

The revascularization of the left subclavian artery with a cross over axilloaxillary bypass for the hybrid repair of thoracic aortic aneurysms

La revascularización de la arteria subclavia izquierda con un bypass axiloaxilar cruzado para la reparación híbrida de aneurismas de la aorta torácica

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Abstract

Aim: We present our subclavian artery revascularization experiences in the patients with thoracic aortic aneurysm who underwent hybrid repair. **Material and Methods:** Between May 2015-December 2018, 4 patients underwent TEVAR procedure following axilloaxillary bypass grafting. The mean age of the patients was 72.5 ± 3.01 years. One patient was female and 3 patients were male. Patients had thoracic aortic aneurysms including the left subclavian artery or aberrant right subclavian artery. **Results:** All patients underwent endovascular stent graft repair following axilloaxillary bypass grafting in the same day. Mortality did not occur in the perioperative period. One patient had graft infection at 8th month of the operation and the graft was removed. He was lost due to pneumonia following the operation. The control computed tomographies of the other 3 patients revealed patent grafts together with successful endovascular interventions and they have been following uneventfully a mean of 27 ± 6.2 months (range: 24-32, median: 29). **Conclusion:** The risk of stroke, spinal cord ischemia, and upper extremity ischemia are found higher in the patients who underwent coverage of the left subclavian artery without revascularization. The axilloaxillary bypass grafting may be performed in the patients with high risk to prevent carotid artery manipulation and clamping during carotid-subclavian bypass with long term promising patency rates.

Keywords: Thoracic aortic aneurysm. Hybrid therapy. Axilloaxillary bypass.

Resumen

Objetivo: Presentamos nuestras experiencias de revascularización de la arteria subclavia en los pacientes con aneurisma de aorta torácica sometidos a reparación híbrida. **Material y métodos:** entre mayo de 2015 y diciembre de 2018, 4 pacientes fueron sometidos a TEVAR después de un injerto de derivación axiloaxilar. La edad media de los pacientes fue $72,5 \pm 3,01$

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años. Un paciente era mujer y 3 pacientes eran varones. Los pacientes tenían aneurismas de la aorta torácica incluyendo el arteria subclavia izquierda o arteria subclavia derecha aberrante. **Resultados:** Todos los pacientes fueron sometidos a reparación endovascular con endoprótesis vascular en el mismo día después de un bypass axiloaxilar, no hubo mortalidad en el perioperatorio, un paciente presentó infección del injerto a los 8 meses de la operación y se retiró el injerto, se perdió por neumonía. Las tomografías computarizadas de control de los otros 3 pacientes revelaron injertos permeables junto con intervenciones endovasculares exitosas y han estado siguiendo sin incidentes una media de $27 \pm 6,2$ meses (rango: 24-32, mediana: 29). **Conclusión:** El riesgo de ictus, isquemia medular e isquemia de la extremidad superior es mayor en los pacientes sometidos a cobertura de la arteria subclavia izquierda sin revascularización; en los pacientes con alto riesgo se puede realizar un bypass axiloaxilar para prevenir la manipulación de la arteria carótida. y pinzamiento durante la derivación carótido-subclavia con tasas de permeabilidad prometedoras a largo plazo.

Palabras clave: Aneurisma de aorta torácica. Terapia híbrida. Bypass axiloaxilar.

Introduction

The conventional surgical therapy of thoracoabdominal aneurysms still includes high mortality and morbidity rates despite it is the gold standard treatment modality of this pathology¹. Even hybrid approaches have some risks, the technique reduces the mortality and morbidity rates especially in high risk patients².

Hybrid repair involves endovascular aortic repair following debranching of the cervical or the visceral arteries². In the treatment of zone 2 thoracic endovascular aortic repair, revascularization of the left subclavian artery (LSA) decreases the ischemic complications such as stroke, spinal cord ischemia, and upper extremity ischemia as well as LSA related type 2 endoleaks³. Also, in the case of the presence of aberrant right subclavian artery (ARSA), the embolization of ARSA is necessary to prevent endoleak when TEVAR is performed following debranching⁴.

In this report, we present our subclavian artery revascularization with a cross over axilloaxillary bypass in the patients with thoracic aortic aneurysm who underwent hybrid repair.

Patients and methods

Between May 2015-December 2018, 4 patients underwent TEVAR procedure following axilloaxillary bypass grafting. Patients had thoracic aortic aneurysms comprising the LSA or aberrant right subclavian artery. The patients who underwent conventional open surgical repair or full endovascular interventions were excluded from the study. The mean age of the patients 72.5 ± 3.01 years (range: 64-78, median: 74).

The first patient was 64 year old female patient. She presented to the clinic with difficulty while swallowing. She had hypertension. Computed tomography

angiography revealed aberrant right subclavian artery aneurysm compressing esophagus together with thoracic aortic aneurysm.

The 75 year old male patient with diabetes mellitus and anemia presented to the clinic with an aneurysmatic dilatation arising from origin of the aberrant right subclavian artery to the thoracic artery (Fig. 1). The patient had also infrarenal abdominal aortic aneurysm.

The 73 year old male patient had a history of previous TEVAR and EVAR. The control computed tomography angiography revealed new ulcerated aortic plaque at the level of left subclavian artery origin and no flow in the right common and external iliac artery. He had diabetes mellitus, gastritis, gastroesophageal reflux disease, hypertension and the history of cerebrovascular event.

The 78 year old male patient had thoracic aortic aneurysm and dissection (Fig. 2). He had coronary artery disease and he was on dialysis 3 days a week through left radiocephalic fistula.

The patients were evaluated and hybrid repair was planned due to their poor conditions and additional pathologies such as aberrant right subclavian artery aneurysm. All patients underwent endovascular stent graft repair following axilloaxillary bypass grafting in the same day.

100 mg of aspirin and 75 mg of clopidogrel were prescribed to the patients for 3 months. After 3 months the patients were treated with single antiplatelet therapy life long. At least 20 mg of atorvastation was added to the medical therapy for 1 year and it is continued depending on the cholesterol levels in the long term.

Surgical technique and endovascular stent graft repair

Bilateral axillary arteries were dissected through infraclavicular incisions with general anesthesia.



Figure 1. The preoperative computed tomography angiography revealing aberrant right subclavian artery.



Figure 2. The preoperative computed tomography angiography revealing thoracic aortic dissection and aneurysm.

Following systemic 5,000 units of heparin, an 8mm subfascially placed ringed PTFE graft was interposed between the bilateral axillary arteries. Depending on the pathology either the LSA or ARSA was proximally ligated.

For the TEVAR procedures, the right femoral artery was dissected surgically. Superstiff 0.035-inch guidewire (Back-up Meier, Schneider Co.; Blach, Switzerland) was inserted at the ascending aorta through the arteriotomy. A 5F sheath was inserted percutaneously to the left femoral artery to provide directing a 5F pig-tail catheter for angiographic monitoring. Following

systemic heparinization (5000 U), longitudinal incision was performed in the right common femoral artery and endovascular stent graft delivery system (Endurant Medtronic Endovascular, Santa Roja, CA, USA) was positioned at the thoracic aorta. Then the stent graft was then expanded. The stent graft covered the left subclavian artery in 2 cases and the aberrant subclavian artery orifice in 2 cases. The femoral artery was reconstructed primarily or with a patch when needed.

Results

Mortality did not occur in the perioperative period. All patients were extubated when they were taken to the intensive care unit. Mean intensive care unit stay was 1.75 ± 0.48 days (range: 1-3, median: 1.5). All patients underwent endovascular stent graft repair following axilloaxillary bypass grafting in the same day. Bleeding or hematoma did not occur in any patients. Mean hospital stay was 4.7 ± 0.45 days (range: 4-6, median: 4.5).

The 64 year old female patient with aberrant right subclavian artery underwent axilloaxillary bypass grafting operation. Following the procedure, the patient was taken to the invasive radiology department. The aberrant right subclavian artery was coiled to prevent retrograde endoleak and the stent graft was inserted from distal of the left subclavian artery orifice to mid portion of thoracic aorta (Fig. 3). The postoperative course was uneventful.

The 75 year old male patient underwent the aberrant right subclavian artery coiling to prevent retrograde endoleak and the stent graft was inserted from distal of the left subclavian artery orifice to mid portion of thoracic aorta, following axilloaxillary bypass grafting. In another session, endovascular aortic stent graft repair was performed to treat infrarenal abdominal aortic aneurysm.

The 73 year old male patient with a history of previous TEVAR and EVAR underwent TEVAR extension to the proximal portion of aorta by covering the left subclavian artery origin following axilloaxillary bypass grafting. Cross femoral bypass grafting was performed in the same session with TEVAR extension to treat right external and common iliac artery occlusion.

The 78 year old male patient with thoracic aortic aneurysm and dissection underwent thoracic endovascular stent graft repair by covering the left subclavian artery origin after axilloaxillary bypass grafting (Fig. 4).

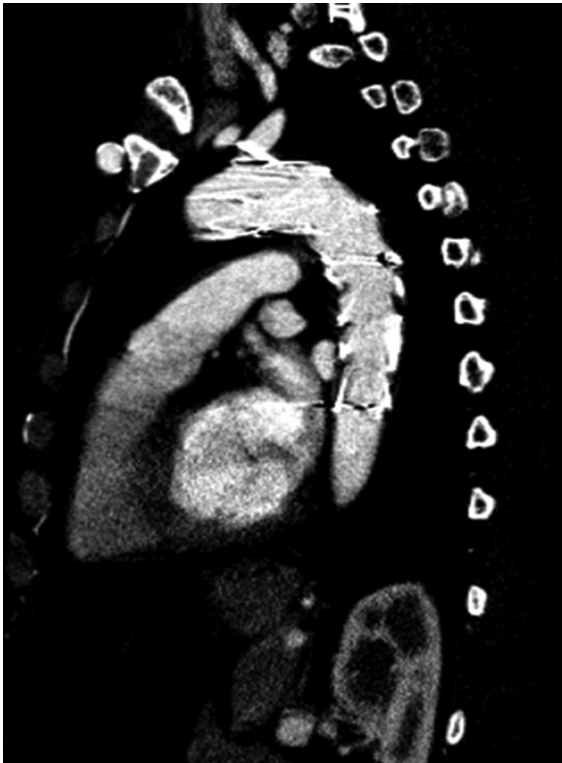


Figure 3. The postoperative computed tomography angiography.



Figure 4. The postoperative computed tomography angiography shows axilloaxillary bypass graft and TEVAR.

In the early period (30 days) of the operation, the mortality or complication did not occur in any patients. The 78 year old patient with chronic renal insufficiency and coronary artery disease presented with graft infection in the 8th month of the operation. The patient had left radiocephalic fistula and the permanent dialysis catheter was inserted in the right subclavian artery due to inappropriate flow of the fistula. The patient underwent graft excision but in the early period of the operation, he was lost due to pneumonia in the intensive care unit.

The control computed tomographies of the other 3 patients revealed patent grafts together with

successful endovascular interventions and they have been following uneventfully a mean of 27 ± 6.2 months (range: 24-32, median: 29).

Discussion

Thoracic endovascular aortic repair (TEVAR) has become standard treatment option for the suitable patients with descending thoracic aortic pathologies in the current era. However, up to one third of these patients require overlapping of the LSA due to involvement of LSA origin in the aortic pathology for an uneventful and successful procedure³.

Although revascularization of the LSCA was recommended as mandatory in the first years of endovascular stent graft repair in the aortic arch, it was thought that it was not necessary due to appropriate collateral flow in later years⁵. Recently, the Society for Vascular Surgery and the European Society for Vascular Surgery recommended routine revascularization of the left subclavian artery in elective patients and selective patients with emergent conditions³. The revascularization may be performed after TEVAR in urgent cases⁶. However, the advices of SVS were based on low quality evidence⁶. The revascularization is mandatory in patients with left internal mammary coronary artery bypass graft, arterial-venous fistula, or dominant left vertebral artery³.

The risk of stroke, spinal cord ischemia, and upper extremity ischemia are reported to be higher in the patients who underwent coverage of the LSA without revascularization in the literature⁶. Left subclavian artery revascularization techniques include surgical and endovascular measures such as LSA to carotid transposition (SCT) or carotid-subclavian bypass (CSB), chimney/snorkel grafting, branched/fenestrated endografts, and creation of insitu fenestration. The advantage of endovascular techniques is elimination of left carotid artery manipulation³. The axilloaxillary artery bypass grafting technique has certain unique advantages. The most effective and optimal revascularization technique of LSA is still unclear in literature^{3,6}.

Aberrant right subclavian artery is the most common aortic arch pathology with 0.5%–2.0% incidence in population^{7,8}. In patients who have ARSA together with thoracoabdominal aneurysms ARSA embolization is necessary to prevent endoleak whom receive TEVAR⁴. Also, the ARSA should be revascularized to prevent ischemic complications in the upper limbs or

vertebrobasilar area and the risk of aneurysmal dilatation and rupture⁸.

Limitations

Small number of patients and retrospective nature of the study are major limitations of the study.

Conclusion

We preferred axilloaxillary bypass to revascularize the LSA or ARSA in our patients. All our patients had certain risks due to older age and comorbidities for conventional thoracic aneurysm repair. The axilloaxillary artery bypass technique prevented the manipulation and clamping of the carotid artery as during carotid-subclavian bypass or transposition. The long term patency rates had been promising. Hence, especially in the patients with certain comorbidities, the revascularization of subclavian artery may be provided with a crossover axillary artery bypass. The technique is simple, durable and prevents the risks due to carotid artery involvement during the surgical therapy.

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Conflicts of interest

The authors declare that does not exist any conflicts of interest.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study.

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors have obtained the written informed consent of the patients or subjects mentioned in the article. The corresponding author is in possession of this document.

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