

# Crossed limb (Ballerina) Endovascular Aneurysm Repair: Presentation of a case and Literature review

Panagiotis G. Theodoridis<sup>1</sup>, Ilias Dodos<sup>1</sup>, Dimitrios Staramos<sup>1</sup>, Tsapaki Virginia<sup>2</sup>, Konstantinos Dervisis<sup>1</sup>

<sup>1</sup>Department of Vascular Surgery, Konstantopouleio General Hospital, Nea Ionia, Athens, Greece

<sup>2</sup>Medical Physics Department, Konstantopouleio General Hospital, Nea Ionia, Athens, Greece

## Abstract:

In modern era of endovascular procedures, the aortic anatomy may influence the potential success of the endovascular abdominal aortic repair (EVAR). To overcome some of these limitations, the crossed-limb (CxL) technique was developed, where catheterization of the contralateral limb performed from the ipsilateral side. This report present a rare case of a 65-years old male patient who treated in our department for a large 7.5 cm infrarenal abdominal aortic aneurysm (AAA) using the CxL technique with an unexpected result, the almost 'double crossing' of the limbs. This resulted from over-rotation of the main body during the deployment with no impact on the blood flow. Two years thereafter the aneurysm sac has been shrinked and both limbs are patent without endoleak. We also contact a literature review regarding the CxL technique and the short and midterm outcome of the method.

## INTRODUCTION

Endovascular aneurysm repair (EVAR) have changed the therapeutic approach in abdominal aortic aneurysms (AAAs) over the last decades<sup>1</sup>. New commercially available devices have increased the safety and success of the method<sup>2</sup>. However, anatomic factors may limit the availability of the method<sup>3</sup>. The crossed-limb (CxL) or 'ballerina position' technique was developed first from Ramaiah VG et al in 2002 for cases where the conventional EVAR configuration were not feasible<sup>4</sup>. In these cases, the deployment of an AneuRx stent-graft made with the contralateral gate of the main body facing the ipsilateral side after rotation of the device.

This report presents an interesting case of a patient treated endovascularly for a 7.5 cm infrarenal AAA using the CxL technique, where over-rotation of the main body had an unexpected result; the almost 'double' CxL configuration which illustrated patent in the two years follow-up. We also contact a literature review concerning the efficacy of this method.

## CASE REPORT

A 65-years old male patient presented in the emergency department due to acute left calf swelling. His medical history

included hypertension, hyperlipidemia, diabetes mellitus, coronary artery disease and obesity (BMI>30). A vein duplex examination revealed an unprovoked deep vein thrombosis (DVT) extending from left popliteal to left external iliac vein and an incidental finding of a large 7.5 cm infrarenal AAA not associated with the thrombosis. Emergency Computer Tomography angiography (CTA) verified the diagnosis. The aneurysm was suitable for standard - EVAR, although the big size of the aneurysm and the extended mural thrombus were concerns for extra consideration (Figures 1a). We also observed the tortuosity of the left external iliac artery with mild angulation of both common iliac arteries (Figure 1b). The patient operated in an emergency setting and we implanted a Zenith Flex<sup>®</sup> AAA endograft (Cook medical, Bloomington, USA). A right main access was selected. Considering the size of the aneurysm and the high volume of mural thrombus into the sac we decided to use the CxL technique. Nevertheless, over-rotation of the main body during deployment resulted in a little bit additional torsion of the main body. This led to the double crossing of the limbs position which had no impact on the blood flow in both limbs. We also hypothesize that winding of the contralateral guide wire to the ipsilateral one may affect the final position of the endograft. Total operative time was 153 minutes and blood loss of 240 mL. The patient was discharged during the fourth post-operative day with no complications under therapeutic doses of low-molecular-weight heparin (LMWH) for six months and an antiplatelet agent for lifetime. Two years thereafter the aneurysm sac has been shrinked and both limbs are patent without endoleak (Figure 2).

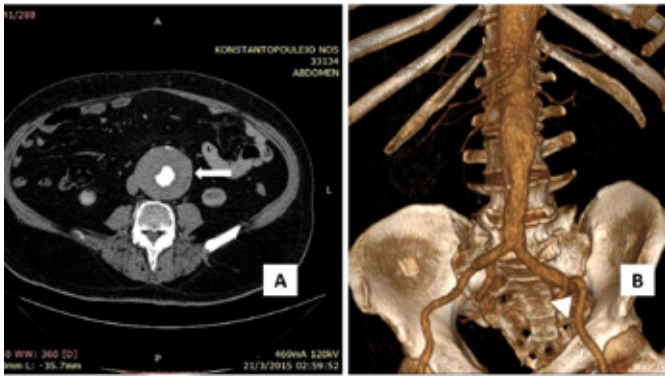
## Author for correspondence:

**Panagiotis G Theodoridis, MD, MSc**

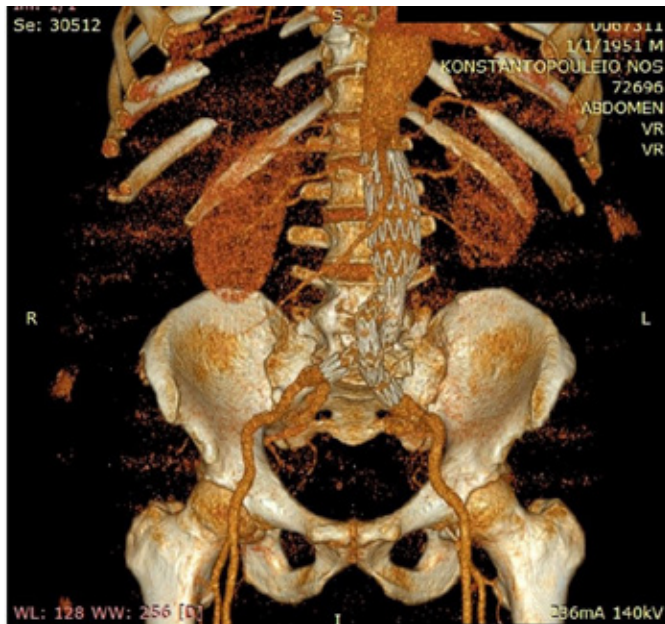
Resident in Vascular Surgery, Department of Vascular Surgery, "Konstantopouleio" General Hospital, Ag. Olgas 3-5, 14233 Nea Ionia, Athens, Greece  
Tel: +30 2132057531

E-mail: pn.theodoridis@gmail.com

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**Figure 1.** a. Pre-operative Computed Tomography Angiography (CTA) revealed the 7.5 cm infra-renal abdominal aortic aneurysm with extended mural thrombus (arrow). b. 3-D reconstruction of the pre-operative CTA showing the small patent lumen with the angulated left common iliac artery and the tortuous left external iliac artery (arrowhead).



**Figure 2.** Two years follow-up CTA revealed the patent cross-limbed endograft in antero-posterior view.

## DISCUSSION

In modern era of endovascular procedures, the aortic anatomy may influence the potential success of the endovascular abdominal aortic repair (EVAR) technique<sup>5</sup>. In cases with severely splayed iliac arteries, large aneurysm sac, severe proximal or distal neck angulation and increased or absent mural thrombus catheterization of the short limb via the contralateral access is difficult<sup>4,6,7</sup>. To overcome this barrier, the crossed-limb (CxL) technique was developed where the short limb gate of main body faces the ipsilateral side, to facilitate catheterization of short limb via contralateral access. Ramaiah et al. reported the use of this technique in 1.6% of their patients treated with EVAR in 2002<sup>4</sup>. This technique does not seem to affect hemodynamic behavior compared to a typically positioned endograft, although it seems to increase forces exert on the limbs<sup>5</sup>. There is no increased risk of graft limb occlusion or of clinically significant endoleaks for the CxL configura-

tion compared to conventional endograft position, but there is lacking evidence to support this view. Our case fulfils two anatomic criteria introduced from Georgiadis et al<sup>7</sup> considering the presence of a large aneurysm with increased mural thrombus. This maneuver reduced the difficulties of a straight catheterization and the possibility of the contralateral limb to be deployed inside the thrombus, but over-rotation resulted in the twisted position of the device. Furthermore, we observed that operative time was higher from the average time of 116.3 minutes that previous report mentioned, making it a time-consuming procedure for non-familiar practitioners<sup>7</sup>.

Finally, we conducted a cross-sectional literature review concerning the use of this technique in patients treated for AAAs. We used the terms “EVAR”, “crossing the limbs technique”, “ballerina EVAR”, “AAA”. Three case series isolated from this search<sup>4,7,8</sup>. The first one described the first use of the technique in patients with an extremely angled aortic neck<sup>4</sup>. Georgiadis et al. reported a case-controlled analysis of 54 patients from 2007 to 2012 who treated by the same EVAR endograft using either the CxL or straight-limb (SL) technique<sup>6</sup>. The authors measured the primary outcomes of both methods in a time – period ranging from 6 – 59 months. There were no difference in short- and midterm outcomes between the two methods, apart from the mean procedural time which were significantly longer in the CxL group (116.3 vs 90.7 minutes). Dattani et al. retrospectively reviewed 312 EVAR patients treated with the crossed (n=43) and uncrossed (n=269) technique at a tertiary vascular center for a 5 years period<sup>7</sup>. The authors concluded that there was no difference in both groups for two years follow – up apart from type II endoleaks which were higher in the crossed group, but it was not associated with sac expansion. They also observed that the main indication for the crossed-limb technique was angulation on the distal portion of the aorta. The two series have some limitations and differences concerning the selected anatomic and exclusion criteria, but both showed similar results.

## CONCLUSION

Crossing the limbs technique (CxL) is a possible option for patients treated for AAA with specific anatomic criteria. This can be planned in a pre – operative planning process for elective repair cases or it can be an option decided during the procedure with acceptable mid-term results compared with the straight-limb (SL) EVAR procedure.

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