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Original Article

Territorial location of cerebral infarcts on imaging in patients with first ever stroke with diabetes

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Abstract:

Aims: *The study was aimed to evaluate vascular territories of infarcts involved in patients with stroke for the first time with diabetes on CT and/ or MRI of brain.*

Methodology: *This cross sectional descriptive study was carried on a total of 100 adult patients with first ever stroke consecutively reported in the Department of Neurology, BIRDEM General Hospital, Dhaka, over a period of six months.*

Results: *The mean age was 61.45 years and majority (35%) belongs to age group of 50-59. Ten (10%) subjects had age above 80 years. Male were 68% and 32% were female. Majority (89%) of the subjects had hemiplegia following acute stroke. Aphasia (71%), headache (39%), convulsion (23%), vomiting (18%) and cranial nerve palsy (17%) were also found. Additional preexisting risk factors were hypertension (72%), dyslipidaemia (59%), smoking (56%) and alcohol abuse (2%). Among the study subjects the diabetic complications were peripheral vascular disease (4%), neuropathy (8%), nephropathy(9%)and retinopathy(25%). CT scan and/ or MRI brain showed parietal lobe lesion in 57% cases. Majority (76%) had infarcts in middle cerebral artery territory. Involvement of anterior and posterior cerebral artery territory was found in 7% and 5% subjects respectively. Vertebro-basilar arterial system involvement was observed in 6% cases. 4% subjects had involvement of both middle and posterior cerebral arteries. Both anterior and posterior arterial territory infarcts were found in 2% cases.*

Conclusions: *In conclusion most of the diabetic subjects with first ever ischemic stroke had involvement of middle cerebral artery.*

Key Words: *Stroke, Cerebral Infarcts, Diabetes mellitus.*

Introduction: A stroke is the rapid loss of brain function due to disturbance in the blood supply to the brain with symptoms lasting for more than 24 hours or resulting in death before 24 hours and in which after adequate investigations symptoms are presumed to be non-traumatic vascular in origin. This can be due to ischemia caused by blockage (thrombosis, arterial embolism), or a hemorrhage.[1] As a result, the affected area of the brain cannot function, which might result in an inability to move one or more limbs on one side of the body, inability to understand or formulate speech, or an inability to see one side of the visual field.[2]

Undoubtedly stroke is more preventable than to look for the cure. In this respect identification of the major risk factors especially modifiable risk factors and their control needs maximum concern.[3, 4] Risk factors for stroke include arterial hypertension, diabetes mellitus, obesity, cigarette smoking, hyperlipdaemia , oral contraceptives, alcohol intake, age, positive family history of stroke, hyperviscosity etc. Every type of cardiac disease is also associated with increased risk of stroke. Control of hypertension, atrial fibrillation appear to greatest chance of reducing risk of for stroke recurrence after an ischemic stroke.[5,6] In the management of stroke we can't cure the disease but we can to some extent prevent it by early detection and treatment of risk factors especially modifiable risk factors.

The clinical syndrome produced by a stroke is determined by the artery or arteries that are occluded. Blood is supplied to the brain by two major sets of arteries, the anterior and posterior circulations. The anterior circulation consists of the right and left internal carotid arteries (ICA) which bifurcate into the anterior cerebral artery (ACA) and middle cerebral artery (MCA) . The MCA supplies most of the temporal lobe, the anterolateral frontal lobe, and the lateral parietal lobe. Perforating branches supply the posterior limb of the internal capsule, part of the head and body of the caudate nucleus and the globus pallidus. The MCA supplies the largest proportion of the brain and its occlusion is the most common cause of

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severe stroke.The ACA supplies most of the medial surface of the frontal lobe, the frontal pole, medial parietal and anterior portions of the corpus callosum. Perforating branches supply the anterior limb of the internal capsule, the inferior portions of the head of the caudate and the anterior globus pallidus. The anterior choroidal artery arises at the distal ICA and supplies the medial anterior temporal lobe and the genu of the internal capsule.

The posterior circulation consists of the vertebral and basilar arteries and their branches. Typically, two vertebral arteries join and form the basilar artery. The vertebrobasilar system supplies the brainstem and has branches to the cerebellum. The basilar artery typically bifurcates into two posterior cerebral arteries (PCA) . The PCAs supply the occipital lobes and portions of the temporal lobes. Proximally, these arteries give rise to perforators that supply the thalami . The left and right anterior circulations are joined to each other by the anterior communicating artery which connects the ACAs. The anterior and posterior circulations are connected by two posterior communicating arteries. This circle of communicating arteries, known as the Circle of Willis, provides collateral cerebral circulation that may be extremely important in maintaining tissue viability during acute stroke. Collateral circulations occur via leptomeningeal (pial) branches between ACA and MCA territories, as well as between the MCA and PCA territories. There is substantial variability in the cerebral circulation in individual patients; this is readily appreciated with modern angiographic neuroimaging.[7]

Cerebral infarction (85% of stroke patients) is mostly due to thromboembolic disease, secondary to atherosclerosis in the major extra cranial arteries eg. carotid and aortic arch.[1] Cerebral infarction is a process which takes some hours to completes, even enough through the patient's deficit may be maximal close to the onset of the causative vascular occlusion, when homeostatic mechanisms fail, the process of ischemia starts and ultimately leads to infarction once blood flow falls below the thresholds for maintenance of electrical activity, neurological deficit appears.[4] The incidence of ischemic stroke in anterior circulation is about 70% where as in posterior circulation it is about 5-10%. [8] Among the anterior circulation the incidence of ischemic strokes is significantly related to middle cerebral artery and it is less than 3% due to occlusion of the anterior cerebral artery.[9]

Many strong evidences support that Diabetes Mellitus is a major health problem among the adult population worldwide and almost half the ischemic stroke population suffer from Diabetes. Diabetes patients had higher rates of stroke as compared to non diabetic patients. Although there has been a decline in mortality and morbidity from stroke in the past 30 years, preventive measures and improvement of treatment modalities should be undertaken in diabetic stroke patients since the prevalence of Diabetes Mellitus is estimated to increase and will become a global burden.[3]

It is well known fact that most of the life threatening clinical features of stroke occur within few minutes to few days of initial attack depending the territory involvement. However the incidence of these features may vary with age, gender, control blood glucose, lipidaemic status of patients etc.[10] Some of these complications are benign and requires no treatment. While some are life-threatening depending upon the territory of brain involvement. So knowledge of territory involvement is always helpful for the neurologist. Better approach for the selection of appropriate treatment like the explanation of prognosis, speech therapy, occupational therapy, physical therapy and social rehabilitation can be planned.

Several studies regarding stroke in diabetic carried out but very few studies regarding the territory involvement had been conducted in recent years. Though this study was not in such a larger scale to enrich modern medicine, nevertheless this obviously would give some information regarding our own patients and would add to the work done in past in this era.

Materials and methods: This cross sectional observational study was conducted in the Dept of Neurology, BIRDEM Hospital. Patients with ischemic stroke with type 2 diabetes, consecutively admitted in the department were recruited in the study for the period of March 2012 to August 2012. Strict recruitment criteria were followed. Inclusion criteria were type 2 diabetes patient presented with first ever stroke irrespective of age and confirmed by imaging (CT-Scan). Demographic information was prospectively recorded and substantiated by means of inspection of medical record. Information included was the subject's age, gender, medical history, clinical history of acute stroke with diabetes, followed by conduction of the study. All the relevant collected data were compiled on a master chart first. Then organized by using scientific calculated and standard statistical formulas, percentage was calculated to find out the proportion of the findings. Further statistical analyses of the results were done by computer software device as statistical packages for social scientist (SPSS). The results were presented in tables, figures, diagrams etc.

Results :

A total of 100 cases were included in the study. The mean age was 61.45 years with standard deviation of mean (SD) ±11.65 years and their age ranged from 35 to 84 years. Majority (35%) of the respondents was found in the age group of 50-59. About 8% subjects were found in 30-39 years age group. Twenty four (24%) subjects had age between 60-69 years. Ten (10%) subjects belonged to 80 years and above age groups(Table I). Out of 100 subjects 68% were male and rest 32% were femal(Table II).

The mean duration of diabetes, was 9.64 (±6) years (Table III). The respondents suffered from diabetes for 3 to 25 years. Majority (27%) of the subjects had diabetes for more than 5 years. Beside Diabetes, the study subjects had hypertension (72%), Dyslipidaemia (59%), history of smoking (56%) and alcoholism (2%). Other risk factors were positive family history of IHD and stroke which prevailed as 12% and 13% respectively (Table IV).

Majority (89%) of the subjects presented with hemiplagia after acute stroke (Figure I). Other common clinical

presentation were aphasia (71%), headache (39%), convulsion (23%), vomiting (18%) and cranial nerve palsy (17%)

Brain imaging was done in all cases. CT scan was performed in 85% subjects and MRI scan of brain was done in 38% cases (Table V).

In most of the cases, parietal lobe of brain (57%) was mostly affected. Basal ganglia (45%), internal capsule (56%), brain stem (6%), thalamus (6%) and cerebellum (8%) were the other common sites of involvement. Ischemic infarcts were also found in paraventricular location (18%), in frontal (6%) and temporal (7%) lobes (Table VI).

In majority of the subjects (76%) middle cerebral arterial territory was affected. Involvements of anterior and posterior cerebral arteries were found in 7% and 5% subjects respectively. In 6% cases, involvement of vertibro-basilar arterial system was observed. Four percent subjects had involvement of both middle and posterior arteries. Both anterior and posterior arterial territory infarcts were found in 2% cases (Table VII).

Table I: Age distribution of the study (n=100)

Age group (Years)	Number	Percentage
30-39	08	08
40-49	10	10
50-59	35	35
60-69	24	24
70-79	13	13
80 and above	10	10
Mean ± SD	61.45	±11.65
Maximum- Minimum	35-84	

Table II: Gender distribution of the study subjects (n=100)

Gender	Number	Percentage
Male	68	68
Female	32	32

Table III: Duration of disease in the study subjects (n=100).

Duration of Diabetes (years)	Number	Percentage
≤5	27	27
6-10	20	20
11-15	23	23
16-20	11	11
21 and above	19	19
Mean ± SD	09.64	±6.00
Range (Minimum-maximum)	03	-25

Table IV: Pre-existing risk factors of the study subjects (n=100)

Co-morbid conditions	Number	Percentage
Hypertension	72	72
Dyslipidaemia	59	59
Smoking	56	56
Alcoholism	02	02
Positive family history of IHD	12	12
Positive family history of stroke	13	13

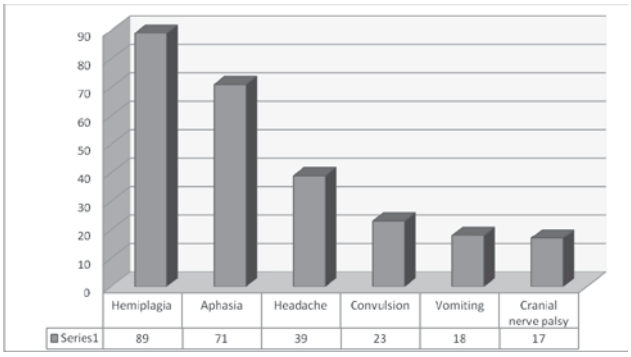

Figure 1: *Bar diagram showing common clinical presentations of the study subjects (n=100)*

Table V: Modality of investigation for detection of stroke (n=100)

Arterial territory	Number	Percentage
CT scan	85	85
MRI	38	38

Table VI: Location of involvement of ischemic lesion (n=100)

Arterial territory	Number	Percentage
Parietal	57	57
Frontal	06	06
Temporal	07	07
Occipital	05	05
Internal capsule	56	56
Thalamus	06	06
Basal ganglia	45	45
Brain stem	06	06
Paraventricular location	18	18
Cerebellum	08	08

Table VII: Involvement of arterial territory in the study subjects (n=100)

Arterial territory	Number	Percentage
Anterior cerebral artery	07	07
Middle cerebral artery	76	76
Posterior cerebral artery	05	05
Vertibro-basilar artery	06	06
Both anterior and posterior arteries	02	02
Both middle and posterior arteries	04	04

Discussion: The traditional definition of stroke, devised by the World Health Organization in the 1970s, is a "neurological deficit of cerebrovascular cause that persists beyond 24 hours or is interrupted by death within 24 hours"[2]. There were several study regarding stroke in diabetic subjects but a very few studies were conducted to see which arterial territory was mostly affected during first ischemic attack. This present cross sectional descriptive study was conducted to evaluate the cerebral vascular territories involvement in diabetic patients with first ever ischemic stroke on 100 subjects. The study result findings were discussed concerning the general objective of the study on basis of related previous study.

The mean age was 61.45 years with standard deviation of mean of ±11.65 years. Majority (35%) of the respondents was found in the age group of 50-59. About 24% subjects were found in 60-69 years age group. The respondents suffered from diabetes for 3 to 25 years. There was an interesting finding in this present study that highest age of occurrence first ischemic stroke was 84 years. It could be thought that strict control of diabetes with control of other diabetic related complications could halt the early onset of stroke.

Among preexisting risk factors, the study subjects had hypertension (72%), dyslipidaemia (59%), history of smoking (56%) and alcoholism (2%). Other risk factor was positive family history of IHD & CVD which prevailed as 12% & 13% respectively. [11] Among the complications of diabetes, about 4% were suffering from peripheral vascular disease, 8% from diabetic Neuropathy, 9% from diabetic nephropathy and 25% from diabetic retinopathy, 7% from peripheral neuropathy in association with diabetes. Previous studies reveal the same risk factors of stroke.[12]

Among the study subjects, majority (89%) of the subjects presented with hemiplagia after an attack of acute stroke. Other common clinical presentation were aphasia (71%), headache (39%), convulsion (23%), vomiting (18%) and cranial nerve palsy (17%). Majority of the present study subjects had motor deficits. Similar result where was found in another study where majority of the subjects were presented with motor deficits[13].

CT scan was performed in 85% subjects and MRI scan of brain was done in 38% cases. In most of the cases, parietal lobe of brain (57%) was mostly affected. Basal ganglia (45%), internal capsule (56%), brain stem (6%), thalamus (6%) and cerebellum (8%) were the other common sites of involvement. Ischemic infarcts were also found in paraventricular location (18%), in frontal (6%) and temporal (7%). Previous study revealed the same site of involvement in stroke patients. [14]

Scans revealed that in majority (76%) of the subjects middle cerebral arterial territory was affected. Kertesz et al (1985) [15] observed that about 88% subjects had single MCA territory involvement and 7% subjects had both middle and posterior cerebral arteries involvement. Stolz et al. (2008)[16] reported similar result where it was seen that about 82% of all stroke patients had involvement of MCA territory. Involvements of anterior and posterior cerebral arteries were found in 7% and 5% subjects respectively. Kang et al (2008)[17] found that ischemic stroke affected mostly ACA territory in their study population (consisting diabetic and non- diabetic). In present study 6% had involvement of vertibo-basilar arterial system. Arboix et al (2011)[18] reported that Posterior cerebral artery (PCA) stroke was less common than stroke involving the anterior circulation which was consistent with the present study findings. Vertibro-basilar arterial territory was affected in 6% subjects in the present study. In a study conducted by Biller et al. (1988)[19] revealed that 8% subjects had vertebro-basilar system. In present study four percent subjects had involvement of both middle and posterior arteries. Both anterior and posterior arterial territory infarcts were found in 2% cases.

Conclusion: Most of the diabetic subjects with first ever ischemic stroke had involvement of middle cerebral artery and further study with large sample size involving multiple centers may be undertaken to conclusively identify cause of involvement of specific territory in ischemic stroke in diabetic subjects.

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