

Research Article

Relevance of Non-Contrast Computed Tomography (NCCT) Based Alberta Stroke Program Early CT Score (ASPECTS) in Predicting Severity of Acute Ischemic Stroke at Presentation and Its Functional and Cognitive Outcome at 90 Days

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Abstract

Introduction: ASPECTS is a NCCT based topographic scoring system that provides quantitative measure of early ischemic changes. The score was initially developed for evaluating candidacy for stroke thrombolysis but currently also predicts functional and cognitive outcomes of stroke.

Methods: 35 patients with acute ischemic stroke presenting within 48 hours of onset were included in the study. NIHSS score was ascertained at presentation and ASPECTS score was calculated (less than 6 and 6 or greater). On presentation NIHSS score and length of hospital stay were considered to be markers of early severity and mRS and MOCA scores were assessed at 90 days. Patients with MoCA less than 26 were considered to be having post stroke cognitive impairment.

Results: Correlation between ASPECTS and NIHSS, stay length, 90-day mRS and MoCA were -0.452, -0.632, -0.778, 0.618 respectively. ASPECTS of less than 6 by univariate analysis was seen to be a risk factor for more severe strokes in acute setting with greater morbidity and cognitive decline at 90 days. Cardioembolic strokes also tended to have greater post stroke cognitive decline.

Discussion: Poorer ASPECTS score at admission had greater stroke severity in acute phase and has worse long-term outcomes both in terms of functional and cognitive impairment and a cut off of less than 6 can be considered for the same.

Conclusion: ASPECTS score is a surrogate marker of early and long-term stroke severity and its impacts.

Keywords: ASPECTS; 90-day outcome; Cognition

Abbreviations: ACA: Anterior Cerebral Artery; CT: Computed Tomography; DALY: Daily Adjusted Life Years; ICH: Intracerebral Hemorrhage; MCA: Middle Cerebral Artery; MOCA: Montreal Cognitive Assessment; MRI: Magnetic Resonance Imaging; MRS: Modified Rankin Scale; NCCT: Non Contrast Computed Tomography; NIHSS: National Institute of Health Stroke Severity Score; NINDS: National Institute Neurological Disorders and Stroke; PCA: Posterior Cerebral Artery; PSCI: Post Stroke Cognitive Impairment; SAH: Subarachnoid Hemorrhage.

Introduction

Stroke is characterized classically as a neurological deficit attributed to an acute focal injury of the Central Nervous System (CNS) due to a vascular cause, including cerebral infarction, Intracerebral Haemorrhage (ICH), and Subarachnoid Haemorrhage (SAH). Stroke was the second-leading cause of death and the third-leading cause when death and disability were taken in combination (5.7% of total Disability-Adjusted Life Year (DALY) s) in 2019 [1]. Post stroke cognitive decline is seen in 60% patients after stroke and most commonly within a year of stroke [2]. The National Institutes of Health Stroke Scale (NIHSS) score is the most commonly used score to assess the clinical severity of acute ischemic strokes. As per the National Institute of Neurological Disorders and Stroke recombinant tissue-type plasminogen activator (NINDS r-tPA) for Acute Stroke Trial (the Trial) NIHSS score was considered to be gold standard for determining clinical severity, outcome and treatment options in acute stroke [3]. Alberta Stroke Protocol Early CT Score (ASPECTS) is a Non-Contrast Computed Tomography (NCCT) based topographic scoring system that provides quantitative measure for early ischemic changes. The score was initially developed for evaluating candidacy for stroke thrombolysis but currently also seems to have significant role in assessing stroke severity and predicting long term outcomes [4]. Post stroke cognitive impairment (PSCI) complicates 60 % of strokes. It may occur early and most frequently immediately after a stroke. If it happens after three to six months of stroke onset, it is considered to be delayed. Lesions involving "strategic areas" like the left frontotemporal region, left thalamus, and right parietal lobe or the left Middle Cerebral Artery (MCA) area increase the likelihood of development of PSCI [2]. Our study also aims at assessing utility of ASPECTS score in predicting possibility of cognitive decline at 90 days.

Methodology

The study was conducted at Department of Neurology, AB-VIMS and Dr RML Hospital, New Delhi. It was an observational prospective study performed over one year from 1st November 2022 to 1st November 2023 and 50 consecutive patients were enrolled. All patients above 18 years of age with acute ischemic stroke presenting within 48 hours of symptom onset and not having disability or aphasia enough to interfere with assessment of Montreal Cognitive Assessment Score (MoCA) at 90 days. Patients with haemorrhagic strokes, anterior or posterior cerebral artery territory (ACA or PCA) infarcts, venous infarcts, those with prior stroke and those with pre-existing cognitive dysfunction were excluded. All patients with acute ischemic stroke presenting within 48 hours of onset at emergency or Neurology Outpatient were included and after taking informed consent and after checking validity as per inclusion and exclusion criteria. NIHSS score was ascertained at presentation. As per stroke protocol, NCCT head was done (Cannon Aquillon Lightning 16-row 32 slice helical CT, Figure 2) and ASPECTS score was calculated. Best suited treatment protocol was decided. The NIHSS score at presentation and length of hospital stay were considered to be markers of acute and early severity. Early physiotherapy and rehabilitation were initiated. Patient after discharge was followed up in 90 days with Modified Rankin Score (mRS) and MoCA. Accordingly, patients were grouped as cognitively impaired (MoCA<26) or cognitively preserved (MoCA 26 and above) and mRS groups of scores 1 and below and 2 and above for functional outcomes. These were considered as markers of long-term outcome. The presentation

of the Categorical variables was done in the form of number and percentage (%). On the other hand, the quantitative data were presented as the means +/- SD as median with 25th and 75th percentiles (interquartile range). The data normality was checked by using Shapiro-Wilk test. The cases in which the data was not normal, we used non parametric tests. The association of the variables which were quantitative and normally distributed in nature were analysed using independent t test and variables which were quantitative and not normally distributed in nature were analysed using Mann Whitney test. The association of the variables which were qualitative in nature were analysed using Fisher's exact test as atleast one cell had an expected value of less than 5. Spearman rank correlation coefficient was used for correlation of Aspects score at presentation with NIHSS at presentation, Length of hospital stay(days), mRS at 90 days and MoCA at 90 days. Univariate linear regression was used to assess effect of Aspects score on NIHSS. Univariate logistic regression was used to assess effect of Aspects score on length of hospital stay (>=7 days), mRS at 90 days(>=2) and MoCA at 90 days(<26).The data entry was done in the Microsoft EXCEL spreadsheet and the final analysis was done with the use of Statistical Package for Social Sciences (SPSS) software, IBM manufacturer, Chicago, USA, ver 25.0.For statistical significance, p value of less than 0.05 was considered statistically significant.

Results

Demographics

The mean age was found to be 55.14 years with a standard deviation of 12.4. (Table 1). The gender distribution in the study cohort indicated male population of 54.29% and female population of 45.71% of the total sample of 35 individuals. (Table 1).57.14% of the individuals with stroke had diabetes while 45.71% had hypertension. Other notable risk factors include smoking (14.29%), alcohol consumption (5.71%), dyslipidemia (8.57%), rheumatic heart disease (11.43%), non-valvular atrial fibrillation (2.86%), and various other cardiac causes. (Table 1).

Stroke Characteristics

Among the 35 patients, 12 patients (34.8 %) had large vessel disease, 12 patients (34.3 %) had small vessel disease, 8 patients (22.9 %) had stroke due to cardioembolic causes and 3(8.6%) patients had stroke due to undetermined etiologies. (Table 1) The distribution of infarct territories among the study participants revealed that 54.29% of the population experienced infarcts in the Left Middle Cerebral Artery (MCA), while 45.71% had infarcts in the Right MCA (Table 1).

Outcome Measures Immediately after Stroke

The NIHSS scores at the time of presentation in the study cohort demonstrated a varied severity of strokes. 68.57% of the subjects presented with NIHSS scores ranging from 5 to 15, indicating a moderate level of stroke severity, 20.00%, had mild strokes with NIHSS scores less than 5, while 11.43% exhibited moderately severe strokes with scores falling within the 16 to 20 range. The mean NIHSS score at presentation was 8.06 ± 4.26 (Table 1). The ASPECTS score assessment at the time of presentation revealed that 77.14% of individuals presented with scores equal to or greater than 6 while 22.86% of the cases had scores below 6. The mean score at presentation was 7.14 ± 2.49 . (Table 1).77.14% of cases had stays of less than 7 days. Conversely, 22.86% of patients experienced a longer hospitalization period of 7 days or more. The mean length of hospital stay was 4.71 ± 2.94 days. (Table 1).

Table 1: Table depicting population demographics (age, gender), stroke risk factors, territory of infarcts, TOAST classification, NIHSS and ASPECTS at presentation and mRS and MOCA at 90 days.

Age (mean)		55.14 +/- 12.4 years
Gender		
·	Female	45.71% (n=16)
·	Male	54.29% (n=19)
Stroke risk factors		
·	Diabetes Mellitus	57.14% (n=20)
·	Hypertension	45.71%(n=16)
·	Smoking	14.29%(n=5)
·	Rheumatic heart disease	11.43%(n=4)
·	Dyslipidemia	8.57%(n=3)
·	Alcohol	5.71%(n=2)
·	Non valvular atrial fibrillation	2.86%(n=1)
·	Vasculitis	2.86%(n=1)
·	Hyperhomocystenemia	2.86%(n=1)
·	Coagulopathy	2.86%(n=1)
		0
TOAST classification		
·	Large vessel	34.3%(n=12)
·	Small vessel	34.3%(n=12)
·	Cardioembolic	22.9%(n=8)
·	Other determined causes	0%
·	Undetermined	8.6%(n=3)
Territory of infarct		
·	Left MCA	54.29%(n=19)
·	Right MCA	45.71%(n=16)
NIHSS at presentation		
·	<5	20.00%(n=7)
·	5 to 15	68.57% (n=24)
·	16 to 20	11.43%(n=4)
·	>20	0
·	Mean +/- SD	8.06 +/- 4.26
ASPECTS score at presentation		
·	<6	22.86%(n=8)
·	>=6	77.14%(n=27)
·	Mean +/- SD	7.14+/-2.49
Length of hospital stay		
·	<7 days	77.14%(n=27)
·	>=7 days	22.86% (n=8)
·	Mean +/- SD	4.71 +/-2.94 days
mRS at 90 days		
·	<2	57.14%(n=20)
·	>=2	42.86%(n=15)
·	Mean +/- SD	1.43 +/- 1.2
MOCA at 90 days		
·	<26	20.00%(n=7)
·	>=26	80.00%(n=28)
·	Mean +/- SD	27.86 +/- 2.53
MOCA domains affected		
·	Visuospatial/executive	20.00%(n=7)
·	Naming	34.29%(n=12)
·	Memory	0
·	Attention	0
·	Language	28.57%(n=10)
·	Abstract	0
·	Recall	11.43%(n=4)
·	Orientation	5.71%(n=2)

Outcome Measures at 90 days

The mean mRS score was 1.43 ± 1.2 . The distribution of mRS scores at 90 days post-stroke revealed majority of individuals (57.14%) achieving functional status of mRS score less than 2. In contrast, 42.86% of participants had an mRS score of 2 or higher. (Table 1). 90-day mRS outcomes for various stroke etiologies as per TOAST was assessed. For LVD, 50% had mRS <2 and 50% had mRS ≥ 2 . For SVD, 83.33% had mRS <2 and 16.67% had mRS ≥ 2 . For Embolic, 25% had mRS <2 and 75% had mRS ≥ 2 . For Another unclassified category, 66.67% had mRS <2 and 33.33% had mRS ≥ 2 . However, it could not be confirmed with significance if any particular stroke etiology was associated with worse outcomes. (Table 1) The assessment of participants' cognitive function MoCA at 90 days post-stroke revealed that

80.00% had cognitive performance at or above the threshold of 26. The mean MoCA score was 27.86 ± 2.53 . (Table 1). The assessment of specific cognitive domains of MoCA at 90 days post-stroke showed that naming was involved in 34.29% of subjects, language in 28.57%, visuospatial/executive function in 20%, recall in 11.43% and orientation in 5.71% of the subjects. (Table 1). The comparison of MoCA scores at 90 days between patients with left MCA and right MCA involvement revealed no significant difference. In patients with left MCA infarcts, 26.32% scored below 26, while 73.68% scored 26 or above. Similarly, in the right MCA group, 12.50% scored below 26, and 87.50% scored 26 or above. The mean MoCA scores were 27.63 ± 2.73 for left MCA and 28.12 ± 2.33 for right MCA, with an overall mean of 27.86 ± 2.53 for the total cohort. The p-values for both the distribution of scores and the mean scores between the two groups were not statistically significant ($p = 0.415$ and $p = 0.574$, respectively). (Table 2, Figure 2) The analysis of MOCA domain performance in patients with left and right MCA involvement revealed significant differences in specific cognitive functions. In the visuospatial/executive domain, none of the patients with left MCA involvement exhibited deficits (0%), while 43.75% of those with right MCA involvement showed impairment ($p = 0.002$). Naming abilities were significantly affected in patients with left MCA involvement (57.89%) compared to those with right MCA involvement (6.25%) ($p = 0.002$). Language skills were compromised in 47.37% of patients with left MCA involvement and 6.25% of those with right MCA involvement ($p = 0.01$). However, no significant differences were observed in the memory, attention, recall, orientation, and abstract domains between the two groups. (Table 3, Figure 3). The MoCA scores at 90 days for patients with different stroke types was assessed. For LVD, 16.67% had MoCA <26 and 83.33% had MoCA ≥ 26 . For SVD, all (100%) had MoCA ≥ 26 . For Embolic, 50% had MoCA <26 and 50% had MoCA ≥ 26 . For Others, 33.33% had MoCA <26 and 66.67% had MoCA ≥ 26 . Overall, 20% had MoCA <26 and 80% had MoCA ≥ 26 . The P value of 0.027 indicates statistical significance. Cognitive worsening (MoCA <26) was most pronounced in the Embolic group, with 50% scoring below 26 (Table 4, Figure 4).

Table 2: Association of MOCA at 90 days with territory of infarct.

MOCA at 90 days	Left MCA(n=19)	Right MCA(n=16)	Total	P value
<26	5 (26.32%)	2 (12.50%)	7 (20%)	0.415*
≥ 26	14 (73.68%)	14 (87.50%)	28 (80%)	
Mean \pm SD	27.63 \pm 2.73	28.12 \pm 2.33	27.86 \pm 2.53	0.574†
Median (25 th -75 th percentile)	28 (25.5-30)	29 (27-30)	28 (27-30)	
Range	22-30	22-30	22-30	

Table 3: Association of MOCA domain with territory of infarct.

MOCA domain	Left MCA(n=19)	Right MCA(n=16)	Total	P value
Visuospatial/executive	0 (0%)	7 (43.75%)	7 (20%)	0.002*
Naming	11 (57.89%)	1 (6.25%)	12 (34.29%)	0.002*
Memory	0 (0%)	0 (0%)	0 (0%)	NA
Attention	0 (0%)	0 (0%)	0 (0%)	NA
Language	9 (47.37%)	1 (6.25%)	10 (28.57%)	0.01*
Abstract	0 (0%)	0 (0%)	0 (0%)	NA
Recall	3 (15.79%)	1 (6.25%)	4 (11.43%)	0.608*
Orientation	2 (10.53%)	0 (0%)	2 (5.71%)	0.489*

Table 4: Association of MOCA at 90 days with TOAST criteria.

MOCA at 90 days	LVD (n=12)	SVD (n=12)	3)Embololic (n=8)	Others (n=3)	Total	P value
<26	2 (16.67%)	0 (0%)	4 (50%)	1 (33.33%)	7 (20%)	0.027*
>=26	10 (83.33%)	12 (100%)	4 (50%)	2 (66.67%)	28 (80%)	
Total	12 (100%)	12 (100%)	8 (100%)	3 (100%)	35 (100%)	

Relation of ASPECTS with NIHSS, length of hospital stay and 90 day mRS and MOCA

Significant moderately negative correlation was seen between ASPECTS score at presentation with NIHSS at presentation with correlation coefficient of -0.452. Significant strong negative correlation was seen between ASPECTS score at presentation with length of hospital stay(days), mRS at 90 days with correlation coefficient of -0.632, -0.778 respectively. Significant strong positive correlation was seen between ASPECTS score at presentation with MoCA at 90 days with correlation coefficient of 0.618. (Table 5, Figure 5.1 to 5.4) On performing univariate regression, ASPECTS score: <6 was significant risk factor of higher NIHSS. Patients with aspects score: <6 had significantly high NIHSS with beta coefficient of 5.273(2.268 to 8.278). On performing univariate regression, ASPECTS score of <6 was significant risk factor of length of hospital stay >=7 days. Patients with ASPECTS score of <6 had significantly high risk of length of hospital stay >=7 days with odds ratio of 27.136(3.522 to 209.097). On performing univariate regression, ASPECTS score of <6 was significant risk factor of MRS at 90 days >=2. Patients with ASPECTS score of <6 had significantly high risk of mRS at 90 days >=2 with odds ratio of 16.129(1.777 to 146.356). On performing univariate regression, ASPECTS score of <6 was significant risk factor of MoCA at 90 days <26. Patients with ASPECTS score of <6 had significantly high risk of MoCA at 90 days <26 with odds ratio of 6.855(1.137 to 41.313). (Tables 6.1 to 6.4) Only 14.29% of the patients were thrombolysed. Effect of thrombolysis on 90-day mRS and MoCA could not be established. The analysis of the mRS at 90 days, categorized as <2 (favorable outcome) and >=2 (unfavorable outcome), showed no significant difference between thrombolysed and non-thrombolysed patients. Among non-thrombolysed patients, 56.67% had an mRS score of <2, indicating a favorable outcome, while 43.33% had an mRS score of >=2. In the thrombolysed group, 60% achieved an mRS score of <2, and 40% had an mRS score of >=2. The overall distribution across the two mRS categories was 57.14% with an mRS score of <2 and 42.86% with an mRS score of >=2. The p-value for the comparison was 1, signifying no statistically significant difference between the two groups in terms of favorable or unfavorable outcomes. The analysis of the MoCA scores at 90 days, comparing thrombolysed and non-thrombolysed patients, revealed no significant difference in cognitive outcomes. In the non-thrombolysed group, 23.33% had MoCA scores below 26, while 76.67% had scores equal to or above 26. Among

Table 5: Correlation of ASPECTS score at presentation with NIHSS at presentation, Length of hospital stay(days), mRS at 90 days and MOCA at 90 days.

Variables	NIHSS at presentation	Length of hospital stay(days)	mRS at 90 days	MOCA at 90 days
ASPECTS score at presentation				
Correlation coefficient	-0.452	-0.632	-0.778	0.618
P value	0.007	0.0001	<0.0001	0.0001

Table 6.1: Univariate linear regression of ASPECTS score to predict NIHSS.

Variable	Beta coefficient	Standard error	P value	Lower bound (95%)	Upper bound (95%)
ASPECTS score					
>=6					
<6	5.273	1.477	0.001	2.268	8.278

Table 6.2: Univariate logistic regression of ASPECTS score to affect length of hospital stay (>=7 days).

Variable	Beta coefficient	Standard error	P value	Odds ratio	Odds ratio Lower bound (95%)	Odds ratio Upper bound (95%)
ASPECTS score						
>=6				1.000		
<6	3.301	1.042	0.002	27.136	3.522	209.097

Table 6.3: Univariate logistic regression of ASPECTS score to affect mRS at 90 days(>=2).

Variable	Beta coefficient	Standard error	P value	Odds ratio	Odds ratio Lower bound (95%)	Odds ratio Upper bound (95%)
ASPECTS score						
>=6				1.000		
<6	2.781	1.125	0.013	16.129	1.777	146.356

Table 6.4: Univariate logistic regression of ASPECTS score to affect MOCA at 90 days(<26).

Variable	Beta coefficient	Standard error	P value	Odds ratio	Odds ratio Lower bound (95%)	Odds ratio Upper bound (95%)
Aspects score						
>=6				1.000		
<6	1.925	0.916	0.036	6.855	1.137	41.313

thrombolysed patients, 100% had MoCA scores above 26. The mean MoCA scores were 27.77 ± 2.7 for non-thrombolysed patients and 28.4 ± 1.14 for thrombolysed patients. The p-values for the comparison of MOCA scores and the distribution across the two categories were 0.388 and 0.559, respectively, indicating no statistically significant difference between thrombolysed and non-thrombolysed patients in cognitive outcomes.

Discussion

The study with a prospective observational design was conducted over a period of one year and three months at the Department of Neurology, ABVIMS and Dr RML Hospital, New Delhi. 35 patients above 18 years of age with acute ischemic stroke presenting within 48 hours of symptom onset and meeting the defined inclusion and exclusion criteria were included in the study. The mean age of study was 55.14 years with a standard deviation of 12.4. The gender distribution in the study cohort indicated male population of 54.29% and female population of 45.71 %. The gender distribution in the study thus came out to be balanced. Majority of the subjects were in the age group of 51-60 years and majority being male subjects. 65% patients with ischemic strokes are usually above the age of 65 as per studies [5]. The distribution of risk factors among the study participants provided valuable insights into the potential contributors to stroke incidence. Diabetes emerged as the most prevalent risk factor, affecting 57.14% of the individu-

als, followed by hypertension at 45.71%; other causes included smoking (14.29%), alcohol consumption (5.71%), dyslipidemia (8.57%), rheumatic heart disease (11.43%) and non-valvular atrial fibrillation (2.86%). 54.29% of the study population had Left MCA territory infarcts while 45.71% had infarcts in the Right MCA territory. In a patient by Ng YS et al, of 2213 stroke patients, anterior circulation strokes were twice as much common as posterior circulation strokes and of the anterior circulation strokes, 51% had MCA involvement [6]. In the study 68.57% of the subjects presented with NIHSS scores ranging from 5 to 15, indicating a moderate level of stroke severity, 20.00%, had mild strokes with NIHSS scores less than 5, while 11.43% exhibited moderately severe strokes with scores falling within the 16 to 20 range. The mean NIHSS score at presentation was 8.06 ± 4.26 . The ASPECTS at the time of presentation revealed a predominantly lesser severity, with 77.14% of individuals presenting with ASPECTS scores equal to or greater than 6. In contrast, 22.86% of the cases had ASPECTS scores below 6, suggesting extensive involvement of brain regions. The mean ASPECTS score at presentation was 7.14 ± 2.49 , reflecting the overall severity of early CT findings. The length of hospital stay for individuals with stroke predominantly falls within a short duration, with 77.14% of cases having stays of less than 7 days. Conversely, 22.86% of patients experienced a longer hospitalization period of 7 days or more. The mean length of hospital stay was 4.71 ± 2.94 days, reflecting a relatively shorter overall duration. The functional outcomes of individuals post-stroke, as measured by the mRS at 90 days, indicated a favorable recovery overall. The mean mRS score was 1.43 ± 1.2 . 20 patients (57.14%) had mRS less than 2 while 15 patients (42.86%) had mRS greater than or equal to 2 at 90 days. The relatively low mean suggests a generally positive trend in functional recovery three months after the stroke event. In our study when the effect of TOAST classification on mRS at 90 days was assessed, no particular TOAST group having worst outcome could be found. For LVD, 50% had mRS <2 and 50% had mRS ≥ 2 while for SVD, 83.33% had mRS <2 and 16.67% had mRS ≥ 2 . For Embolic group, 25% had mRS <2 and 75% had mRS ≥ 2 . Studies have shown that large vessel occlusion followed by cardioembolic stroke occluding large vessels have poor outcome when followed up at two months to one year time period [7]. The assessment of participants' cognitive function using MoCA at 90 days post-stroke revealed encouraging findings. Majority (80.00%) demonstrated cognitive performance at or above 26, indicating a favourable cognitive outcome. The mean MoCA score of 27.86 ± 2.53 further supports the overall cognitive well-being of the study population. The assessment of specific cognitive domains MoCA at 90 days post-stroke provides valuable insights into the participants' cognitive profiles. The distribution of scores across different domains indicates varying patterns of cognitive function. Notably, the majority of participants demonstrated disability in naming (34.29%) and language (28.57%), while memory, attention, abstract thinking showed no impairment in our study. Recall domains, Visuospatial/executive function, orientation domains also exhibited relatively lower frequencies of impairment. This comprehensive evaluation contributed to a nuanced understanding of the cognitive outcomes following stroke, highlighting areas of both strength and potential challenges in the studied population. There was no significant difference noted in the final MoCA score depending on whether left or right MCA territories have been involved. However, deficits in visuospatial and executive domains were found to be more in right MCA strokes while naming and language were involved more in left MCA strokes. In our study an attempt was made to correlate MoCA scores at 90 days for

patients with different stroke types based on TOAST classification. For LVD, 16.67% had MoCA <26 and 83.33% had MoCA ≥ 26 while for SVD all (100%) had MoCA ≥ 26 . For Embolic, 50% had MoCA <26 and 50% had MoCA ≥ 26 while for strokes of other etiologies, 33.33% had MoCA <26 and 66.67% had MoCA ≥ 26 . Cognitive worsening (MoCA <26) was most pronounced in the Embolic group, with 50% scoring below 26. (p value 0.027) According to our study there is significant moderately negative correlation between ASPECTS score at presentation and NIHSS at presentation with correlation coefficient of -0.452. There was also significant strong negative correlation between ASPECTS score at presentation and length of hospital stay (in days) with a correlation coefficient of -0.632. There was also significant strong negative correlation between at presentation ASPECTS and mRS at 90 days with correlation coefficient of -0.778. There was strong positive correlation between ASPECTS score at presentation with MoCA at 90 days with correlation coefficient of 0.618. On performing univariate regression, ASPECTS score of less than 6 was a significant risk factor of higher NIHSS at presentation (beta coefficient of 5.273(2.268 to 8.278)) prolonged hospital stay (>7 days odds ratio 27.136(3.522 to 209.097)) poorer mRS score at 90 days (≥ 2 with odds ratio of 16.129(1.777 to 146.356)) and greater incidence PSCI at 90 days (MOCA < 26 with odds ratio of 6.855(1.137 to 41.313)). Thus it can be concluded that the at presentation ASPECTS score is a predictor of immediate and long term outcomes in stroke. A study by David et al in 2005 showed an inverse relationship between the at presentation ASPECTS score and the NIHSS score in a linear fashion with a 10 point increase in NIHSS score with every 3 point decrease in ASPECTS score.⁽⁸⁾ In a study by Esmael et al, 120 patients with stroke were assessed. The mean ASPECTS score was 7.11 ± 2.43 . The mean NIHSS was 13.4 ± 6.9 at presentation. As for long term functional outcomes at three months, patients were divided into groups with mRS less than equal to 2 and more than 2. The average ASPECTS score in both the groups were found to be 8.12 ± 1.76 and 5.85 ± 2.47 respectively with a p value of 0.001. Thus, patients with lower ASPECTS had poorer functional outcomes at three months. For assessing PSCI, the patients were divided into groups with MOCA cut off of 26 at three months. A strong positive correlation was found between the initial ASPECTS score and MoCA score at 3 months ($r=0.69$, $P=0.003$). These findings are similar to observations made in our study [9]. Our study had few limitations. The sample size in our study was small and it may could be the reason why effect of thrombolysis could not be established in our study Though both Hindi and English versions of MoCA were used, educational status of patients might have had an effect on the final interpretation and hence final diagnosis of post stroke cognitive impairment.

Conclusion

The above observational prospective study among 35 stroke patients presenting within 48 hours of stroke onset were studied with an aim to assess the ability of NCCT based ASPECTS score at presentation to determine immediate and 90-day stroke outcomes. The mean age of the subjects was 55.14 years and most were males. Diabetes was the most common risk factor and LVD and SVD emerged as most common stroke etiologies. It was so found that ASPECTS score was correlated negatively with at presentation NIHSS (moderate), length of hospital stay (strong) and 90 day mRS score (strong) and positively to 90 day MoCA score (strong). An ASPECTS score of less than 6 was also a risk factor for greater NIHSS scores, longer hospital stays, greater functional and cognitive disability at 90 days. Also, car-

dioembolic strokes were found to have greater risk of PSCI at 90 days. ASPECTS score can hence be used as a predictor of immediate and 90-day outcome with respect to both morbidity and cognitive outcomes.

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