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SHORT REPORT

Stent-graft Treatment of Carotid Pseudoaneurysms: Case Report and Review of the Literature

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Over the past decades the treatment technique for carotid aneurysms has changed. Endovascular methods have become more widespread and offer an alternative to surgery, which is often difficult in this region. Stent-graft treatment is a less invasive approach to exclude the aneurysm while maintaining patency of the carotid artery. We report two cases of internal carotid artery pseudoaneurysm which were treated using Wallgraft®.

Keywords: Pseudoaneurysm; Wallgraft endoprosthesis; Internal carotid artery; Endovascular repair; Aneurysm exclusion.

Case 1

A 66-year-old diabetic man was admitted to the regional hospital with lower limb ischemia. During the routine examination enlarged lymph nodes were found in the right submandibular region. The patient underwent ultrasound guided aspiration cytology and he was discharged on the following week. Six months later the patient returned to the hospital with a pulsatile mass at the right mandibular angle. The patient was referred to our institute for further management.

Carotid ultrasound showed extravasation at the origin of the right ICA into a 2.5–3 cm^2 diameter pseudoaneurysm and diagnosed a left internal carotid artery (ICA) occlusion. Contrast-enhanced computer tomography confirmed the diagnosis and described a 4.2×3.2 cm^2 pseudoaneurysm medial to the right carotid bifurcation, containing thrombus (Fig. 1).

Parent artery occlusion was not a therapeutic option due to the occluded contralateral ICA; the surgical reconstruction was limited because of the known contralateral carotid disease and the large size of the pseudoaneurysm. The patient would have not tolerated the clamping well because of insufficient collateral flow.

Angiography verified the left ICA occlusion; the middle cerebral artery on the left side was filled through the left posterior communicating artery. We localized the neck of the aneurysm on the proximal ICA just distal the bifurcation (Fig. 2). Control angiography on the following day of the procedure showed no contrast extravasation into the aneurysm and filling of the ECA was delayed (Fig. 3). The patient was discharged on the third day. The patient remained asymptomatic at the 6 weeks, 6 months and 1 year follow-up examinations. Duplex US demonstrated patent carotid artery with continued obliteration of the pseudoaneurysm during the follow-up period.

Case 2

The 81-year-old asymptomatic man presented with a slowly growing mass on the left side of the neck. He underwent carotid endarterectomy 23 years ago and had a long history of ischemic heart disease. Carotid duplex scan showed a large pseudoaneurysm at the bifurcation (Fig. 4). The subsequent angiogram confirmed the diagnosis and the size of the aneurysm was measured 4 cm in diameter (Fig. 5). Considering the age and the cardiac status of the patient we decided to exclude the aneurysm using an endograft. Despite

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Fig. 1. Axial CT scan of the neck. The aneurysm had a pronounced mass effect, compressing and dislocating the pharynx.

Fig. 2. Angiography demonstrated a large aneurysm at the carotid bifurcation.

balloon dilation after the deployment, postprocedural angiography still showed filling of the aneurysm sack.

A control angiography 5 h after the intervention showed no filling of the pseudoaneurysm (Fig. 6). On the following day the patient complained of dyspnoe, cardiology consultation found signs of heart failure but no major cardiac event. Blood pressure remained in the normal range, control carotid duplex scan 2 days later confirmed patency of the graft and showed no extravasation. However, 3 days later repeated duplex examination was performed because of amaurosis of left eye and revealed occlusion of the endograft. Follow-up neuro exams showed no neurological symptoms.

Endovascular Technique

Informed consent was obtained from the patients prior to the endovascular procedure.

We used local anesthesia to be able to monitor the neurological status of the patients. The right femoral artery was punctured and a 4F sheath was placed into the femoral artery to introduce a diagnostic Headhunter (Cordis) catheter. The patients received 5000 units of Heparin; a Jindo® (Cordis) steerable 0.035 in., 300 cm long guidewire was advanced into the ICA and the diagnostic catheter was removed. The 4F sheath was replaced by a 10F introducer. Due to the lack of appropriate length 10F guiding catheter, the left femoral artery was punctured and a 4F Headhunter catheter was introduced to the aortic arch to provide access for control angiogram. The 50 mm long 10 mm diameter Wallgraft was advanced into the ICA on the exchange wire and deployed across the neck of the aneurysm. After deployment the stent was dilated using an appropriate size PTA balloon (Wanda® Boston Sc.) to assure fixation to the wall. Control angiography was obtained at the end of the procedure. The large introducer sheath was removed and the bleeding was controlled using mechanical compression. The 4F sheath was left overnight in the patient. The heparin was discontinued and the patients were observed in the intensive care unit for 12 h. The patients were placed on daily oral administration of 325 mg aspirin.

Discussion

Aneurysms of the extracranial carotid artery are rare and may occur spontaneously or due to trauma.[1–5] In the modern era blunt and penetrating trauma accounts for a significant proportion of carotid aneurysms.

Fig. 3. Follow-up angiogram on the next day demonstrated patent ICA and complete exclusion of the aneurysm.

Injuries may lead to pseudoaneurysm formation secondary to disruption of the arterial wall. Hematoma forms around the vessel, which subsequently liquefies and becomes a cavity that communicates with the arterial lumen. Iatrogenic ICA pseudoaneurysms can be associated with arterial injury during surgery (tonsillectomy, middle ear surgery, etc.) or other invasive procedure. False aneurysms can develop after previous carotid surgery.

Rupture and hemorrhage are unusual complications, however, transient or permanent central neurological symptoms due to embolic events are

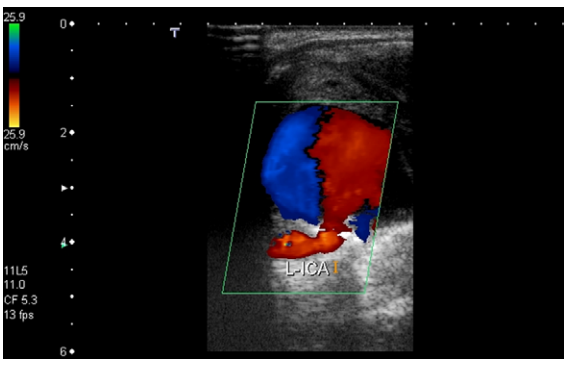

Fig. 4. Color duplex scan revealed the carotid aneurysm.

Fig. 5. Selective left carotid angiography verified the location of the aneurysm on the ICA.

relatively common. Depending on the location and size of the aneurysm peripheral neurological signs may occur because of nerve compression. Compression of the pharynx and larynx can cause symptoms ranging from sore throat to dysphagia.

The detection of aneurysms is essential before neurological deficit occurs. Aneurysms arising in the lower cervical regions are easier to detect, distal aneurysms often cause diagnostic problems. These lesions usually appear as pulsatile masses. Duplex scanning is only able to identify aneurysms when they are located on the common carotid artery or near to the carotid bifurcation. Angiography gives diagnosis in most of the cases and helps detecting other or associated lesions on the carotid artery. Computer tomography and its 3D reconstruction capability can provide valuable information both on the aneurysms and the surrounding tissues.

Treatment of extracranial carotid artery aneurysms depends on the location and size of the aneurysms. Conservative treatment consists of anticoagulation to prevent thromboembolic complications. Conservative treatment cannot prevent the further growth and rupture of aneurysm and carries the risk of

Fig. 6. Completion angiogram showed successful exclusion of the aneurysm.

hemorrhages. Until the 1950s parent vessel ligation was the only surgical treatment for carotid aneurysms.[2] Seventy percent of those patients who did not undergo surgery later died of aneurysm related complications.[4] Ligature of the internal carotid artery had an associated stroke rate of 12–40%.[2,3,5] Today internal carotid artery sacrifice is reserved for those cases when no other treatment is possible and the patient would tolerate the artery occlusion.

Reconstructive surgery is performed using grafts or less frequently direct end-to-end anastomosis. Resection and patch angioplasty may be another surgical option in some cases. The difficulty of the surgery depends on the size and location of the aneurysm, adequate exposure and control of the distal ICA is often difficult. The mortality-serious morbidity risk of these procedures is 4–10.8%[1,2,5] and nerve injury is not uncommon.

In the last decades endovascular techniques have been developed for the treatment of aneurysms. Detachable balloons were used for aneurysm occlusion in the 1980s but they were replaced by Guglielmi detachable coils (GDC) in the early 1990s.[6] The GDC embolization technique possesses certain limitations; while it is successful for treating smaller aneurysms, incomplete occlusion and recanalization is frequent when treating large and wide neck aneurysms. Stent assisted coiling allows dense packing of these wide neck aneurysms via preventing coil migration or protrusion into the parent vessel. However, pseudoaneurysms lack a well defined neck and sufficient wall structural integrity which makes this therapeutic approach less favorable.

Several papers described the usefulness of bare stent for aneurysm treatment. Geremia[7] first reported successful carotid aneurysm treatment using stents in a canine model. The placement of the stent across the neck of the aneurysm modifies the flow in the aneurysm as well as decreasing the wall shear stress. The currently available, high porosity stents may decrease the inflow enough to induce thrombosis.[8] Limitation of this technique is the delayed thrombosis, in some cases several months passed before occlusion occurred.[8,9]

Graft covered stents have a very low porosity stents and are ideal for the treatment of aneurysms, AV fistulas and vascular injuries because the lesions are immediately excluded from the circulation. The first transfemoral endovascular aortic aneurysm exclusion was reported by Parodi in 1991.[10] Since then clinical experience has been accumulated using stent-grafts for the treatment of a variety of vascular pathologies.[11–14] There have been several reports of covered stent placement for carotid aneurysm.[15–25] Due to the lack of available endograft the first treatments were attempted using 'home-made' devices; successful treatment was described using autologous vein, polyethylene terephthalate (PET) and polytetrafluoroethylene (PTFE) as graft material mounted on commercial stents.[15–17]

The currently available peripheral stent-grafts are PET, PTFE or polyurethane covered stainless steel or nitinol stents. Because of balloon expandable stents are prone to deform or collapse and due to the diameter difference between the CCA and ICA, self-expandable stents are advised to use in the carotid bifurcation. Synthetic grafts have been successfully used by vascular surgeons for more than 30 years in large-diameter applications like the aorta or in the aortoiliac region; however, the patency rates of small-diameter vascular grafts are low. Several studies have reported favorable immediate and long-term results using PTFE grafts for carotid reconstruction.[26,27]

The Wallgraft endoprosthesis is a PET covered self expandable stainless steel stent (Wallstent) which is mounted on a 9F diameter 90 cm long catheter. We choose Wallgraft because it is flexible, low profile and it conforms well to the different diameter of the CCA and ICA. Reviewing the literature seven papers were found describing 17 cases of carotid aneurysm

treatment in 16 patients using Wallgraft.[18–25] Percutaneous access was utilized in the majority of the procedures. The immediate result was excellent in all cases without complication. Fourteen patients were followed up to 24 months; two patients refused the further cooperation. Ultrasound follow-up detected patent vessel in 12 cases at the last exam. Only one author reported an occlusion and a late graft stenosis.[23] One of these patients had bilateral carotid bifurcation aneurysms 10 years after carotid endarterectomy on both sides. The aneurysms were treated by Wallgraft; 5 months later the patient suffered a stroke and the ultrasonography confirmed occlusion of the left carotid artery. In the other case 10 months after the treatment routine follow-up angiography detected asymptomatic 50% stenosis.

PTE and PTFE are highly thrombogenic materials. Animal studies described a marked inflammatory vessel wall response to the PET coating of the endografts.[28–31] The endothelialization was delayed compared to bare stents and the endothelial layer was thicker. These unfavorable attributes may be responsible for the neointima formation in certain clinical cases.[23] Appropriate antiplatelet medication is important to prevent early occlusion. Unfortunately Clopidogrel was not available at the time of our procedures, which might have helped preventing the reocclusion in Case 2.

The use of Wallgraft for the management of carotid artery aneurysms is an excellent alternative to surgical repair in certain situations: major co-morbidity, hostile neck and contraindications to surgery. The procedure is quick, there is no need for general anesthesia and the hospitalization is short. The relatively low incidence of these carotid lesions makes difficult to collect enough clinical information to determine the optimal indication and assess the complication rate. While the technical success rate is good, the long-term effectiveness is still uncertain. Postoperative surveillance is extremely important to detect restenosis or thrombosis.

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