Extracranial Carotid and Vertebral Artery Aneurysms

22

Sachinder Singh Hans

Extracranial Carotid and Vertebral Artery Aneurysms

A. Extracranial Carotid Artery Aneurysms

Aneurysms of the extracranial carotid artery are rare and account for less than 1% (0.3–0.6%) of all arterial aneurysms [1, 2]. The aneurysm is most often located at the common carotid artery and internal carotid artery junction. The mid-to-distal ICA is the second most common location of such aneurysms. Atherosclerosis is by far the most common cause, but fibromuscular dysplasia (dysplastic), trauma, prior surgical intervention, congenital deficits, infection, and irrigation can result in the formation of true carotid aneurysm or pseudoaneurysm. Sir Astley Cooper, in 1805, ligated the carotid artery in order to treat the carotid artery aneurysm; however, the patient died a few days later [1]. Dimtza reported the first successful carotid aneurysm excision in 1952, performing an end-to-end anastomosis. Winslow et al. in 1926 reviewed the early reported cases of carotid artery aneurysms and found that among 134 patients, 82 underwent carotid ligation with operative mortality of 28%. The direct arterial repair following resection of aneurysm with end-to-end anastomosis or interposition vein graft became the standard mode of surgical treatment about five decades ago [3–7]. Surgical repair of extracranial carotid aneurysms is necessary to prevent thromboembolization and rupture of the aneurysm.

True aneurysm of the extracranial carotid artery can be fusiform or saccular. Fusiform carotid artery aneurysms are often bilateral and degenerative in etiology and are located near the carotid bifurcation [1]. Saccular aneurysms are unilateral and occur in the mid-segment of the internal carotid artery in the neck. Pseudoaneurysms result from disruption of the vessel wall, usually occurring at the site of patch grafting, secondary to infection in the prosthetic patch, arterial dissection, and or blunt/penetrating carotid artery trauma [4–8].

Clinical Presentation

Patients may present with neck mass or symptoms of TIA or stroke due to embolization. The neck mass may be mistaken for cervical lymphadenopathy, an abscess, or carotid body tumor. Large aneurysms may cause compression of the surrounding nerves and upper aerodigestive tract. Dysphasia, headache, occipital pain, and retro-orbital pain

S. S. Hans
Medical Director of Vascular and Endovascular Services, Henry Ford Macomb Hospital, Clinton Township, MI, USA

Chief of Vascular Surgery, St. John Macomb Hospital, Warren, MI, USA

Department of Surgery, Wayne State University School of Medicine, Detroit, MI, USA

S. S. Hans (ed.), *Extracranial Carotid and Vertebral Artery Disease*,
https://doi.org/10.1007/978-3-319-91533-3_22

may occur. Patients may present with Horner's syndrome and hoarseness. Tracheal compression from ruptured carotid artery aneurysm can result in airway compromise. Rupture of carotid aneurysm in the neck is rare, but expanding hematoma in the neck may result in airway compromise secondary to compression of the trachea.

Clinical Diagnosis and Imaging Studies

On physical examination, a pulsatile mass in the neck may be palpable. In elderly patients who are thin and hypertensive, a normal pulse in the common carotid artery and subclavian artery can be confused with a common carotid artery aneurysm. In patients with mycotic aneurysms of the carotid artery, neck mass may be tender with surrounding erythema of the skin. Carotid duplex study is usually the first study performed for the diagnosis of carotid aneurysm. CT angiography of the neck or MR angiography of the neck is useful in confirming the diagnosis and planning treatment (Figs. 22.1 and 22.2). Catheter-based carotid/cerebral arteriography is often helpful in evaluating crossover intracranial circulation in the event; ICA ligation may become necessary in patients with inaccessible location of the aneurysm. However, catheter-based arteriography has a small risk of embolization with resulting TIA or stroke.

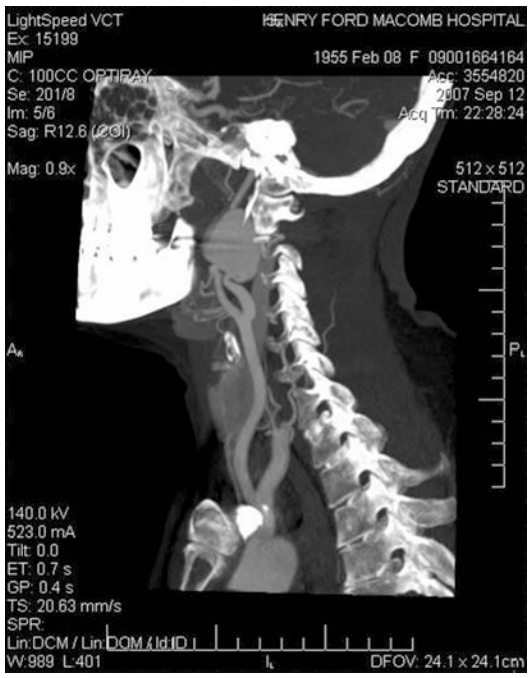

Fig. 22.1 CTA showing internal carotid artery aneurysm with tortuosity of ICA

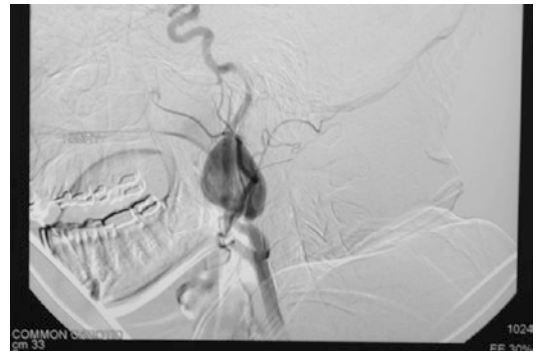

Fig. 22.2 Catheter-based arteriography showing carotid aneurysm involving ICA

Surgical Treatment

The primary aim of treatment is resection of the aneurysm and maintaining the flow through the ICA. Aneurysm resection should be undertaken following thorough understanding of the size, location, and tortuosity of the CCA/ICA along with the presence of surrounding inflammatory response. The incision in the neck is similar to the one used for carotid endarterectomy (see Chap. 10). Internal jugular vein is mobilized after ligating and dividing all its branches, hypoglossal, vagus, and in aneurysms extending cephalad. Glossopharyngeal nerve is preserved if the dissection extends cephalad (see Chap. 11). If there is any concern of the exposure of the distal ICA and anticipating difficulty in the distal control, mandibular subluxation should be considered preoperatively. Author usually has maxillofacial or ENT surgeon who performs the procedure under nasotracheal intubation. Mobilization of the aneurysm and CCA/ICA should be careful and deliberate to prevent embolization and injury to surrounding structures including important nerves. Intraoperative shunting is rarely necessary. Author performs EEG monitoring and measurement of back pressure in the ICA as a guide to the placement of shunt (40 mmHg back pressure as cutoff for use of shunt). Heparin is

administered intravenously by anesthesia to keep the ACT close to 300 s. Ligation of the internal carotid artery is usually not recommended unless the aneurysm is in an inaccessible location and patient has satisfactory intracerebral collateral flow.

Small aneurysms with redundant ICA can be resected and a direct end-to-end anastomosis performed with 6.0 "or 7.0" cardiovascular polypropylene suture (Ethicon: Somerville, NJ). Internal carotid artery should be spatulated so that an end-to-end (functional side-to-side) anastomosis is performed (Figs. 22.3, 22.4, and 22.5). Partial resection of the aneurysmal wall with patch angioplasty using prosthetic patch is another option available in patients with anatomically high lesions. All the thrombotic material in the aneurysm should be carefully removed in such instances. In majority of such patients, anterior wall of the aneurysm should be resected to prevent injury to nerves lying behind the aneurysm. Interposition grafting is performed using synthetic graft (Ringed PTFE, W.L. Gore Newark, DE). The PTFE interposition graft can be straight or tapered. A greater saphenous vein graft or superficial femoral artery harvested from the groin and the thigh area can also be used for conduit following resection of the aneurysm. In mycotic aneurysms involving the CCA/ICA, autogenous conduit is preferred. The most common complication of carotid aneurysm is cranial nerve injury (3–17%). The postoperative stroke-free rate varies from 80 to 87%. The stroke rate of untreated aneurysms is greater than 50%.

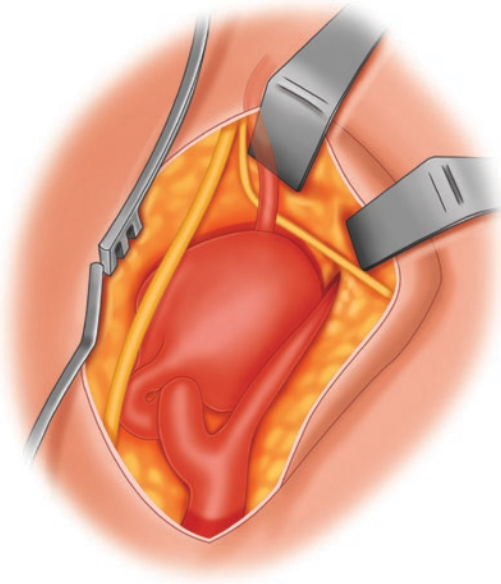

Fig. 22.3 Diagrammatic representation of the carotid artery aneurysm and surrounding XII and X nerves

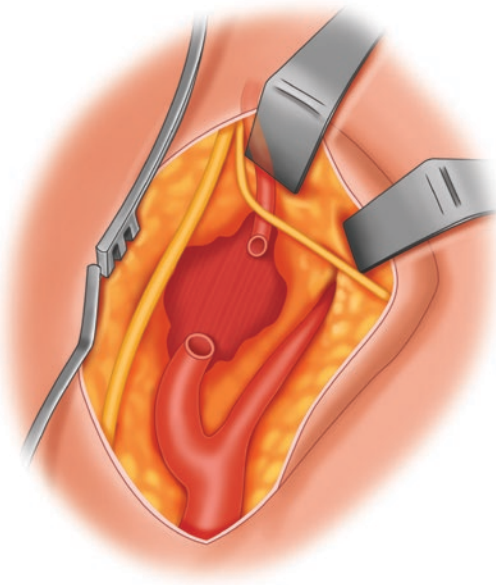

Fig. 22.4 Resection of the aneurysm

Endovascular Treatment

During the last decade, endovascular options have been proposed. Placement of a covered stent graft is helpful in treating patients with bleeding, rupture, and aneurysms near the base of the skull. In patients with hostile neck secondary to neck radiation, tracheostomy following laryngectomy with radical neck dissection endovascular techniques may be a better option.

Coil embolization with thrombosis of the sac has been performed with mixed results. There is risk of distal embolization. Extracranial to intracranial carotid bypass following ligation of the ICA may be indicated for carefully selected carotid aneurysms which cannot safely be approached via cervical approach. However, this procedure is rarely performed.

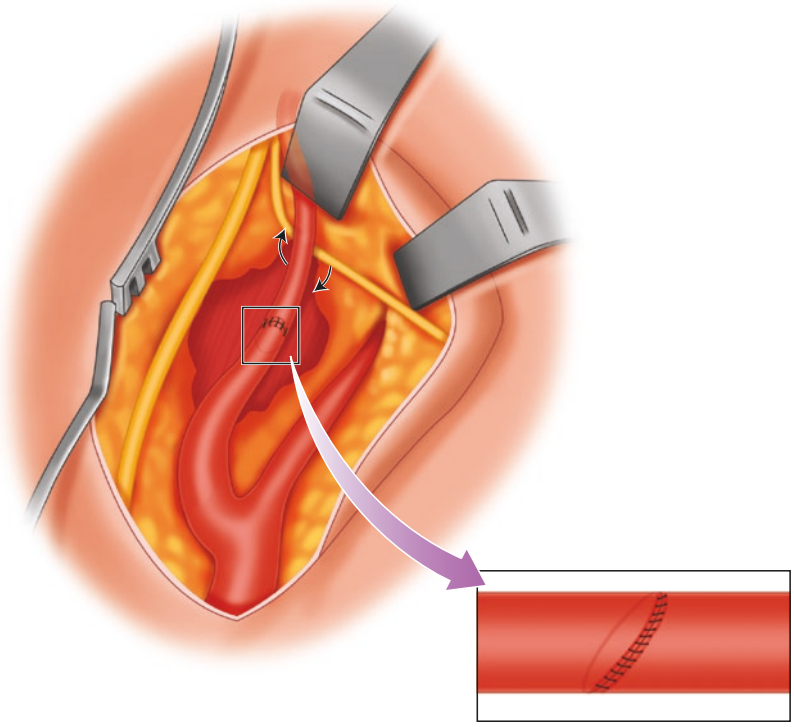

Fig. 22.5 Spatulated end-to-end anastomosis

B. Extracranial Vertebral Artery Aneurysms

Extracranial vertebral artery aneurysms are rare and usually associated with trauma or dissection. Primary cervical vertebral aneurysms may result from connective tissue or hereditary disorder including Ehlers-Danlos syndrome, Marfan's disease, and neurofibromatosis [9]. Morasch et al. reported nine extracranial vertebral artery aneurysms in seven patients. Majority of the patients underwent operation in the form of vertebral bypass with saphenous vein, external carotid artery autograft, and vertebral transposition to ICA [9]. Natural history of vertebral aneurysm is not well known. Therefore, open surgical repair should be considered in large or symptomatic aneurysms. Some patients may require hybrid techniques with detachable balloons and coils. Embolization without revascularization can result in posterior circulation stroke. In patients with Ehlers-Danlos syndrome, the repair is extremely difficult due to tissue degradation, and interrupted monofilament suture using minipledgets should be used, and in spite of careful technique, the vertebral artery may require ligation.

Review Questions

1. The common cause of extracranial carotid aneurysms is:
   A. Mycotic
   B. Atherosclerosis
   C. Connective tissue disorder
   D. Cystic medial necrosis

   Answer: B

2. The most commonly used test in planning resection of extracranial carotid artery aneurysm is:
   A. Duplex ultrasound
   B. CTA
   C. MRA
   D. Transcranial Doppler

   Answer: B

3. The best method of treatment for accessible extracranial carotid aneurysm is:
   A. Resection with end-to-end anastomosis or interposition graft
   B. Coil embolization of the aneurysmal sac

C. Covered carotid stent
D. Carotid ligation

Answer: A

4. The most common postoperative complication following repair of an extracranial carotid aneurysm is:
   A. Stroke
   B. Neck hematoma
   C. Thrombosis at the site of anastomosis
   D. Cranial nerve injury

   Answer: D

5. Endovascular repair is best indicated for the management of localized extracranial carotid aneurysms when:
   A. The carotid aneurysm is at the bifurcation of common carotid artery
   B. A saccular aneurysm is in the mid-ICA with tortuosity of the ICA
   C. Aneurysm is secondary to arterial dysplasia
   D. Aneurysm is in an inaccessible location in the neck or in patient with hostile neck

   Answer: D

References

1. Srivastava SD, Eagleton MJ, O'Hara P, Kashyap VS, Sarac T, Clair D. Surgical repair of carotid artery aneurysms: a 10-year, single-center experience. Ann Vasc Surg. 2010;24(1):100–5.
2. Brock RC. Astley Cooper and carotid artery ligation. Guys Hosp Rep. 1968;117(3):219–24.
3. Dimtza A. Aneurysms of the carotid arteries; report of two cases. Angiology. 1956;7(3):218–27.
4. Fankhauser GT, Stone WM, Fowl RJ, O'Donnell ME, Bower TC, Meyer FB, Money SR. Surgical and medical management of extracranial carotid artery aneurysms. J Vasc Surg. 2015;61(2):389–93.
5. Zwolak RM, Whitehouse WM Jr, Knake JE, et al. Atherosclerotic extracranial carotid artery aneurysms. J Vasc Surg. 1984;1(3):415–22.
6. Painter TA, Hertzer NR, Beven EG, O'Hara PJ. Extracranial carotid aneurysms: report of six cases and review of the literature. J Vasc Surg. 1985;2(2):312–8.
7. El-Sabrout R, Cooley DA. Extracranial carotid artery aneurysms: Texas Heart Institute experience. J Vasc Surg. 2000;31(4):702–12.
8. Li Z, Chang G, Yao C, Guo L, Liu Y, Wang M, Liu D, Wang S. Endovascular stenting of extracranial carotid artery aneurysm: a systematic review. Eur J Vasc Endovasc Surg. 2011;42(4):419–26.
9. Morasch MD, Phade SV, Naughton P, Garcia-Toca M, Escobar G, Berguer R. Primary extracranial vertebral artery aneurysms. Ann Vasc Surg. 2013;27(4):418–23.