Original Article

A clinico-radiological profile of the patients with cerebral ischemia at tertiary health care centre

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Abstract

Background: Stroke is the third leading cause of morbidity in the developed world and it is emerging as a potential public health problem in the developing world as well. The diagnosis of many of the subtypes such as cardio-embolic and athero-thrombotic stroke require detailed clinical, radiological and laboratory evaluation. This study was carried out to correlate the clinical data and radiological findings in cases of stroke. **Material and Methods:** A total of 1325 patients clinically suspected of having stroke were included in the study. Among 1325 cases, 55 patients with hemispheric symptoms of ischemic stroke were enrolled and subjected to non enhanced CT followed by perfusion analysis (n=25) or CT angiography. **Results:** Majority of the patients were in the age range of 31-50 yrs constituting 23 (41.8%) of the total with male predominance. Hemiplegia (92.7%) was the commonest presenting symptom with facial nerve as the commonest cranial nerve involvement (12.7%). majority of the patients showed lesions in the internal cerebral artery followed by the middle cerebral artery. **Discussion:** Radiologist needs to play a more significant role in patient treatment by planning better protocols and studies in investigating the patient rather than following a prescription pattern, as the clinicians are not aware of many innate advantages of certain procedures like perfusion which can be done at the same sitting.

Keywords: Stroke, ischemia, perfusion computed tomography, angiography.

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INTRODUCTION

Cerebrovascular accidents constitute the commonest neurological disorder encountered in an Emergency Department. Stroke is the third leading cause of morbidity in the developed world[1,2]. It is emerging as a potential public health problem in the developing world as well. Stroke is defined according to the World Health Organization (WHO) criteria as rapidly developing signs of focal or global disturbance of cerebral function, lasting more than 24 hours or leading to death, with no apparent cause other than vascular[3]. The four major types of stroke are cerebral infarction, intracerebral haemorrhage (ICH), primary subarachnoid haemorrhage (SAH) and venous occlusion. Among the stroke subtypes, cerebral ischemic events account for 70-80% of all types of stroke[4] and cover a wide range of clinical presentations that range from transient ischemic attacks (TIAs) to cerebral infarction. The acute ischemic strokes are characterized by a sudden onset of neurological deficits suggestive of damage to a localized structure of the brain. Hemiplegia, visual deficits, aphasia or other concomitant symptoms like facial palsy and loss of consciousness. Evaluation of stroke patients must be done to by diagnostic procedure to demonstrate lesion in the tissue, detect vascular lesion responsible for attack and assessment of pathophysiological changes that might indicate the course and prognosis of event. The diagnosis of many of the subtypes such as cardio-embolic and athero-thrombotic stroke require detailed clinical, radiological and laboratory evaluation. Computerized tomography (CT) scan is a widely available, affordable, non- invasive and relatively accurate investigation in patients with stroke

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and is the modality of choice as an initial investigation in patients with stroke. The purpose of CT is to differentiate ischaemic stroke from ICH and to rule out other pathological processes such as tumour, which may present as stroke. The reasons for the greater burden of stroke in Eastern Asian population remain unclear and direct reliable evidence about the determinants of stroke in this region is therefore needed. For further management and initiation of appropriate treatment, it is essential to differentiate strokes from non-ischemic strokes i.e., intracerebral haemorrhage, subarachnoid haemorrhage and venous thrombosis. In addition, radiographic imaging techniques are helpful in classifying subtypes of ischemic strokes due to emboli, stenosis or thrombosis of large vessels, small vessel disease, or other pathological conditions. This study has been carried out to obtain data regarding the types of stroke and data has been planned to provide idea about clinical and radiological profile of patients suffering from stroke due to ischemic events.

MATERIAL AND METHODS

In this prospective study 1325 patients with complaints of ischemic stroke with varied presentation admitted to the emergency ward, from August 2008 to September 2010 were included. The subjects belonged to a mixed ethnic and predominantly lower socioeconomic group. Stroke was defined according to the WHO criteria and ischemic strokes were classified as per Oxford shire Community Stroke project classification and TOAST classification[5,6]. Besides detailed medical history and clinical examination, complete blood count, blood sugar, blood urea, serum creatinine, serum uric acid, lipid profile, urinalysis and electrocardiogram was done in all patients. Cranial CT Scan (plain) was done in all the cases in emergency hours immediately. Adults of more than 18 years' age with hemispheric symptoms such as, hemiplegia, aphasia, hemianopia and with acute stroke of less than 12 hours' duration for CTP and more than 12 hours' duration for CT angiography were included in the study. Patients with signs of intracranial hemorrhage on plain CT, excessive movements, history of an allergic reaction to contrast dye or iodine allergy and evidence of renal insufficiency as determined by a measured serum creatinine level >1.5 mg/dl and pregnant females were excluded from the study. As per the inclusion and exclusion criteria of the study only 25 patients were eligible and hence selected for the perfusion data. Of the rest of the patients, those who could be convinced and where the clinician agreed a CT angiography were done. 55 patients with hemispheric symptoms of ischemic stroke were subjected to non enhanced CT followed by Perfusion analysis (n=25) or CT angiography (n=30). Of them 25 presented within 12 hrs duration were subjected to CT Perfusion and in them follow-up imaging was performed with NECT (n=25) within 2-7 days (mean, 2.32 days) of admission. Rest (n=30) presented after 12 hr were subjected to CT angiography. The study cases were mostly from the casualty as most of these cases presented with acute symptoms, some of the patients were inpatients mostly from the intensive care unit. After this the data was tabulated and statistically analyzed and the clinical features and various risk factors were correlated with the CT findings.

RESULTS

A total of 1325 patients clinically suspected of having stroke were included in the study. Among 1325 cases, 55 patients with hemispheric symptoms of ischemic stroke were enrolled and subjected to non enhanced CT followed by perfusion analysis (n=25) or CT angiography (n=30). Out of 55 cases 43 (78.1%) were males and 12 (21.8%) were females. Twenty-one males and four females underwent perfusion CT and 22 males and eight females underwent CT angiography. In this study ischemic events were commoner in males (78.1%) than females. A total of 23 (41.8%) patients were within 31-50 yrs age group; whereas 20 (36.3%) patients were in 51-70 yrs age group. Nine (16.3%) and three (5.4%) were within 10-30 yrs and 71-90 yrs age group respectively. Majority of the patients were in the age range of 31-50 yrs constituting 23 (41.8%) of the total.

Clinical profile

Clinical presentations of cases were hemiplegia, facial nerve palsy, headache, aphasia, loss of consciousness and hemianopia as the most common, seen in 51 (92.7%), 7 (12.7%), 8 (14.5%), 6 (10.9%), 5 (9%) and 2 (3.6%) of patients respectively, whereas visual obscurations, apraxia / agnosia and vertigo were seen less frequently. The commonest cranial nerve involved was the facial nerve involved in 7 (12.7%) cases. (Table 1).

Table 1: Presenting features of the ischemic stroke patients (n=55)

Presenting feature	No. of patients	Percentage
Hemiplegia	51	92.7
Facial nerve palsy	7	12.7
Headache	8	14.5
Aphasia	6	10.9
Unconsciousness	5	9.0
Hemianopia	2	3.6

Radiological Profile

Table 2 show distributions according to degree of ischemia, patients who had a normal Plain CT and Perfusion CT are depicted as normal, patients shown as abnormal only on follow up Plain CT are those patients who had lacunar and pontine infarcts which were not detected on Perfusion CT. This study points to the significance of perfusion CT in the 8 cases (i.e. 32%) wherein ischemic penumbra was seen suggestive of

reversible ischemia. Signs of salvageable hyper acute infarct (having ischemic penumbra) were seen on plain CT in 3 (38%) patients with infarct out of the 8 patients in CTP. Hence comparative Sensitivity was 38%. Signs of all hyper acute- acute infarct (both with and without ischemic penumbra) on plain CT (<12 hrs) were seen in 10 cases as compared to 15 patients on CTP. Hence comparative Sensitivity was 67%.

Table 2: Distribution of cases according to degree of ischemia

Findings	Ischemic penumbra	Infarct/ irreversible ischemia	Infarct on follow up NECT in CTP cases	Normal
Cases	8	7	3	7
Percentages	32%	28%	12%	28%

Of the total 25 cases underwent perfusion CT study, majority of the patients showed lesions in the territory supplied by the left middle cerebral artery constituting nearly 56% of the total followed by the right middle cerebral artery constituting 36%. Of the total 30 cases underwent CT angiography, majority of the patients showed lesions in the internal cerebral artery followed by the middle cerebral artery. It was observed that involvement of left anterior circulation (9 case) was more common than right anterior circulation (7 cases). Of the total 9 significant stenosis cases, involvement of carotid and vertebro- basilar arteries (no=8) was more common than vessels of Circle of Willis and intracranial vessels (no=5). This suggest that inclusion of Carotid and vertebro- basilar arteries in angiographic evaluation of stoke is obligatory. Significant stenosis was found in both intra and extra-cranial cerebral vessels in about 2 cases only. This study suggests that angiographic abnormality was found in the 18 cases (i.e. 60%). Significant stenosis was found in more than half (55.56%) of them and insignificant stenosis was seen in less than half (44.44%). Angiography was normal in 12 cases (40%). Overall sensitivity of angiography to detect cause of stroke in all patients with presented with acute ischemic stroke was 60%. In our two cases we observed that even with insignificant angiographic stenosis (<50%) large territorial infarct was seen. In both of them there were ulcerated soft atherosclerotic plaque with lipid core (HU value between -40 to 50) in carotid bulb causing <50% stenosis. In our three cases we observed that even with significant angiographic stenosis (>50%), no infarct was seen. All three cases were presented with transient ischemic attack and recovered completely. In our 9 cases with infarct on plain CT significant angiographic stenosis was seen in about 7 patients (sensitivity=77.78%). Remaining two patient showed ulcerated soft plaque in carotid bulb causing insignificant stenosis (<50%). These findings suggested that cause of ischemia was detected in around 100% of established infarct. This justifies the use of CT angiography in all patients with established infarct on initial CT. Graph 1 shows distribution of types of plaque in vessels with significant stenosis or patients with significant infarct. This point toward that significant stenosis or occlusion rate and infarct rate was higher in patient with soft plaque with lipid core.

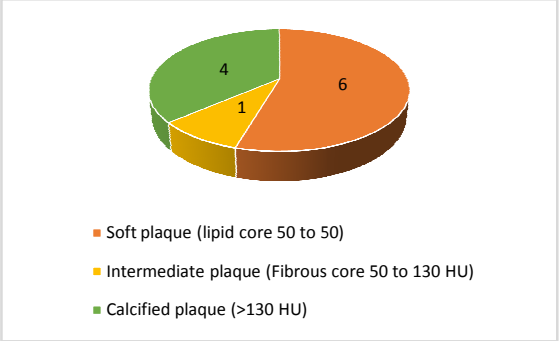

Figure 1: Distribution of types of plaque in vessels

DISCUSSION

Globally ischemic strokes account for about 80% of all stroke patients. Cerebrovascular accidents (CVA) is a frequent cause of death and disability and is a major problem in most part of the world[7]. Acute stroke is usually diagnosed by neurological examination or Plain CT only. Although clinical symptoms are very sensitive to cerebral ischemia, they are nonspecific. Perfusion CT for the diagnosis of acute stroke is a rapidly emerging adjunct to conventional CT studies; the advent of possible therapeutic strategies for acute stroke has increased the need for a simple, quick, reliable and effective method of assessing cerebral blood flow that is practicable in any hospital admitting patients with acute stroke[8]. In this study ischemic events were commoner in males (78.1%) than females. Majority of the patients were in the age range of 31-50 yrs constituting 23 (41.8%) of the total. In our study Perfusion CT was used as an adjunct to conventional CT in 25 patients with hemispheric symptoms of acute stroke within 12 hrs of symptom onset the mean age of the patients was 47.12 years. In a study by Naik *et al*, males (68%) were common than females (31.8%). 18 cases were more than 40 years of age. 2 cases (one 9-year old female and one 26-year old male) were less than 40 years age[9]. Shah *et al* also found stroke in 64.7% cases with male preponderance, however, they found first attack of stroke cases more in sixth and seventh decade of life with mean age 62.5% which is contrary with the present study[10]. In the present study hemiplegia was the commonest presenting symptom/sign. In studies by Shah *et al* (2012), Naik *et al* (2006) and Kaul S *et al* (2000) the commonest presenting symptom was hemiparesis in 70.4%, 49.3% and 45% respectively[9,10,11]. Our finding that Perfusion CT added to

information obtained on plain CT outlining exact areas of reversible and irreversible perfusion defects was an expected finding. It has already been documented by Eastwood *et al*[12] in their study, where they showed regional CBF differences in areas of low attenuation on plain CT. Correlation with final infarct extent was possible in about 75%. Regional abnormalities in four sections of Perfusion CT correlated well with final infarct size which has also been reported by Konig *et al*[13]; Wintermark *et al*[14] and Sorenson *et al*[8]. However, with Perfusion CT, a non lacunar stroke was not missed. We also identified false-negative areas occurring in patients with true-positive disease (i.e., Perfusion CT demonstrated most ischemic areas but missed lacunar infarct out of coverage). Three lacunar strokes were not identified on Perfusion CT because of a lack of spatial resolution. In our study we demonstrated the effectiveness of Perfusion CT in determining the choice of treatment modality in 8 patients with CBV/ CBF mismatch. Though our study included pts within 0 -12 hrs from onset of symptoms, we found greater chances of salvageable ischemic areas within 2-6 hrs (window period) of onset of symptoms. With increasing time of onset of stroke after 6 hr dramatic decrease in significant salvageable penumbra is seen. This is in conjunction with multiple studies reported in literature including Peter Schramm *et al*[15]; Phan TG *et al*[16] and Ringleb *et al*[17]. We included patients within 12 hrs because of unreliability of history obtained during emergency situations; hence we included a wider window so that a few patients who can benefit by intervention should not be left out of the study. Our finding that CT angiography added to information obtained on plain CT outlining exact site block or stenosis was expected finding. It has already been documented by SA Josephson and SO Bryant[18] and many others[18-20] in their study. Of the total 30 cases, majority of the patients showed lesions in the internal cerebral artery followed by the middle cerebral artery. It was observed that involvement of left anterior circulation (9 cases) was more common than right anterior circulation (7 cases). Of the total 9 significant stenosis cases, involvement of Carotid and vertebro- basilar arteries (no=8) was more common than vessels of Circle of Willis and intracranial vessels (no=5). This suggest that inclusion of carotid and vertebro- basilar arteries in angiographic evaluation of stoke is obligatory. Significant stenosis was found in both intra and extra-cranial cerebral vessels in about 2 cases. This study suggests that angiographic abnormality was found in the 18 cases (i.e. 60%). Significant stenosis was found in more than half (55.56%) of them and insignificant stenosis was seen in less than half (44.44%). Angiography was normal in 12 cases (40%). Overall sensitivity of angiography in all patients with presented with acute ischemic stroke in determining cause of disease was 60%. This was comparable with 57.9 % demonstrated by Kloska *et al*[21] in their study; the sensitivity and specificity of CT angiography as a modality in detecting atherosclerotic disease in ischemia (established infarct on initial NECT) are 77.78% and 85.71 % respectively. In our 9 cases with infarct on plain CT significant angiographic stenosis was seen in about 7 patients (sensitivity=77.78%). Remaining two patient showed ulcerated soft plaque with lipid core in carotid bulb causing insignificant stenosis (<50%). These findings suggested that cause of ischemia was detected in around 100% of cases with established infarct on plain CT. This justifies the use of CT angiography in all patients with established infarct on initial CT. In our study atherosclerotic plaque analysis of 9 cases significant stenosis and 2 cases with insignificant stenosis having large infarct on NECT we found significant stenosis/ occlusion rate and infarct rate was higher in patient with soft plaque with lipid core. In our three cases we observed that even with significant angiographic stenosis (>50%), no infarct was seen. All three cases atherosclerotic plaques causing narrowing were extensively calcified (density >130 HU). In our two cases we observed that even with insignificant angiographic stenosis (<50%) large territorial infarct were seen. In both of them there were ulcerated soft atherosclerotic plaque with lipid core (HU value between -40 to 50) in carotid bulb causing <50% stenosis. CT angiography is useful in plaque characterization into soft plaque with lipid core (density <50 HU), fibrous plaque (density 50-130 HU) and calcified plaque (density >130 HU). Findings our study suggest that atherosclerotic plaque with lipid core are highly unstable, though they do not cause significant stenosis, there is high chance of rupture and progression to thrombosis or embolism. Conversely, calcified plaque are relatively stable, though they cause significant stenosis, there is very low rate rupture and progression to thrombosis or embolism. These observations are well supported by Oliver *et al*[22] assessed whether features seen at CT angiography might be used to predict carotid plaque stability by comparing CT angiograms and found CT angiography is a promising method for assessing the lumen and wall of the carotid artery. The apparent correlation between histologic appearance and plaque density on CT angiograms has important implications for the prediction of plaque stability, even though ulceration is shown inconsistently. The socioeconomic, geographic and transport problems, problems of social awareness need to be tackled parallel. India being the next hub of maximum patients with hypertension and diabetes emerging at the younger age, the threat for early strokes has already emerged as a forthcoming social health

problem. In this scenario an urgent social awareness program needs to be conceived so that the common man understands the significance of reaching the hospital in time. As for angiography, the cost of the study, the inclination of the clinician and the basic non contrast CT used to exclude bleed and manage patient without further evaluation (a protocol) is still favored by the clinician. Hence few patients could be convinced to undergo angiography. We actually recommend that the imaging protocol for stroke patients should combine all three which can include plain CT, CT perfusion and CT angiography at one sitting if possible than including Doppler and MRI as this saves time and give information of intra and intracranial vessels with precession at the same sitting. It is suggested that the radiologist needs to play a more significant role in patient treatment by planning better protocols and studies in investigating the patient rather than following a prescription pattern, as the clinicians are not aware of many innate advantages of certain procedures like perfusion which can be done at the same sitting at no extra cost rather than doing a contrast enhanced CT which has no real significance.

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