Long-Term Results of Endovascular Exclusion of Extracranial Internal Carotid Artery Aneurysms and Dissecting Aneurysm

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Objectives: Surgery remains the standard option to treat symptomatic or complicated aneurysms of the extracranial internal carotid arteries (EICA). When located more distally to the EICA, surgery appears to be very invasive and disabling. Endovascular treatment of high aneurysmal EICA has been poorly reported. We report our experience in this particular field.

Methods: We treated five EICA endovascularly, using covered stents and stentgrafts in four patients, two males and two females. One male was treated bilaterally. The average age was 59.2 years (39–80). Three patients were symptomatic (two transient ischemic attack and one stroke). Patients were followed by duplex scan, CT scan, or angio MR.

Results: Protecting devices were used in two cases. No in-hospital complication was observed. During follow-up (3.6 ± 1.3 years), no adverse event was observed and all devices remained patent at duplex scan and angiography. One early endoleak was observed and treated with covered stent extension. No sign of in-stent stenosis was observed. All the aneurysmal sacs thrombosed.

Conclusion: Covered stents and stentgrafts allow a less invasive approach to treat highly located internal carotid aneurysms. Larger series are needed to assess the role of covered stents in treating aneurysmal EICA as first choice. (J Interven Cardiol 2004;17:245–252)

Introduction

Before endovascular technologies were developed, surgical strategies were the only chance to heal symptomatic or complicated aneurysmal diseases of the extracranial internal carotid arteries (EICA), while antiplatelet and anti-aggregant drugs have remained the treatment of choice for asymptomatic aneurysmal lesions. Surgery is difficult and challenging when the lesions are located in the distal portion of the EICA, at the basis of the skull.1 In such cases the surgical option becomes really invasive, and may be disabling. Now that the endovascular treatment of stenotic internal carotid arteries (ICA) has proven to be both feasible and durable,2–4 highly located aneurysms and dissecting aneurysms the EICA may also benefit from endografts and covered stents. We are presenting our experience in this particular field and our preliminary long-term results.

Material and Methods

Patients. We report six endovascular procedures to treat five aneurysmal EICA in four patients, one of which was treated bilaterally. The average age was 59 years, ranging from 39 to 80 years. All the lesions were distally located on ICAs, but limited to their cervical part, at the base of the skull. Two of them were referred to a neurosurgeon.

Three patients were symptomatic: two transient ischemic attacks (TIA) and one minor stroke. One asymptomatic patient presented with two huge bilateral dissecting aneurysms. The etiologies of the lesions treated were as follows:
Four dissecting aneurysms: two spontaneous and two posttraumatic (Fig. 1).

—One atheromatous aneurysm (Fig. 2).

**Imaging.** The preoperative imaging techniques included duplex scan (DS), transcranial Doppler (TCD), angiography, and/or CT scan and magnetic nuclear resonance (MNR). During the procedure in our operating room, we used a mobile C-arm. All the patients underwent DS, angio MR or CT scan and/or angiography as follow-up examinations.

**Endovascular Procedure.** After examination by an independent neurologist, the patients gave informed consent. We achieved six endovascular procedure and implanted six endovascular prostheses (one procedure was bilateral). We used a cervical retrograde percutaneous access, as described previously, in all but one case, because the femoral route was considered to be either too tortuous or not adapted to the stent-graft progression. We used five PTFE covered stents (Jomed®) and one Dacron® stentgraft (Wallgraft®; Fig. 3). In this last case, we needed a small neck cut-off to better introduce the sheath due to its larger profile. The two procedures were achieved under cerebral distal protection, with a distal occluding balloon (Percusurge®), and clot debris were retrieved in one case.

**Results**

**In-Hospital Results.** No adverse neurological event occurred intraoperatively. During the in-hospital course, one immediate TIA was reported in a patient...
who had a transient facial hemiparesis that completely resolved during one night. The same patient developed an access-related cervical hematoma that required a surgical management. There was no other procedural neurological or cardiac complication. At discharge, the patients were given clopidogrel and aspirin for 1 month and then only clopidogrel as a long-term daily treatment.

**Follow-Up Period.** During the follow-up period (mean: 43 months; range: 1–4.6 years), DS was routinely performed every 6 months and angiography, CT scan, or MRI was taken every year after the procedure. The patients also underwent a neurological examination regularly.

During this period, one early asymptomatic endoleak was detected and successfully treated after 4 months with a covered stent extension (Figs. 4 and 5). All the aneurysmal sacs thrombosed. At the moment, we
have seen no sign of in-stent stenosis and no new neurological event has been observed.

**Discussion**

Asymptomatic aneurysms and dissecting aneurysms can lead to late embolic complications, nerve compression, or rupture. In these cases, they must be considered for surgery. Currently, the standard method to treat distal aneurysmal lesions of the EICA remains surgical reconstruction, either by excision or by graft repair. However, reaching the distal part of the EICA is a very challenging operation, including mandibular luxation, which often requires the expertise of different surgeons. Among complications related to the surgical approach, the ancient ligation technique of the EICA leads to 25–60% stroke rate and 40% death.
rate. This option must be abandoned except in the case of impossible reconstruction. Ligation can be safely performed in patients with a good controlateral blood flow supply, which can be identified with intraoperative TCD. Then, the procedure must be followed by postoperative heparinotherapy. Pure surgical reconstruction hopefully offers better results with only 5–15% stroke rate and a 2–4% death rate.

We reviewed in Table 1 some of the largest series presenting the results of the surgical approach used to treat aneurysms of the cervical carotid arteries, including some rare cases of ligation, during the last 15 years.

In addition to the disabling scars and complications like transient or definite cranial nerve palsies, some cases of deafness have also been reported, thus justifying this type of extensive surgery for symptomatic and complex aneurysms only. Asymptomatic patients are currently treated medically with antiplatelet drugs. Although natural evolution of dissecting aneurysms of the EICA makes the need to intervene questionable, the endovascular therapy offers an appealing approach still rarely reported, except in case reports. The neurological complications following endovascular exclusion of EICA aneurysms and dissecting aneurysms are very few and there is no nerve damage.

In addition to some rare similar works, we report that covered stents and endografts offer a new therapeutic option for vascular surgeons and interventionists, excluding nerve injury from procedural complications.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Year</th>
<th>Nb Aneurysms</th>
<th>Nb Patients</th>
<th>Length of Follow-Up</th>
<th>Immediate AE Rate (%)</th>
<th>Immediate Death Rate (%)</th>
<th>Late AE Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alberti</td>
<td>2002</td>
<td>19</td>
<td>17</td>
<td>From 1980 to 2000</td>
<td>7 (63.4)</td>
<td>0</td>
<td>1 (9)</td>
</tr>
<tr>
<td>El-Sabrout and Cooley</td>
<td>2000</td>
<td>65</td>
<td>NA</td>
<td>Mean 5.9 years</td>
<td>10 (15.4)</td>
<td>4 (6.1)</td>
<td>NA</td>
</tr>
<tr>
<td>Rosset and Branchereau</td>
<td>2000</td>
<td>25</td>
<td>25</td>
<td>Mean 5.5 years</td>
<td>14 (56)</td>
<td>0</td>
<td>2 (8)</td>
</tr>
<tr>
<td>Zhang</td>
<td>1999</td>
<td>66</td>
<td>63</td>
<td>Mean 5.5 years</td>
<td>4 (6)</td>
<td>1 (1.6)</td>
<td>NA</td>
</tr>
<tr>
<td>Pulli and Pratesi</td>
<td>1997</td>
<td>21</td>
<td>21</td>
<td>Mean 2 years</td>
<td>1 (4.7)</td>
<td>0</td>
<td>NA</td>
</tr>
<tr>
<td>Faggioli and D’addato</td>
<td>1996</td>
<td>24</td>
<td>20</td>
<td>Mean 8 years</td>
<td>1 (4.5)</td>
<td>0</td>
<td>1 (4.5)</td>
</tr>
<tr>
<td>Liapis</td>
<td>1994</td>
<td>12</td>
<td>12</td>
<td>Mean 5.5 years</td>
<td>1 (8)</td>
<td>0</td>
<td>1 (8)</td>
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<tr>
<td>Schievink</td>
<td>1994</td>
<td>22</td>
<td>22</td>
<td>Mean 6.2 years</td>
<td>2 (9)</td>
<td>0</td>
<td>NA</td>
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<tr>
<td>Moreau and Thévenet</td>
<td>1994</td>
<td>38</td>
<td>35</td>
<td>From 6 to 30 years</td>
<td>10 (29)</td>
<td>1 (2.9)</td>
<td>0</td>
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<tr>
<td>De Jong and van Urk</td>
<td>1989</td>
<td>NA</td>
<td>11</td>
<td>NA</td>
<td>6 (54.5)</td>
<td>0</td>
<td>NA</td>
</tr>
</tbody>
</table>

*AE: Adverse events, including fatal and nonfatal major strokes, minor strokes, TIAs and cranial nerve injury.
Figure 6. (A) The dissecting aneurysm on this female patient was healed with a Wallgraft® stentgraft. The arteriography at 2.5 years shows a durable exclusion of the aneurysmal formation (arrow head). (B) This patient presented in Figures 1, 4 and 5 was examined by duplex scan at 4 years. The endoprosthesis is very well visualized on the black and white Doppler ultrasound image and shows no intraluminal stenosis as well as no endoleak.
LONG-TERM RESULTS OF ENDOVASCULAR EXCLUSION

Conclusion

Our long-term results on this short series support the idea that endovascular exclusion of aneurysms and dissecting aneurysms of the EICA could be the first option. As for asymptomatic enlarging lesions, a preventative treatment can be discussed. Covered stents used without coil embolization offer very good long-term results in terms of patency, absence of migration, and successful exclusion, as shown in Figure 6. However, larger series must be reported before proposing covered stents as the preferred therapeutic option.

References
