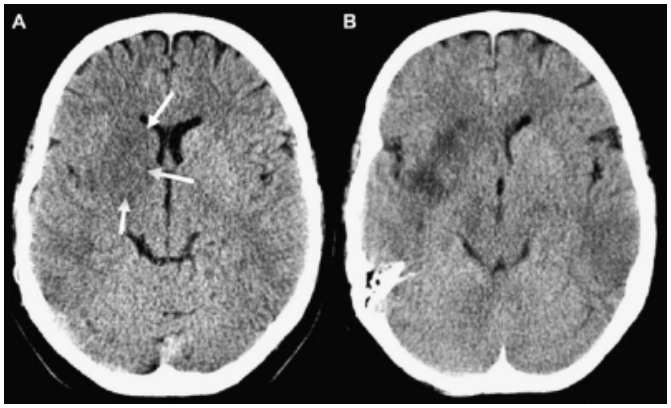
Two cases for example the use of ASPECTS in ischemic stroke patients with blockages in the M1 and M2 segments are as follows:
(1). Figure 3A shows hypodensity in the cerebral artery branch of the "dot sign" media in the right Sylvii fissure (white arrow). Figure 3B shows the parenchymal hypodensity in the ASPECTS M2 and M3 (white triangle) territories so that the ASPECTS value on this CT scan is 8.[34]

Figure 3



(2) The second example is the case of a 44-year-old woman with complaints of left hemiparesis. Head CT scan without initial contrast shows hypodensity in the right lentiform nucleus and right caudate nucleus, internal capsule and insula (ASPECTS L, C, CI and I territories), so the ASPECTS value in this patient is 6 (Figure 4A). Figure 4B is a follow-up CT scan of the same patient, and shows an ischemic lesion in the same place.

Figure 4



The advantage of ASPECTS over its predecessor method, the one-third rule, is that ASPECTS has better inter-observer similarities between experienced neurologists, radiologists and neuroradiologists. The use of ASPECTS is only limited to ischemic strokes that occur in the area of the media cerebral arteries, but even so, ischemic strokes are twice as common in the area of the media as other cerebral arteries.[9,38,39]

THE ROLE OF ASPECTS IN ACUTE ISCHEMIC STROKE

1. ASPECTS helps in making clinical decisions

The results of the National Institute of Neurological Disorders and Stroke (NINDS) rT-PA Stroke Study mention that CT-scan imaging is used as a screening tool to rule out intracranial hemorrhage before administration of recombinant tissue plasminogen activator (rt-PA) and in that study the extent of initial ischemic change does not affect patient eligibility.[3,40]

The European Cooperative Acute Stroke Study (ECASS-1) is the first to emphasize the importance of assessing early ischemic changes in the CT picture of acute ischemic stroke as an external predictor of intravenous thrombolysis therapy, where extensive ischemic lesions have a high risk for post-therapy bleeding. thrombolysis. The ECASS study at that time introduced a one-third rule, as a crude screening tool prior to thrombolysis therapy. One-third rule states that patients with ischemic lesions that cover more than one-third of the area of cerebral artery media are at high risk of bleeding after thrombolysis therapy. The use of this one-third rule of MCA area proved difficult to apply even by experienced neurologists or radiologists and had a similar perception among poor observers, and therefore a systematic method of assessing the extent of initial ischemic change in acute stroke is needed.[7,8,34,38]

a.The ability of ASPECTS to predict patient responses to intravenous thrombolysis therapy using recombinant tissue plasminogen activator (rt-PA) was investigated by Demchuk et al in 2005, by applying ASPECTS to the initial CT scan of the NINDS rtPA Stroke Study subject. Demchuk et al mentioned that patients with high ASPECTS (8-10) had greater benefits from thrombolysis therapy (19.5% risk benefit and number-needed-to-treat (NNT) = 5) and also had a lower risk of mortality. Patients with an ASPECT score of 3-7 will also benefit from thrombolysis therapy (13.3% risk benefit and NNT = 8) and also with a low risk of mortality. Only patients with ASPECTS 0-2 did not benefit from thrombolysis therapy, but only 2.6% of the NINDS rtPA Stroke Study subjects had ASPECT 0-2 so that this group had limited clinical relevance. The ability of ASPECTS to predict post-thrombolysis outcomes has a sensitivity of 78% and specificity of 96%.[38,41]

b.ASPECTS can also predict the incidence of bleeding after thrombolysis therapy. The original study from ASPECTS found a 14-fold increased risk of bleeding in subjects with ASPECTS <7 compared to subjects with ASPECTS> 7, with a sensitivity of 90% and specificity of 62%. A second study by the NINDS-stroke trial found that patients with ASPECTS> 7 and 3-7 had almost the same risk of post-thrombolysis bleeding, 4.5% and 5%. Patients with extensive infarction (ASPECTS 0-2) have an increased risk of bleeding up to 20% .[7,34]

c.The role of ASPECTS in determining clinical decisions varies based on the time of stroke onset. ASPECTS is not used as a filter in the administration of intravenous thrombolysis therapy in patients with onset of stroke infarction under 3 hours, but patients with ASPECT 0-3 may not benefit from thrombolysis therapy and have a high risk of post-thrombolysis bleeding. Patients with ASPECTS 0-3 are likely to get worse due to extensive cerebral infarction so that they can be used as a basis for offering early hemicraniectomy.[7,34,38]

2.ASPECTS as Predictors of Ischemic Stroke Clinical Outcomes

ASPECTS can be used to predict the prognosis of a stroke infarction, and this has been proven in the Canadian Alteplase for Stroke Effectiveness Study (CASES) in Canada with 936 stroke patients. The CASES study states that ASPECTS on the initial CT scan is a good predictor of functional outcomes from stroke infarction, whereas low

ASPECTS indicates a low likelihood of patients to have good functional outcomes. Further analysis shows that with ASPECTS 6-10, around 50% of patients can live functionally independent, and patients with ASPECTS 0-3, the probability of independent living is very low.4,38

ASPECTS can also be applied to predict the prognosis of intra-arterial thrombolysis therapy using pro-urokinase. Hill et al. Re-evaluated CT scans of the study subjects Prourokinase Acute Cerebral Infarct Tial-II (PROACT-II) and mentioned that patients who received intra-arterial thrombolysis therapy who had ASPECTS> 7 had better clinical outcomes compared to patients with ASPECT <7.38,42

The onset of stroke infarction does not affect the reliability of ASPECTS as has been investigated by Huisa et al in 2010, which compared the ability of ASPECT to predict outcome of stroke infarction based on modified Rankin Scale (mRS) in patients with stroke onset under 4 hours and unknown stroke onset, with the example of a patient who is known to have a stroke when he wakes up. Huisa said that there were no significant differences from ASPECTS in the two groups when correlated with mRS. The application of ASPECTS in patients with onset of stroke for more than 6 hours has also been investigated by Goyal et al in 2011, showing that stroke patients with ASPECTS> 7 have good outcomes, although thrombectomy is done at 6 hours more than stroke onset.43,44

CONCLUSION

ASPECTS is a simple, reliable and systematic method for assessing ischemic initial changes in CT-scan images without contrast. ASPECTS is devoted to assessing the extent of ischemic lesions in the area of the cerebral artery media. ASPECTS on the initial CT scan is a good predictor of functional outcome from stroke infarction, where a low ASPECTS indicates a low likelihood of patients to have good functional outcomes.

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