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Research Article

The role of computed tomography in the evaluation of cerebrovascular accidents

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ABSTRACT

Background: Cerebrovascular accidents (CVA) or stroke ranks first in frequency and important among all the neurological diseases of adult life. 50% of neurological disorders in a hospital are of this type. It is the third leading cause of death throughout the world. The prolonged morbidity and extended hospitalization required by these patients makes the disease one of the most devastating in medicine. The purpose of the present study was to document the presence or absence of hemorrhage or infarct, to determine the size, location of infarct, reasonably assessing the territory to blood vessels involved and to detect the incidence of negative cases of clinically suspected stroke.
Methods: 100 cases admitted to KIMS, Hubli and those referred to the NMR scan centre, Hubli with the clinical diagnosis of acute stroke were taken up for the study. The study was done from May 2010 to April 2012.
Results: Out of 100 patients clinically suspected of CVA, submitted for CT scan study of the brain, 69 patients had infarcts, 21 patients had hemorrhage, 8 patients had CVT, 1 patient had SAH and 1 patient had normal scans. Infarcts (69%) formed the major group of the CVA cases involving most commonly the LMCA territory in 10 (14.49%) patients. Hemorrhage (21%) formed the second major group of CVA cases involving most commonly the RMCA territory 9 (42.85%) patients.
Conclusions: CT scanning is a gold standard technique for the diagnosis and management of stroke and can be ideally done in all cases.

Keywords: Cerebral infarction, Cerebrovascular accident, Intracranial haemorrhage, Tomography, X-ray computed

INTRODUCTION

Cerebrovascular accidents (CVA) are one of the leading causes of death after heart disease and cancer in the developed countries and became one of the leading causes of death in India.[1] The exact prevalence rate of this disease in the Indian population is not known, although it accounts for about one percent of admissions to general hospital.

The incidence rate and death rate from stroke increases dramatically with age. About 15 to 30% of patients die with each episode of cerebral infarction and 16 to 80% with cerebral hemorrhage. Those who survive are usually left with permanent disability. Thus, stroke becomes a great medical and social problem. Accurate and early diagnosis may improve the morbidity and mortality rates in the future as newer and more effective therapies are currently being instituted.[2]

There is a potential for prominent impact for radiologic imaging on care for patient with acute stroke.[3] Computed tomography (CT) is very important in diagnosis of CVA as it shows if it is hemorrhagic or ischaemic.[4] CT helps to compare patterns of abnormalities viewed with clinical profiles and pathologic anatomic findings at necropsy.[5] It has proven to be of significant potential prognostic value in the evaluation of the acute stroke patient.[6] However, it is a relatively new and scarcely available facility in a yet developing country like India. Its use is further restricted

by patient's economic status. CT is still the method of choice for most of acute stroke patients despite of many improvements in MR technology. Contrary to a long existing opinion CT is a good diagnostic instrument even in early phase of acute ischemic stroke.[7] In combination with new helical CT techniques (CT angiography) all important decision regarding early therapeutic decisions can be answered.[8]

There is paucity of literature on CT studies of patients with CVA. Hence the present study was conducted to assess the presence or absence of hemorrhage or infarcts, determining the size, location and assessing the territory of blood vessels involved in selected patients with CVA.

METHODS

The present study was carried out in the Department of Radiology, KIMS, Hubli and at NMR scan centre, Hubli for a period of 24 months starting from May 2010 to April 2012. All patients with the clinical diagnosis of acute stroke were referred to the radiology department for CT scan of the brain.

All patients with clinical diagnosis of acute stroke aged above 12 years, admitted in the KIMS and those referred to NMR scan centre, Hubli, were included in the study. Patients with neurological defects due to obvious cause other than vascular, such as hypoglycaemia, diabetic ketoacidosis and traumatic cause were excluded from the study. After meeting the requirements of inclusion criteria a total of 100 patients were included in the study.

All patients referred for CT evaluation were scanned by using GE Hi speed dual slice spiral CT scanner and Toshiba helical CT scanner machine with the following specifications: 80 milliamperage, 120 kilovoltage, tilting angle ±22^{o}, matrix size of 512×512. Scans are taken parallel to the floor of the anterior fossa, the lowest section through the external auditory meatus and continuing to the top of the head. The gantry is angled towards the feet. Slice thickness of 4mm was used for scanning posterior fossa, 7mm for remainder of the head and wherever necessary still thinner sections were taken.

Routine IV contrast was carried out by using 40 ml of 76% iodinated contrast agent (calculated as 300 mg iodine per kg body weight) in all the cases of stroke except in intracerebral hemorrhage of non-traumatic origin. Follow up was done for a period of two months by subsequent repeat scans of the patient. These scans will be correlated with surgical finding where ever necessary or by favorable clinical outcome. Size of the lesion, peri-lesional edema, attenuation values will be compared with prior to and after treatment.

RESULTS

Out of 100 patients clinically suspected of CVA submitted for CT scan study of brain 69 patients had infarction, 21 patients had hemorrhage, 08 patients had cerebral venous thrombosis (CVT), 01 patient had subarachnoid hemorrhage (SAH), 01 patient had normal scan. None of them had tumorous pathology as presented in Figure 1.

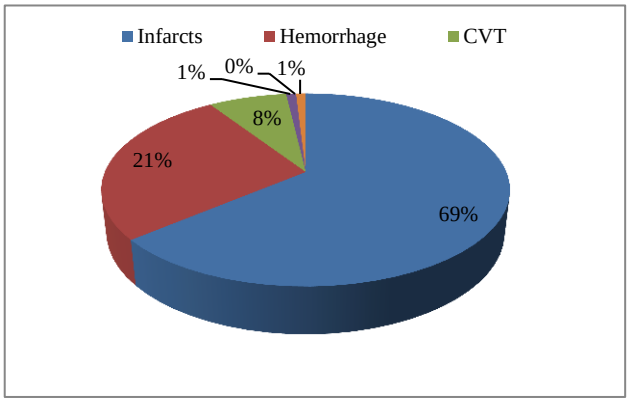

Figure 1: Distribution of 100 cases of clinically suspected CVA on CT study.

In present study the age of the patient varied from second decade to ninth decade. The youngest patient was 22 years old and oldest was 92 years. The age distribution in case of infarcts and hemorrhage are illustrated in Table 1.

Table 1: Age distribution in case of infarcts and hemorrhage.

Age (in years)	No. of cases with infarct	No. of cases with hemorrhage
20-29	3	0
30-39	4	0
40-49	8	1
50-59	9	3
60-69	19	9
70-79	18	6
80-89	7	2
90-99	1	0

Table 2 presents sex distribution among cases of infarcts and hemorrhage. Among the 100 cases included in the study, 52 patients were males (52%) and 48 patients were female (48%).

Table 2: Sex distribution among cases of infarcts and hemorrhage.

Sex	Infarction	Hemorrhage
Males	53.62%	52.3%
Females	46.38%	47.7%
Male:Female	1.15:1.0	1.1:1.0

Among the risk factors, past history of hypertension and diabetes in CVA patients were given importance. Many patients were not tested previously for evidence of hypertension and diabetes before the onset of stroke. Out

of 100, 36 patients had history of pre-existing hypertension and 25 had diabetes. Prevalence of Infarction and hemorrhage among patients with these two risk factors were given in Table 3.

Table 3: Prevalence of infarction and hemorrhage in hypertensive and diabetic patients.

	Diabetes	Hypertension
Infarction	19 (76%)	17 (47.22%)
Hemorrhage	6 (24%)	19 (52.77%)

Out of 100 cases of CT evaluation of CVA, 69 cases of infarction and 21 of intracerebral hemorrhage were diagnosed for involvement of vascular territory. Of them by 9 Patients had lacunar infarcts along with other large infarcts.

Table 4: Involvement of vascular territory among cases of infarction and hemorrhage.

Vascular territory	Infarction	Hemorrhage
Right MCA territory	8 (11.59%)	09 (42.85%)
Left MCA territory	10 (14.49%)	02 (9.52%)
Right PCA territory	03 (4.34%)	02 (9.52%)
Left PCA territory	06 (8.69%)	02 (9.52%)
Right ACA territory	03 (4.34%)	-
Left ACA territory	03 (4.34%)	-
Right MCA and ACA	01 (1.44%)	-
Left MCA and ACA	02 (2.89%)	-
Right MCA and PCA	04 (5.79%)	01 (4.76%)
Left MCA and PCA	09 (13.04%)	-
MCA and vertebro basilar artery	02 (2.89%)	-
MCA and PCA on both sides	03 (4.34%)	-
Right MCA , PCA and ACA	02 (2.89%)	-
Both sides of MCA	03 (4.34%)	-
Vertebro basilar artery	06 (8.69%)	-
Isolated lacunar infarcts	04 (5.79%)	04 (19.04%)
Haemorrhagic infarction	-	01 (4.76%)

Table 5: Incidence of intracerebral hemorrhage in different parts of brain.

Areas of brain	No. of cases	Percentages
Putamen / External capsule	10	47.61%
Thalamus	3	14.28%
Lobar	2	9.52%
Cerebellum	2	9.52%
Pons	2	9.52%
Haemorrhagic infarcts	1	4.76%
Miscellaneous	1	4.76%

Table 5 shows the affected areas of brain in case of intracerebral hemorrhage in 21 patients. In the present study intraventricular extension was noted in 12 cases accounting for 57.14% which had bad prognosis. The size of bleed in brain will reflect the severity of. In our study 10 patients had bleed in the size of 2-5 cms and the remaining patients showed damage in different sizes as given in Figure 2.

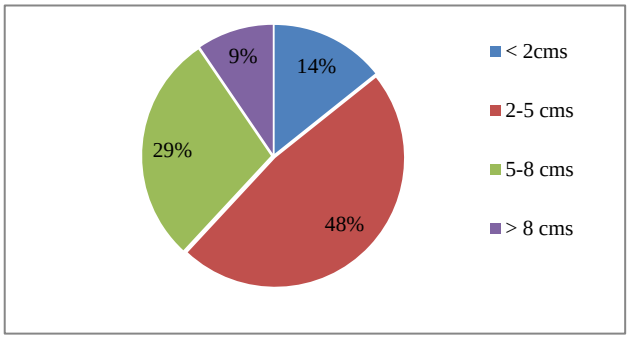

Figure 2: Distribution of ICH according to the size of the bleed.

In present study 01 case had subarachnoid hemorrhage. 08 cases had reported with CVT. All the cases were associated with cortical/subcortical hemorrhages adjacent to the occluded sinus. Out of 8 cases, 6 cases were female and 2 cases were male. Female: Male ratio was 3: 1. Out of 6 females, 4 patients were in puerperium. All the cases of CVT belonged to the age group of 20-30 years (3rd decade). Table 6 demonstrates different areas of brain affected with CVT.

Table 6: Different areas of brain affected with CVT.

Areas of brain affected with CVT	No of cases (%)
Superior sagittal sinus thrombosis	3 (37.5%)
Sigmoid sinus thrombosis	2 (25%)
Transverse sinus thrombosis	1 (12.5%)
Sigmoid sinus and Transverse sinus thrombosis	1 (12.5%)
Superior sagittal sinus, Sigmoid sinus and Transverse sinus thrombosis	1 (12.5%)

DISCUSSION

This study was directed to evaluate the role of CT scan in patients presenting with acute CVA in differentiating between hemorrhage, infarct and other causes of stroke.[1]

Before the advent of CT scan and in places where CT scan is not yet available, physicians were mainly dependent on the history, physical findings and the Allen's method of scoring to differentiate between hemorrhage and infarct using this scoring system. Allen studies 174 cases of acute stroke and was able to make an accurate diagnosis in 90% of cases.[9] However, the scoring system had certain limitations as it is dependent

on the history given by the relatives of patients and sometimes they are not able to give a clear description of signs and symptoms which correlated with the scoring system. 100% accuracy in distinguishing hemorrhage from ischemic stroke based on clinical findings was not possible.

Previous studies have reported the usefulness of CT scan in patients suffering from stroke by ability to differentiate between hemorrhage and infarct and other causes of stroke and thus aiding in the clinical management. Oxford shire community stroke project that assesses 325 consecutive patients of acute stroke highlighting the role of usefulness of CT scan.[10]

Cerebral CT is a mainstay in emergency diagnostic work up of acute stroke patients and conveys important information within a few hours after the ictus. Harring et al., found that in a recent series of patients with MCA territory infarctions the incidence of positive findings was 68% in cerebral CT scans performed within 2 hours of stroke onset increasing to 89% within 3 hours, thus emphasizing the great value of emergency cerebral CT scanning in acute stroke management, which is superior to MRI.[11]

In the present study 100 patients of stroke were analysed for a period of two years and of them 69% patients had infarct, 21% patients had hemorrhage, 08% patients had CVT, 1% patient had subarachnoid hemorrhage and 1% patients had normal scan. These findings of the study in relation to infarct and hemorrhage were almost similar to the studies reported by Jacob et al. In his study 60% infarcts, 30% hemorrhage and 8% subarachnoid hemorrhage were reported.

The findings of the study revealed that there is a male preponderance over female in the incidence of infarction and hemorrhage. There are male:female ratio of 1.15:1.0 for infarction and 1.1:1.0 for hemorrhage were recorded in the study. This study was similar to study in South-West Nigeria reported a male to female ratio 1.3:1.[12] Also, a retrospective study of medical admissions at the University of Nigeria Teaching Hospital, Enugu reported a male gender preponderance.[13]

This male preponderance in CVA suggests that men have more risk factors for CVA such as hypertension and diabetes mellitus than women. Although, we did not review the lifestyle and habits of the patients, we think that men are more involved in high-risk habits such as smoking and alcoholism, and probably work harder under stressful conditions. These factors are closely associated with hypertension and other cardiac diseases which may elicit CVA.

Over 75% of all infarcts occur in MCA territory. Detection of MCA territory hypodensity on hyper acute CT is a sensitive, prognostic and reliable indicator of the amount of MCA territory undergoing infarction.[14] In the present study 59 (85.5%) cases had infarcts of MCA territory and 6 (8.69%) cases had infarct in vertebra basilar artery. This finding was similar to the results reported by Razzaq who performed a CT study to investigate the role of CT in diagnosis and management of young stroke patients.

In his study, about 80% of the patients had infarcts of carotid territory and 20%, the vertebro basilar distribution. More than half of the infarcts were cortical (56%).[15] In our study, left MCA territory 10 (14.9%) was the most commonly affected site in cases of infarction associated with CVA and right MCA territory 9 (42.85%) was the most commonly affected site in case of hemorrhage.

In this study intracerebral hemorrhage was observed in 21 patients with involvement of different areas of brain as demonstrated in Table 5. Putamen is the most commonly affected area in almost 10 (47.61%) patients. This is in accordance with the observations of Thaker et al.[16] In the present study of 100 patients, 08 cases of CVT and 1 case of subarachnoid hemorrhage was detected and the patients presented with an acute stroke like picture.[17]

Detection of early CT findings in acute ischemic stroke has proved to be of prognostic value in the evaluation of these patients. The use of CT coupled with early acute phase therapy of stroke such as thrombolytic therapy has been shown to improve outcome in acute stroke patients.[18]

CONCLUSION

CT scanning is the gold standard technique for diagnosis of acute stroke as the rational management of stroke depends on accurate diagnosis and should be ideally done in all cases. Since risk factors such as hypertension, diabetes, cardiac disease and previous episodes of stroke play major role in the evolution of cerebrovascular accidents, thorough analysis by CT scan, other investigations and treatment in these patients will decrease the incidence of fresh episodes of CVA.

Recommendations

- CT scanning should be the first line of investigation for diagnosis of acute stroke as it is widely available than MRI and the rational management of stroke depends on accurate diagnosis and should be ideally done in all cases. In addition, CT is fast and is easily performed in severely ill patients who are dependent on support and monitoring devices.
- CT scanning should be done in patients with sudden onset of neurological deficit or unexplained headache for the possibility of stroke.
- Non-contrast CT Scanning should be performed prior to administration of thrombolytic therapy in all cases of acute stroke to exclude intracerebral hemorrhage. Non-contrast CT scanning also plays a key role in

the detection of hemorrhage or other possible mimics of stroke (e.g., neoplasm, arteriovenous malformation) that could be the cause of the neurologic deficit.

- CT scanning is pivotal in determining which course of treatment is called for. Treatment for ischaemic stroke is thrombolysis. Treatment of hemorrhagic stroke aims to relieve pressure on the brain, including with surgery or medication. And CT scanning is also helpful for Follow up studies to look for the resolution of the intracerebral hemorrhage and the effectiveness of the given treatment.
- Multimodal CT evaluation that combines non-enhanced CT, perfusion CT, and CT angiography has been shown to improve detection of acute infarction, permit assessment of the site of vascular occlusion, the infarct core, and salvageable brain tissue; and help assess the degree of collateral circulation.

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