CT AS A FIRST PRIME IMAGING MODALITY IN EVALUATION OF CEREBROVASCULAR STROKEShruti Patil¹, Suresh B. Masimade², Govinda Raju B. T³, Mahesh⁴**HOW TO CITE THIS ARTICLE:**

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ABSTRACT: Cerebrovascular stroke is defined as a focal or global deficit of brain function lasting for more than 24 hours which had occurred within 2 weeks of the patient's presentation and which was considered on admission to be of vascular cause. Computed tomography with its widespread availability and cost effectivity has greatly helped in the early diagnosis and further management of stroke. The purpose of the study is to document the presence or absence of infarct or hemorrhage to determine, the location, territory of blood vessels involved and evaluate age and sex incidence, and various risk factors predisposing to stroke and to reasonably assess the clinical outcome of these patients. **INTERPRETATION AND CONCLUSION:** Computed tomography is a simple, inexpensive, highly effective imaging modality, to rapidly evaluate patients with symptoms of stroke. CT is one of the most comprehensive diagnostic modality for accurate localization of site and type of stroke, thereby aiding in the accurate line of treatment.

KEYWORDS: Computed tomography; infarct, haemorrhage.

INTRODUCTION: Cerebrovascular stroke is defined as focal neurological abnormality due to disturbance in cerebral blood flow, of any cause, generally of sudden onset that does not resolve completely in 24 hours.¹ Early imaging plays an important role in ruling out vascular causes of symptoms, defining extent of an acute ischemic process, differentiating between infarct or a hemorrhage, identifying cause of an acute ischemic process thereby helping in further management of patients.²

Non-contrast CT-scanning allows surveillance of emergency therapeutic approaches such as evacuation of intracerebral hemorrhage and thrombolysis in 'ischemic stroke after exclusion of major early signs of ischemia. CT angiography and CT perfusion can add important etiologic aspects to diagnosis and initial treatment.³

Despite the superior sensitivity of diffusion MRI to the presence of acute stroke, lack of immediate, 24 hour availability with high cost, limits its utilisation in most clinical settings.

Therefore, CT remains the first prime imaging modality for evaluation of patients with suspected cerebrovascular stroke.

AIMS AND OBJECTIVES:

1. To document the presence of hemorrhage or infarct by using CT.
2. To evaluate age and sex incidence of stroke.
3. To determine size, location and reasonably assess the territory of blood vessels involved.
4. To evaluate various risk factors predisposing to stroke.
5. To prognosticate and explore the possibility of an effective treatment.

ORIGINAL ARTICLE

METHODOLOGY: Source of Data: The present study was carried out in patients clinically diagnosed with stroke, referred to H.K.E. Society's Basaveshwar Teaching & General Hospital, and Sangameshwar Teaching & General Hospital, Gulbarga attached to M. R. Medical College, Gulbarga in the Department of Radiodiagnosis during the period from September 2006 to August 2008.

Sample Size: The Study comprised a total of 100 patients, clinically diagnosed to have stroke, admitted to Basaveshwar Teaching & General Hospital, and Sangameshwar Teaching & General Hospital, Gulbarga.

Inclusion Criteria:

- Patients presenting with symptoms of stroke of vascular origin.
- Patients of all age presenting with symptoms of stroke.
- Patients presenting with primary symptoms within 7 days of initial onset.

Exclusion Criteria:

- Patients with stroke associated with head injury.
- Patients of neonatal age group, presenting with symptoms of stroke due to birth injuries.
- Patients presenting with neurological deficits due to obvious causes besides vascular.

Plan of Study: A complete clinical history of patients was noted on proforma, which include age, sex, chief complaints, detailed past history of risk factors like hypertension, diabetes mellitus, chronic heart disease and personal history. Follow-up of the patients during their hospital stay was performed.

Equipments:

- The patients were scanned using Hitachi W400 Matrix size – 512.
- Slice thickness – 10 mm, 5 mm.
- KV – 80 to 130
- MAS – 50 to 270.

CT Protocol:

Patients Position: Patients were made to lie down in supine position, with head in head rest, arms by the side and chin was kept as far down as comfortably possible.

Plan of Section: 10-25 degree to Reids line or parallel to orbitomeatal line. Continuous axial sections of slices thickness 5 mm were taken for posterior fossa and 10 mm for supratentorial regions. Thinner sections were also obtained in the region of interest.

IV Contrast: Routine IV contrast of at least 40 ml of 76% iodinated contrast agent (calculated as 300mg per kg body weight) was used in all cases of stroke exception in ICH of non-traumatic origin.

RESULT: The present study was carried out in patients with clinically diagnosed with stroke, referred to H.K.E. Society's Basaveshwar Teaching & General Hospital, and Sangameshwar Teaching

ORIGINAL ARTICLE

& General Hospital, Gulbarga attached to M. R. Medical College, Gulbarga in the Department of Radiodiagnosis during the period from September 2006 to August 2008.

Total 100 patients of stroke were examined.

Sex Distribution: In the present study of 100 cases, 65 patients were males (65%) and 35 per cent were females (35%). Among the 65 male patients, 30 patients (46.2%) were cases of infarction and 20 (30.8%) had hemorrhage.

Among the 35 female cases, 20 (40%) had infarction and 10 (33%) had hemorrhage.

The male to female ration is 1.5:1 in infarct, while it was 1:1.07 in hemorrhage.

In this study it was observed that males were more affected in both infarct and ICH.

Risk Factors: Hypertension: Among the risk factors, past history of hypertension was given importance. In this study 44% of total patients had history of pre-existing hypertension, however many admitted that they were not tested for hypertension before the onset of stroke.

Out of 100 cases, 44 patients had hypertension. 21 patients i.e., 47.72% with hypertension showed infarct and 23 patients i.e., 52.27% with hypertension showed ICH.

This study showed that hypertension formed a predominant risk factor for cases of intracranial hemorrhage.

Diabetes Mellitus: In this study, 39% of patients had history of diabetes mellitus. Many patients were not tested previously for diabetes mellitus before the onset of stroke.

Out of 100 cases, 39 patients had diabetes mellitus. 28 patients i.e., 71.7% of patients with diabetes mellitus showed infarct and 11 patients i.e., 28.2% with diabetes mellitus showed ICH.

This study showed that diabetes mellitus formed a predominant risk factor for cases of infarct.

Heart Disease: In this study, 12% of patients had history of existence ischemic heart disease.

Out of 100 cases, 12 patients had cardiac disease. 7 patients i.e., 58.33% with cardiac disease showed infarct and 5 patients i.e., 41.66% with cardiac disease showed ICH.

Involvement of Vascular Territory: Cerebral Infarction: Out of 100 cases of CT evaluation of CVA, 50 cases of infarcts were diagnosed accounting for 50% of the cases.

In this study, the vascular territory of involvement is maximum in right MCA accounting for 36% of cases.

Intracerebral Hemorrhage: In this study of 100 patients clinically suspected of CVA, 30 patients turned out to have ICH accounting for 30% of cases.

Size of Infarct: In the present study, it was observed that the size of infarct in cases of stroke was noted, with the smallest size being 10 x 12 mm and largest being 70x60mm.

In cases of hemorrhage, largest was 65 x 65mm, smallest was 10 x 15mm.

ORIGINAL ARTICLE

Subarachnoid Hemorrhage as a Percentage of All Strokes: In the present study of 100 cases of CVA, 5 cases had subarachnoid hemorrhage accounting for 5%. These studies of primary subarachnoid hemorrhage include subarachnoid due to aneurysm rupture, rupture of AV malformation and subarachnoid of unknown cause.

Cerebral Venous Thrombosis (CVT): In this study of 100 cases of CVA, 4 cases of CVT accounting for 4%. Interestingly all CVT patients were females and all were subjected to CT study in post-partum period.

Tumors: In this study, stroke mimics, tumors was detected in 6 cases (6%). Signs and symptoms of tumor were mimicking signs and symptoms of stroke, which later turned out to be tumorous pathology on CT scanning.

Clinically Suspected CVA but Normal on CT Brain: Out of 100 cases, 5 cases i.e., 5% turned out to be normal. These were taken as negative cases. There were technical problems to detect infarction but certainly hemorrhage was ruled out.

Clinical Outcome: Out of 100 patients diagnosed to have stroke, 50 patients had infarct and 30 patients had ICH. The clinical outcome and sequelae of these patients were categorized as follows.

DISCUSSION: This study was conducted to prove the role of Ct as the first prime imaging modality in the evolution of stroke.

In studies conducted by Joseph Becker, it was concluded that CT scanning of brain was mandatory for rapidly distinguishing ischemic from hemorrhagic infarction and for defining the anatomic distribution of stroke.⁴

Gaskill Shipley in a comparison study of MRI and CT concluded that CT is fast, reliable, easily available and cost-effective for patients clinically diagnosed to have stroke.⁵

In studies conducted by Vaishali et al it was noted that CT helps in detecting lesions that mimic stroke such as tumors, infections, vascular malformation and subarachnoid hemorrhage.

In this study, a total of 100 patients clinically suspected to have stroke were evaluated by CT brain.

Out of these 50 patients (50%) were diagnosed to have infarct, 30 patients (30%) of cases diagnosed to have hemorrhage, 5 patients (5%) of cases had subarachnoid hemorrhage, 4 patients (4%) had CVT, 6 patients (6%) had tumor, 5 patients (5%) were normal.

In studies done by Karetol AM and Pradhan for evaluation of stroke in Indian population, out of 107 cases studied clinically and by CT 77 cases i.e., (71.9%) of stroke were diagnosed to have infarct and 30 cases (28%) had hemorrhage.⁶

In the present study, the incidence of infarct (50%) was also more than hemorrhage (30%).

In studies conducted by Roy Chowdhary et al on 30 cases of acute stroke, diagnosed by CT had infarct in 70.3%, intracerebral hemorrhage in 25.9% of cases, while subarachnoid hemorrhage in 3% of cases.⁷

The average age of patients was 60 years with a male preponderance of 51.8% and females 48.2%.

ORIGINAL ARTICLE

In the present study, it was also observed that both infarct and hemorrhage were most common in the age group of 60-69 years. Out of 100 cases evaluated 65% of males were of stroke involved as compared to only 35% of females being involved. Hence, it was observed that predominantly males were more affected by CVA as compared to females.

In studies conducted by Ariesen M et al on 1000 patients to evaluate risk factors affecting intracerebral hemorrhage, it was observed that untreated hypertension accounted for 65% of cases of ICH followed by diabetes mellitus (20%), alcohol (15%).⁸

In the present study, out of 100 patients 44 had hypertension 21 patients (i.e., 47.72%) with hypertension showed infarct and 23 patients i.e., 52.27% with hypertension showed ICH. Therefore, it can be noted that hypertension forms a predominant risk factor for ICH.

In a population based study conducted by John et al on 80 patients of clinically diagnosed to have stroke to identify the most commonly involved vascular territory, 55% of patients had insular infarcts (MCA territory), 38% patients had hemorrhage in putamen and external capsule regions, 5% were found to involve posterior cerebral circulating.⁹

In the present study, it was noted that infarct and hemorrhage predominantly involved MCA territory, accounting for 36% of infarcts and 30% of hemorrhage involved right MCA and left MCA respectively.

In studies done by Minnesota et al, 75 patients with stroke, 7.2% patients had subarachnoid hemorrhage. In the present study 5% of cases had subarachnoid hemorrhage. These studies of subarachnoid hemorrhage include those due to rupture of AV malformations, aneurysmal rupture and those of unknown cause.¹⁰

In Oxfordshire Community Project, 5 non-stroke lesions were detected by CT (2 gliomas, 2 subdural hematomas, 1 metastasis) out of 325 patients clinically diagnosed as having definite stroke.¹¹

In the present study of 100 cases, 5% of them had subarachnoid hemorrhage, 4% of cases had CVT and 6% of cases had tumors as stroke mimics.

CONCLUSION: Stroke being the 3rd leading cause of death worldwide, and associated with a permanent sequelae of disability, obliges the need of very early diagnosis and neuroimaging.

Neuroimaging techniques provide some of the most important diagnostic, prognostic and pathophysiological information in the management of cerebrovascular accidents. Beside the correct diagnosis itself, the time to establish a diagnosis above all has a crucial impact on successful management and good outcome of these patients.

Computed tomography is a simple inexpensive, highly effective modality in detecting hemorrhage or infarct and differentiating it from various stroke mimics. CT brain aids in categorizing patients for receiving thrombolytic therapy, while patients with hemorrhage are taken down a completely different diagnostic and therapeutic pathway.

CT is one of the most comprehensive diagnostic modality for accurate localization of infarct or hemorrhage. Hence, it is justifiable that CT brain should be considered the first prime imaging modality of choice in cases of cerebrovascular accidents as it forms the cornerstone for rapid and effective diagnosis.

ORIGINAL ARTICLE

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CT Findings	No. of cases	Percentage
Infarcts	50	50.00
Hemorrhage	30	30.00
SAH	5	5.00
CVT	4	4.00
Tumor	6	6.00
Normal	5	5.00

Table 1: CT Findings

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Fig. 2: Age wise Distribution of Infarcts

Fig. 3: Age wise distribution of Hemorrhage cases

Vascular Territory Involved	No. of Cases	Percentage
Right MCA	18	36.00
Left MCA	8	16.00
Right ACA	3	6.00
Left ACA	2	4.00
Right PCA	3	6.00
Left PCA	2	4.00
Both MCA	4	8.00
Right MCA+PCA	4	8.00
Left MCA + PCA	3	6.00
Basilar artery except PCA branch	3	6.00
Table 2: Involvement of Vascular Territory		

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Outcome	Infarct		Hemorrhage		Total	
	No. of Cases	Percent	No. of Cases	Percent	No. of cases	Percent
Recovery	32	71.11	13	28.89	45	100.00
Neurological deficit	9	50.00	9	50.00	18	100.00
Death	6	40.86	8	57.14	14	100.00
Discharge against medical advice (DAMA)	3	100.00	--	--	3	100.00

Table 3: Outcome of Infarct and Hemorrhage Cases

$\chi^2 = 4.79$ d.f. = 2 $p > 0.05$ Insignificant.

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