Simultaneous Bilateral Carotid Stenting in High-risk Patients: A Single-center Experience with Review of Literature

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Abstract

Background: The aim of the present study is to determine the role of simultaneous carotid artery stenting in high-risk patients with triple vessel coronary artery disease and to determine the safety and efficacy of the procedure in these cases. Materials and Methods: The present study is a retrospective analysis of 33 patients who underwent carotid artery stenting in the same setting in our institution from 2009 to 2016. There were 22 male and 11 females with a mean age of 65 years (53–76 years). Demographic factors clinical characteristics and atherosclerosis risk factors were documented. Results: Technical success was 100% in our series. Intraprocedural and postprocedural events in the form of hypotension and bradycardia due to hemodynamic depression were seen in 11 patients. We did not encounter hyperperfusion syndrome in any of our patients. Twenty-nine patients underwent cardiac bypass surgery after 3 weeks, and 4 patients were kept on medical management for coronary artery disease. No deaths or major strokes occurred in our series. Conclusion: Simultaneous bilateral carotid artery stenting is a safe treatment option even in patients with high-risk factors and can be considered as the therapeutic option in patients with significant bilateral carotid artery disease.

Keywords: Carotid stenting, high risk, hyperperfusion

Introduction

Carotid artery disease accounts for 20% of ischemic stroke with a prevalence of bilateral disease in 8%–39% of patients undergoing carotid revascularization. The prevalence of coexisting coronary and carotid artery disease range between 2% and 14%. Carotid artery stenting has widely emerged as the treatment option for the past decade and is an effective alternative to carotid endarterectomy (CEA). Simultaneous bilateral carotid stenting is a challenging procedure because of the concerns regarding the cerebral hyperperfusion syndrome (HPS) and hemodynamic depression (HD) in these patients.

Bilateral severe carotid stenoses, concurrent arterial hypertension (HT), poorly controlled diabetes mellitus (DM), age older than 80 years, and ulceration of the carotid artery stenosis are described as high-risk factors for carotid stenting in the literature. All the patients in the present series have triple vessel coronary artery disease, and simultaneous bilateral carotid artery stenting (SBCAS) was done to prevent the delay of the cardiac surgery or treatment of contralateral carotid disease. Stent-supported percutaneous angioplasty of the Carotid Artery versus Endarterectomy failed to show a clear benefit of “protected” versus unprotected CAS in reducing periprocedural ischemic events.

The first report of SBCAS was described by Mathur et al. There are few other reports in the literature which described the safety and efficacy of SBCAS. In our present study, we describe SBCAS in a series of 33 patients with bilateral carotid disease and coexisting triple vessel coronary artery disease with highlight on selection criteria, treatment strategy, and clinical outcome in these patients.

Materials and Methods

The present study is a retrospective analysis of prospectively collected institutional database of carotid artery stenting cases

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done in our institution. A total of 654 patients underwent carotid artery stenting in our department from 2009 to 2016. Among these patients, 71 patients (10.8%) had significant bilateral carotid artery stenosis. Inclusion criteria were similar to the eligibility criteria of the Carotid Revascularization Endarterectomy versus Stenting Trial which is >50% in symptomatic patients and >60% in asymptomatic patients on angiography. The measurement is based on the North American Society carotid endarterectomy trial criteria where smallest luminal diameter at the level of stenosis was compared to the normal arterial diameter distal to the stenosis on DSA. All the patients in the series had a history of at least one significant medical illness (DM, HT). SBCAS was performed in 33 patients who included 22 males and 11 females. The presenting symptoms due to carotid disease ranged from recurrent transient ischemic attacks (TIA) lasting for few minutes to hemiparesis with a history of at least one risk factors (DM or HT or both). Magnetic resonance imaging (MRI) of the brain and carotid Doppler was done in all the patients. We did not include the patients with deranged renal function [Table 1] (serum creatinine >2 mg%), carotid thrombus, and compromised cardiac reserve (ejection fraction <35% on two-dimensional echocardiogram) and patients with tandem intracranial lesions (exclusion criteria).

All the patients also had triple vessel disease on coronary angiogram. Three weeks after, SBCAS 29 patients underwent coronary artery bypass surgery (CABG), and four patients were kept on medical management for coronary artery disease. High-risk informed consent was obtained from all the patients.

All the patients presented to the Department of Neurology and had at least one symptomatic carotid lesion on presentation. Complete medical history, evaluation, and neurological examinations before and after the procedure for each patient were performed by independent neurologists. On detailed history taking, cardiac symptoms (shortness of breath, difficulty in breathing, and chest pain) were evaluated, and cardiologist opinion was taken.

Twelve patients presented with recurrent bilateral TIAs, 8 patients had recurrent right upper limb paresthesias, and 6 patients had recurrent left upper limb paresthesias. Seven patients presented with hemiparesis.

MRI brain was done in all the patients. Small foci of diffusion restriction suggesting acute infarcts were seen at least in one MCA territory in 21 patients. Subacute infarcts in the presenting territory were seen in 4 patients. Chronic infarcts in the symptomatic side were seen in 3 patients.

MRI was normal in 4 patients who presented with TIAs. All the patients underwent treatment within 2 weeks of onset of the most recent episode of TIA or stroke. All the patients were on clopidogrel 75 mg/day and enteric coated aspirin 150 mg/day for at least a week before the procedure. Satisfactory control of blood pressure and cardiac rhythm was achieved by adjustment of drugs before the procedure. We do not routinely use embolic protection devices (EPDs) in our institution for carotid artery stenting. We believe reducing the number of endovascular maneuvers decreases the risk of plaque dislodgement and thus the periprocedural embolic events. Poststenting balloon angioplasty is strictly avoided in all our patients.

**Carotid artery stenting procedure**

All procedures were done in local anesthesia with continuous monitoring of intrarterial pressure, electrocardiography, and neurologic status throughout the procedure. An eight introducer sheath was positioned and heparin (1 mg/kg) was administered, and guiding catheter (Vista Brite MPS) was placed in the common carotid artery proximal to the lesion. Systemic heparinization was given to maintain the activated clotting time >250 s.

The stenosis was crossed with 0.014 wires. Balloon angioplasty before the stent placement was done in 6 lesions to ease the navigation of the stent across the lesion. Self-expanding stents used include protégé (ev3), wall stent (boston), and acclink (abott), and the choice of the stent was based on the operator’s discretion. Postdilation was strictly avoided in all the patients, and residual stenosis of <30% is accepted [Figures 1 and 2]. We do not use the EPDs in our institution, and the number of endovascular steps for the stent placement is kept to the minimum to reduce the periprocedural events.

All the patients were observed in intensive care unit and carefully monitored for headache, vomiting, seizures, and any fresh neurological deficit.

| **Table 1: Clinical symptoms in the patients** |
|---------------------------------------------|
| **Clinical presentation** | **Number of patients** |
| Recurrent bilateral MCA territory TIAs | 12 |
| Right-sided TIAs (left MCA territory) | 8 |
| Left-sided TIAs (right MCA territory) | 6 |
| Hemiparesis | 7 |

MCA: Middle cerebral artery, TIAs: Transient ischemic attacks

**Results**

Technical success was 100% with successful stent placement in all the lesions. HD was defined as any symptomatic or asymptomatic hypotension and/or bradycardia (systolic blood pressure <90 mmHg; heart rate <50 beats/min) and evaluated as mild, prolonged, and severe.\[^{10}\]

Grading scale of HD is as follows 0 = none, 1 = mild, temporary with hospital stay not prolonged, 2 = prolonged with extended hospital stay, 3 = severe with severe major neurological or cardiac adverse event. Postprocedural events due to HD occurred in four patients after the placement of stent on one side and in seven patients after the placement of stent on the second side. Atropine was given in 4 of these patients. Mephentermine (16 mg) was used for mild HD which was seen in seven patients. Prolonged HD seen in four patients was treated with postprocedure dopamine (5–15 µg/kg/min) or noradrenaline (2–4 µg/min) infusion.
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for 4–13 h. The majority of the patients were discharged on fifth postprocedure day, and 29 patients underwent CABG after an interval of 3 weeks. We did not have any cases of HPS in our patients which was another major concern in these patients. In patients who underwent CABG, antiplatelets were stopped 2 days before surgery and restarted after 2 days of surgery. Patients were kept on low molecular weight heparin during this period. No deaths or major or minor strokes occurred in any of the patients. At 3 and 6 months, clinical follow-up all the patients were asymptomatic and with a normal neurological examination.

**DISCUSSION**

We described in the present study, a series of patients with high-risk factors and triple vessel coronary artery disease who underwent SBCAS in our institution. Few series in the literature reported the role of SBCAS in patients. The rationale of doing simultaneous stenting in our patients is to the decrease the delay of treatment for coronary artery disease or for contralateral carotid disease in our cases. Twenty-nine patients underwent CABG in an interval of 3-week poststenting with a successful clinical outcome. The advantages of SBCAS have been described in the literature.

Meticulous hemodynamic monitoring and good intensive care unit facility are required for these patients. As a protocol, we did not use EPDs in our institution. Although there are many reports that support the hypothesis that EPD can decrease in the incidence of 30 day combined stroke and death rate. There is evidence that EPD is associated with predominantly silent ischemia in 25% of the cases, and it does cause severe spasm and does not offer guarantee of completely eliminating risk of embolic complications. Al-Mubarak et al. demonstrated using transcranial Doppler that embolic events increase due to the endovascular manipulations. The number of procedure-related steps is kept to the minimum, in our series, and balloon angioplasty was only done to facilitate the stent navigation, and strictly, which we believe this is more important to decrease the periprocedural embolic events in these cases. We did not have any deaths, major or minor strokes in our series.

The two important concerns regarding the SBCAS include occurrence of HPS and HD because of carotid sinus reflex. Intensive periprocedural blood pressure control is the critical factor to prevent HPS. Risk factors for developing HPS include high-grade stenosis, peri- and post-operative HT, and contralateral carotid.
Stenosis or occlusion, recent ischemia, and application of Ib/IIIa inhibitor.[18] Although our patients had high-risk factors, we did not have any incidence of HPS in our series. We set the postoperative blood pressure at a relatively low level with systolic < 120 because HPS is associated with worse outcomes than HD. Careful observation to the occurrence of symptoms such as throbbing headache, vomiting, seizures, or fresh deficit alerts to the detection of HPS at the earliest. Cerebral autoregulation takes several days to normalize after procedure, and hence, all patients were counseled to report to us immediately in case of occurrence of above symptoms even after discharge.[19]

HD is another important concern which is due to the stimulation of sinus receptors in these patients. The incidence of HD in literature is reported between 13% and 75.9%.[20,21] The incidence of HD is 33.3% which is similar to unilateral CAS. HD is graded as mild, prolonged, and severe.[10] The majority of the patients with HD recovered spontaneously. The patients with mild HD were managed with mephentermine which is a short-acting vasopressor drug. Prolonged HD was managed with intravenous fluids, dopamine, and Noradrenaline. Li et al.[8] in their series of comparison between SBCAS and staged stenting procedure did not find any significant difference in prolonged HD between both groups. Three possible explanations were given by the authors. Staged procedure may cause two episodes of HD, risk of HD events increases by untreated stenosis, and risk of occurrence of ischemic stroke may occur in waiting period. The target pressure with systolic < 120 was maintained, and possible because of no risk due to untreated lesion, in all the patients in the postprocedure period. Decreased endovascular maneuvers (less guidewire manipulations, avoiding balloon angioplasty as far as possible, no steps of placing, and retrieving the EPD) cause less stimulation of the receptors and thus form the key of the successful procedural outcome. The main limitation of our present study is it is a retrospective analysis. In addition, there is no comparison with endarterectomy because in our institution; the presence of bilateral carotid stenosis is a contraindication for CEA. The staged procedure may be other alternative in these cases.

**Conclusion**

SBCAS is an effective treatment option even in patients with high-risk factors and with bilateral carotid disease. It should be considered as the therapeutic choice to prevent the delay of cardiac surgery in patients with coronary artery disease and the delay of treatment of contralateral carotid disease. Multicenter randomized studies in these patients with SBCAD should give us more insight in these cases with respect to safety and efficacy of the various treatment options.

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**Conflicts of interest**

There are no conflicts of interest.