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STUDY OF ASPECTS IN RELATION TO PROGNOSIS IN MCA TERRITORY STROKE IN TERTIARY CARE CENTRE OF SOUTHERN RAJASTHAN

Neurology

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ABSTRACT

Aim: To study correlation of Alberta Stroke Program Early CT Score (ASPECTS) and clinical prognosis among middle cerebral artery (MCA) territory infarct patients who presented within 48 hours of stroke onset.

Materials and Methods: This is a prospective cohort study conducted from June to November 2017 in Udaipur district of Rajasthan where a total of 50 patients with Acute Middle Cerebral Artery Ischemic stroke who had presented to our institute within 48 hrs of stroke onset were included. A detailed history of all subjects including personal details, risk factors, details of onset of stroke (time, activity while onset and date), reporting time at hospital and time of CT scan, and presenting symptoms was noted. All the patients underwent detailed neurological and other systemic examination, routine blood investigation, lipid profile, electrocardiogram and CT scan. Glasgow Coma Scale (GCS) and National Institute of Health Stroke Scale (NIHSS) were assessed at time of presentation and discharge. Time and date of CT scan were noted and ASPECTS was calculated by two observers independently in the absence of clinical information of the recruited patients. We divided patients in to two groups with 'Better' and 'Worse' ASPECTS with score of 8-10 and 0-7 respectively and compared the primary and secondary stroke outcome measures.

Results : The mortality, GCS at discharge are significantly better among patients with 'Better' compared to 'Worse' APSECTS.

Conclusion: We conclude that in the setting of acute ischemic stroke in middle cerebral artery territory, ASPECTS at less than 48 hours of stroke onset has good correlation with severity of stroke, and is strong predictor of early outcome in acute ischemic stroke.

KEYWORDS

ASPECTS , MCA territory infarct

INTRODUCTION

Stroke is the second largest killer disease in the world and stands third among the leading causes of disease burden.[1] The disability caused by a stroke is the worst of all in majority of those who survive the acute phase.

Stroke is defined by the World Health Organization as "a clinical syndrome consisting of rapidly developing clinical signs of focal (or global in case of coma) disturbance of cerebral function lasting more than 24 hours or leading to death with no apparent cause other than a vascular origin".[2]

The estimated adjusted prevalence rate for stroke in India varies between 84-262/100,000 in rural to 334-424/100,000 in urban population centres.[3]

Also, based on recent population studies the incidence rate in India is approximately 119-145/100,000.[3]

Eighty to ninety percent of these events are ischemic strokes. This becomes all the more important in India, where 20% of strokes occur in patients of < 40 yrs of age.

In cerebral infarction, occlusions of large vessels are responsible for 40-50%of the cases, followed by small vessel lacunar infarcts (25%). Imaging of the brain parenchyma is important to differentiate between hemorrhagic stroke and ischemic stroke and also to rule out other structural causes mimicking stroke. Since last four decades, computed tomographic (CT) scanners were started to use and have since become the main diagnostic tool in acute stroke. Recent advances in CT technology helps to differentiate salvageable from the non salvageable brain tissue and also to identify pathophysiological mechanisms (vascular occlusion or stenosis) of stroke. Thrombolysis as a treatment in acute ischemic stroke therefore requires rapid diagnosis, both clinically and radiologically because time lost will damage more brain tissue hence, the saying which goes by 'time is brain'.

The Ischemic Penumbra :-

In acute ischemic stroke, arterial occlusion results in a decrease in cerebral blood flow (CBF). The decrease in CBF varies regionally, within the distribution of the affected artery. The ischemic penumbra is that tissue between an upper CBF threshold of electrical silence and a lower flow threshold of ion pump failure resulting in loss of cellular membrane integrity.[7] In simpler terms, the penumbra is the hypoperfused, hypoxic tissue that is structurally intact, at risk of infarction but potentially salvageable with early reperfusion. Tissue which is irreversibly injured is referred to as the infarct core. With increasing time to reperfusion, the infarct core expands to include the penumbral tissue. Neurological outcomes after stroke correlate with penumbral tissue salvage; the current therapeutic strategies for acute stroke are, therefore, aimed at preservation of penumbral tissue and arresting its transition to infarction.

Evidence from numerous studies suggest that early ischemic change (EIC) on NCCT before the administration of acute stroke therapies can predict both functional outcome and the risk of ICH.

CT findings in acute ischemic stroke :-

1. Focal parenchymal hypodensity
2. Cortical swelling with sulcal effacement and loss of gray-white matter differentiation
3. Hyperdense MCA sign

Although MRI has uncovered considerable information on the process of ischemic infarction, most patients with a stroke present to community hospitals without readily available MRI.

Alberta Stroke Program Early CT score (ASPECTS) is a valid, robust and reliable method to judge degree of early ischemic changes (EIC) (focal parenchymal hypo-attenuation, loss of gray-white differentiation, and sulcal effacement) on CT scan in patients with acute ischemic stroke.[4]

ASPECTS has been shown to have modest prognostic value for determining clinical outcome after intravenous tissue plasminogen activator (i.v. tPA) in management of acute ischemic stroke. ASPECTS has shown good correlation in predicting intracranial haemorrhage (ICH) following i.v. tPA and it has also shown to be well correlated with other advanced modality of imaging in stroke like CT angiography source images (CTA-SI), perfusion CT (CTP), multimodal magnetic resonance imaging (MRI) with diffusion-weighted imaging (DWI) and perfusion imaging (PI).[5]

Most studies using ASPECTS is done in the setting of acute stroke with i.v. tPA (recombinant tissue plasminogen activator) use only, while only 1% of population with acute ischemic stroke received i.v. tPA.[6]

Hence, it might not translate the real association of ASPECTS with other variable in patients presented after the standard window period.

Hence, we aim to study correlation of ASPECTS with mortality and early and late morbidity among the patients with acute ischemic stroke

who presented within 48 hours of stroke onset, but not necessarily within the window period.

AIMS AND OBJECTIVES

To evaluate correlation of Alberta Stroke Program Early CT Score (ASPECTS) and early outcome measures among acute ischemic stroke (middle cerebral artery territory) patients who presented within 48 hours of stroke onset.

MATERIALS AND METHODS

This is a prospective cohort study, conducted at the Department of Medicine and Neurology, RNT Medical College , Udaipur (Rajasthan) India.

This study was approved by the Institutional Ethical committee of RNT Medical College.

The study was conducted between June 2017 and November 2017.

We recruited consecutive patients with Acute Ischemic stroke who had presented to this institute within 48 hrs of stroke onset.

Sample Size : 50 Patients

Inclusion Criteria :-

1. The patients with first episode of acute middle cerebral artery (MCA) territory infarction who presented to hospital within 48 hours duration.
2. Age more than 18 years were included in study.

Exclusion Criteria :-

1. Anterior or Posterior cerebral artery infarction.
2. Posterior circulation infarction.
3. Infarction due to cortical venous thrombosis.
4. Past history of stroke.

STUDY DESIGN

- Our study is a prospective cohort study.
- After an informed consent, all the patients were assessed at presentation, and at the time of discharge.
- A detailed history of all subjects including personal details, risk factors, details of onset of stroke (time, activity while onset and date), reporting time at hospital and time of CT scan, and presenting symptoms was noted.
- All the subjects were examined in terms of vital signs, carotid bruit and detailed nervous system and other systemic examination. Glasgow Coma Scale (GCS) and National Institute of Health Stroke Scale (NIHSS) were assessed at time of presentation and discharge.
- All the patients underwent routine blood investigation, lipid profile, electrocardiogram and CT scan.
- Some patients underwent echocardiography, carotid Doppler, MRI and CT/MR angiography.
- Time and date of CT scan were noted and ASPECTS was calculated by two observers independently in the absence of clinical information of the recruited patients.
- If patients were hospitalized, then inpatient treatment, need for decompressive surgery, inpatient complications and hospital stay was noted.
- CT scan reporting was done by two separate radiologists (R1& R2) independently.

Outcome Measures :-

- The primary outcome measures included death and morbidity at time of discharge (by comparing admission ASPECTS with GCS and NIHSS at discharge)
- The secondary outcome measures included assessment of severity of stroke (comparison of admission ASPECTS with admission GCS and admission NIHSS), length of hospital stay, and development of complication during hospitalization.

Image :-

- Standard non contrast CT was performed with a multislice CT scanner (Siemen Systems) using 110 kV, 280 mA, 1-second scan time, and 3-mm slice thickness, which was reconstructed at 9 mm.
- Coverage, was from skull base to vertex with contiguous axial slices parallel to the inferior orbitomeatal line.

Ischemic Stroke Parameters: ASPECTS, GCS, NIHSS :-

The Alberta Stroke Program Early CT Score (ASPECTS) gives a means of quantitatively assessing acute ischemia on CT images by using a 10-point topographic (M1–M6, I = insula, IC = internal capsule, L = lenticular, and C = caudate), each of which accounts for one point in the total score. The normal CT scan is assigned a total score of 10. For each area involved in stroke on the unenhanced CT images, one point is deducted from that score. Hence, a score of 0 translates into a finding of diffuse ischemic involvement throughout the MCA territory. ASPECTS system is a systematic and practical method that is applicable to axial images acquired at different levels with better clinician agreement than 1/3 MCA rule.[7] ASPECTS is a valid, robust and reliable method to judge degree of IEC on CT scan in patients with acute ischemic stroke.

GCS and NIHSS are widely used parameters in stroke trials for assessing severity at admission and also to judge early morbidity.

Statistical Analysis :-

The data was entered into Microsoft Excel format and was analysed using SPSS version 16.0. The data was represented as mean ± SD (standard deviation) as well as median (with range). The comparison between the two groups in case of continuous variables was made by applying One way ANOVA or Kruskal-Wallis test followed by post hoc analysis by Bonferroni post hoc test, wherever applicable. The categorical data was compared by applying Chi-Square test or Chi-square trend. 'p' value less than 0.05 was considered as significant. Inter-rater agreement was calculated according to Intraclass correlation coefficient.

OBSERVATIONS

The present study was conducted on 50 patients suffering from Acute Ischemic Stroke (AIS) presented to Maharana Bhupal Government Hospital, RNT Medical College, Udaipur within 48 hrs of stroke onset.

Age Distribution :-

In this study, the age ranged from 32 to 85 years.
Mean - 60.68 years

Table-1

Age	Number of Patients (%)
< 60 years	21 (42)
≥60 years	29 (58)

Out of 50 patients, 21 patients (42%) were < 60 years and 29 patients (58%) were ≥ 60 years.

Sex Distribution

Out of 50 patients of Acute Ischemic Stroke, 30 were male (60%) and 20 were female (40%).

The male to female ratio was 1.5:1

Associated Co-morbities

Table-2

S.No.	Co-morbidities	Number of Patients (%)
1.	Hypertension	18(36)
2.	Diabetes	14(28)
3.	Coronary Artery Disease	11(22)
4.	Atrial Fibrillation	0
5.	Valvular Heart Disease	1(2)
6.	Dyslipidemia	6(12)

Out of 50 patients, 18 patients (36%) were having hypertension as a co-morbidity, 14 patients (28%) were diabetic, 11 patients (22%) were suffering from coronary artery disease, 1 patient (2%) was having valvular heart disease, 6 patients (12%) were having dyslipidemia. There was no evidence of atrial fibrillation in any of the patient.

Clinical Presentation

Table-3

Clinical Presentation	Number of Patients (%)
Right Hemiparesis/Hemiplegia	16 (32)

Left Hemiparesis/Hemiplegia	29 (58)
Facial Palsy-UMN type	30 (60)
Aphasia(Broca's/Wernicke/Global/Anomic)	14 (28)
Dysarthria	4 (8)
Unconscious	3 (6)

Out of 50 patients, 16 patients (32%) presented with right sided hemiparesis/ hemiplegia, 29 patients (58%) presented with left sided hemiparesis/ hemiplegia.

Facial palsy-UMN type was present in 30 patients (60%).

14 patients (28%) presented with Aphasia (Broca's/ Wernicke / Global/ Anomic), while 4 patients (8%) were having dysarthria, and 3 patients (6%) were unconscious.

Addiction

Out of 50 patients, 23 patients (46%) were smokers, 15 patients (30%) were alcoholic, 9 patients (18%) were tobacco chewers, 2 patients (4%) were having other addiction in the form of Bhaang.

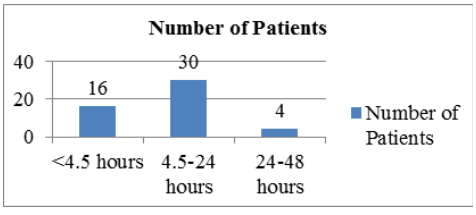
Time of Presentation to Hospital
Table-4

Time of Presentation to Hospital	Number of Patients (%)
< 4.5 hours	16 (32)
4.5-24 hours	30 (60)
24-48 hours	4 (8)

Out of 50 patients, 16 patients (32%) reached hospital in less than 4.5 hours, while 30 patients (60%) reached between 4.5-24 hours, and 4 patients (8%) reached between 24-48 hours.

Average time for the patient to reach hospital after onset of stroke symptoms is 9.6 hours.

Figure-1



Time to do NCCT Head in Hospital :

Average time to do NCCT Head of the patient after getting admission is 66.10 minutes i.e. 1.1 hours.

Time of NCCT Head from stroke onset :-

Average time taken to do NCCT Head from onset of symptoms is 10.7 hours.

Distribution According To GCS
Table-5

	GCS on Admission			GCS on Discharge		
	13-15	8-12	0-7	13-15	8-12	0-7
Number of Patients (%)	23(46)	24(48)	3(6)	26(52)	13(26)	3(6)

Out of total 50 patients on admission, 23 patients (46%) had GCS between 13-15, 24 patients (48%) had GCS between 8-12 and 3 patients (6%) had GCS between 0-7.

On discharge, 26 patients (52%) had GCS between 13-15, 13 patients (26%) had GCS between 8-12 and 3 patients (6%) had GCS between 0-7.

There were total 8 mortality out of 50 patients, so they were not included on discharge.

Distribution According To NIHSS
Table-6

	NIHSS on Admission			NIHSS on Discharge		
	0-5	6-16	17-42	0-5	6-16	17-42
Number of Patients (%)	3(6)	29(58)	18(36)	6(12)	24(48)	12(24)

Out of total 50 patients on admission, 3 patients (6%) had NIHSS between 0-5, 29 patients (58%) had NIHSS between 6-16 and 18 patients (36%) had NIHSS between 17-42.

On discharge, 6 patients (12%) had NIHSS between 0-5, 24 patients (48%) had NIHSS between 6-16 and 12 patients (24%) had NIHSS between 17-42.

There were total 8 mortality out of 50 patients, so they were not included on discharge.

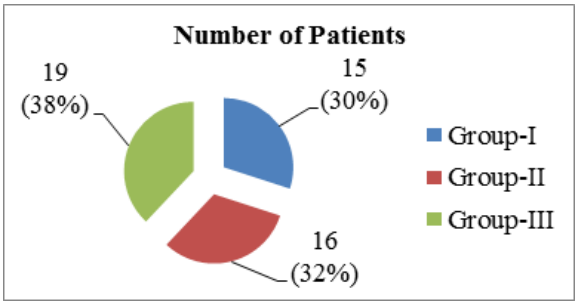
Better ASPECTS & Worse ASPECTS
Table-7

		ASPECTS	Number of Patients %)
Better ASPECTS	Group-I	8-10	15 (30)
Worse ASPECTS	Group-II	5-7	16 (32)
	Group-III	0-4	19 (38)

Out of 50 patients, 15 patients (30%) came under Better ASPECTS (8-10) Group-I.

Worse ASPECTS is divided into Group-II (5-7) and Group-III (0-4). 16 patients (32%) were found to be under Group-II, and 19 patients (38%) in Group-III.

Better ASPECTS & Worse ASPECTS
Figure-2



Primary Outcome Measures Based on ASPECTS
Table-8

Variables	Better ASPECTS 8-10 (n=15)	Worse ASPECTS		p value
		5-7 (n=16)	0-4 (n=19)	
Mortality Death	0	1	7	0.006
Morbidity GCS at Discharge	13.53±2.32	12.88±3.82	7.16±6.12	0.00 [A]
NIHSS at Discharge	11.07±6.44	11.31±6.85	10.63±10.42	0.97

GCS: Glasgow coma scale, NIHSS: National Institute of Health Stroke Scale [A]significant between Group 1 & 3, 2 & 3 but not between 1 & 2

In primary outcome measures, there is statistically significant difference in mortality between Better and Worse ASPECTS group (p=0.006).

Likewise, GCS at discharge, was statistically significantly better in group 1 &2, but no statistically significant difference was noticed between group 1 and 2.

NIHSS at discharge has not shown any significant difference among all 3 groups (p=0.97).

Secondary outcome measures based on ASPECTS
Table-9

Variables	Better ASPECTS 8-10 (n=15)	Worse ASPECTS		p value
		5-7 (n=16)	0-4 (n=19)	
Stroke Severity GCS at Admission	12.47±3.06	13.44±2.27	10.63±3.09	0.018B
NIHSS at Admission	12.40±6.12	12.44±5.73	19.37±7.01	0.002 *

GCS: Glasgow coma scale, NIHSS: National Institute of Health Stroke Scale
[B] significant between group 2 & 3 but not between 1 & 2, 1 & 3. * significant for group 1 & 3, 2 & 3 but not between 1 & 2.

In secondary outcome measures, GCS was statistically significantly different in group 2 & 3 but not between group 1 & 2, 2 & 3.

NIHSS on admission was significantly different between 1 & 3, 2 & 3 but not between 1 & 2.

DISCUSSION

In this study, we recruited 50 patients of acute ischemic stroke presented within 48 hrs either to emergency or out-patient department of our institute. We found that mean age of patients was 60.68 years, out of which 58 % were ≥ 60 years and 42 % were < 60 years. Gender wise distribution suggests that 60 % were male and 40 % were females.

82% patients had atleast one co-morbidities, and among them hypertension was seen as most common in 36 % of patients. This is similar to results of other studies like that of carried by Paresh Zanzmera. Other co-morbidities in decreasing order were Diabetes (28%),CAD (22%), Dyslipidemia (12%) and Valvular Heart Disease (2%). 2 patients also had history of transient ischemic attack in the past.

In our study, smoking was seen as a most common addiction in 46 % of patients followed by alcohol (30%), tobacco (18%) and 2 patients have addiction to bhang.

Reaching hospital in cases of stroke at the earliest is very crucial in the future prognosis of patient. In this study majority of patients i.e. 60 % presented between 4.5-24 hours after the onset of stroke symptoms followed by 32 % patients within 4.5 hours and 8 % reached hospital between 24-48 hours. Average time for patient to reach hospital in our study was found to be 9.6 hours.

In this study, we predicted stroke outcome by topographic quantitative scoring of EIC on CT scan after acute ischemic stroke who had presented within 48 hours of stroke onset.

The inter-rater reliability of ASPECTS was 0.99 in our study. This is excellent when compared to good inter-rater agreement of 0.71 and 0.85 in ASPECTS between stroke neurologist and neuroradiologist in other studies. This translates the fact that inter-rater agreement in ASPECTS is better than one third MCA rule. [9]

Moreover, ASPECTS seems easy to calculate with little experience and practice, and gives quantitative measurement of the lesion volume on CT scan.

We found that ASPECTS gives a good prediction for mortality, as patients died more in Group 3 i.e. ASPECTS of 0-4, and single mortality in Group 2 i.e. ASPECTS 5-7.In short, death occurred in Worse ASPECTS group only and not in Better ASPECTS group.

These findings are similarly present in other studies like that conducted by Paresh Zanzmera et al in AIIMS, New Delhi.

When ASPECTS on admission was compared with GCS at discharge, we found the significance difference between Groups 1 & 3, 2 & 3 meaning thereby that ASPECTS gives a good idea about the future clinical condition of the patient, means whether patient will improve or deteriorate in future course of time. However, in our study, we have not find any difference between Group 1& 2 with respect to GCS and in all groups with respect to NIHSS.

This is slightly different in other study where they observed difference in Better (group 1) and Worse (group 2) ASPECTS. [8]

Prabhakar et al in their study at PGIMER, Chandigarh found NIHSS scores had inverse correlation with ASPECT values, where as NIHSS score had a positive correlation with infarct volume. [12]

When stroke severity is taken into consideration, ASPECTS again is a good predictor. It establishes a good relation with GCS and NIHSS on admission, meaning thereby that it correlates well with how big the stroke occurred when patient's clinical condition is compared (as calculated by GCS and NIHSS).

It shows statistical significance when compared with GCS and NIHSS on admission, but it does not shows significant difference between Group 1 & 2,1 & 3 with respect to GCS and Group 1 & 2 with respect to NIHSS.

This again deviates slightly with other study where they found significant difference between Group 1 & 2, which in our study we didn't.

In this study, 16 patients presented with us within window period of < 4.5 hrs, and out them 2 patients were thrombolysed with r-tPA with prior written consent and after ruling out all the contraindications.

Progression of stroke again is a bad prognostic sign. In our study, 1 patient underwent neurosurgical intervention in the form of decompression of enlarging infarct with edema. This further complicates the condition of the patient apart from various other hospital stay related and in-patient related complication like aspiration seen in 2 patients.

Minor stroke patients usually recover sooner and do not develop many inpatients complications. However, we noticed that development of inpatient complications do not correlate with better or worse ASPECTS. Various reasons for development of inpatient complications could be patient's immunity level, tendency to acquire infection, development of iatrogenic infections, worsening of co-morbid illness and development of dyselectrolytemia. Nevertheless, patients with minor stroke tend to recover faster despite of inpatient complication, and have shorter stay at hospital.

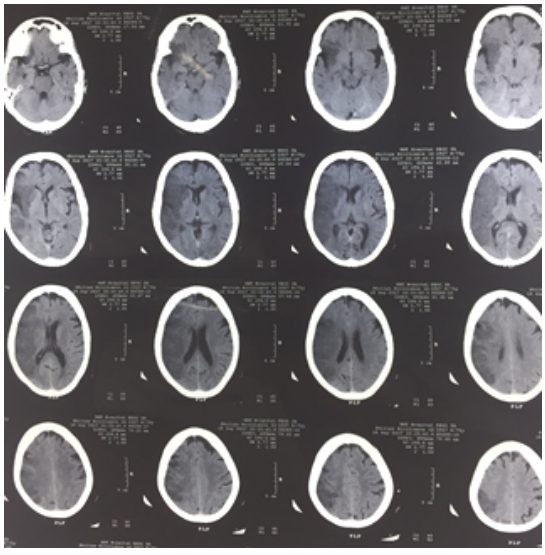


Figure-3 – Non-Contrast CT of Patient Number 29 showing hypodensity in Insular cortex,M1,M2,M4,M5,M6 regions. ASPECTS=4

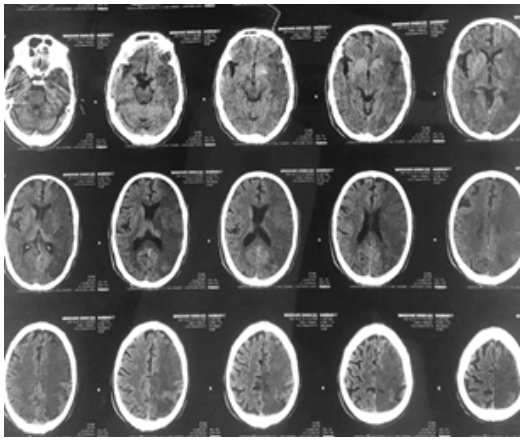


Figure-4 – Non-Contrast CT of Patient Number 34 showing hypodensity in Caudate nucleus, Putamen, Internal capsule, Insular cortex, M1, M2, M3, M4, M5, M6 regions. ASPECTS=0.

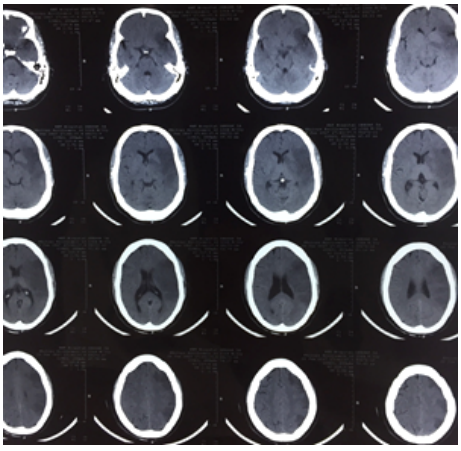


Figure-5 – Non-Contrast CT of Patient Number 22 showing hypodensity in Caudate nucleus, Putamen, Internal capsule, Insular cortex, M1, M2, M3, M4, M5, regions. ASPECTS=1.

Limitations of Study :-

1. In cases of hyperacute infarct, NCCT is not capable to pick the early ischemic changes and it is not supportive. The sensitivity of CT detecting EIC in acute ischemic stroke depends on the severity and duration of the focal cerebral ischemia.[19] EIC on CT do not have clinical correlation unless follow up CT changes are available, therefore EIC on CT have never been shown to correlate with acute ischaemic stroke outcomes and it do not guide medical treatment in acute stroke patients.[11]
2. Number of subjects were less.
3. Movement artefact in some patients while undergoing NCCT, which can affect the reporting.
4. Discharge dates were different for every patient and so the time for improvement will be different for each one which will have its impact on calculation of GCS and NIHSS on discharge.
5. Availability of r-tPA is again a issue in this setup, which might affect calculation of GCS and NIHSS on discharge.

CONCLUSION

After completing study on 50 patients of acute ischemic stroke who presented within 48 hours in our tertiary care hospital, following highlights were noticed:-

1. Majority of stroke patients were more than 60 years of age, however, percentage of patients below 60 years are also on a rising trend.
2. Males were found to be more in number suffering from ischemic stroke when compared to females in our study, This observation may be because of more prevalence of addiction in the form of smoking, alcohol and tobacco in males.
3. Patient presenting to the hospital after noticing the symptoms of stroke is vital in the future prognosis. This time in which patient presents to hospital can be reduced by creating more awareness in public regarding the illness and also at the same time creating the infrastructure to deal with stroke. Since majority of patients were from rural background, there is a need to strengthen the infrastructure at grassroot level.
4. Almost every patient has got one risk factor in the form of either co-morbidities or addiction. This again tells us that having a healthy life reduces the chances of having stroke. Thus, leading a healthy and addiction free life needs to be encouraged among public.
5. GCS and NIHSS are two scales which are established and frequently use worldwide to assess the disease status of the patient. This holds true in our study too.
6. GCS and NIHSS on admission when compared with ASPECTS gives a good idea about the future course of disease with respect to clinical prognosis.
7. ASPECTS which is easy to calculate in ischemic stroke patients with primary imaging modality in the form of NCCT helps clinician to assess the condition and disease status of the patient.

We conclude that in the setting of acute ischemic stroke in middle cerebral artery territory, ASPECTS at less than 48 hours of stroke onset has good correlation with severity of stroke, and is strong predictor of early outcome in acute ischemic stroke.

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