Turk Gogus Kalp Dama 2014;22(2):341-346
doi: 10.5606/tgkdc.dergisi.2014.8923

*Original Article / Özgün Makale*

# Surgical treatment of true aneurysms of subclavian and axillary arteries: results of eight cases

## *Subklaviyan ve aksiller arterin gerçek anevrizmaları ve cerrahi tedavisi: Sekiz olgunun sonuçları*

**İsmail Yürekli,[1] Orhan Gökalp,[2] Levent Yılık,[1] Tevfik Güneş,[3] Muhammet Akyüz,[1] Ali Gürbüz[2]**

*Institution where the research was done:*
Department of Cardiovascular Surgery, İzmir Atatürk Training and Research Hospital, İzmir, Turkey

*Author Affiliations:*
[1]Department of Cardiovascular Surgery, İzmir Atatürk Training and Research Hospital, İzmir, Turkey
[2]Department of Cardiovascular Surgery, Medical Faculty of İzmir Katip Çelebi University, İzmir, Turkey
[3]Department of Cardiovascular Surgery, Diyarbakır Training and Research Hospital, Diyarbakır, Turkey

***Background:*** In this study, we investigated the true aneurysms of the subclavian and axillary arteries.

***Methods:*** Eight patients (6 males, 2 females; median age 58 years; range 38 to 73 years) who were operated due to true aneurysms of the subclavian and axillary arteries between February 1998 and December 2007 were examined retrospectively in terms of clinical and preoperative, intraoperative, postoperative parameters.

***Results:*** Six patients had axillary and two patients had subclavian artery aneurysms. Complaints on admission were ischemic symptoms in two patients (25%), asymptomatic mass in three (38%), feeling of compression in two (25%), and bleeding in one (12%). The etiological factor was atherosclerosis in five patients (62%), a probable connective tissue disorder in one (13%), and idiopathic in two (25%) patients. Median follow-up was 106 months (range, 64 to 170 months). No operative mortality was seen. One patient developed pseudoaneurysm on 40$^{th}$ postoperative day. Secondary graft patency rate was 100% during follow-up.

***Conclusion:*** True aneurysms of the subclavian and axillary arteries are rarely seen. These pathologies present with different etiological causes and symptoms. Following the diagnosis, treatment can be achieved by surgery successfully.

*Keywords:* Axillary artery; subclavian artery; true aneurysm.

***Amaç:*** Bu çalışmada subklaviyan ve aksiller arterlerin gerçek anevrizmaları incelendi.

***Çalışma planı:*** Şubat 1998 - Aralık 2007 tarihleri arasında subklaviyan ve aksiller arterin gerçek anevrizması nedeniyle ameliyat edilmiş sekiz hasta (6 erkek, 2 kadın; ort. yaş 58 yıl; dağılım 38-73 yıl) klinik ve ameliyat öncesi, sırası ve sonrası parametreler eşliğinde retrospektif olarak değerlendirildi.

***Bulgular:*** Altı hastada aksiller arter, iki hastada subklaviyan arter anevrizması vardı. Başvuru yakınmaları iki hastada (%25) iskemik semptomlar, üç hastada (%38) asemptomatik kitle, iki hastada (%25) bası hissi veren kitle ve bir hastada ise (%12) kanama idi. Etyolojik faktör beş hastada (%62) ateroskleroz, bir hastada (%13) muhtemel bağ dokusu hastalığı, iki hastada (%25) idiyopatik olarak tespit edildi. Medyan takip süresi 106 ay (dağılım 64-170 ay) idi. Ameliyata bağlı mortalite görülmedi. Bir hastada ameliyat sonrası 40. günde psödoanevrizma gelişti. Takip süresince sekonder greft açıklık oranı %100 idi.

***Sonuç:*** Subklaviyan ve aksiller arterin gerçek anevrizmaları nadiren görülür. Bu patolojiler farklı etyolojik nedenler ve semptomlar ile ortaya çıkar. Tanı konulduktan sonra tedavi cerrahi olarak başarı ile gerçekleştirilebilir.

*Anahtar sözcükler:* Aksiller arter; subklaviyan arter; gerçek anevrizma.

Available online at
www.tgkdc.dergisi.org
doi: 10.5606/tgkdc.dergisi.2014.8923
QR (Quick Response) Code

*Received:* June 19, 2013 *Accepted:* September 09, 2013

Correspondence: İsmail Yürekli, M.D. İzmir Atatürk Eğitim ve Araştırma Hastanesi, Kalp ve Damar Cerrahisi Kliniği, 35360 Basın Sitesi, İzmir, Turkey.
Tel: +90 505 - 525 12 02 e-mail: ismoyurekli@yahoo.com

Aneurysms are not commonly encountered in either subclavian or axillary arteries.[1-3] The ratio of subclavian artery aneurysms to all peripheral arterial aneurysms, whether true or false, is 0.5%. Although no particular figure has been given for axillary artery aneurysms, the ratio of arterial aneurysms of the upper extremity to all peripheral arterial aneurysms is 0.6%.[2] Most of these aneurysms are pseudoaneurysms that developed after blunt penetrating trauma. True aneurysms in both of these arteries are very seldom seen.[3-6] Although rare, these pathologies may cause vascular and neurological complications because of the close localization of the brachial plexus; thus, a dynamic treatment approach is crucial. In this study, we investigated patients who were operated on for true aneurysms of the subclavian and axillary arteries.

## PATIENTS AND METHODS

In this study, we evaluated eight patients (6 males and 2 females; mean age 58 years; range 38 to 73 years) who underwent surgery because of true aneurysms in the subclavian or axillary arteries between February 1998 and December 2007. Their hospital records were investigated with regard to clinical, perioperative, and late postoperative parameters. Selective peripheral arteriography, color Doppler ultrasound, and contrast-enhanced thoracoabdominal computed tomography (CT) were performed on all of the patients to measure the vessel diameter and assess whether or not there were any stenotic or occlusive lesions and/or additional true or pseudoaneurysms in order to determine the best possible therapeutic approaches (Figures 1-3). All of the patients were operated on under general anesthesia, and the subclavicular approach was preferred except for one patent who had surgery to repair a pseudoaneurysm. In that particular case, the supraclavicular approach was used for the first operation, and a supraclavicular incision plus a partial median sternotomy was utilized for the second. Generally, if the calibration of the saphenous vein graft (SVG) was appropriate for the arterial segment, then it was used; otherwise an artificial graft was interposed. If acute ischemia was coexistent, a brachial embolectomy was also performed.

**Figure 1.** Preoperative angiographic view of the giant aneurysm in the left axillary artery. The arrow indicates the aneurysm.

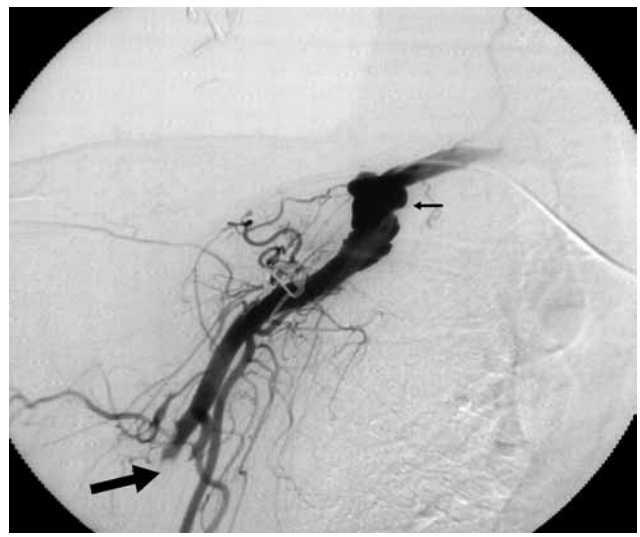

**Figure 2.** Preoperative angiographic view of a patient who developed an embolic occlusion of the brachial artery due to an aneurysm in the left axillary artery. The small arrow indicates an aneurysm in the right subclavian artery, and the large arrow indicates the embolic occlusion in the right brachial artery.

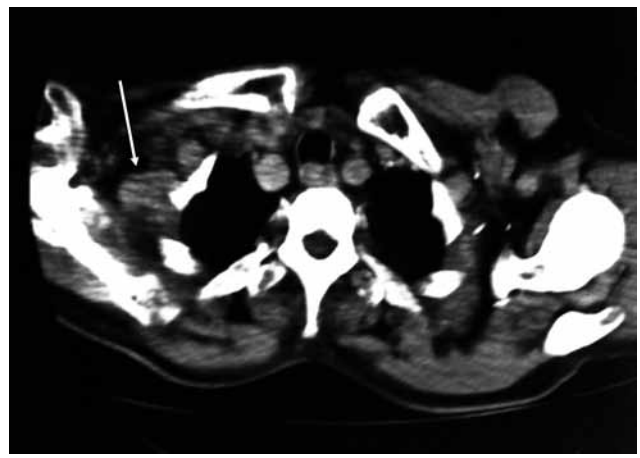

**Figure 3.** Preoperative computed tomographic view of a patient with an aneurysm in the right axillary artery. The arrow indicates the aneurysm.

Patients with diffuse aneurysmatic dilation of the aortic arch and related branches, including the subclavian artery, were excluded from the study. In addition, aneurysms that developed after trauma or diagnostic/therapeutic interventions were considered to be pseudoaneurysms and patients with these were also not included. The postoperative intubation time, length of intensive care unit (ICU) stay, the amount of blood products used, and complications, for example surgical wound infections and bleeding, were recorded, and after being discharged, the patients were examined via Doppler ultrasound at the first-month and first-year follow-up visits.

## RESULTS

Two of the eight patients had aneurysms in the subclavian artery while six had axillary artery aneurysms. The median diameter of the aneurysms was 46 mm (range 30-60 mm). The chief complaint was ischemic symptoms in two patients (25%), a non-disturbing mass in three (38%), a feeling of compression in two (25%), and bleeding in the remaining patient (12%).

The etiological factors included atherosclerosis in five patients (62%) and a probable connective tissue disorder in one (13%). In the other two

**Table 1. Clinical characteristics of the patients**

| Patients number | Age/gender | Localization | Diameter | Etiology | Symptom | Surgery | Follow-up (months) | Patency |
|---|---|---|---|---|---|---|---|---|
| 1 | 49/M | RSA | 3.0 cm | İdiopathic | Acute ischemia symptoms in right arm | Resection + SAB w/8 mm PTFE graft + Brachial embolectomy | 96 | Patent |
| 2 | 61/F | RSA | 5.2 cm | Atherosclerosis | Non-disturbing mass | Resection + SAB w/ASVG | 136 | Patent* |
| 3 | 53/M | LAA | 6.0 cm | Probable connective tissue disorder** | Non-disturbing mass | Resection + ABB w/ASVG | 64 | Patent‡ |
| 4 | 60/M | RAA | 5.0 cm | Atherosclerosis | Bleeding | Resection + ABB w/8 mm PTFE graft | 125 | Patent¶ |
| 5 | 69/M | RAA | 6.0 cm | Atherosclerosis† | Feeling of compression | Resection + SAB w/8 mm PTFE graft | 170 | Patent |
| 6 | 56/M | LAA | 3.5 cm | Atherosclerosis | Acute ischemia symptoms in left arm | Resection + ABB w/ASVG + Brachial Embolectomy | 112 | Patent |
| 7 | 73/M | RAA | 4.2 cm | Atherosclerosis | Non-disturbing mass | Resection + ABB w/ASVG | 100 | Patent |
| 8 | 38/M | RAA | 3.0 cm | Idiopathic | Feeling of compression | Resection + SAB w/8 mm PTFE graft | 65 | Patent |

RSA: Right subclavian artery; SAB: Subclavian-axillary bypass; PTFE: Polytetrafluoroethylene; ASVG: Autologous saphenous vein graft; LAA: Left axillary artery; ABB: Axillo-brachial bypass; RAA: Right axillary artery; LSA: Left subclavian artery; * The pseudoaneurysm developed 40 days after the initial operation at the same site. The redo axillo-subclavian bypass was performed with ASVG; ** No histopathological diagnosis was made, but, the patient was phenotypically marfanoid and had undergone a previous iliac arterial aneurysm repair; ‡ The graft was patent, but the patient died due to other reasons; ¶ The patient underwent emergency surgery. He already had a previous brachial plexus injury, but this resolved postoperatively with physical therapy; † The patient had been operated for a left axillary aneurysm nine years earlier. A histopathological examination of the resected aneurysm material revealed atherosclerotic changes.

patients (25%), a histopathological examination revealed no prominent atherosclerotic changes, and no other factors were identified. Thus, the causes were considered to be idiopathic in these two participants. One patient with a probable connective tissue disorder had no histopathological diagnosis, but he was phenotypically marfanoid, and his past medical history indicated the need for surgery due to an iliac artery aneurysm. A preoperative contrast-enhanced thoracoabdominal CT examination revealed no other aneurysmatic segment. The past medical history of another patient was also significant because he had previously undergone surgery for a contralateral axillary artery aneurysm, but a histopathological examination revealed atherosclerotic changes. Therefore, this patient was not considered to have a connective tissue disorder (Table 1).

Additionally, one patient with a ruptured axillary artery aneurysm underwent emergency surgery, and bleeding was found.

One patient with a subclavian artery aneurysm underwent a resection of the aneurysm and subclavian-axillary bypass surgery via a brachial embolectomy using a polytetrafluoroethylene (PTFE) graft; whereas another underwent a resection of the aneurysm and subclavian-axillary bypass surgery with an SVG. In addition to the resection of the aneurysm, three out of the six patients with an axillary artery aneurysm underwent an SVG interposition and the other three underwent a PTFE graft interposition. Moreover, one patient with acute ischemia underwent an additional brachial embolectomy (Table 1).

The median duration of the operation was two hours (range 1-3), and the median intubation period was 3.5 hours (range 2-5). Furthermore, the median length of ICU stay was 1.5 days (range 1-2), and the median length of hospital stay was three days (range 2-4). In addition, the median unit of blood products used perioperatively was 1 unit (range 0-3) (Table 2).

As an early postoperative complication, one patient developed a perianastomotic pseudoaneurysm 40 days after the initial operation for a subclavian artery aneurysm. This patient underwent a subclavian-axillary bypass, and the saphenous vein was also used in the second operation. Another patient that had an emergency operation due to bleeding had weakness in the affected upper extremity as the result of a preoperative brachial plexus injury. This weakness improved to some extent postoperatively, but for it to disappear completely, physical therapy was needed.

**Table 2. Perioperative data of the patients**

| | n |
|---|---|
| Median operation time (hours) | 2 |
| Median duration of intubation (hours) | 3.5 |
| Median duration of intensive care unit stay (days) | 1.5 |
| Median duration of hospital stay (days) | 3 |
| Median perioperatively units of used blood products | 1 |

No early postoperative mortality was seen, but one patient died five years after the surgery because of unrelated causes. The median follow-up period was 106 months (range 64-170), and the secondary patency rate was 100% during follow-up.

## DISCUSSION

Among all peripheral arterial aneurysms, isolated aneurysms of the subclavian or axillary artery are very rare.[1-10] In a study conducted by Dent et al.[7] in 1972, only two (0.13%) out of 1,488 atherosclerotic peripheral arterial aneurysms were subclavian artery aneurysms. In another epidemiological study, Lawrence et al.[2] examined 51,949 surgically corrected peripheral arterial aneurysms, and only 0.5% were subclavian in nature. They did not provide a particular percentage for isolated axillary artery aneurysms, but 0.6% were determined to be upper extremity aneurysms. The true aneurysms of these particular arteries are even less infrequent.[1,3-6,9] The etiological factors for isolated subclavian and axillary artery aneurysms are mainly iatrogenic causes, trauma, and infections (e.g., syphilis and other bacterial infections).[1,3-6,9,10] Furthermore, atherosclerosis and thoracic outlet syndrome are etiological factors that are particularly associated with true aneurysms.[1,3-6,8,9] In extremely rare cases, fibromuscular dysplasia, cystic medial necrosis, and genetic disorders such as Turner syndrome and Marfan syndrome,[11-15] infections,[1] congenital malformations such as an aberrant subclavian artery[9] and idiopathic aneurysms have also been identified causes of true aneurysms.[16] Consistent with the literature, atherosclerosis was the most common cause in our study.

The most common symptoms of subclavian artery aneurysms are pain around the shoulder and upper chest region as well as pain, coldness, and numbness in the affected extremity due to thrombosis of the aneurysm or embolization.

Hyperesthesia caused by compression of the brachial plexus, hoarseness due to laryngeal nerve palsy, and Horner syndrome secondary to compression of the cervical or thoracic sympathetic chain are not very common.[1,9,14,17] Moreover, pseudoaneurysms of

the subclavian artery, in particular, have the potential to cause hemoptysis due to the erosion of the lung apex after the rupture.[1,18] In addition, asymptomatic aneurysms may be detected coincidentally by investigations conducted for other reasons. The most common symptoms of axillary artery aneurysms are similar to those of subclavian artery aneurysms, with ischemia of the affected extremity due to thrombosis of the aneurysm sac or distal emboli from the sac and a neurological deficit resulting from a brachial plexus injury occurring most often.[6,8,10,18] Axillary artery aneurysms may also manifest as pulsatile, non-disturbing, or compressing masses or bleeding may be present. In our study, bleeding was the primary identifiable factor.[5,6,8,10,16,19]

Both subclavian and axillary artery aneurysms should be promptly treated after being diagnosed due to the aforementioned complications and because the possibility of rupture or thrombosis becomes greater when the diameter of the aneurysm is increased. Similarly, the possibility of aneurysm-related embolization and the development of neurological complications is also higher.[20,21] Although the number of reports related to the endovascular treatment of these types of aneurysms has recently risen,[20-22] the primary treatment modality is still surgery.[1,3,5,6,8,9,11-14] In our study, all of the patients were treated by open surgery. Many authors have indicated that the best incisions for the surgical approach are a median sternotomy for an intrathoracic right subclavian artery aneurysm, a left thoracotomy for an intrathoracic left subclavian artery aneurysm, and a supraclavicular incision for those that are extrathoracic.[1,14] Many other approaches are also commonly used including subclavicular incisions, subclavicular incisions extending to the axillary incision, anterolateral incisions, and posterolateral incisions,[2,7,9,14,20] with the localization of the aneurysm being the primary determinant.[1,17] We used a subclavicular incision for one patient and a supraclavicular incision for another when performing surgery for a subclavian artery aneurysm, but a median sternotomy was added to the supraclavicular incision in the second operation for the second patient because of the development of an pseudoaneurysm after the initial surgery that utilized a single supraclavicular incision. In axillary artery aneurysms, however, infraclavicular, deltoidopectoral, and subpectoral incisions are generally used,[3,5,6,10] but we chose a subclavicular approach in our study.

The surgical treatment of axillary and subclavian artery aneurysms usually consists of the resection of the aneurysm and the interposition of a graft.[1,3,5,6,8-19] Extra-anatomic bypasses, such as a carotid axillary bypass, may be preferred, especially in patients with an infection,[1,6] and SVGs and PTFE or Dacron grafts usually being employed as conduits in these cases.[1,3,5,8-19] The established practice is to use the saphenous vein whenever possible. However, if this is not an option due to low quality, a mismatching diameter, or the prior use of a saphenous vein conduit (coronary bypass, etc.), then synthetic graft material can be used.[1,3,6,10] We used the saphenous vein in four of our patients and a PTFE graft in the other four.

Only a few clinical studies exist that include the results of surgical treatment for subclavian and axillary artery aneurysms. Porcellini et al.[13] examined five cases that were operated on for atherosclerotic subclavian artery aneurysms and reported no early complications. Furthermore, only one patient (20%) developed late complications. In another study by Davidović et al.[1] three out of 14 patients (21%) with subclavian artery aneurysms who underwent surgery experienced postoperative complications. Two of these patients had a pneumothorax and median nerve palsy was seen in the other. Additionally, they reported no late complications. In a clinical study that focused on the surgical treatment of axillary artery aneurysms, Tetik et al.[6] reported that a preoperative brachial plexus injury did not recover postoperatively, but no other complications were seen. In our study, two out of the eight patients (25%) that we operated on developed early postoperative complications.

One of the limitations of this study was the small sample size. In addition, we investigated two different pathologies concomitantly, although they had a similar anatomical localization.

In conclusion, true aneurysms of the subclavian and axillary arteries are very rare. Careful attention is needed in the diagnosis and treatment processes because of the complications associated with both of these pathologies and the need to make the best choice for surgical intervention.

**Declaration of conflicting interests**

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

**Funding**

The authors received no financial support for the research and/or authorship of this article.

## REFERENCES


1. Davidović LB, Marković DM, Pejkić SD, Kovacević NS, Colić MM, Dorić PM. Subclavian artery aneurysms. Asian J Surg 2003;26:7-11.
2. Lawrence PF, Gazak C, Bhirangi L, Jones B, Bhirangi K, Oderich G, et al. The epidemiology of surgically repaired aneurysms in the United States. J Vasc Surg 1999;30:632-40.
3. Tetik O, Yazici M, Bayatli K, Gurbuz A. A giant arteriosclerotic aneurysm of the axillary artery. Turk Gogus Kalp Dama 2005;13:267-269.
4. Michalakis D, Lerais JM, Goffette P, Royer V, Brenot R, Kastler B. True isolated atherosclerotic aneurysm of the axillary artery. J Radiol 2003;84:1016-9. [Abstract]
5. Malik MK, Kraev AI, Hsu EK, Clement MH, Landis GS. Spontaneous axillary artery aneurysm: a case report and review of the literature. Vascular 2012;20:46-8.
6. Tetik O, Yilik L, Besir Y, Can A, Ozbek C, Akcay A, et al. Surgical treatment of axillary artery aneurysm. Tex Heart Inst J 2005;32:186-8.
7. Dent TL, Lindenauer SM, Ernst CB, Fry WJ. Multiple arteriosclerotic arterial aneurysms. Arch Surg 1972;105:338-44.
8. Morris-Stiff G, Coxon M, Ball E, Lewis MH. Atherosclerotic axillary artery aneurysm. Minerva Chir 2008;63:61-3.
9. Iida M, Hata H, Kimura H. A case of atherosclerotic aneurysm of the right subclavian artery with the right axillary arterial stenosis and enlargement of the ascending aorta. Ann Thorac Cardiovasc Surg 2011;17:599-602.
10. Tripp HF, Cook JW. Axillary artery aneurysms. Mil Med 1998;163:653-5.
11. Hirooka S, Oshikiri N, Kimura M, Sugawara M, Oguma H, Irisawa T, et al. A left subclavian arterial aneurysm caused by fibromuscular dysplasia: a case report. Kyobu Geka 1995;48:221-3. [Abstract]
12. Özbudak E, Kanko M, Yavuz Ş, Gümüştaş S, Arıkan AA, Çiftçi E, et al. İzole iliyak arter anevrizmaları: Cerrahi yöntem ile endovasküler girişimlerin karşılaştırılması. Turk Gogus Kalp Dama 2013;21:317-24.
13. Porcellini M, Selvetella L, Scalise E, Bauleo A, Baldassarre M. Arteriosclerotic aneurysms of the subclavian artery. Minerva Cardioangiol 1996;44:433-6. [Abstract]
14. Dougherty MJ, Calligaro KD, Savarese RP, DeLaurentis DA. Atherosclerotic aneurysm of the intrathoracic subclavian artery: a case report and review of the literature. J Vasc Surg 1995;21:521-9.
15. Vierhout BP, Zeebregts CJ, van den Dungen JJ, Reijnen MM. Changing profiles of diagnostic and treatment options in subclavian artery aneurysms. Eur J Vasc Endovasc Surg 2010;40:27-34.
16. Gray RJ, Stone WM, Fowl RJ, Cherry KJ, Bower TC. Management of true aneurysms distal to the axillary artery. J Vasc Surg 1998;28:606-10.
17. Sato K, Nonami Y, Yamamoto A, Ono H, Matsumoto Y, Ogoshi S. A right subclavian artery aneurysm with hoarseness. Nihon Kyobu Geka Gakkai Zasshi 1995;43:567-70. [Abstract]
18. Bechini J, Cuadras P, Tenesa M, Lisbona C, Casas D, Olazábal A. Chronic traumatic pseudoaneurysm of right subclavian artery. Eur Radiol 1998;8:63-5.
19. Szuchmacher PH, Freed JS. Axillary aneurysms. N Y State J Med 1980;80:795-6.
20. Roh YN, Park KB, Do YS, Kim WS, Kim YW, Kim DI. A hybrid operation in a patient with complex right subclavian artery aneurysm. J Korean Surg Soc 2012;82:195-9.
21. Van Leemput A, Maleux G, Heye S, Nevelsteen A. Combined open and endovascular repair of a true right subclavian artery aneurysm without proximal neck. Interact Cardiovasc Thorac Surg 2007;6:406-8.
22. Troutman DA, Mohan CR, Samhouri FA, Sohn RL. Open repair and endovascular covered stent placement in the management of bilateral axillary artery aneurysms. Vasc Endovascular Surg 2010;44:708-9.