Subclavian Artery Aneurysms

Lazar B. Davidović, Dragan M. Marković, Siniša D. Pejkić, Nataša S. Kovačević, Momčilo M. Čolić and Predrag M. Đorić, Institute for Cardiovascular Diseases, Clinical Center of Serbia, Belgrade, Yugoslavia.

We report the management of 14 subclavian artery aneurysms (13 true, one false) occurring in seven male and seven female patients (average age, 48 years). The aetiology of the aneurysms included thoracic outlet syndrome in eight, atherosclerosis in five and infection in one patient. Twelve aneurysms were of extrathoracic location, while two aneurysms were intrathoracic. Symptoms related to subclavian artery aneurysms were present in 11 patients (compression in four, haemorrhage in one, and ischaemia in six patients), whereas three aneurysms were asymptomatic. All aneurysms were treated surgically. The supraclavicular approach was used in 11 cases, and the combined transsternal and supraclavicular approach was used in two cases. After aneurysm resection, the reconstruction was performed with end-to-end anastomosis in five cases and with saphenous vein or synthetic grafts in eight cases. One infected subclavian artery aneurysm was treated with carotid to axillary saphenous vein bypass after exclusion of the aneurysm. Five associated brachial embolectomies and one bypass from the axillary to the distal brachial artery were performed. In all thoracic outlet syndrome cases, decompression at the thoracic outlet was also performed. There was no operative mortality, and the early patency rate was 100%. The follow-up period was from 6 months to 10 years (mean, 3.92 years). During this period, one patient died of malignancy and one patient required reoperation due to aneurysmal degeneration of the saphenous vein graft. Surgical treatment is recommended for all patients with subclavian artery aneurysms to prevent potential complications. (Asian J Surg 2003;26(1):7–11)

Introduction

Subclavian artery aneurysms (SAAns) are infrequently seen peripheral aneurysms.1–5 There are cases of intrathoracic and extrathoracic subclavian artery involvement.3,6,7 In 1818, Mott reported the first unsuccessful treatment of an SAAn by ligation of the innominate artery.6 Halsted was the first to successfully combine ligation with resection of an SAAn in 1892,8 while Muller described seven SAAns treated with endoaneurysmorraphy.9 In 1953, Bahnson reported the first successful resection and reconstruction of a SAAn.10 Three years later, Schein performed the same procedure using an arterial homograft for reconstruction.11 We report our experience with the management of SAAns treated at the Institute for Cardiovascular Diseases, Serbian Clinical Center, Belgrade, Yugoslavia.

Patients and methods

There were seven men and seven women, with a mean age of 48 years (range, 23–65 yr) who were treated for SAAns at our Institute. Patient demographic and clinical data are presented in the Table.

The aetiologies of SAAn included thoracic outlet syndrome (TOS) in eight, atherosclerosis in five and infection following an intra-arterial drug injection in one patient (Figure 1). Two of our patients had intrathoracic aneurysms (Figure 2), while 12 patients had extrathoracic aneurysms (Figure 3). Three patients had partially thrombosed giant aneurysms, with a mean diameter of 6.1 cm, presenting as asymptomatic pulsatile masses. Of these, two were extrathoracic, and one with a 10-cm diameter was intrathoracic.

Symptoms related to SAAns were present in 11 patients.

Address reprint requests to Dr. Lazar B. Davidović, Institute for Cardiovascular Diseases, Clinical Center of Serbia, 8 Dr K. Todorović Street, Belgrade 11 000, Yugoslavia. E-mail: lazard@eunet.yu • Date of acceptance: 6th September, 2002
Four patients had symptoms caused by compression or acute aneurysm expansion. The mean aneurysmic diameter in these four cases was 39mm. One patient had dysphagia from oesophageal compression, one had right-sided chest and back pain, and two patients had sensory and motor signs of brachial plexus compression. The patient with the infected aneurysm presented with supraclavicular skin necrosis and bleeding. The other six patients had upper extremity ischaemic symptoms (one had blue finger syndrome and five had acute hand ischaemia) from brachial artery thromboembolism. In two such cases, transitory ischaemic attacks (TIA) with contralateral hemiparesis were associated with hand ischaemia. The reason was retrograde embolism of the right carotid artery.

The diagnosis was established using selective angiography and duplex ultrasonography. In two patients with intrathoracically located aneurysms, computed tomography of the thorax was also performed.

All patients were treated surgically. In 12 cases, a supraclavicular approach to the subclavian artery was used, while in two, a combined transternal and supraclavicular approach was used. Procedures for all patients are described in the following two paragraphs and the Table. Direct subclavian reconstruction using a polytetrafluoroethylene (PTFE) graft was performed in five patients, while a saphenous vein graft was used in two patients. One bypass from the left common carotid artery to distal subclavian artery using a Dacron graft was performed after resection of the proximal left SAAn (Figures 4 and 5) in one patient. After excision and debridement was performed in the patient with the infected aneurysm, an extra-anatomic...
carotid to axillary artery bypass using a saphenous vein graft was performed. In the remaining five cases, after aneurysm resection, arterial continuity was established with an end-to-end anastomosis, which is described below.

In five of eight patients with TOS, after aneurysm resection, an end-to-end anastomosis was performed. In all patients with TOS, a decompression procedure at the thoracic outlet also was performed before the reconstruction (two cervical rib resections, two resections of both the cervical and the first ribs and four first rib resections, through the supraclavicular approach). Five brachial embolectomies in cases complicated with brachial artery embolism were performed. In one such case where embolectomy was not possible, a bypass from the axillary to distal brachial artery, with a saphenous vein graft was performed.

Results

The overall postoperative complication rate was 21% (three cases). There were two pneumothoraces after first rib resection performed for decompression, in cases caused by TOS, and one transient median nerve paresis. Both pneumothoraces were treated by drainage. The early patency rate was 100% Patients were monitored postoperatively by physical examination, Doppler and duplex ultrasonography at 1-, 3-, 6- and 12-month intervals, and once yearly thereafter. The mean follow-up period was 3.92 years (range, 6 mo to 10 yr). During this time, there were no late occlusions, yielding a long-term patency rate of 100% One patient died with a patent graft due to malignancy. One late complication was identified, which was partial thrombosis of the saphenous vein graft true aneurysm. This aneurysm was resected and replaced with a PTFE graft. Postoperative histological examination showed a connective tissue disorder of the vein wall.

Discussion

Most true SAAns are caused by atherosclerotic disease (five of our cases) and TOS (eight of our cases). It is well...
recognized that TOS may be the leading cause of SAAn. Our eight such cases are one of the largest series. Fibromuscular dysplasia,\(^\text{1,18}\) cystic idiopathic medionecrosis,\(^\text{1,19,20}\) infection\(^\text{1,21,22}\) and congenital anomalies,\(^\text{23,24}\) are very rare causes of true SAAn. Subclavian artery pseudoaneurysms result from penetrating\(^\text{2,25}\) or blunt trauma,\(^\text{27-29}\) especially in relation to clavicle or first rib fracture.\(^\text{30,31}\) We had one infected subclavian artery pseudoaneurysm after intra-arterial injection in a drug addict. Such aneurysms are also described by other authors.\(^\text{32,33}\) Other forms of subclavian artery pseudoaneurysms include iatrogenic false aneurysms after various diagnostic\(^\text{34-36}\) or reconstructive surgical procedures.\(^\text{37,38}\)

Atherosclerotic SAAn of intrathoracic location usually occur in patients over 60 years of age of either sex, but appear to be more common in men (both of our cases). Extrathoracic SAAns frequently occur in young\(<45\)yr) female patients.

The common complications of SAAn include compression, thrombosis, distal embolization and rupture.\(^\text{6,12,39}\) Compression or acute expansion of the SAAn can produce other symptoms and signs than chest, neck or shoulder pain, and thus, confuse the diagnosis. There could be respiratory problems because of tracheal compression; dysphagia from oesophageal compression; hoarseness from compression of the right recurrent laryngeal nerve; Horner’s syndrome due to compression of the stellate ganglion; as well as sensory and motor signs due to brachial plexus compression.\(^\text{6,12,25,40,41}\)

Four patients with SAAn in our series of patients presented with compression symptoms.

SAAn rupture can produce intra- or extrathoracic bleeding, including hemothorax from rupture and erosion into the apex of the lungs. Subclavian artery pseudoaneurysms (especially infected ones, like the one we had in our series) are more prone to rupture than true aneurysms.\(^\text{5,20,26-28}\)

Most SAAns manifest with upper extremity acute or chronic ischaemic symptoms caused by distal thrombembolization.\(^\text{6,11,12,15-17,31,40}\) We had six such cases. Neurological problems from retrogradethromboembolism of the right carotid or vertebral circulation, are also described.\(^\text{40,42}\) We recognized these manifestations in two of our patients.

Preoperative duplex ultrasonography and angiography are always mandatory for planning the surgical treatment of an extrathoracic SAAn. Nonetheless, in cases of intrathoracic aneurysms, computed tomography or magnetic resonance imaging scans is necessary.\(^\text{6,7,20,27,29,31}\)

Large aneurysms are more prone to cause compression and to rupture while small aneurysms tend to thrombose and produce distal embolism. The surgical approach to SAAns is dependent on the aneurysm location.\(^\text{6,7,28,40,41}\) For right-sided intrathoracic SAAns, a median sternotomy is the preferred approach (one of our cases), whereas intrathoracic aneurysms of the left subclavian artery are best managed through a left thoracotomy. Nonetheless, in on-such situation, we performed a median sternotomy combined with a left supraclavicular extension. Extrathoracic SAAns can be approached through supraclavicular incisions. SAAn resection and direct graft replacement is the recommended treatment for all extensive lesions.\(^\text{2,3,7,12,13}\) We performed such procedures in seven of our patients, while in one case, a bypass from the common carotid artery to the distal subclavian artery was necessary. Some SAAns caused by TOS allow arterial reconstruction by end-to-end anastomosis after aneurysm resection, as were possible in five of our cases.\(^\text{15-17}\) An infected aneurysm (one of our cases) can be treated with aneurysm exclusion and extra-anatomic carotid to axillary artery bypass using a saphenous vein graft.\(^\text{4,22,30}\) In all cases of associated distal arterial embolization, embolectomy or some other reconstructive procedure is indicated. Various endovascular procedures for the treatment of subclavian artery pseudoaneurysms are described.\(^\text{26,34,43-48}\) It would be very interesting to compare surgical and endovascular treatments of SAAn, though our institution does not have any experience with endovascular surgery.

**Conclusions**

Aneurysms of the subclavian artery are an uncommon form of peripheral arterial aneurysm. Despite their infrequent occurrence, the potential for serious complications (rupture, thrombosis and embolization) mandates surgical or endovascular treatment of all diagnosed SAAns.

**References**

6. Salo JA, Ala-Kulju K, Heikkinen L, et al. Diagnosis and treatment of...
42. Symonds CP. Two cases of thrombosis of subclavian artery with contralateral hemiplegia of sudden onset, probably embolic. Brain 1927:50:259.