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Evaluation of Extra-Cranial Carotid Arteries by Digital Subtraction Angiogram (DSA) in Stroke Patients in a Tertiary Care Hospital

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Abstract

Introduction: *Carotid artery stenosis is one of the important causes of ischemic stroke. This may be diagnosed by Doppler Ultrasound and Digital Subtraction Angiogram (DSA) both of which have some advantages and disadvantages.* ***Objective:*** *The aim of this study was to assess extra-cranial carotid artery with the help of DSA among patients of ischemic stroke and transient ischemic attack (TIA).* ***Materials and Methods:*** *This observational cross sectional study was conducted in the Department of Neurology in Bangabandhu Sheikh Mujib Medical University (BSMMU) Dhaka from July 2013 to June 2015 for a period of two years. This study included a total of 50 patients. Diagnostic performance test of DSA was done at 50%, 50-69%, 70-99%, 100% cut off point of stenosis of right internal carotid artery (RICA) and Left internal carotid artery (LICA).* ***Results:*** *The mean age of cases was 61 ± 11.42 years. Out of 50 vessels, maximum cases were diagnosed as <50% stenosis of carotid artery (26 cases of RICA, 23 cases of LICA. Out of 50 vessels, 50%-69%, 70 but ≤ less than near occlusion and total occlusion were found among 10, 10, 4 vessels in RICA and 10, 9, 8 vessels in LICA respectively. The present study showed that 50 vessels of RICA was measured by DSA and diagnosed 28 (56%), 10 (20%), 7 (14%) and 5 (10%) carotid vessels as ≤ 50%, 50-69%, ≥70% but less than total occluded and total occluded cases respectively. This study also showed that 50 vessels of LICA was measured by DSA and diagnosed 23 (56%), 12 (24%), 8 (16%), 7 (14%) carotid vessels as ≤ 50%, 50-69%, ≥ 70% but less than total occluded and total occluded cases respectively.* ***Conclusion:*** *DSA as the gold standard has amply been performed in most diagnostic circumstances of carotid artery stenosis. So, the present study was done to evaluate extra cranial carotid arterial system by DSA in stroke patients in Bangladesh.*

Keywords: *Stroke, Transient ischemic attack, Digital subtraction angiogram, Color doppler sonography, Internal carotid artery.*

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Introduction:

Stroke stands second among the leading causes of death in the developed world[1]. Even in Bangladesh, stroke is a significant cause of mortality, morbidity and disability[2]. About 85% of stroke is ischemic stroke (infarct) and 15% is hemorrhagic stroke. There are many risk factors for ischemic stroke. Atheromatous carotid artery stenosis is one of the important causes of ischemic stroke. This is responsible for 10% of all ischemic strokes events[3].

Atheroma may cause transient ischemic attacks (TIAs) and ischemic stroke as it obstructs the blood stream to the brain or generates emboli that obstruct the cerebral arteries. The first part of internal carotid artery immediately beyond the bifurcation is the most frequently involved anatomical site of stenosis in carotid system. Carotid artery stenosis may be diagnosed by various investigations like duplex USD, CT-angiogram, Magnetic resonance angiogram (MRA) but DSA is thought to be gold standard. Carotid artery stenosis has different treatment options like medical, surgical, interventional measures according to different clinical settings. Medical treatment includes - use of statin agent, aspirin, control of HTN, good glycemic control and cessation of smoking whereas surgical option is carotid end - arterectomy or stenting.

Ability to accurately assess the degree of carotid artery stenosis and its importance for management of ischemic stroke and TIA has become significant with studies like NASCET[4] (North American symptomatic carotid end arterectomy, ECST[5] (European carotid surgery trial. ACAS[6] (Asymptomatic carotid atherosclerosis study), ACST[7] (Asymptomatic carotid surgery trial).

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Symptomatic Carotid stenosis was studied in the NASCET[4] and ECST[5] trial. Both showed a substantial benefit for surgery in patients with a stenosis >70%. In 659 patients with 70% to 90% stenosis randomized by NASCET[4] study the cumulative risk of any ipsilateral stroke at 2 years was 26% in medically treated patients and 9% in surgically treated patients. NASCET[4] study also showed a significant, although less robust benefit for patient with 50%-70% stenosis.

The indication for surgical treatment of asymptomatic carotid disease have been clarified by the results of the study of ACAS[6] and ACST[7]. ACAS[6] study randomized asymptomatic patients with >60% stenosis to medical treatment with aspirin or the same medical treatment plus carotid end- arterectomy. The surgical group had a risk over five years for ipsilateral stroke of 5.1% compared to a risk in the medical group of 11%. In both ACAS[6] and ACST[7] study the perioperative complication rate was higher in women, perhaps negating any benefit in the reduction stroke risk within five years. The natural history of asymptomatic stenosis is 2% per year stroke rate while symptomatic patient experience 13% per year risk of stroke.

Patients with either symptomatic stenosis >50% or asymptomatic stenosis 70% are presently considered for carotid recanalization done by endarterectomy or stenting. Before doing any of the above procedures, diagnosis of site, size and severity of extra cranial carotid artery stenosis should be confirmed.

Materials and Methods:

This observational cross-sectional study was carried out on 50 patients who had symptoms and signs of a stroke or TIAs from July 2013 to July 2015 for a period of 2 years. This study was done in Department of Neurology in Bangabandhu Sheikh Mujib Medical University (BSMMU) and National Institute of Nuclear Medicine and Allied Sciences (NINMAS), BSMMU. All patients of ischemic stroke and TIAs in outdoor and indoor of department of Neurology, BSMMU were enrolled in study population. Patients were selected using purposive sampling technique without any age, sex, ethnic, or socioeconomic discrimination. A detailed history and thorough physical examination were carried out on a questionnaire. Risk factors such as hypertension, diabetes mellitus, smoking, and ischemic heart disease were documented. The patients underwent computed tomography (CT) scan study prior to the DSA of carotid arteries and findings were documented. Cases with history, clinical and CT scan findings consistent with cerebral ischemic stroke were included in this study. Patients having symptoms suggestive of hemorrhagic stroke, vertebrobasilar insufficiency, head injuries, and those having primary and metastatic brain tumors were excluded from the study.

Patients were referred to cardiac cathlab of BSMMU for intra arterial DSA performed by two interventional neurologists blinded of USD finding. DSA included right and left CCA and ICA angiography with a 5 F H1 picard catheter and imaging in at least two planes (45° anterior oblique and 90° lateral on both side). Two to three angiographic projections were obtained per bifurcation during manual injection of 6-10 ml of contrast medium. The degree of stenosis was assessed by taking compass measurement by means of overhead projection and measured by tabulating diameters at the point of the most severe narrowing and at the distal non-stenotic segment according to the NASCET[4] criteria.

Data was collected in a data collection sheet. Diagnostic performance test of DSA was done at 50%, 50%-69%, 70%-99%, 100% cut off point of stenosis of RICA and LICA.

Prior ethical committee clearance was obtained to conduct this study. The collected data were analyzed with the aid of a calculator and presented in the form of tables, figures, graphs, and diagrams wherever necessary.

Results:

Table I shows among 50 patients 3 patients belonged to age group 41-50, 15 patients in 51-60, 27 in 61-70, 05 in > 70 year group. Maximum 54 % (n-27) patients were in age group 51-60. Minimum age was 50 and maximum was 74 years, with a mean of 61 ± 11.42 years. Table 1 also shows among 50 patients 38 (76%) were male and 12 (24%) were female.

Table I: Distribution of age and gender of patients (n = 50)

	Age	
Age group	**Number**	**Percentage**
41 - 50	3	
51 - 60	15	30
61 - 70	27	54
>70	05	10
Total	**50**	**100**
	Gender	
Male	38	76
Female	12	24
Total	**50**	**100**

Table II shows that out of fifty patients, 34 (68%) were hypertensive whereas 18 (32%) were normotensive and 19 (38%) had diabetes mellitus and 31 (62%) were non- diabetic. Table 2 also shows 29 (58%) were smoker and 21 (42%) were non-smoker.

Table II: Distribution of the risk factors of carotid artery stenosis among patients

	Number	Percentage
HTN		
Present	34	68
Absent	16	32
Total	**50**	**100**
Diabetes mellitus		
Present	19	38
Absent	31	62
Total	**50**	**100**
History of smoking		
Present	29	58
Absent	21	42
Total	**50**	**100**

Table III shows out of all patients 12 (24%) patients had family history of DM. In case of hypertension, stroke and IHD it was 20 (40%), 7 (14%), 11 (22%) respectively.

Table III: Distribution of patients' family history of different diseases by group (n=50).

Family	Number	Percentage
DM	12	24
Hypertension	20	40
Stroke	7	14
IHD	11	22

Table IV shows out of 50, number of patients of stroke were 45 (90%) and TIAs' were 5 (10%) .

Table IV : Distribution of patients by clinical diagnosis (n = 50)

Diagnosis	Number	Percentage
Stroke	45	90
TIA	5	10
Total	**50**	**100**

Table V shows distribution of patients' by diagnosis of carotid stenosis by duplex USD. Here maximum cases were diagnosed as <50% stenosis of carotid artery (26 cases of right internal carotid artery, RICA, 23 cases of Left internal carotid artery, LICA). Out of 100 vessels total occlusion was 04 in RICA and 8 in case of LICA.

Table V: Distribution of patients by diagnosis of carotid stenosis by duplex USD (n=50).

Degree of stenosis (%)	RICA (n=50)	LICA (n=50)
<50	26	23
50-69	10	10
≥ 70 but less than total occlusion	10	09
Total occlusion	**04**	**08**

Table VI showed that 50 vessels of RICA was measured by DSA and diagnosed 28, 10, 7 and 5 carotid vessels as ≤ 50%, 50-69%, ≥ 70% but less than total occluded and total occluded cases respectively. This study also showed that 50 vessels of LICA was measured by DSA and diagnosed 23, 12, 8 and 7 carotid vessels as ≤ 50%, 50-69%, ≥70% but less than total occluded and total occluded cases respectively.

Table VI: Distribution of patients by diagnosis of carotid stenosis by DSA (n=50)

Degree of stenosis	RICA (n=50)	LI CA (n=50)
<50	28	23
50 - 69	10	12
≥ 70 but less than total occlusion	07	08
Total occlusion	**05**	**07**

Discussion:

The mean age of ischemic stroke and TIA was 61 ± 11.42 years. Most of the cases belonged to 6th and 7'h decade. Minimum age was 50 and maximum was 74 years. This study shows that male patients (n-38) out numbers female (n-12) with a ratio of 3.16:1. Stroke is a male predominant disease as shown in different studies in Bangladesh like khan MRK et al study[10] and Hannan MA et al study[11]. They found M: F, 2.75:1 and 2.53:1

Niaz AS et al[12] studied on 100 patients of carotid artery stenosis in the city of Karachi of Pakistan. Of them 61% were male and 39% were female and M:F ratio was 1.56:1.

This study showed that among 50 patients 29 (59%) were smoker, 19(38%) were diabetic and 34 (68%) were hypertensive. Khan et al[10] studied 162 patients with ischemic stroke and it showed HTN (n=95, 58.6%), smoking (n=64, 39.5%) and DM (n=52, 32.1%) as associated risk factors. According to Anwar Ullah AKM et al[13] in review of 100 stroke patients' risk factors showed HTN in 65%, smoking in 44%, DM in 21% of patients.

Niaz AS et al[12] studied over100 patients with ischemic stroke and it showed HTN (n=67, 67%), smoking (n=41, 41%) and DM (n=31, 31%) as associated risk factors.

An Indian study conducted by Sethi SK et al[14] showed that among 63 patients 35 (55.5%) were hypertensive, 16 (25%) were diabetic and 10 (25%) were smoker.

Out of 50 patients 12 (24%) had a family history of DM. In case of HTN, stroke and IHD it was 20 (40%), 7 (14%) and 11 (22%) respectively. In khan MRK[6] series and Hannan MA[7] series, the patients with ischemic stroke had a family history of Stroke was 23% and 26.06% respectively.

This study shows that out of 100 vessels, significant stenosis (>50%) was found in 51 (51%) vessels on colour doppler imaging. Chamarth M et al study[15] found that 60(40%) vessels, out of 150 vessels had significant stenosis (>50%). Fernandes M et al[16] studied 100 carotid vessels and observed that 47 (47%) vessels had significant stenosis (>50%).

This study showed that 50 vessels of RICA was measured by DSA and diagnosed 28 (56%), 10 (20%), 7 (14%), 5 (10%) carotid vessels as ≤ 50%, 50-69%, ≤ 70% but less than total occluded and total occluded cases respectively.

On the other hand, this study also showed that 50 vessels of LICA was measured by DSA and diagnosed 23 (56%), 12 (24%), 8 (16%), 7 (14%) carotid vessels as ≤ 50%, 50-69%, ≤ 70% but less than total occluded and total occluded cases respectively.

Dey SK et al[17] studied 38 patients of stroke and found 32 patients as ≤ 70% and 6 cases as ≥ 70% stenosis during measuring RICA by DSA test. They also found 30 patients as ≤ 70% and 8 cases as ≤ 70% stenosis during measuring RICA by DSA.

SF Maroufi et al[18] studied 375 cases and he measured 202(53.8%), 105(28%), 21(5.6%), 20(7.4%), 19(5%) vessels as 0-15%, 16-49%, 50-69%, 70-99% and 100% stenosis of carotid vessels done by DSA.

HM Silvennoinen et al[19] studied 37 stroke patients After performing DSA test they found that 4 (5%) carotid arteries were occluded, 20 (27%) had a high-grade stenosis (70%–99%), and 16 (22%) had a moderate- grade (50%–69%) stenosis. There were 16 (22%) mild stenoses (50%) and no

stenosis was detected in 17 (23%).

Nederkoorn et al[20] study measured total 313 carotid vessels by DSA. They calculated 22(7%), 19(6%), 44(14%), 167(53.5%), 61(19.5%) vessels as 0-29%, 30-49%, 50-69%, 70-99% and 100% stenosis of carotid vessels done by DSA.

Conclusion:

Doppler ultrasound of carotid vessels is safe, cheap, less sensitive- Specific and accurate than digital subtraction angiogram for evaluation of carotid stenosis. With expert hand DSA is safe and it is more sensitive, specific and accurate than USD. So before endarterectomy or carotid stenting DSA is mandatory and doppler USD is supportive to measure extracranial carotid stenosis.

Conflict of Interest: None.

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