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Advanced vasospasm in carotid stenting using the distal filter-type embolic protection device: A case report

Ahmet Yabalak [1], Murat Yılmaz [2]

[1] Department of Neurology, Izzet Baysal State Hospital, Bolu, Turkey
[2] Department of Neurology, Bolu Abant Izzet Baysal University Faculty of Medicine, Bolu, Turkey

ORCID ID of the author(s)

AY: 0000-0002-3317-9567
MY: 0000-0002-5308-4653

Abstract

There are difficulties in the use of embolic protection devices (EPD) for carotid artery stenting (CAS), and various side effects can be observed. We presented a patient who underwent CAS with a distal filter-type (DF) EPD for symptomatic right internal carotid artery (ICA) stenosis and showed advanced vasospasm. A 68-year-old male patient was hospitalized with a pre-diagnosis of transient ischemic attack (TIA) in the form of left-sided weakness. Computed tomography angiography revealed 90% stenosis in the right ICA. On the 5th day, he underwent an angiography, which showed a plaque causing 90% stenosis. A 5F Spider FX (Medtronic Corp.; Minneapolis, MN, USA) was placed in the cervical ICA. At this time, mild vasospasm was observed in the cervical ICA, but the flow was normal. After pre-dilatation, a Protégé 8-6x40 stent was placed in the stenotic segment. Due to the 50% residual stenosis, a post-dilatation was performed. After post-dilatation, advanced vasospasm developed distal to the stent and the flow was completely obstructed. Vasospasm significantly regressed within a few minutes with intra-arterial nitrate administration. There was no change in the neurological examination of the patient during and after the procedure. Although vasospasm is usually a self-limiting complication that resolves without clinical symptoms, it may cause a TIA or an infarct. In CAS procedures, the possibility of a vasospasm should be kept in mind and if it occurs, the irritant should be removed. If there is no improvement, an intra-arterial vasodilator should be administered.

Keywords: Carotid stenosis, Carotid stenting, Vasospasm, Distal filter, Embolic protection device

Introduction

Carotid artery stenting (CAS) is recommended as an alternative treatment to carotid endarterectomy operation (CEA) in the centers where the complication rate for symptomatic and asymptomatic patients is below 6% and 3%, respectively. The frequency of minor stroke was higher in CAS compared to CEA operations [1, 2]. Embolic protection devices were developed to reduce the risk of distal embolism during the CAS procedure. These can be classified as distal occlusion balloons, distal filters (DF), and proximal occlusion devices. Nowadays, combined systems are also used, the most common ones in daily practice being the DFr group EPDs. While there are publications reporting that the perioperative stroke risk is lower in EPD use, there are also studies which report that there is no significant difference in neurological complications between the patients in whom an EPD was or was not used [3-5]. There are difficulties in the use of EPDs, and side effects may occur. We here present a patient who underwent CAS with a DF type EPD due to symptomatic right internal carotid artery (ICA) stenosis and showed advanced vasospasm.

Corresponding Author
Ahmet Yabalak
Izzet Baysal State Hospital, Department of Neurology, 14300, Bolu, Turkey
E-mail: yabalakahmet@gmail.com

Informed Consent
The authors stated that the written consent was obtained from the patient presented with images in the study.

Conflict of Interest
No conflict of interest was declared by the authors.

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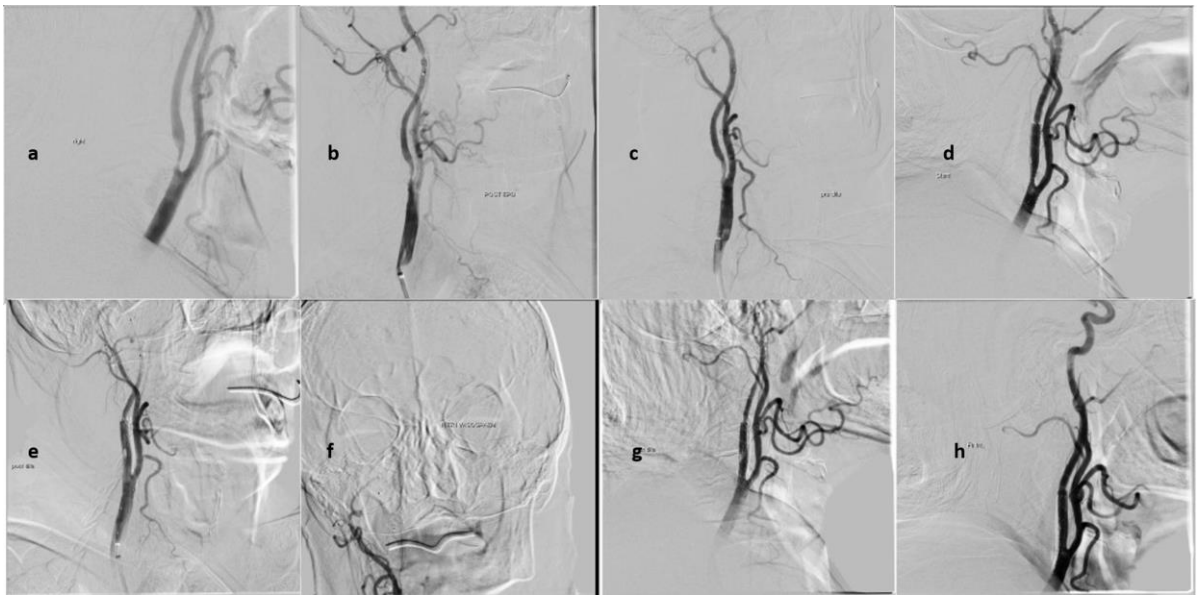
Figure 1: (a) Diagnostic examination revealed a 90% stenosis. (b) Mild vasospasm was observed in the cervical ICA after the distal filter was placed. (c) After pre-dilatation. (d) There was approximately 50% residual stenosis after stenting. (e) After post-dilatation (f) After post-dilatation, there was no flow in the ICA. (g) Immediately after intra-arterial nitrate administration. (h) Five minutes after intra-arterial nitrate administration.



Case presentation

In September 2020, a 68-year-old male patient with known hypertension, diabetes mellitus and a history of coronary artery bypass surgery eight years ago was admitted to the emergency department of our hospital due to left-sided weakness that started five hours ago. On admission, the neurological examination showed that the left nasolabial fold was flattened and the muscle strength for left upper and lower extremities were 3/5 and 4/5, respectively. His National Institutes of Health Stroke Scale (NIHSS) score was 5. No acute pathology was detected in diffusion-weighted magnetic resonance imaging (MRI). Computed tomography angiography (CTA) revealed a 90% stenosis in the right ICA. The patient was hospitalized and acetylsalicylic acid and ticagrelor were started. Within six hours of follow-up, the neurological examination returned to normal; transient ischemic attack (TIA) was considered in the etiology of carotid stenosis and right ICA stenting was planned. On the 5th day, the patient's neurological examination was normal, and he was taken to angiography. A 6F long sheath was placed in the right ICA over the 8F femoral access sheath. Diagnostic examination revealed an ulcer extending from the right CCA to the ICA and a plaque forming a 90% stenosis at its narrowest point. After the stenotic segment was passed with a micro-guidewire, a 5F Spider FX (Medtronic Corp.; Minneapolis, MN, USA) EPD was placed in the distal cervical ICA. Vasospasm developed in the segment where the DF was opened, but the flow was normal. Then, pre-dilatation was performed with a 2.75x20 mm balloon catheter, and a Protege 8-6x40 (Medtronic Corp.; Minneapolis, MN, USA) stent was placed in the stenotic segment. Due to 50% residual stenosis, a post-dilatation was performed with a 5x15 mm balloon catheter. After post-dilatation, advanced vasospasm developed distal to the stent and the flow was completely obstructed in the cervical ICA. Meanwhile, the neurological examination did not deteriorate. After intra-arterial nitrate administration, vasospasm significantly regressed within a few minutes.

The 5F Spider FX EPD was properly collected. In the control injection, the ICA and intracranial circulation were normal and there was no residual stenosis (Figure 1). The patient, whose neurological examination was normal, was discharged after 24 hours of follow-up. Informed consent was obtained from the patient before discharge. At the 3rd month control, the neurological examination was normal, and no residual stenosis was detected in Doppler USG.

Discussion

The DF group forms the most extensively used EPDs in daily practice to reduce the risk of distal embolism in CAS. The advantage of distal filter group EPDs over proximal protective devices and distal balloon devices is that cerebral perfusion can continue during the procedure. However, there are also several disadvantages: The stenotic segment must be passed without cerebral protection; if pre-dilatation is needed, it must be performed without cerebral embolic protection; in patients with tortuous vascular structures, the implantation can sometimes be arduous or even impossible. Also, they may cause vasospasm or dissection, thrombus may occur directly in the filter, and there is a possibility of thrombus formation within the EPD, which may embolize distally during retrieval or filter malposition. In a randomized controlled study comparing the use of a proximal occlusion device and a DF, vasospasm was observed in 23% of the DF group and 2% of the proximal occlusion group. There was no significant difference between the two groups in terms of clinical events [6]. In a retrospective study evaluating CAS cases in whom DFs were used, vasospasm causing more than 50% stenosis developed in 9.1% of the patients, which spontaneously regressed within a few minutes in all patients [7].

A study comparing first-, and second- generation DF and no DF use reported that vasospasm developed in 67% of those in the first-generation DF group, 17% of those in the second-generation DF group, and 14% of those in the non-DF group [8].

Another study on 640 cases in which DF was used reported that 4.29% of the patients developed a vasospasm large

enough to disrupt the flow, which regressed after intra-arterial nitrate administration without giving out clinical signs [9], as was the case in our patient. Vasospasm is more common among females, in those with high tortuosity index, and during long procedures [10].

Even in the most experienced hands, DFs move a little during the process. This can trigger a vasospasm due to endothelial irritation or damage done by the micro-guidewire or DF. Although it usually resolves spontaneously with withdrawal of the irritant, intra-arterial nitrate, nimodipine or milrinone administration may be required. A vasospasm can also make it quite difficult to recover the DF. Although vasospasm is usually a self-limiting complication that resolves without clinical symptoms, it may cause a TIA or an infarct. The risk is especially high if it is overlooked or noticed late [11-13]. Advanced vasospasm can cause flow interruption in the ICA, which may be confused with an ICA occlusion.

Conclusion

In CAS procedures, the possibility of a vasospasm should be kept in mind. If it occurs, first, the irritant should be removed, and if there is no improvement, an intra-arterial vasodilator should be administered. The key is keeping the risk of vasospasm in mind and detecting it early.

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