Role of Computed Tomography in Evaluation of Cerebrovascular Accidents.

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ABSTRACT

Background: Our study was to evaluate the role of computed tomographic scan in patients with cerebrovascular accidents. **Methods:** patients with CVA were subjected to computed tomography scan of the head using GE Revolution ACTs 16 slice MDCT scanners, Slice Thickness – 2mm, 5mm and 10mm and Matrix size of 512 X 512. **Results:** Data was analyzed by using MS-Office software. **Conclusions:** CT scanning was the "Gold standard" technique for diagnosis of acute stroke as the rational management of stroke depends on "Accurate diagnosis" and it should be ideally done in all cases.

Keywords: Stroke, computed tomographic scan.

1

INTRODUCTION

Cerebrovascular accident or stroke is defined as an acute loss of focal and at times global (applied to patients in deep coma and those with subarachnoid haemorrhage) cerebral function, the symptoms lasting more than 24 hours or leading to death with no apparent cause other than that of vascular origin (WHO). [1]

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Stroke is a generic term that describes a clinical event characterized by sudden onset of neurological deficit. Stroke syndromes have significant clinical and pathological heterogeneity that is reflected in their underlying gross pathologic and imaging appearance. Arterial ischemia /infarction are by far the most common cause of stroke, accounting for 80% of all cases. The remaining 20% are mostly hemorrhagic, divided between primary spontaneous intracranial hemorrhage (sICH), nontraumatic subarachnoid hemorrhage (SAH), and venous occlusions.[2]

Cerebrovascular accidents are one of the leading causes of death after heart disease and cancer in the developed countries and one of the leading causes of death in India. 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 the 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 haemorrhage. 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]

The advent of CT in early 1970s greatly facilitated the diagnosis and management of stroke and added significantly to our understanding of patho-physiological brain alterations in case of humans. With CT it is now possible for the first time to non-invasively and reliably diagnose and distinguish between stroke due to cerebral infarction and stroke due to hemorrhage. In addition, other brain lesions, at times, may clinically present as stroke like syndromes such as primary or metastatic brain tumor or subdural hematoma that can usually be clearly differentiated by CT examination.[3]

Computed Tomographic is one of the most accurate methods available for identifying and localizing an infraction within the brain. Ischemic infarction, haemorrhagic infarction and intracerebral hematoma are usually differentiated. CT also permits identification of the acute and chronic sequence that may develop after a sequence of infarction. These include, in acute phase, brain swelling and conversion of a bland infarct into haemorrhagic infarct and in chronic phase, cystic parenchymal change, cortical atrophy and focal ventricular dilation.[2]

Despite many improvements in MR technology, CT is still the method of choice for most of the patients being evaluated for cerebrovascular accidents because of its fast acquisition. CT is a good diagnostic instrument even in early phase of acute ischemic stroke. In combination with new helical CT technique (CT angiography) all- important decisions regarding early therapeutics can be answered.

Clinical approach to stroke has undergone many changes in the past few years. CT scan has become an essential and integral part of the assessment and has given a more objective basis to the management and use of the IV contrast material. After non-contrast CT and the availability of follow-up studies in many instance significantly aids in the determination of the correct vascular etiology of the stroke, as does correlation of CT changes with patient's age, sex, history and neurological deficit. Aims of our study were to detect the presence or absence of infarct or hemorrhage, to determine the location and arterial territories involved of infarct with respect to onset of clinical symptoms and to detect other causes simulating stroke.

MATERIALS & METHODS

A total of 60 patients (40 males and 20 females) with age group 20 to 85 years with stroke were included in this study. The attendant of entire subject signed an informed consent approved by institutional ethical committee of Katihar Medical College, Katihar, Bihar, India was sought. Data was collected on the basis of inclusion and exclusion criteria, with irrespective of sex in OPD or the ward, of department of Medicine/Radio diagnosis, Katihar Medical College, Katihar, Bihar during period of November 2014 to October 2016.

Patients with clinical history of stroke were subjected to computed tomography scan of the head using GE REVOLUTION ACTs 16 slice MDCT SCANNER. The imaging protocol consisted of acquisition of sequential 5x5 mm axial sections with image reconstruction (coronal and sagittal) and viewing MPR images without intravenous contrast material administration. Images were evaluated with brain window settings.

Definition of study subject: The study subject was considered as a case of cerebrovascular accident if he/she has an acute stroke which is defined as a focal or global deficiency 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 have a vascular cause. Clinical details and the computed tomography findings of the case were recorded as per the proforma. No attempt was made to compare computed tomography with other imaging modalities like M.R.I, Angiography or Doppler.

Inclusion Criteria was patients with clinical diagnosis of acute stroke. Patients with neurological deficiency due to obvious cause other than vascular, such as hypoglycemia, diabetic keto acidosis and traumatic cause were excluded in this study.

Equipment used: GE Revolution ACTs 16 slice MDCT scanners, Slice Thickness – 2mm, 5mm and 10mm and Matrix size of 512 X 512.

Computed Tomography Scan Technique:
Patient Position: Patient was supine with the head on the head rest, arms by the sides and the chin was as far down as comfortably possible. Plane of Section at 100 – 250 to Reids line or parallel to orbito-meatal Line. **Reid's base Line**: Passes from infraorbital margin to the upper border of external auditory meatus. This ensures that a minimum number of scans will pass through the lens. **OM Line (Orbito-metal line):** Passes from lateral canthus to the middle of the external auditory meatus. **Scan Parameter:** Lateral head scanogram: scans were 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. To decrease the artifacts from beam hardening from the petrous bone across the posterior fossa, higher mA scans may be helpful. Factors of 140 kV and 100 mA were constant for all cases. **Slice thickness:** 5mm sections of the brain were obtained. Wherever necessary, 3mm sections were taken. **Window settings:** Window width – 100, Window level – 30

Statistical Analysis
Data was analyzed by using of simple statistical method with the help of MS-Office software.

RESULT

Observations
Total of 60 patients with clinically suspected of CVA were submitted for CT scan study of brain. Out of 60 patients, 38 patients had infarction, 15 patients had hemorrhage, 3 patients had Subarachnoid hemorrhage (SAH), 1 patient had tumorous pathology, 2 Patient had cerebral venous thrombosis and 1 Patient had normal study.

Table 1: Distribution of patients with clinically suspected CVA

CT Findings	No. of cases	Calculation for 60 cases
Infarcts	38	63.33%
Haemorrhage	15	25%
SAH	3	5%
Tumor	1	1.6%
CVT	2	3.33%
Normal	1	1.6%

Patient with age group 20-29 years 1 patient had infarcts. Age group 30-39 years 2 patients had

infarcts. Age group 40-49 years 5 patients had infarct. Age group 50-59 years 5 patients had infarct. Age group 60-69 years had 14 patients had infarcts. Age group 70-79 years had 10 patients' infarcts. And age group 80-89 years had 1 patient infarcts. Out of 60 patients, there had total of 38 patient's infarcts. That is 65.7 % male had infarcts and 34.21 % females had infarcts; male and female ratio was 1.05:0.5.
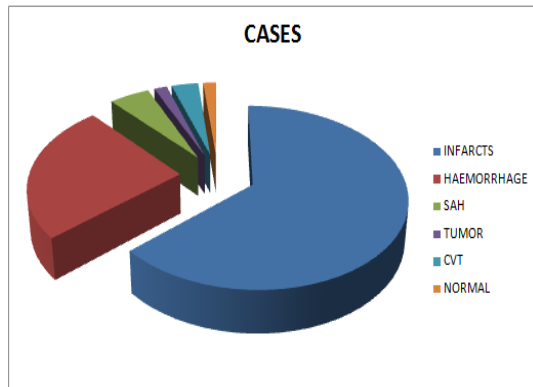

Figure 1: Distribution of patients with clinically suspected CVA

We were studied on hemorrhage. Then we were seen that patients with age group 20-29 years, 1 patient were hemorrhage. Age group 30-39 years also 1 patient was hemorrhage. Age group 40-49 years also 1 patient was seen hemorrhage. Age group 50-59 years was no case of hemorrhage. Age groups 60 -69 years 6 patients were hemorrhage. Age group 70-79 years 4 patients were hemorrhage. And age groups 80-89 years, 2 patients were hemorrhage. That is in out of 60 patients only 15 totals of 15 patients was hemorrhage. 66.66% male was hemorrhage and 33.33% female was hemorrhage, male and female ratio was 2:1. Our study showed that infarction and hemorrhage were mostly seen in the age group of 60-69 yrs.

Risk factors of stroke of this study:
Hypertension: Among the risk factors, past history of hypertension was given importance. 18 patients i.e., 30% had history of pre-existing hypertension, however many patients admitted that they were not tested for hypertension before the onset of stroke. 10 patients i.e., 55.55 % with hypertension showed cerebral haemorrhage. 6 patients i.e., 33.33% with hypertension showed infarct.

Diabetes mellitus: In our study 30% of the patients had a history of Diabetes mellitus. Many patients were not tested previously for evidence of diabetes before the onset of stroke. Out of 60 patients 18 patients had diabetes. 66.66% of the diabetic patients had cerebral infarction i.e., in 12 patients. 33.33% of the diabetic patients had cerebral hemorrhage i.e., 6 patients.

Heart disease: In our study history revealed the existence of heart disease in 20 % of the patients i.e., in 12 cases. Out of 12 cases, 6 had cardiac disease, which was previously detected, 4 had ECG changes after stroke attack and 2 had silent cardiac chest pain.

Involvement of vascular territory cerebral infarction:
Out of 60 cases of CT evaluation of CVA, 38(63.33%) cases of infarcts were diagnosed. 10 patients had infarct in right MCA territory accounting for 26.31%. 8(21.05%) patients had infarct in left MCA territory. 4 patients had infarct in right PCA territory accounting for 10.52%. 02(5.26%) patients had infarct in left PCA territory. 1(2.63%) patient had infarct in right ACA territory. 1(2.63%) patient had infarct in left ACA territory. 3(7.89%) patients had infarct in Rt. MCA and PCA territory. 2(5.26%) patients had infarct in Lt. MCA and PCA territory. 4 (10.52%) patients had infarct in both MCA territories. 1(2.63%) patient had infarct in vertebro-basilar artery territory. 2(5.26%) patients had lacunar infarcts. That is most common affected site was right MCA.

Intracerebral haemorrhage (ICH):
In our study of 60 cases of clinically suspected CVA, 15 cases (25%) were turned out to be intracerebral haemorrhage. 7 (46.66%) patients were putamen/external capsule ICH. 3(20%) were thalamus ICH. 2(13.33%) patients were cerebellum ICH. 1(6.6 %) patient was pons ICH. 2(13.33%) patients were miscellaneous ICH.

Out of 60 patients of CVA, 3(5%) patients were subarachnoid haemorrhage. In out of 60 patients 1(3.33%) patients were cerebral venous thrombosis and these patients were non diabetic and non hypertensive.

Out of 60 cases of clinically suspected CVA subjected to CT study, 1(1.6%) case turned out to be normal. This case was taken as negative case. There was a technical problem to detect infarction but certainly the haemorrhage was ruled out.

Out of 60 patients, 1(1.6%) patients was tumors. Signs and symptomatology of tumor were mimicking the signs and symptoms of stroke, hence clinicians suspected these cases as stroke, which turned out to be of tumorous pathology on computed tomography scanning. These patients presented with loss of sensory and/or motor functions on one side of the body was mimicking stroke.

DISCUSSION

R.H. Rosenwasser et al. (2000) emphasized the need for CT Scanning as a tool in the early diagnosis of cerebrovascular accidents in providing therapy via intra-arterial or intravenous pathway.[4]

Our study was to evaluate the role of CT scan in patients presenting with acute cerebrovascular accident in differentiating between haemorrhage, infarct and other causes of stroke.

Before the advent of CT scan and in places where CT scan was not available, physicians were mainly dependent on the history, physical findings and the Allen's method of scoring system to differentiate between haemorrhage and infarct using this scoring system. Allen studied 174 cases of acute stroke and was able to make an accurate diagnosis in 90% of cases.[5]

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 due to poor literacy level, which correlated with the scoring system. 100% accuracy in distinguishing haemorrhage from ischemic stroke based on clinical findings was not possible.

Ogun S.A, et al. (2000) assessed the frequency of misdiagnosis of stroke using CT of the brain. 156 patients admitted with clinical features suggestive of stroke were reviewed with CT brain. It was found that only 89 of them (57%) had neuroradiological features suggestive of stroke of which 59 (66%) had cerebral infarctions while 30 (34%) had cerebral haemorrhage. In 67 (43%) of the cases there were no features of cerebrovascular accident on CT scan. The misdiagnosis of surgically treated patients was 13.5%. He concluded that patients with clinical diagnosis of CVA should have CT scan evaluation to ensure appropriate treatment.[6]

Other studies have reported the usefulness of CT scan in patients suffering from stroke by ability to differentiate between haemorrhage and infarct and other causes of stroke and thus aiding in the clinical management. Oxford shire Community Stroke project that assessed 325 consecutive patients of acute stroke highlights the role of usefulness of CT scan. [3]

Mukherjee N, et al. (1998) studied on 80 patients suffering from stroke. On the settings of clinical and CT scan findings and with follow up to 6 months. He found that even though some of the clinical and CT scan findings are found to be important in prediction of outcome of stroke patients, clinical assessment appears to be more important.[7]

Previously, CT was considered insensitive in the evaluation of acute ischemic stroke patient; however, more recently detection of early CT findings 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 shown to improve outcome in the acute stroke patients. 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. Hans Peter 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.[8]

Razzaq AA, et al. (1999) performed a CT study to investigate the role of CT in diagnosis and management of young stroke patients. CT scan findings of 108 stroke patients between 15 and 45 years of age were reviewed retrospectively. About 80% of the patients had infarcts of carotid territory and 20% of the vertebro basilar distribution. More than half of the infarcts were cortical (56%).[9]

In the present study 60 patients of stroke were analyzed and of them 38 patients had infarct i.e., 63.33%, 15 patients had haemorrhage i.e., 25%, 2 patients had CVT i.e., 3.33%, 1 patient had tumor i.e., 1.6%, 3 patients had SAH i.e., 5% and 1 patient had normal scan i.e., 1.6 %. Gaskill et al. (1999) emphasized that although new imaging techniques have emerged in the diagnosis of cerebrovascular accidents, CT remains the primary imaging test for evaluation of acute stroke. It is fast reliable, readily available and an accurate method of screening patients prior to thrombolytic therapy.[10]

In this present study, Out of 60 cases of clinically suspected CVA subjected to CT study, 1 case turned out to be normal accounting for 1.6%. This case is taken as negative cases.

There are technical problems to detect infarction but certainly the haemorrhage is ruled out in all cases.

Future Research

Science is dynamic and there is always a scope of improvement and change in time to come ahead. With progressive aim to move ahead we aspire to achieve highly accurate and reliable results. Thus every study leaves back scopes for other researcher to do something more advanced and varied in order to touch the height of perfection. This study examined only 60 subjects (40 males and 20 females), future researchers can expand the study by including more number of subjects so as to make generalization of the results and practice, further studies with a larger sample size and in multiple centers are required. Thus it could be applied to real life situation.

Relevance to Clinical Practice

This study is relevant to the role of Computed Tomography in Evaluation of patients with Cerebrovascular Accident. It opens up new possibilities of prevention of CVA and makes maintain the good health of population. Such knowledge in future would not only reduce this disease but also have significant medical benefits on the health care systems.

Limitation

There were several limitations like, the sample size was small, the instrumentations and investigations may be different from a different health setup.

Summary

A total of 60 patients who were clinically suspected of stroke were subjected to computed tomographic study. Among these 60 patients 63.33% of patients had infarcts, 25% patients had intracerebral haemorrhage, 3.33% patients had cerebral venous thrombosis, 5% patients had subarachnoid hemorrhage, 1.6% of patients had tumorous pathology and 1.6% had normal scan. It was observed that both infraction and intracerebral haemorrhage were most common in the age group between 60-69 years. Males were more commonly affected with stroke than females. Risk factors like hypertension and Diabetes mellitus were played major role in the evolution of stroke. Out of 18 patients who had history of pre-existing hypertension, 55.55% of them showed cerebral haemorrhage and 33.33% of patients showed infarction. Out of 18 diabetic patients, 66.6% of patients had cerebral infarction and 33.33% of patients had cerebral haemorrhage. 20% of our patients had pre-existing heart disease. Commonest territory affected was right middle cerebral artery territory in cases of cerebral infarction, which accounts for 26.31%. However, most of the large infarcts were noted involving more than one arterial territory. In cases of intracerebral haemorrhage putamen and external capsule were commonly affected i.e., in 46.66 % of cases. 2 cases (3.33 %) were turned out to be cerebral venous thrombosis. 1 case (1.6%) was turned out to be normal on brain scan through there were technical problems to detect infarction, certainly the haemorrhage was ruled out. 1 case (1.6%) was shown tumor mimicking stroke symptomatology.

CONCLUSION

CT scanning was the "Gold standard" technique for diagnosis of acute stroke as the rational management of stroke depends on "Accurate diagnosis" and it should be ideally done in all cases. Risk factors such as hypertension, diabetes and previous episodes of stroke play major role in the evolution of cerebrovascular accidents, it was suggested that such patients should be investigated carefully; Sudden onset of neurological deficit or unexplained headache should further be investigated for the possibility of CVA. And if treatment is given early some of the cases of CVA can be saved from life threatening problems

REFERENCES

1. Hatano S. Experience from a multicenter register, Bull. WHO, 1976; 54: 541- 553.
2. Osborn AG. Arterial Anatomy and Stroke, Chapter 8, In: Brain Imaging, pathology and anatomy: AMIRSYS. 2013; 169-214.
3. Sandercock P, Molyneux A, Arlow C. Value of CT in patients with stroke: Oxfordshire Community Stroke Project, BMJ. 1985; 290: 193-197.
4. Rosenwasser RH, Annonda RA. Diagnostic imaging for stroke, Clinical Neurosurgery.2000 ; 46 ; 237-260.
5. Kinkel WR Jacobs L. Computed axial tomography in cerebrovascular disease. Neurology. 1976; 26: 924-930.
6. Ogun SA. Olawole O, Fatade B. Misdiagnosis of stroke: A computerized. Tomography scan study, West. African Journ of Medicine. 2000; 19 (1): 19- 22.
7. Mukherjee N, Hazra BR. Evaluation of stroke patients with reference to CT scanning findings. Journal Indian Medicine Assoc. 1998; 96 (6): 174-176.
8. Weisberg LA. How to identify and manage brain haemorrhage, Post Graduate Medicine, 1990: 88(3): 169-175.
9. Razzaq AA, Khan BA, Baig S. CT imaging in young stroke patients. Journal of Pakistan Medical Assoc. 1999; 49 (3): 66-68.
10. Gaskill. Shipley MF. Routine CT evaluation of acute stroke. Neuroimaging Clin. N. Am. 1999; 9 (3): 411-412.