CT and MR Imaging in Young Stroke Patients

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Abstract

Background: This study investigates the role of CT and MR imaging in the diagnosis and management of young stroke patients.
Methods: CT scan findings of 108 patients and MR findings of 30 patients between 15-45 years of age were reviewed retrospectively. The variables included the territory of infarct on CT and MR imaging, the cortical distribution and size of infarct.
Results: About 80% of the patients had infarcts of the carotid territory and 20% the vertebro-basilar distribution. More than half of the infarcts were cortical (56%). The yield of MR imaging was much higher for deeper structures such as basal ganglia, thalamus and brainstem. In half the cases, the infarct size was more than 3 cm. **Conclusion:** The ratio of carotid to vertebro-basilar infarcts was similar to that reported previously. A large proportion of the carotid territory infarcts were cortical. Deeper irifarcts were better imaged with MR scan. There was a high proportion of large infarcts (JPMA 49:66, 1999).

Introduction

The present study is part of a larger project at the Aga Khan University Hospital , Karachi. This project is evaluating the clinical spectrum, diagnostic techniques and the etiology of ischemic stroke in young patients. Although the role of CT and MR imaging has been well defined for ischemic stroke in elderly patients, it is not clear in individuals with young stroke[1-8]. Since the etiologic pattern of young stroke patients is entirely different from that of older people[1,2,9], it is reasonable to assume that imaging studies may need to be tailored accordingly. The present study aims to provide data regarding the precise indications and relative role of CT and MR scanning in young stroke patients. This may enable physicians to prioritize their diagnostic work-up in the setting of limited resources.

Patients, Methods and Results

This study was conducted at the Aga Khan University Hospital in Karachi, a tertiary care hospital with facilities similar to those available at modern stroke units. We retrospectively reviewed the medical records and CT/MR imaging reports of patients aged 15-45 years admitted with a diagnosis of ischemic stroke between November 1, 1992 to October 30, 1997. The scans were reported by a trained radiologist with special interest in CT/MR imaging. A total of 118 cases met the inclusion criteria. In all cases the diagnosis of ischemic stroke was established by excluding intra-cranial hemorrhage on the basis of computerized tomographic (CT) scan. The CT scanning was performed using a third generation CT scanner. The MR imaging was performed on different machines, using magnets ranging from 1.0 tol .5 Tesla. Although all 118 patients underwent CT scan, the reports were available for 108 patients. MR imaging was performed on 30 of these 108 patients. These patients were selected on a case by case basis, according to the needs of the diagnostic The study variables for the present study included the brain territory involved in the infarct on CT and MR imaging (cortical, lacunar, brainstem, cerebellar). The cortical territory infarcts were further sub-divided according to their lobar location (frontal, temporal, occipital). The size of the infarct was also studied (small= 0-1.5 cm, medium= 1.5-3 cm and large >3 cm). The data was analyzed using standard data base software, including FoxPro and Microsoft Excel.

CT scanning was performed in 108 patients at the Aga Khan University Hospital. The remaining 10 patients had CT scanning at other centers and report were not available in the medical records. Out of these 108 patients, 61(56.5%) had a cortical infarct not involving the deep structures (basal ganglia, internal capsule). The remaining patients had infarcts in other areas of brain. The CT scan showed no abnormality in 10 patients (Table 1).

Table 1. Territory of infarct in 108 patients undergoing CT scan.

	No.	%
Cortical	61	56.5
Lacunar	1	0.9
Internal capsule	11	10.2
Basal ganglia	9	8.3
Thalamus	4	3.7
Brainstem	7	6.5
Cerebellar	5	4.6
Normal	10	9.3
Total	108	100

MRI scan was performed in 30 patients. Cortical territory involvement sparing the deep structures, was found CT scan with probable etiology of stroke. in 11 patients. Infarcts in lacunar area and basal ganglia, brain stem and cerebellar regions were seen in 17 patients. None of these patients had a thalamic infarct on MR scan. in 11 patients. Infarcts in lacunar area and basal ganglia, brain stem and cerebellar regions were seen in 17 patients. None of these patients had a thalamic infarct on MR scan. The MR scan was normal in 2 patients (Table 2).

Table 2. Location of infarct on MR scan.

	No.	%
Cortical	11	36.6
Lacunar	5	16.6
Internal capsule	1	3.33
Basal ganglia	4	13.3
Brainstem	5	16.6
Cerebellar	2	6.6
Normal	2	6.6
Total	30	100

The pattern of lobar involvement was studied in patients undergoing CT scan. Information regarding lobar involvement was available in 46 patients. The largest number of infarcts were found in the parietal region, followed by temporo-parietal, fronto -parietal, occipital, fronto-temporal, frontal and temporal (Table 3).

Table 3. Cortical location on CT scan in 46 patients.

	No.	%
Frontal	3	6.5
Parietal	16	34.8
Temporal	2	4.3
Occipital	6	13.0
Fronto-parietal	7	15.2
Fronto-temporal	3	6.5
Temporo-parietal	9	19.6
Total	46	100

Information about size of infarct was available in 35 patients. Infarct size was found to be small in 12 cases (34.3%), medium in 7(20%) and large in 16(46%) cases.

The distribution of infarcts was correlated with probable etiology of stroke. The results are presented in Table 4.

Table 4. Correlation of infarct location on CT scan with probable etiology of stroke.

Location on CT	No.	%	Probable etiology	No.	%
Cortical	61	56.5	Intracranial atherosclerosis	10	16.4
			Extracranial atherosclerosis (Carotid stenosis)	18	29.5
			Cardiac embolism	21	17.2
			Anti-cardiolipin ab.	2	3.2
			Undetermined	10	16.4
Lacunar	1	0.9	Migrane	1	100
Internal capsule	11	10.2	Non-atherosclerotic vasculopathy (e.g. vasculitis)	7	63.6
			Intracranial atherosclerosis	2	18.1
			Undetermined	2	18.1
Basal ganglia	9	8.3	Non-atherosclerotic vasculopathy	3	66.6
			Anti-cardiolipin Ab	2	22.2
			Intracranial atherosclerosis	3	33.3
Thalamus	4	3.7	Cardiac embolism	2	50.0
			Carotid stenosis	2	50.0
Brainstem	7	6.5	Cardiac embolism	4	57.0
			Undetermined	3	43.0
Cerebellar	5	4.6	Cardiac embolism	2	40.0
			Non-atherosclerotic vasculopathy	2	40.0
			Anticarodiolipin Ab.	1	20.0
Normal	10	9.3	Carotid stenosis	2	20.0
			Cardiac embolism	3	30.0
			Undetermined	5	50.0

Comments

Among the total of 108 patients who underwent CT scanning at this institution, a high proportion (about 75%) were found to have carotid territory infarcts. This is comparable to previous reports[1,2,9] and can be explained on the basis of probable etiologies of ischemic stroke. The following major etiologies have been found in large prospective studied[1-4,9].

1) Atherothrombotic disease of extra-cranial and intra-cranial vessels (15-20%);
2) Cardiac embolism and patent foramen ovale (20-30%) ;
3) Non-atherosclerotic vasculopathy (carotid dissection, fibromuscular dysplasia, vasculitis - 5-10%);
4)Hematologic abnormalites, oral contraceptives and migraine (10%) and
5) Indeterminate (15-20%). A large proportion of these etiologies are associated with pathology in the anterior circulation and this is reflected by the predominance of carotid infarcts in our series.

Among the patients who underwent CT scan, majority had pure cortical infarcts (57%), with basal ganglia and internal capsule involved in 8 and 4% of cases respectively. This is again related to the predominant involvement of the anterior circulation by the extra-cranial etiologies. Lacunar infarcts were found in a relatively small number of cases compared to other studies (n=l), (0.9%), reflecting the lesser contribution of small vessel disease to young stroke.

The proportion of patients with vertebro-basilar infarcts (20%) was similar to other studies[4,6,9]. Several investigators have previously reported vertebral artery dissection as a major cause of ischemic stroke in young individuals[1-3]. Therefore, a posterior circulation infarct in a young individual without an obvious cause merits cerebral angiography to rule out vertebral artery dissection.

In this study, 46% had large, 20% medium and 34% small infarcts. This relatively high proportion of large infarcts reflects the greater contribution of embolic causes, which affect the proximal trunks of major intra-cranial vessels leading to larger infarcts. The distribution of infarcts on CT scan was correlated with the probable etiology of infarct based on the diagnosis of the treating physician. This relationship has not been well studied peviously[1-10]. Cortical infarcts were most commonly caused by cardio-embolic causes such as patent foramen ovale, valvular abnormalities etc. The other major contributors were intracranial atherosclerosis and carotid stenosis. The infarcts in deep structures were caused by a variety of etiologies including small vessel atherosclerosis, non-atherosclerotic vascu lopathy (e.g., vasculitis) and hematologic abnromalities such as anti-cardiolipin antibody syndrome. Brainstem infarcts were related to similar causes (Table 4).

We also studied the lobar distribution of cortical infarcts. The parietal lobe was most frequently involved, followed by approximately equal frequencies in other areas. This again corresponds to a greater burden of disease in the middle cerebral artery due to embolic causes.

MR imaging was performed in addition to CT scan in 30 of the 108 patients. The proportion of brainstem infarcts was higher in the group imaged with MRI as compared to CT scan (14.6% vs 6.5%). Similarly, the proportion of cerebellar infarcts was also higher in the MR group. This adds to accumulating data pointing to superior imaging of the posterior fossa structures with MRI scan.

In conclusion, this study emphasizes the role of imaging modalities in accurately managing the young stroke patient and presents important new data about CT and MR imaging in young stroke. This will help physicians to select appropriate imaging techniques and tailor the diagnostic work-up according to the needs of the individual patient.

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