Symptomatic Ipsilateral Limb Twisting Due to Extensive Rotational Re-orientation of the C3 Excluder

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Introduction: Since the introduction of the Gore C3 device, which allows level re-positioning and contralateral gate cannulation, there have been very few reported complications due to excessive readjustment attempts. A case is reported of ipsilateral limb twisting and severe stenosis caused by extensive rotational re-orientation of the C3 system during a challenging intra-operative gate catheterisation.

Report: Endovascular aortic aneurysm repair (EVAR) was performed for an infrarenal abdominal aortic aneurysm. Owing to difficulties encountered during contralateral gate cannulation using a Gore C3 device, the device was re-constrained and rotated clockwise several times, which induced twisting and severe symptomatic stenosis of the ipsilateral limb. The stenosed ipsilateral limb was successfully dilated with a bare stent two days after EVAR.

Discussion: Ipsilateral limb twisting due to extensive rotational re-orientation of the Gore C3 Excluder may occur during challenging intra-operative gate catheterisation. Thus, in cases that require extensive rotational re-orientation of the C3 system, it is advisable to carefully inspect for ipsilateral limb twisting during surgery.

INTRODUCTION
The Gore Excluder endoprosthesis with a C3 delivery system enables both level and rotational orientation repositioning before final deployment. It allows for the re adjustment of proximal stent graft deployment and contralateral intra-operative gate catheterisation. A case of ipsilateral limb twisting caused by extensive rotational re-orientation of the C3 system during a challenging intra-operative gate catheterisation is reported.

The patient signed an informed consent form for the publication of the case. This study was conducted in accordance with the Declaration of Helsinki.

CASE REPORT
A 76 year old woman was admitted to hospital with an asymptomatic abdominal aortic aneurysm (AAA), which had a maximum diameter of 53 mm (Fig. 1). The left common iliac artery was short (8.5 mm in length), which was considered inappropriate for stent graft distal landing. Therefore, left internal iliac artery embolisation and endovascular aortic aneurysm repair (EVAR) was planned with a Gore C3 Excluder (W.L. Gore & Associates, Flagstaff, AZ, USA), in which the distal landings were the right common iliac and left external iliac arteries.

The procedure was performed under general anaesthesia. The C3 Excluder was inserted from the left common iliac artery. Owing to the wide space in the thrombus free aneurysm sac and its angulated shape, catheterisation to the contralateral gate was difficult. The C3 Excluder was constrained and rotated clockwise several times. Thereafter, contralateral gate cannulation was achieved using right femoral artery access and the Excluder was deployed as planned. Completion angiography revealed uninterrupted flow and no major endoleaks. The patient did not complain of lower limb rest pain, however she did complain of left leg claudication on walking, in the afternoon of the day after the surgery. The ankle brachial pressure index (ABPI) on the left side had decreased from 1.30 before surgery to 0.55 after surgery. Careful review of the abdominal imaging revealed twisting of the Excluder in the ipsilateral leg (Fig. 2).

Re-intervention was performed two days after the EVAR procedure. The systolic pressure gradient from the right brachial artery to the left common femoral artery was approximately 60 mmHg. An intravascular ultrasound (IVUS) catheter was passed into the ipsilateral limb smoothly. However, during IVUS, severe stenosis of over 60 mm in length was observed from the bifurcation of the ipsilateral
limb (Fig. 3). Over 50% stenosis remained after dilatation with a 14 mm balloon; therefore, a PALMAZ L stent (Cordis, Baar, Switzerland) was placed for further dilatation and prevention of restenosis. Finally, the pressure gradient from the right brachial artery to the left common femoral artery decreased to less than 10 mmHg.

After the second procedure, the claudication in the patient’s left leg disappeared and the ABPI on the left side recovered to 1.01. Post-operative computed tomography revealed no stenosis of the ipsilateral limb or evidence of endoleaks (Fig. 4).

DISCUSSION
Iliac artery diameter, graft kinking, and extension into the external iliac artery have been identified as risk factors for iliac limb complications. Excluder limbs have been described as an optimal adaptation for moderate to highly angulated iliac anatomies. Based on this evidence, the Excluder device was selected for this external iliac artery distal landing case. The left femoral artery was chosen for the main approach as it would allow the procedure to be performed with two devices (main body and contralateral limb); whereas, at least three devices (main body, and contralateral and additional ipsilateral limbs) would have been needed when approaching from the right.

However, several problems made contralateral gate catheterisation difficult. First, the angles between the proximal neck and the aneurysm and between the aneurysm and the right iliac artery were moderate (55° and 63°, respectively, Fig. 1B). Second, the longitudinal axes of the contralateral gate and the right common iliac artery were non-intersecting.

Figure 1. Computed tomography imaging. (A) Computed tomography shows an infrarenal abdominal aortic aneurysm with a short left common iliac artery. (B) The proximal neck is long, narrow, and moderately angulated (55°). The aneurysmal sac is thrombus free, and the angle between the aneurysm sac and the right common iliac artery is 63°.

Figure 2. Abdominal Xray images on the day after the endovascular abdominal aortic repair procedure and schematic model of the ipsilateral limb twisting of the Gore Excluder. (A) The evaluation of the shape of the ipsilateral limb was difficult because of the overlapping images of the ipsilateral and contralateral limbs. (B) The magnified image shows ipsilateral limb stenosis (arrows) and twisting, which is reproduced in (C).
Third, the wide and free space of the thrombus free aneurysm sac made it difficult to control the catheters and guidewires. Therefore, repositioning by rotational orientation was needed to establish contralateral intra-operative gate catheterisation. In this case, the narrow and long proximal neck (53 mm in length and 15.5–19.5 mm in diameter) was expected to prevent rotation of the main trunk. The rotation of the C3 system could not be transmitted to the main trunk, which was very close to the narrow aorta, even with a constrained proximal edge. To establish contralateral intra-operative gate catheterisation, clockwise rotation of the C3 system was absolutely necessary.

Figure 3. Intravascular ultrasound and intra-operative fluoroscopy imaging. Intravascular ultrasound (IVUS) images of a stent graft in the main trunk (A), orifice of the ipsilateral limb (B), narrowest point of the ipsilateral limb (C), and left common iliac artery (D). The main trunk and ipsilateral limb in the left common iliac artery show no stenosis. The stenosis of the ipsilateral limb starts from its orifice. At the narrowest point, only a small space is observed outside of the IVUS probe. (E) Intra-operative fluoroscopy image, which was rotated to separate the two limbs, shows an approximately six cm twisting of the ipsilateral limb.

Figure 4. Post-operative computed tomography imaging. (A) Post-operative computed tomography images show no evidence of endoleaks. The bare stent (B: a, b, c) is well dilated, with no visible stenosis. LA: left anterior, AR: anterior right, RP: right posterior, PL: posterior left, LSA: left superior-anterior, RIP: right inferno-posterior.
Katsargyris et al.\(^4\) reported that ipsilateral twisting occurred in one of 200 patients in whom the C3 Excluder was used. In their report, they stated that ipsilateral limb twisting due to extensive rotational re-orientation may be recognised under high quality fluoroscopy. In this case, the final angiogram showed no flow stagnation in the ipsilateral limb. Furthermore, no difficulty was observed with passing any of the devices through the twisted ipsilateral limb. During surgery, there was no suspicion of limb stenosis. Thus, it was not considered necessary to change the fluoroscopy angle to separate the ipsilateral and contralateral limbs.

In the manufacturer’s instructions for the use of the Gore Excluder there is no warning concerning rotational re-orientation. However, extensive rotational re-orientation may cause limb twisting and may also result in delivery system damage and/or premature deployment. Therefore, the trunk delivery catheter should not be rotated beyond 360°, even when re-orientation is required.

In cases that require rotational re-orientation of the C3 system, it is advisable to carefully inspect for ipsilateral limb twisting during surgery. Even if limb twisting cannot be identified, it is better to add reverse rotation according to the rotational re-orientation. In addition, careful intra-operative positioning of the trunk and ipsilateral limb endoprosthesis, which does not then require extensive rotational re-orientation, is important. Furthermore, if cannulation is difficult, switching to other approaches, such as the pull through technique from the brachial artery or the crossover technique from the ipsilateral limb, should be considered.

CONCLUSION

A case of ipsilateral limb twisting and symptomatic severe stenosis caused by extensive rotational re-orientation of the Gore C3 Excluder is reported. The stenosed ipsilateral limb was dilated successfully with a bare stent two days after EVAR. This complication is considered to be unique to the repositionable system. Ipsilateral limb twisting by extensive rotational reorientation of the C3 system may occur during challenging intra-operative gate catheterisation. In cases that require extensive rotational re-orientation of the C3 system, it is advisable to carefully inspect for ipsilateral limb twisting during surgery.

CONFLICTS OF INTEREST

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