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Carotid Near-Occlusion Stent Experiences

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ABSTRACT

Introduction: Treatment strategy for near-occlusions (NO) of the internal carotid artery (ICA) is still controversial. In this study, we aimed to present the clinical results of stent placement in 50 patients with carotid artery (NO) stenosis that presented to our center, and upon which revascularization will be performed.

Methods: Between 2014 and 2017, 50 patients with (NO) from 180 patients who had stents in the Interventional Vascular Neurology clinic were retrospectively studied. All the patients whether using or not using the proximal and distal protection device during the procedure were included. Patients had clinical neurologic evaluation, and underwent carotid artery radiologic imaging before the carotid artery stent (CAS) procedure. Balloon dilatation was applied before the stent procedure for patients that had advanced stenosis. Post-dilatation was applied with a balloon of appropriate size in case of residual narrowing. Findings such as bradycardia, hypotension, reperfusion hemorrhage during and after the stent placement procedure, as well as patients that developed restenosis within 12 months were recorded.

Results: This study includes 50 (30 males, 20 females) patients that underwent carotid stent placement. The mean age of patients was 65 (28–81). Reperfusion hemorrhage was seen in 1 (2%) patient and the patient died in week 3. Ten (20%) patients complained of chills and tremor lasting less than 3 hours after the procedure. One (2%) patient had encephalopathy and agitation for less than 24 hours. Two (4%) patients had hypotension, and 15 (30%) patients had a headache for less than 24 hours. Three patients developed local hematoma at the site of the sheath, and were treated by applying compression. Restenosis signs in the stent site was observed in 6 patients (12%) in color Doppler ultrasonography of the carotid performed in the 6th and 12th months.

Conclusion: Although the innate process of ICA NO is not well known, it might be more frequent than currently considered. Especially after the diagnosis of ICA stenosis, it is important to make the right diagnosis in patients that have new ipsilateral symptoms. After the diagnosis is made, CAS, when performed by an experienced neuro-interventional team, seems beneficial with low complication rates.

Keywords: internal carotid artery, near-occlusion, stent, revascularization

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INTRODUCTION

Stroke is one of the important causes of permanent disability and death. Most of the strokes are associated with ischemic reasons, and the cause in nearly one third of these patients is carotid artery disease. Recurrence rate is high in strokes associated with symptomatic carotid artery stenosis followed by medical treatment. Carotid artery stenosis is generally associated with atherosclerotic causes, where the risk of stroke increases with increasing severity of stenosis. Therefore, performing revascularization in patients that develop stroke or transient ischemic attack due to severe carotid artery stenosis and in asymptomatic patients with severe carotid artery stenosis is an effective and safe method in the primary and secondary prevention of stroke (1). The riskiest patients among those with carotid stenosis are near-occlusion (NO) cases. In this study, we aimed to present the clinical results of stent application in 50 patients with carotid artery NO stenosis that presented to our center, and on which revascularization will be performed.

METHODS

Between 2014 and 2017, 50 patients with NO from 180 patients who had stents in the Gaziantep University Medical Faculty, Interventional Vascular Neurology clinic were retrospectively studied. All the patients whether using or not using the proximal and distal protection device during the procedure were included. Gaziantep University Medical Faculty Ethics Committee's approval (date 18.01.2018, decision no: 2018/27) was obtained for the study. The patients and their relatives were informed about the risks and possible complications before under going the procedure, and were given an informed consent form to sign. Symptomatic patients that had carotid artery NO in angiography and asymptomatic patients that had carotid artery NO, all of those who underwent stent placement for these reasons were included in the study. Patients to undergo stent placement were started on dual antiplatelet therapy (Acetylsalicylic acid 300 mg + Clopidogrel 75 mg) for at least 1 week before the procedure. Patients in whom antiplatelet therapy was contraindicated, patients with unsuitable vascular anatomical structure, and patients that did not choose carotid endarterectomy as a treatment option were not included in the study. Vascular risk factors such as age, gender, hypertension, hyperlipidemia, and smoking as well as demographic characteristics of patients were obtained from the hospital records. Symptomatic carotid artery stenosis was defined as a patient having experienced a transient or permanent ischemic attack or stroke within the last 6 months before the procedure. Transient ischemic attack was defined as a stroke that heals without any sequel within 24 hours. Electrocardiogram and laboratory blood tests

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were performed on all patients that were included in the study. Patients were evaluated with cranial computerized tomography (CT) or magnetic resonance imaging (MRI) before the procedure. For the diagnosis with CT, the criteria suggested by Bartlett et al. were applied. In addition, the degree of carotid artery stenosis was identified using Doppler ultrasonography of the carotid artery before angiographic examination. The occlusion typical recognized sonography appearance is a very tight stenosis with a minimal flow channel, slow flow velocities, and a grossly pathologic flow profile. Before CAS, all patients underwent four-vessel angiography for confirmation of NO of the ICA. The criteria for identification of NO were: 1) delayed cranial arrival of ICA contrast compared with the external carotid artery (ECA); 2) intracranial collaterals seen as cross-filling of contralateral vessels or ipsilateral contrast dilution; 3) obvious diameter reduction (>50%) of the ICA compared with the opposite ICA; or 4) ICA diameter reduction compared with the ipsilateral ECA, as defined by Fox et al., with some modification (2). NO was considered to be present when two or more of these criteria were recognized. These imaging procedures were repeated in patients that exhibited additional neurological symptoms after carotid artery stenting. All patients were started on 300 mg acetylsalicylic acid and 75 mg Clopidogrel treatment at least one week before the procedure and dual antiplatelet therapy was continued for 6 months after the procedure. Patients were monitored for at least 24 hours and patients with normal neurological examination findings were discharged. Patients were invited for examination in the first week and 1 month after they were discharged. Occurring transient ischemic attacks, stroke and other complications associated with the procedure were recorded, and the imaging processes were repeated. In the angiography procedure, 7F sheath was placed in the right or left femoral artery. Heart rate and blood pressure were monitored during the procedure; 70 U/kg bolus unfractionated heparin was administered intravenously. For selective imaging of each of the carotid arteries, diagnostic vertebral catheter (Cordis, USA, Boston Scientific Wall Stent, USA), right Judkins (Cordis, USA, Boston Scientific Wall Stent, USA) coronary catheter and/or 5F Simmon (Cordis, USA, Boston Scientific Wall Stent, USA) catheter was used depending on the variation state of the vascular structure. Hydrophilic wire (0.035) was inserted into the external carotid artery using road-map, and assisted by a diagnostic catheter. The wire was left in place and diagnostic catheter was removed. Afterwards, Envoy catheter with a 6F-7F wide lumen (Cordis, USA, Boston Scientific Wall Stent, USA) was inserted into the common carotid artery, and the wire was removed. Before the procedure, the cranial vessels were evaluated in anterior and lateral poses. Balloon dilatation (Simpass 3×20 mm 3×30 mm) was performed on patients with advanced stenosis before stent placement. Then the stent (Precise Cordis, USA, Boston Scientific Wall Stent, USA) was placed in a suitable localization. Post-dilatation was applied with a balloon of appropriate size (aviator 4×20 mm, 5×20 mm) in case of residual narrowing. Lesions of 6 (12%) patients had an appearance consistent with thrombus during the procedure, and therefore a distal protection device (angioguard) was used. Patients who developed bradycardia (pulse rate <40 or a decrease of ≤50% for up to 24 hours) or hypotension (systolic blood pressure <90 mmHg or mean arterial pressure <50 mmHg) during and after the stenting procedure were recorded. At the end of the procedure, anterior posterior (AP) and lateral cranial angiographic imaging were performed again and the procedure was ended (Figure 1).

Statistical Analysis

The SPSS (Statistical Package for the Social Sciences) package program was used for data analysis. Descriptive statistics were given as mean values, standard deviations, and the frequency distribution in percentages.

RESULTS

This study included 50 (30 males, 20 females) patients that underwent carotid stent placement. The mean age of the patients was 65 (28–81). In terms of vascular risk factors, 29 (58%) patients had previous stroke history, 26 (52%) patients had hypertension, 11 patients (22%) had hyperlipidemia, 14 patients (28%) had diabetes, 9 patients (18%) had smoking history, 1 patient (2%) had atrial fibrillation, 15 patients (30%) had coronary artery disease. 30 (60%) patients had vertigo, 30 (60%) patients had visual symptoms, 10 (20%) patients had syncope, 19 (36%) patients had transient ischemic attack, 20 (40%) patients had complaints of ischemic stroke that occurred within 30 days (Table 1).

Table 1. Patient characteristics

Patients	**Total n=50 (%)**
Age (yrs)	65
Indication for procedure	
Vertigo	30 (60)
Visual disturbance	30 (60)
Syncope	10 (20)
CVA/TIA	39 (78)
Comorbidities	
History of Stroke	29 (58)
Hypertension	26 (52)
Diabetes	14 (28)
Hyperlipidemia	11 (22)
Smoking	9 (18)
Atrial fibrillation	1 (2)
Coronary artery disease	15 (30)

Stent placement sites were as follows; the stents were placed in the right internal carotid artery (ICA) in 23 (46%) patients and in the left ICA in 27 (54%) patients. Pre-dilatation was performed on all patients in order to allow stent placement or placement of the stent more easily during

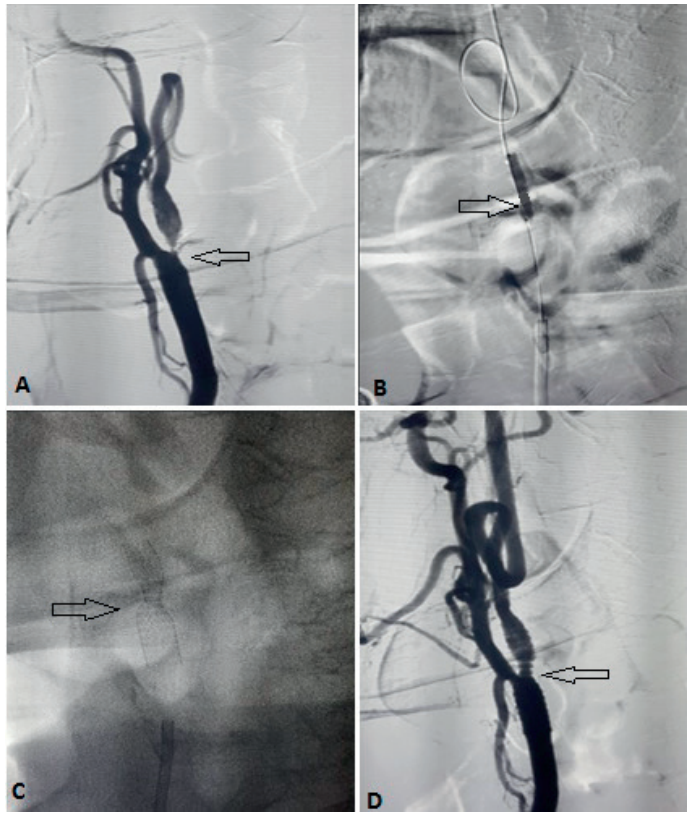

Figure 1. a-d. Right internal carotid artery (ICA) near-occlusion (NO) before endovascular procedure (a). Ballon pre-dilatation before carotid artery stenting (b). ICA angiogram after stent placement (c, d).

the procedure. Post-balloon dilatation procedure was performed on 11 (22%) carotid lesions on the right and 12 (24%) carotid lesions on the left (Table 2). Three patients (6%) developed asystole during post-dilatation and 12 patients developed bradycardia (24%) during stent opening. The rhythm returned to normal after intravenous administration of 1 mg atropine. Two patients (4%) had middle cerebral artery (MCA) branch infarction within one hour in the stent ipsilateral. Reperfusion hemorrhage was seen in 1 (2%) patient and the patient died in week 3. Ten (20%) patients complained of chills and tremor lasting less than 3 hours after the procedure. One (2%) patient had encephalopathy and agitation for less than 24 hours. Two (4%) patients had hypotension, 15 (30%) patients had a headache for less than 24 hours. Three patients developed local hematoma at the site of the sheath and it was treated by applying compression. Restenosis signs in the stent site were observed in 6 patients (12%) in color Doppler ultrasonography of the carotid was performed in the 6th and 12th months (Table 2).

Table 2. Procedural complications

	n=50	Percent
Bradycardia	12	24
Asystole	3	6
Hypotension	2	4
Ischemic stroke	2	4
Encephalopathy	1	2
Headache	15	30
Restenosis	6	12
Cold chill	10	20
Inguinal local hematoma	3	6

DISCUSSION

Carotid artery stenosis is a very important cause of ischemic stroke. In patients that had a stroke due to symptomatic carotid artery stenosis, stroke recurrence rate within the first two years of medical treatment reaches nearly 26%. Annual stroke incidence in patients with an asymptomatic carotid artery stenosis (>60% under medical treatment) was reported as 2.5% (3, 4). The riskiest patients among those with carotid stenosis are NO cases. NO of the ICA is defined as the presence of an atherosclerotic plaque causing hemodynamically critical stenosis usually in the bulb of the ICA. A residual slow flow through this segment and a reduced post stenotic perfusion pressure frequently leads to the collapse of the distal segments of ICA, and this may be seen on angiography as a 'string sign' (2). Treatment strategy for NO patients is still controversial. In the analyses conducted in randomized controlled trials such as the North American Symptomatic Carotid Endarterectomy Trial (NASCET) and the European Carotid Surgery Trial (ECST), it was reported that the risk of stroke was low with medical treatment, and surgical therapy was not beneficial for internal carotid NO. However, it was reported in other studies that the risk of ipsilateral stroke within the first years of medical treatment was 11.1–33%. In addition, patients' comorbid conditions definitely affect the treatment process. Concerning our patients, 58% had previous stroke history, 52% had hypertension, 22% had hyperlipidemia, 28% had diabetes, 18% had smoking history, and 30% had coronary artery disease. Different values of stroke risk for the one-month period after NO stenting have been reported in literature. The incidence of stroke was reported as 6.7% in the study conducted by Gil-Peralta et al., and as 2.2% in the study conducted by Akkan et al. (5, 6). According to our study, the incidence of stroke after stent placement was found to be 4%. Our findings were consistent with the literature.

In a study conducted by Gonzalez et al., post-stenting incidence of hypotension was reported as 37.1%, bradycardia as 48.3%, and asystole as 24.1%. In our study, the incidence of hypotension was 4%, bradycardia 24% and asystole 6% (7).

Various headache incidences after carotid stenting were reported. Marti et al. found the incidence of headache as 21.4% (8). In another study conducted by Gündüz et al., the incidence of headache was found as 39% (9). In our study, the incidence of headache lasting less than 24 hours was found as 30%.

The incidence of contrast-induced encephalopathy after stenting varies between 0.3% and 1%, whereas this value might reach 4% when hyperosmolar iodinated contrast agents are used (10). 2% of the patients had impaired consciousness for less than 24 hours. Ruiz-Salmeron et al. found the incidence of intracerebral hemorrhage after NO stenting performed on 54 patients as 5.5%, and Choi et al. reported the same to be 10% (11, 12). In our study, the incidence of reperfusion hemorrhage was 2%.

Reported incidences of in-stent restenosis after carotid stenting vary significantly due to definitions, deviation of measurements, and inconsistencies in the follow-up schedule. Gonzales et al. reported the incidence of restenosis as 4.3%, and occlusion as 2.6% during the 36-month follow-up period. Terada et al. reported the incidence of restenosis as 5.9% during the 25-month follow-up period. Gil-Peralta et al. reported the same to be 13.3% during the 10-month follow-up period (6, 7, 13). In our study, the incidence of in-stent restenosis was observed to be 12% (6 patients) during the 12-month follow-up period. Our findings were consistent with the literature.

CONCLUSION

Although the innate process of ICA NO is not well known, it might be more frequent than currently thought. Especially after the diagnosis of ICA stenosis, it is important to make the right diagnosis in patients that have new ipsilateral symptoms. After the diagnosis is made, CAS, when performed by an experienced neuro-interventional team, looks beneficial with low complication rates. Due to numerous complex clinical presentations and hemodynamic factors in all patients with ICA NO, larger series are required in order to assess which patient groups will benefit the most.

Ethics Committee Approval: The study was approved by the Ethics Committee of Gaziantep University.

Peer-review: Externally peer-reviewed

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