Choice of Protection Devices in Carotid Angioplasty
Two Case Reports

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Abstract. Patient selection is of the utmost importance with all endovascular procedures. It is equally important to select the appropriate protection device during carotid angioplasty/stenting (CAS). CAS in two patients was unsuccessful due to the chosen protection device. Occlusion of the external carotid artery while deploying a Parodi Anti-Embolic-System Device (PAEC® - ArteriA) resulted in cerebral ischaemia. Conversion to the Angioguard® System (Cordis) made carotid angioplasty possible, but was complicated by thrombosis of the filter. In the second case it was impossible to negotiate tortuous vessels with the Angioguard® system. Our experience illustrates that both devices have limitations. Choosing the wrong device may have serious consequences.

Introduction

Endovascular surgery is evolving rapidly. Techniques for CAS have improved and carotid stenting is increasingly used. CAS is limited by its potential for producing emboli (1). Protection devices have been developed to avoid emboli reaching the brain (2, 3).

The available protection devices have advantages and limitations. We describe two patients in whom CAS was complicated by failure of two different devices.

Case reports

Case 1

A 73-year old female suffered a transient ischaemic attack with aphasia. Duplex showed bilateral carotid stenoses of more than 90%. Arteriography (DSA) demonstrated subocclusion of the internal carotid artery (ICA) on the right side. The left ICA had a stenosis of 95%. The external carotid arteries (ECA) and common carotid arteries (CCA) were open (Fig. 1).

We planned CAS for the left, symptomatic ICA, with the Parodi Anti-Embolic System Device®. Clopidogrel 2 × 75 mg and acetylcysteine 600 mg were given. Under local anesthesia (20 ml. lidocaine hydrochloride 1%) a 10 F introducer sheath was placed in the right common femoral artery and a 5 F sheath in the right common femoral vein. 7500 IU of heparin were administered. The Parodi anti-embolic catheter (PAEC) was positioned in the CCA and the guide catheter was connected to the femoral vein introducer with an interposed blood filter. The Parodi external balloon (PEB-balloon) was placed in the ECA. Inflation of the PEB balloon resulted in convulsions and loss of consciousness. The balloon was deflated, and the patient recovered. A second attempt to inflate the PEB-balloon had the same effect. The blood pressure remained stable throughout the procedure.

An Angioguard Emboli Capture Guidewire was delivered through the PAEC-catheter. It was deployed successfully distal to the ICA stenosis. During predilation of the lesion, a third attack occurred, with immediate recovery after deflating the balloon. A Carotid Wall
stent (8 × 20 mm) was placed. During postdilation moulding of the stent, the patient collapsed again with loss of consciousness. Angiography showed occlusion of the ICA with debris in the filter. The filter was removed along with the retrieval device. Flow was restored, the patient recovered and a good angiographic result was obtained (Fig. 2).

The patient left hospital two days later with no neurological deficit on clopidogrel 75 mg, acetylsalicylic acid 160 mg and nadroparine 7500 units for three weeks.

Case 2

A 74-year old asymptomatic right handed male had bilateral carotid bruits. Duplex showed bilateral stenoses of more than 90%. Arteriography confirmed a filiform stenosis of the left ICA and ulceration in the right carotid bulb (Fig. 3).

We planned bilateral carotid angioplasty with the Angioguard System, first of the left, then of the right side. Clopidogrel 2 × 75 mg and acetylcystein 600 mg were given. Under local anesthesia a 7 F Cook introducer sheath was positioned in the CCA. 7500 IU of heparin were given. Several attempts were made to transverse the lesion with the protection device. Due to angulations, the stiffness of the guidewire and the very tight lesion, it was impossible to position the device. During this procedure the patient remained haemodynamically stable and had no neurological deficits.

The next day a second attempt was made with the Parodi System. The 7 F sheath was replaced by a 10 F PAEC catheter, positioned in the CCA, the femoral vein was punctured and the filter was interposed. Again 7500 IU of heparin were given and the ECA and CCA were occluded. Back bleeding was obtained via the filter into the femoral vein. Predilation of the lesion with a 4 × 20 mm balloon, delivery of a Wall stent (8 × 20 mm) and postdilation with a 4 × 20 mm balloon was performed with good angiographic result (Fig. 4).

Postoperatively the patient had no neurological deficits and was discharged 24 hours later. He went on to have a similar procedure on the right with no problems.

Discussion

CAS is less invasive than carotid endarterectomy and has advantages in terms of patient comfort (1). Several authors (4, 5) have suggested that carotid angioplasty has a similar risk compared to carotid surgery. Stenting
is safer than simple balloon angioplasty because dislodging of emboli, dissection and thrombosis of the carotid artery are less likely. The stent maintains flow and seals the site of dissection, preventing a free intimal flap.

CAS is associated with release of emboli into the cerebral circulation (1, 3). Cerebral protection appears to be effective in reducing procedure-related neurological complications. The size and number of particles the brain can tolerate remains unknown – intuitively, the lesser the better (6, 7). There are different approaches to the problem.

1. Protection distal to the lesion, between the stenosis and the brain.
   a. Occlusion of the ICA with a balloon distal to the lesion. After dilation and stenting the emboli can be aspirated. (e.g. PercuSurge Guardwire®, Medtronic ; Theron Balloon®; Henry-Amor® Balloon) (2, 3, 8)
   b. Umbrella like-filter (e.g. SPIDER-device®, ev3 ; Angioguard System®, Cordis ; Epi FilterWire EX®, Boston Scientific) (3, 6, 8)

2. Blood flow reversal in the ICA
   e.g. Parodi-Anti-Embolic-System Device (PAES®), ArteriA (6, 8, 9) ; MOMA® (Inovatec).

In the cases described above, we used the Angioguard System® (Cordis) and the Parodi Anti-Embolic System Device® (ArteriA). In both cases the initial choice was incorrect, but we could perform dilation and stenting safely with the other type protection device.

In the first patient, occlusion of the ECA resulted in convulsions and loss of consciousness. The occlusion reduced the collateral circulation from the ECA to the ipsilateral ICA and the result was an insufficient collateral flow through the circle of Willis and transient ischaemia. A potential drawback of the Parodi device is intolerance to occlusion of flow in the CCA, when the contralateral carotid artery is occluded or when there is insufficient collateral flow. This problem, expected in less than 10% of the cases, can be predicted in some patients when preoperative intracerebral angiograms showing the absence of an anterior or a posterior communicating artery. Transcranial Doppler or duplex mapping of the circle of Willis can also be helpful (8, 10).

Using the Angioguard system dilation and stenting was possible but another complication occurred : thrombosis of the filter with a large quantity of embolic debris. Urgent removal of the filter saved the patient. Echolucent plaques and plaques with a stenosis of more than 90% produce a higher number of embolic particles, with a higher risk of obstructing a filter device (11). This device was chosen for this patient because flow reversal resulted in cerebral ischaemia.

In the second case, the device could not be deployed due to tortuosity of the vessels and the tightness of the

### Table 1

<table>
<thead>
<tr>
<th>ADVANTAGES</th>
<th>LIMITATIONS</th>
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<tr>
<td>Complete protection of distal ICA</td>
<td>Interruption blood flow during protection</td>
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<tr>
<td>Low crossing profile / Flexibility (compared to filtration devices)</td>
<td>Laborious procedure (active aspiration)</td>
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<tr>
<td>Distal occlusion (2, 3, 9)</td>
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<tr>
<td>Preservation of flow</td>
<td>Larger crossing profile</td>
</tr>
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<td>Angiography during protection possible</td>
<td>Possibility of missing smaller particles, emboli during deployment</td>
</tr>
<tr>
<td>Distal filter (3, 7, 9)</td>
<td></td>
</tr>
<tr>
<td>Complete protection prior to lesion manipulation</td>
<td>Interruption of flow during protection</td>
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<tr>
<td>Capturing particles of all sizes</td>
<td>Requirement of larger puncture site hole in the groin</td>
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<tr>
<td>Ability to treat tight / tortuous lesions</td>
<td>Potential dissection / spasm in ECA or CCA</td>
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<tr>
<td>Ability to use guidewires of choice</td>
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<td>Proximal occlusion (7, 9, 10)</td>
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ICA Internal Carotid Artery
ECA External Carotid Artery
CCA Common Carotid Artery

(*) risk of embolization when passing the lesion with the protection device.
lesion. Systems based on proximal occlusion are able to treat tight and/or tortuous lesions.

Advantages and disadvantages of the different protection systems are summarized in table 1. The knowledge of the characteristics of the available protection devices is of great importance when selecting the appropriate cerebral protection device for CAS.

Conclusion

Complications due to embolization during CAS can probably be prevented by use of protection devices (1, 2, 3). A variety of filters and devices have been developed, each with their own advantages and limitations. A correct choice in function of the individual patient seems important. Full acknowledgement of cerebrovascular protection device types could result in safer endovascular treatment of carotid artery stenoses.

References