Bangladesh Journal of Neuroscience 2021; Vol. 37 (2): 55-60

Association of Hemodynamic Instability with Periprocedural Stroke following Carotid Stenting

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Abstract:

Background: *Carotid stenting is a preventive treatment option for recurrence of stroke in ischemic stroke patients with carotid stenosis. Hemodynamic Instability including hypotension, bradycardia, hypertension are procedural complications during carotid stenting. It has an influence on periprocedural stroke. Aim of this study was to evaluate the association of hemodynamic instability with periprocedural stroke following carotid stenting.* ***Methods:*** *ThisProspective longitudinal Study was conducted with 42 ischemic stroke patients with carotid artery stenosis at BSMMU from November 2020 toMarch 2022.The incidence of hemodynamic instability and stroke during periprocedural period following carotid artery stenting and subsequent 30 days follow up period were recorded.Then association of HI with periprocedural stroke was evaluated (p= < 0.05).* ***Results:*** *In this study, among 42 patients, severe carotid stenosis was 87.2% and ulceration was 64.1%. Hemodynamic instability was 33.3%.Among them, incidence of bradycardia, hypotension and hypertension was 28.2%, 25.6% and 2.6% respectively. Periprocedural stroke rate was7.1%.Associationof hemodynamicinstability with periprocedural stroke after stenting was statistically not significant (p =>0.05).* ***Conclusion:*** *Hemodynamic Instability is not associated with periprocedural stroke following carotid stenting.*

Key words: *Carotid Artery Stenosis, Carotid Artery Stenting,Hemodynamic instability.*

Inrtoduction

Stroke is second leading causes of adult deaths and major cause of physical disability worldwide[1]. Prevalence of stroke in Bangladesh is 0.3% and stroke is the third leading cause of death in Bangladesh[2]. Large vessel atherosclerosis was a major cause of ischemic stroke[3]. Stroke recurrence is a major problem around the world, leading to permanent and more severe disability[4]. Carotid artery stenosis is the major cause of ischemic stroke recurrence within 30 days[5]. Recurrence of stroke due to atherosclerotic carotid stenosis is prevented by medical therapy or in combination with carotid intervention[4].Carotid intervention has been shown to reduce the risk of recurrent stroke by a half in patients with symptomatic severe carotid stenosis[4]. Carotid endarterectomy was the gold standard of carotid revascularization for moderate to high grade carotid stenosis[6].The

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results of CREST indicated that, the two revascularization procedures were equivalent[7].As Carotid artery stenting is a less invasive procedure and does not involve cervical dissection, the patient may experience less periprocedural discomfort and a lower risk of cardiac and pulmonary complications[8].However, the major risk of carotid artery stenting(CAS) is the possibility that, it may result in another stroke[9]. Besides, hemodynamic instability (bradycardia, hypotension and hypertension) is a another complication following carotid stenting[10]. Carotid stenting techniques may trigger a baroreceptor reflex through instrumental manipulations at the carotid sinus[10]. Baroreceptors located in carotid sinuses are a crucial part of the regulation of blood pressure and heart rate. The stretching of the carotid sinus caused by angioplasty and stenting can trigger the baroreceptors to transmit signals to the brainstem, resulting in a transient decrease in sympathetic tone and an increase in parasympathetic output. Bradycardia and hypotension may result that in turn may increase CAS complications such as myocardial infarction and stroke [11]. Extreme or prolonged (>1 hour) episodes of periprocedural HI after CAS have been shown in some studies to be associated with worse clinical outcomes[12]. So, aim of this study was to evaluate association of HI with periprocedural stroke.

Materials and Methods

This prospective longitudinal study was done in the Neurology Department of BSMMU from November 2020 to July 2022. After the approval from Institutional Review Board, 42 patients were selected .Ischemic stroke patients of age more than 18 years with carotid stenosis more than 50%, willing to be included were enrolled in this study. Patients with total carotid occlusion,tortuous anatomy, presence of visible thrombus and had a major stroke with no useful recovery of function were excluded from enrollment.

Informed written consent was taken from each patient. Proper history was taken, physical and neurological examination was done, keeping in mind of the demographic and clinical variables. All relevant investigations were completed including CT scan /MRI of Brain. Then vascular imaging was performed by any of the modalities like MRA, CTA of brain and neck vessels or duplex study, the one being more feasible for the patient according to the consultant. Finally, cerebral digital subtraction angiography (DSA) was done to assess the percentage of internal carotid artery (ICA) stenosis according to the NASCET criteria. The indication for revascularization was approved by interventional neurologist. Counselling was done to the suitable patients for carotid artery stenting(CAS) with explaining the risks and benefits. Patients were closely monitored during and after carotid artery stenting CAS (up to 72 hour).Recurrent stroke and Hemodynamic Instability including bradycardia, hypotension and hypertension that developed during this period were recorded in data collection sheet. Recurrence of stroke within 30 days after carotid stenting was recorded in data sheet. If patient's history and clinical examination suggested a new stroke then one or both of the following were used as confirmatory evidence of stroke, one point increase on the modified Rankin scale (mRS) or an appropriate new or extended abnormality on CT scan of head or MRI of brain. Stroke was considered as periprocedural, when it occurred within 30 days of carotid stenting. Hemodynamic instability (HI) is defined as hypertension (SBP>160 mm Hg), hypotension (SBP <90 mm Hg), and/or bradycardia (heart rate <60 beats per minute).

Result

Among 42 patients 81% were male and 19% were female.Majority (54.8%) of the patients were above 60 years of age followed by 45.2% were ≤60 years. Mean age of the patients was 60.4±9.1 years (Table-I). Initial presentation of the patients was 76.2% had stroke and 23.8% had TIA.

Hypertension was found most common among the patients (81%) followed by DM (59.5%), dyslipidemia (35.7%), CHD (28.6%),CKD (11.9%), PCI (7.1%) and CABG (2.4). Besides, 47.6% had smoking habit, 35.7% had family history and 9.5% had previous history of stroke.

Table-I

Distribution of the patients by Age group (n=42)

Age group	Frequency (n)	Percentage
≤60	19	45.2
>60	23	54.8
Mean±SD	60.4±9.1	
Total	42	100

Majority (57.1%) of the patients had both sided carotid artery stenosis followed by 26.2% had right sided and 16.7% had left sided carotid artery stenosis. Besides, 50% of the patients had right sided carotid stenting and 50% had left sided carotid stenting (Table-II).

Table-II

Distribution of the patients according to stie (n=42)

Site	Frequency (n)	Percentage
Site of carotid artery stenosis		
Left	7	16.7
Right	11	26.2
Both	24	57.1
Site of carotid stenting		
Right	21	50
Left	21	50

Among all, 88.1% had severe stenosis where near total occlusion was 4.7%. Besides, 42.9% had length of lesion >15 mm, 26.2% had lesion calcification and 64.3% had ulceration (Table-III).

Table-III

Characteristics of ipsilateral carotid lesion (n=42)

Ipsilateral characteristics	Frequency (n)	Percentage
Percentage of stenosis		
Severe	37	88.1
Moderate	5	11.9
Near total occlusion	2	4.7
Length of lesion >15 mm	18	42.9
Lesion calcification	11	26.2
Ulceration	27	64.3

During periprocedural period 33.3% had developed Hemodynamic instability including bradycardia (28.6%), hypotension (23.8%), and hypertension (2.4%) (Table-IV).

Among all, within 30 days 7.1% had developed recurrent stroke. Hemodynamic instability including bradycardia, hypotension and hypertension with recurrent stroke after stenting was statistically not significant (p =>0.05).

Table-IV

Association of periprocedural events with recurrence stroke after stenting (n=42)

Periprocedural outcome	Recurrence stroke (n=3) n (%)	No stroke(n=39) n (%)	P value*
Hemodynamic instability	1 (33.3)	13 (33.3)	0.746^{NS}
Bradycardia	1 (33.3)	11 (28.2)	0.646^{NS}
Hypotension	0 (0)	10 (25.6)	0.432^{NS}
Hypertension	0 (0)	1 (2.6)	1.000^{NS}

*p-value was determined by Fisher Exact test. S= significant, NS= Not significant

Discussion

This study evaluate the association of hemodynamic instability with recurrence of periprocedural stroke.

Total 42 patients of ischemic stroke with moderate and severe carotid artery stenosis, who had carotid stenting were included in this study. Analysis of the data revealed that the mean age was 60.4 ± 9.1 years. An observational cross-sectional study was performed at Dhaka, Bangladesh, where 200 patients with CAS were evaluated with majority in 50-59 years (72.0%) and mean age of 57.7±3.06 years[13]. In another cross-sectional study, conducted by Kayani et al. at the Rawalpindi Institute of Cardiology, where 140 patients were evaluated with mean age of 59.6±7.1 years[14]. Another retrospective, observational study in Bangladesh showed patients with CAS had mean age of 55±5.5 years[15]. Mean age in the CAS registry in 2878 patients from 31 hospitals was 70.0±8.6 years and it was 75.2±7.6 years among US Medicare population in 2013-14[16-17]. Mean age of western population undergone carotid stenting was higher than Asian may be due to poor life expectancy of Asian population compared to European or American.

In this study, 81% were male and 19% were female. Marked male predominance was apparent Previous studies also observed similar findings regardinggender [12,18.]

Of these 42 patients, 76.2% presented with stroke and 23.8% had a TIA. AbuRahma et al. also revealed that the mean age of the patients was 68.5 years and male patients were predominant but found TIA more common than stroke[19].

The current study revealed that 3 (7.1%) patients had developed recurrence of ischemic stroke during periprocedural period. Among them, 1(2.3%) had a major stroke and 2(4.7%) had a minor stroke. Which was similar with pevious study. SPACE Collaborative Group found that stroke rate was 7.2%[20]. International Carotid Stenting Study showed that stroke rate was 7.4%[21]. Tsai et al. found that perioperative stroke rate was 6.3%[22]. A previous study by AbuRahma et al. showed that the 30-day perioperative stroke rate for all left-sided lesions was 2.6% and 1.7% for right carotid lesions[13]. Obeid et al. found perioperative stroke and death rate was 3.0% [18].Brott TG et al. found perioperative stroke rate was 5.7%[23]. Mas et al. showed that perioperative stroke rate was 9.2%[24]. Stenting and Angioplasty with Protection in patients at High Risk for Endarterectomy found that recurrent stroke rate was 3.2%[25]. In Bangladesh, Momenuzzaman et al. found 30-day stroke rate was 5.5% [15]. Cause of major stroke was undetermined. Minor strokes were due to carotid embolism due to they were ipsilateral to the carotid stenting, one in the watershed region and another one in the capsuloganglionic region.

Hemodynamic instability including bradycardia, hypotension and hypertension were also found among the patients (33.3%). But no significant association was found with recurrence of stroke. Hemodynamic instability during CAS may affect the incidence of perioperative stroke[13]. Some authors have reported similar outcome as well as found a higher incidence of periprocedural stroke in patients with pre-and post-procedural hypotension[12,18]. A recent study showed that HI was not statistically associated with periprocedural stroke[26].

Conclusion

Hemadynamic instability is a common periprocedural event following carotid stenting. Hemadynamic instability including bradycardia, hypotension and hypertension are not associated recurrence of periprocedural stroke.

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