

Pattern of Stroke among Adult (A-MMD) and Childhood Onset (C-MMD) Moyamoya Disease

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Abstract

Background: Though relatively rare, moyamoya disease (MMD) may have varied presentation in different age group. Different stroke types are major presentation of this enigmatic disease. **Objective:** The aim of this study was to compare the stroke subtypes among adult (A-MMD) and childhood onset (C-MMD) patients with Moyamoya disease (MMD). **Methodology:** This was a hospital based observational study, conducted in the department of Neurology, Dhaka Medical College Hospital, Bangabandhu Sheikh Mujib Medical University and National Institute of Neurosciences and Hospital, Dhaka, Bangladesh in between July, 2007 to June, 2016. Sample size included 36 children and 14 adult patients of MMD presenting with either ischemic or hemorrhagic stroke, within one month of the index event. **Result:** Majority of participants were below 10 years of age with a mean age at onset of 16.56(±10.6) years. There was a female predominance. Patients younger than 20 years, presented mostly with ischemic stroke (32 versus 4 patients); whereas those above 20 years of age presented mostly with hemorrhagic stroke (6 versus 8 patients). The difference was statistically significant (p value = 0.006). Large artery infarct (15) and hemodynamic infarct (17) were common among patients in children; whereas intracerebral hemorrhage (dICH, lICH, IVH among 3, 4 and 1 patients respectively) was frequent (8) among the adult (p value = 0.006). **Conclusion:** While different pattern of ischemic stroke is common among children with MMD, the adults present mostly with hemorrhagic stroke subtypes. [Journal of National Institute of Neurosciences Bangladesh, July 2020;6(2): 87-90]

Keywords: Stroke; moyamoya disease; adult onset-moyamoya disease; childhood onset-moyamoya disease

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Introduction

The term “MOYAMOYA”, a Japanese one, means "something hazy like a puff of cigarette smoke drifting in the air". It is actually a descriptive term that is applied to denote the peculiar angiographic picture consisting of abnormal net-like vessels at the base of the brain. The Moyamoya disease (MMD) induces progressive occlusion of the bilateral carotid forks associated with a

fine vascular network at the base of the brain, the “moyamoya” vessels¹. Though the disease was more common among the Japanese, now-a-days seen in different parts of the world². The MMD has two peaks of incidence in disease onset and presentation among two age groups: children who are approximately 5 years of age and adults in their mid-40s³. Several studies have reported a considerable variation in presentation of

MMD among children and adult^{4,6}. While the ischemic symptoms in the form of transient ischemic attack (TIA) and cerebral infarction predominates in pediatric age group, most of the adult shows hemorrhagic presentation^{4,6}. We all know the stroke pattern is largely influenced by the pathophysiologic mechanism of stroke. Even the pattern of infarct may not follow the conventional arterial territory of ischemic stroke due to presence of abnormal vascular network at the base of the brain rather than a conventional atherosclerotic occlusion^{7,8}.

Direct comparison studies on the childhood onset (C-MMD) and adult onset (A-MMD) stroke types in patients with MMD have not been many. Any association of such stroke subtypes among Bangladeshi C-MMD and A-MMD will add to the current knowledge about the natural history and hemodynamic changes of moyamoya vessels. Understanding the relation between the ages of onset and stroke types may be helpful in predicting the vascular imaging findings in suspected case of MMD. Such association may help physicians to line up further evaluation strategy in this group of patients. So, this study was conducted to analyze the relation of stroke subtypes with age of onset of MMD.

Methodology

This was a cross sectional type of observational study conducted between July 2007 to June 2016 among patients with MMD admitted in or attending to stroke clinic and outpatient Department of Neurology of Dhaka Medical College and Hospital, Bangabandhu Sheikh Mujib Medical University, Dhaka and National Institute of Neurosciences and Hospital, Dhaka, Bangladesh. Fifty consecutive patients aged 5 to 45 years, had CT and/ MRI proven stroke and DSA done within one month of stroke to confirm the MMD were included for the study. The patients with suspected or probable MMD, patients with moyamoya syndrome and those undergoing surgical procedure for MMD were excluded from this study. Important demographic variables, stroke subtypes and angiographic findings were recorded. All the data were collected in a structured questionnaire. Thorough neurological examination was done on every patient and was verified by a neurologist. Stroke subtypes were ascertained depending on presentation and the imaging features in CT scan or MRI, which had further been confirmed by a consultant radiologist. Angiographic findings and the staging were confirmed by at least two interventional neurologists who are fellows in interventional neurology. Subjects with incomplete data were

excluded before final analysis. The diagnostic criteria provided by the Research Committee on the Spontaneous Occlusion of the Circle of Willis of the Ministry of Health and Welfare, Japan (RCMJ) was used as operational definition of MMD⁷. Further subclassification of stroke subtypes were done following the suggested classification of Mugikura et al⁸ and Kim et al⁹. Data analysis was done with the help of Statistical Package for the Social Sciences (SPSS) version 19.0 software facilities. Appropriate statistical methods were applied for data analysis and comparison among different variables with 95.0% confidence interval (CI) taking p value ≤ 0.05 as significant. Prior to the commencement of this study, the research protocol was approved by the Local Ethical Committee.

Results

This study involved 50 patients with MMD encountered in three specialized hospitals. About half (48%) of the patients were within 10 years of age and mean age of the patients was 16.56(± 10.6) years at onset with a range of 5 to 43 years. Among them male were 23(46%) and female were 27(54%). Male and female ratio was 1:1.2. Most of the patients (38, 76%) had ischemic stroke (IST) and the rest (12, 24%) had hemorrhagic stroke includes intracerebral hemorrhage and subarachnoid hemorrhage (Table 1).

Table 1: Distribution of patients by age, sex and stroke types (n=50)

Age group	Frequency	Percent
5 to 10 Years	24	48.0
11 to 20 Years	12	24.0
21 to 30 Years	05	10.0
31 to 40 Years	04	8.0
41 to 50 Years	05	10.0
Total	50	100.0
Mean (\pm SD)	16.56(± 10.6)	5 to 43
Gender		
• Male	23	46
• Female	27	54
Stroke types		
• Ischemic	38	76
• Hemorrhagic	12	24

Among the patients with IST 57.9% had hemodynamic infarct like watershed zone infarct in 47.4% and perforator infarct in 10.5% and the rest had large artery infarct like ACA infarct, MCA anterior and posterior half infarct and PCA infarct among 15.8%, 7.9%, 10.5% and 7.9% patients respectively. In hemorrhagic

group, half of the patients had deep intracerebral hemorrhage (basal ganglia in 33.4% and thalamus in 16.6%), followed by lobar intracerebral hemorrhage in 41.6% patients (frontal, parietal and occipital lobe involvement in 16.6%, 16.6% and 8.4% respectively) and intraventricular hemorrhage in 8.4% (Table 2).

Table 2: Distribution of Patients by Stroke Subtypes (n=50)

Stroke Subtypes	Frequency	Percent
Ischemic Stroke (n= 38)		
ACA infarct	6	15.8
ACA-MCA watershed zone infarct	10	26.4
MCA anterior half infarct	03	7.9
MCA posterior half infarct	04	10.5
MCA-PCA watershed zone infarct	08	21
ACA infarct	03	7.9
Perforator infarct	04	10.5
Hemorrhagic Stroke (n= 12)		
Frontal lobe	02	16.6
Parietal lobe	02	16.6
Occipital lobe	01	8.4
Basal ganglia	04	33.4
Thalamic	02	16.6
Cerebellar	00	00
Brainstem	00	00
Intraventricular	01	8.4
Subarachnoid	00	00

On angiographic evaluation majority of the patients were at stage 3 (40%); followed by stage 4 and stage 2 in 24% and 16% patients respectively. Stage 5 and stage 6 were found in 10% cases in each group. There was none in stage I. LAI was more frequent in stage 2 (5) while HI was frequent in stage 3 (13). Among the hemorrhagic stroke subtypes dICH was frequent stage 4 (3) and stage 5 (1); whereas lICH in stage 5 (2) and stage 6 (3). The only case of IVH had stage 6 at presentation. The difference was statistically significant (p value = 0.001) (Table 3).

Discussion

This was a hospital based cross sectional type of observational study including 50 patients. Majority of the patients were within 10 years of age at onset with a range of 5 to 43 years. This was similar to the

nationwide epidemiologic survey in Japan conducted by Kuriyama et al³ with collaboration of Ministry of Health and Welfare in Japan. They observed a peak age of distribution in between 10 to 14 years of age. Similar to this study, 47.8% were younger than 10 years of age. Another epidemiologic survey conducted in South Korea by Ikezaki et al¹⁰ also reported the highest peak of MMD below 10 years of age (35.9%) and in contrary to this study they found a second peak between 20-40 years of age. Regarding sex distribution, majority of the patients were female (54%) with a ratio of 1.17:1. This was a little lower than the report of Ikezaki et al¹⁰ who found a ratio of 1.3. But in Japan the reported ratio (1.8) was a bit higher³.

Similar to the reports of other studies, ischemic presentation (78%) was more common¹⁰⁻¹². Among those with ischemic stroke; most of the patients (57.9%) had hemodynamic infarct. In the hemorrhagic stroke subtypes; half of the patients had deep intracerebral hemorrhage. Considering all the patients with stroke; most (42%) had hemodynamic infarct (HI) followed by large artery infarct (LAI) in 34.0% cases and deep ICH (dICH), lobar ICH (lICH), IVH among 12.0%, 10.0% and 2.0% cases respectively. This was contrary to the report of Jang et al¹³ who showed in their 181 cases of MMD, LAI was present in 37 cases, HI in 48 cases and dICH in 82 cases and lICH in 14 patients. This is probably due to the difference in methodology of the studies as Jang DK had higher number of patients with hemorrhagic stroke.

Similar to the report of Jang et al¹⁴ and Houkin et al¹⁴, most of the patients presented stage 3. There was statistically significant difference (p value=0.001) in angiographic stages between ischemic and hemorrhagic onset of MMD. Ischemic stroke was more frequent in stage 2 to stage 4. On the other hand hemorrhagic stroke was frequent from stage 4 onwards. LAI was frequent in stage 2 while HI in stage 3. Among the hemorrhagic stroke subtypes dICH was frequent in stage 4 and stage 5; whereas lICH in stage 5 and stage 6. The difference was also statistically significant (p value = 0.001). The finding was consistent with the report of Jang et al¹⁴ who showed that the hemorrhagic hemisphere in patients with MMD had more advanced stage than ischemic hemisphere. In contrast to this

Table 3: Distribution of Angiographic Stages in Major Stroke Types (n=50)

Stroke Types	Angiographic stages						p value
	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6	
Ischemic	0	8	20	10	0	0	0.001
Hemorrhagic	0	0	0	2	5	5	

report Houkin et al¹⁴ did not find any significant difference between ischemic and hemorrhagic onset.

The study had several limitations; firstly, this is a hospital based study which may not reflect the whole scenario of the country. Sample size was also small.

Conclusion

Patients younger than 10 years of age had ischemic stroke at presentation whereas those older than 10 years had mostly hemorrhagic stroke at presentation. Patients of MMD presenting with hemorrhagic stroke at the onset had more advanced angiographic stage than the patients with ischemic stroke.

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