Original Article

A study on CVA and its clinical correlation with CT scan brain findings

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Abstract

Background: Stroke/CVA is an abrupt onset of neurological deficit due to focal vascular cause, and it needs both clinical and laboratory studies including brain imaging for diagnosis. The clinical manifestations of stroke are highly variable because of complex anatomy of brain and its vasculature. Early diagnosis and treatment is necessary to prevent mortality and morbidity. CT plays a major role in CVA to assess the site, size, nature of the lesion. **Aim:** This study was conducted to correlate clinical features with CT brain findings in CVA. **Methods:** This is a hospital based prospective study done in department of general medicine, Katuri Medical College and Hospital, Guntur, Andhra Pradesh. In 102 CVA patients admitted in the hospital between November 2014 to October 2016. All the subjects were thoroughly examined clinically to find the features suggestive of the lesion. Then the patients were subjected to basic lab investigations like Urine analysis, blood urea, serum creatinine, blood sugar levels, serum electrolytes, lipid profile and 12 lead ECG,2D Echo, CT brain. **Results:** Out of 102 patients 62 were males and 40 were females.86 showed lesion(positive CT) in the CT scan, either infarct or haemorrhage and in 16 patients CT scan was normal(negative CT).Out of 102 cases,clinically,77 cases presented as infarcts and 25 cases presented as haemorrhage. On CT Scan, 62 cases had infarcts (60.7%), 24 cases had haemorrhages (23.5%) and 16 cases showed normal CT findings(15.6%). **Conclusion:** Various clinical aspects in CVA do not correlate exactly with CT Scan findings in all cases, hence both thorough clinical examination and CT Scan brain are mandatory.

Key Words: CVA-Cerebrovascular Accident, CT-Computerized Tomography, MRI-Magnetic Resonance Imaging, ECG-Electrocardiography, ECHO-Echocardiography, MRC-Medical Research Council, FND-Focal Neurological Deficit, MCA-Middle Cerebral Artery, ICH-Intracranial Haemorrhage.

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INTRODUCTION

Stroke/CVA is an abrupt onset of neurological deficit due to focal vascular cause, and it needs both clinical and laboratory studies including brain imaging for diagnosis[1] The incidence of stroke increases with age[2] and increased in individuals with hypertension, diabetes, hypercholesterolemia, smoking[3]. The clinical manifestations of stroke are highly variable because of complex anatomy of brain and its vasculature. Early diagnosis and treatment is necessary to prevent mortality and morbidity[4]. Though MRI is superior to CT [5] the higher cost of MRI and the easy availability of CT scan brain makes CT the commonest investigation in diagnosis and treatment of stroke. CT plays a major role in CVA to assess the site, size, nature of the lesion[6]. This is a prospective study done in Katuri Medical College &Hospital, Chinakondrupadu, Guntur, Andhra Pradesh during the period of 1st November 2014 to 31st October 2016,in inpatients admitted for CVA and tried to correlate the clinical features with CT findings.

MATERIALS AND METHODS

This is a hospital based prospective study done in department of General Medicine, Katuri Medical College & Hospital, Guntur, Andhra Pradesh.

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Inclusion Criteria

Any patient admitted with

1. Acute onset of focal neurological deficit pertaining to vascular territory and on clinical examination suggestive of CVA was included in this study.
2. Stroke developing in already hospitalized patients.
3. All the patients clinically diagnosed as CVA irrespective of their age were included in this study.

Exclusion Criteria

History of trauma preceding the time of onset of deficit were excluded from the study

Total number of patients in the study

Total number of patients in the study is 102.

Period of Study: Two years

Limitation of the Study

1. Angiogram could not be done to assess the vascular territory involved and severity of ischemia.
2. MRI could not be done in all patients because of its cost factor.
3. Follow up study could not be done for these patients.

Selection and study of this patients were done as per inclusion and exclusion criteria. All the patients underwent a thorough and detailed general and neurological examination. Other systems examination was done in all the patients. Neurological examination was done with reference to motor, sensory, autonomic and higher functional disturbances.

Basic lab Investigations

a) Urine analysis.
b) Blood-Sugar, Urea, Creatinine.
c) Serum electrolytes.
d) Lipid profile.

II ECG

12 lead ECG was taken at least once in all those patients.

III ECHO: The ECHO was done in 18 patients who showed ischaemic and other changes in ECG.

IV CT Scan Brain

CT Scan Brain was done in all patients included in this study within 24 – 48 hrs of admission. It was repeated after 48 hrs when the initial CT Scan was negative and also repeated when the patient suddenly deteriorated or if there is no expected recovery.

OBSERVATIONS AND RESULTS

AGE AND SEX DISTRIBUTIONS

The total number of patients included in the study were 102 during the period of 2014 – 2016 in Katuri Medical College and Hospital. Out of which 62 were male and 40 were female patients.

Table 1: Age and sex distribution

Sex	20-40 years	41 – 60 years	61 – 80 years
Male	8	22	32
Female	4	10	26

Nature of lesion in CT scan

Out of the 102 cases, 62 cases showed infarct in CT Scan and 24 showed intra cerebral haemorrhage in CT.In16 patients CT Scan was normal.

Table 2: Infarcts and haemorrhages in CT

Sr. No	INFARCT		HAEMORRHAGE		NORMAL CT
i)	Massive infarct with midline shift	6	Massive haemorrhage with midline shift	4	
ii)	Infarct without midline shift	52	Haemorrhage without midline shift	20	
iii)	Lacunar infarcts	4			
	Total	**62**		**24**	**16**

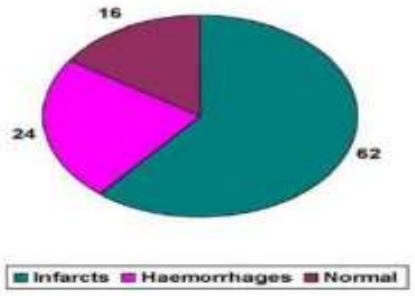

Figure 1: Nature of Lesion in CT

Analysis of the site of lesion

Pure Motor Hemiplegia: Out of the 102 patients 50 patients presented with pure motor hemiplegia alone without any cortical lobar dysfunction or brain stem or cerebellar signs. Most of these patients, about 36 revealed recent lesion in capsulo ganglionic region in CT Scan.

Table 3: Site of lesion in patients with pure motor hemiplegia

Capsuloganglionic region	Brain stem	cerebellum	Cortical lobar areas	Normal CT
36	6	0	5	3

Motor hemiplegia with cortical deficits: Out of the total 102 patients 26 patients showed clinically motor hemiplegia with cortical deficits like aphasia, neglect, visual field defects, visuospatial abnormalities, apraxia, release reflexes etc.

Table 4: Site of lesion in patients with motor hemiplegia with cortical deficits

Capsuloganglionic region	Brain stem	cerebellum	Cortical lobar areas	Normal CT
19	-	-	4	3

Pure sensory deficits: Out of the 102 patients only two patients presented clinically with pure sensory deficits. Their CT Scans were found to be normal.

Brain stem deficits: Out of the 102 patients 12 patients showed brain stem deficits clinically. Of which most of the patients about 8, showed normal CT Scan.

Table 5: Site of lesion in patients with brain stem deficits

Capsuloganglionic region	Brain stem	Cerebellum	Cortical lobar areas	Normal CT
3	1	-	-	8

Cerebellar stroke: Only two patients showed clinically cerebellar signs. Out of which one showed lesion in right cerebellar hemisphere and the other in frontoparietal region explaining the phenomenon of crossed cerebellar diaschisis.

Motor Hemiplegia with higher cerebral dysfunction: Totally only 10 patients showed motor hemiplegia with higher cerebral dysfunction in the study. Out of which 4 patients who presented clinically with frontal lobe dysfunctions, as evidenced by failure to do "FIST RING" test, three patients showed lesion in the subcortical areas (capsuloganglionic area) in CT scan and the 1 in frontoparietal region which correlated well.4 patients presented clinically with parietal lobe dysfunctions showed lesion in the non dominant parietal lobe which correlated well with clinical features. Out of the 2 patients who showed occipital lobar sign clinically, one showed lesion exactly in occipital cortex and the other in capsuloganglionic area.

Table 6: Site of lesion in higher cerebral dysfunctions:

Capsuloganglionic region	Brain stem	Cerebellum	Cortical lobar areas	Normal CT
4	-	-	1 frontal 4 parietal 1 occipital	-

From these results it was clear that most of the cases showed lesion in the subcortical white matter (63%). Since **capsuloganglionic** area is the mostly involved site, it is clear that **'MCA territory'** is the artery most commonly involved in hemiplegia patients in the study. Also clinical features correlated well with the site of lesion in CT scan except few cases (16 patients–16%) whose CT was Negative. These patients may be investigated by MRI scans for better correlations and occult lesions missed by CT scan.

Analysis of Severity of Lesion

7 patients out of 102 patients presented clinically with pure dense hemiplegia of power 0/5 and were disoriented and drowsy on examination. These patients who were expected to have large lesions in CT Scan showed only tiny lesions (<3mm) in CT Scan brain. From this it was clear that severity of lesion clinically does not correlate with size and extent of lesion in CT Scan.

DISCUSSION

All the 102 patients selected for this study were thoroughly examined and the diagnosis of CVA was made clinically and CT scan was done in all patients. It has been established well in this study, that there are some variations in the clinical and CT scan findings and they do not correlate exactly in all. CT scan is useful in differentiating vascular from non vascular disorder and infarct from haemorrhage[7]

Incidence of Age

In this study the youngest was 22yr and oldest was 80 yrs, the incidence of stroke is maximum in the age group of 61 – 80 years which comprises 56.8 % of total patients.

young strokes (<40years) comprised of 12 members in this study which is 11.7 % of all patients and closely correlates with the study done by Mehatakanika et al [8] young stroke constitute 12.4% of all patients .

Table 7: Comparison of age groups

AGE GROUP	PRESENT STUDY n=102	MEHTA KANIKA n=250
20-40 years	12 (11.7 %%)	31(12.4%)
41-60 years	32	89
61-80 years	58(56.8%)	108(43.2%)

Diagnosis of CVA: clinical versus CT[9]

Out of 102 patients clinically diagnosed as CVA included in this study,86 showed lesion(positive CT) in the CT scan, either infarct or haemorrhage and in 16 patients CT scan was normal (negative CT)[7]. Out of 16 patients who showed normal CT, 8 patients belong to posterior circulation(brainstem stroke) clinically i.e.,50% of normal CT scan brain[10] explained by studies done by lewissc, dennis MS *et.al* showed, patients presented with clinical features, with normal CT scan brain. 4 patients clinically presented with pure motor hemiplegia and 2 patients presented clinically as pure sensory stroke, also showed normal CT[11]. In 2 patients CT scan was initially negative when taken very early within 24 hours and the repeat CT scan revealed capsuloganglionic infarcts.

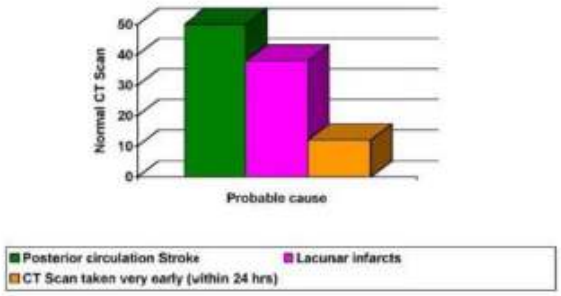

Figure 2: Causes of normal ct in the study

This shows that 12% of normal CT in this study were due to early CT scans taken within 24hours.There are 6 case which are suspected to have small lacunar stroke, which were occult and CT might have failed to pick up these lesions which needs further evaluation with MRI. It is clear that 38% of the normal CT in this study were suspected to be lacunar infarcts.

Nature of lesion: clinical versus CT

In distinguishing cerebral haemorrhage from cerebral infarction the following collective criteria though not always diagnostic, may prove helpful in suspecting an intra cerebral bleed. These are:

1. Moderately severe to intense headache (throbbing, pulsating or pounding) in a known hypertensive subject, accompanied by nausea or vomiting.
2. Altered state of consciousness (drowsiness progressing to deepening coma) with irregular respirations.
3. Neck stiffness, accompanied by dissociated eye movements or forced gaze deviation.
4. Blurred disc margins or pre retinal haemorrhage with changes suggestive of hypertensive retinopathy.
5. Hemiparesis on one side with shivering movements or even frank convulsions on the non paralysied side or quadriparesis with an extensor plantar on both sides etc.

Absence of these clinical findings with pure motor hemiplegia, intermittent progression of signs, relative preservation of consciousness and some degree of recovery were suspected to be infarcts in CT scan brain. Out of 102 cases, clinically, 77cases presented as infarcts and 25 cases presented as haemorrhage. On CT Scan, 62 cases had infarcts, 24 cases had haemorrhages and 16 cases showed normal CT findings.

Table 8: Comparision of nature of lesion in CT

	Present Study	Jahangir Khan et. al[12]	Jayaraj Durai et. al[13]
Infarct	62 (60.7%)	53%	68%
Haemorrhage	24 (23.5%)	23%	32%
Normal CT	16 (15.6%)		

6 (6%) out of 102 patients diagnosed clinically as CVA probably due to haemorrhage(ICH) showed massive infarct with midline shift in the CT scan brain. 5 patients (5%) who presented clinically as pure motor hemiplegia, in the absence of signs of ICH(headache, seizures, vomiting, altered sensorium, papilloedema) showed small haemorrhagic lesions in capsuloganglionic region in CT scan brain. Since small haemorrhagic lesions in CT mimicked ischemic stroke, clinically it is unwise to start antiplatelets in patients with CVA before taking CT scan brain. Thus it was clear that clinical signs and symptoms alone cannot establish an exact diagnosis of nature of lesion, like haemorrhage or infarction and hence CT is mandatory.

Site of Lesion Clinical Versus CT

In this study the most commonly involved vascular territory is MCA, and the most common site, for both infarct and haemorrhage is capsuloganglionic area.

Table 9: Comparison of nature of lesion clinically and site of lesion in CT

	Clinical	CT
Infarct	77	62
Haemorrhage	25	24
Normal		16

Predominant site of lesion in pure motor hemiplegia

Out of 50 patients presented clinically with pure motor hemiplegia alone without any cortical lobar dysfunction or brainstem or cerebellar signs revealed lesion is in capsuloganglionic area in CT scan. It was clear that site of lesion correlated well with pure motor hemiplegia (72%) in this study. The rest of the lesions were in frontoparietal and brain stem regions. This was explained by the "phenomenon of cortical subcortical diaschisis. This refers to functional deactivation of morphologically intact subcortical brain region remote from but connected to an area of cortical primary structural damage and also due to interruption of neural connections between cortical and subcortical structures according to Vonmonakow.

Site of Lesion in Motor Hemiplegia with Cortical Defecits

26 patients out of 102 presented clinically as motor hemiplegia with cortical defecits like aphasia, neglect, visual field defects, visuo spatial abnormalities, apraxia and release reflexes. Most of these patients about 19 showed lesion in the capsuloganglionic areas, this was explained by "phenomenon of subcortical cortical diaschisis. Lesions in subcortical white matter eg. Capsuloganglionic region showed cortical deficits clinically such as aphasia, neglect, visuo spatial abnormalities due to interruption of neural connections between subcortical structures and cortex, therefore to represent diaschsis .

Site of Lesion in Pure Sensory Defecit

2 cases presented clinically with pure sensory stroke showed normal CT which needs further evaluation with MRI to detect occult lacunar infarcts.

Site of Lesion in Brain Stem Defecits

Most of the patients (about 8) with brainstem stroke (posterior circulation stroke) showed normal CT probably due to bony artefact and lack of sensitivity in detecting posterior fossa lesions. 3 patients (3%) presented clinically as brain stem stroke clinically with features of depressed consciousness, pupillary abnormalities, paralysis of conjugate ocular movements were found to have massive lesions with midline shift in the CT .

Site of Lesion in Cerebellar Stroke

Out of 2 patients who presented clinically with signs of involvement of cerebellar hemisphere, one patient showed lesion exactly in the ipsilateral cerebellar hemisphere which correlated well. The other patient showed lesion in contra lateral frontal lobe. This is explained by phenomenon of crossed cerebellar diaschisis. According to this CCD is a matched depression of blood flow and metabolism in the morphologically intact contralateral cerebellar hemisphere.

Site of Lesion in Motor Hemiplegia with Higher Cerebral Dysfunction

4 Patients who presented clinically with parietal lobe dysfunctions like sensory neglect, hemi anopia, anasagnosia, dressing and constructional apraxia, visuospatial disorientation showed lesion exactly in non dominant parietal lobe which correlated well. (100%). Out of 2 patients who presented clinically with occipital features like hemi anopia, cortical blindness, one showed lesions exactly in occipital lobe which correlated well. Patients presented with frontal lobe features showed lesion in capsuloganglionic area predominantly which doesn't correlate, which could explained by the phenomenon of sub cortical cortical diaschisis.

Severity of Lesion Clinical Versus CT

Seven patients presented clinically with dense pure motor hemiplegia of power 0/5.Out of the 7 patients, 4 patients showed small lacunar infarcts and 3 showed tiny intra cerebral haemorrhage (ICH <3 mm). From this it was clear that severity of lesion clinically does not correlate with the size and extent of lesion in CT scan[14]. Comparison of clinical diagnosis with CT in ascertaining type of stroke, shows clinical diagnosis in majority of the case is not as reliable as CT, it can help in diagnosis but not confirm it, so high suspicion both clinically and radiologically is needed. Depending upon the location of occlusion, vascular lesions extra cranial or intra cranial, the availability of the collateral flow to that area, presence or absence of anatomical variations in the cerebral vasculature–kinks, bends, asymmetry, etc., associated diseases (e.g. hypertension, cardio pulmonary disease, diabetes mellitus etc.) Viscosity of blood and other ischemia modifying factors, the size of the cerebral infarction resulting from the thromboembolism may be minimal to massive and the resulting neurovascular deficit may be trivial to catastrophic.

CONCLUSIONS AND SUMMARY

1. Regarding the role of CT Scan Brain in the diagnosis of CVA it has been found that in this study, CT Scan was positive in 84% of the clinically diagnosed CVA and Negative (i.e. Normal) in 16% of the patients. Normal CT was found in the following clinically diagnosed CVA cases
    a. Posterior circulation stroke (Brain Stem Strokes).
    b. Small occult lacunar infarcts in cortical, subcortical areas which were not picked up by the CT.
    c. When taken very early (within 24 hours).In these cases repeat CT Scan was positive.

2. Regarding the nature of lesion in CVA it has been found that in some Cases, Massive infarcts in CT Scan mimicked Haemorrhagic stroke clinically and small haemorrhagic lesions mimicked ischemic stroke clinically. Also massive lesions with midline shifts resembled brain stem stroke clinically.
3. a. Regarding the site of lesion in CVA Clinical localization correlated well in majority (70%) of cases with CT Scan brain and only in 30% of cases if does not correlate which was explained by phenomenon of "Diaschisis"

   b. It has been found that, the most common site of lesion in CT Scan was found to be capsuleganglionic region (63%) indicating MCA territory involvement.
4. Size and extent of lesion in CT Scan does not correlate with severity of lesion clinically.
5. Finally to conclude overall, the various clinical aspects in CVA do not correlate exactly with CT Scan findings in all cases, hence both thorough clinical examination and CT Scan brain are mandatory.

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