Multi-Branch AOrtic reconstruction with G-iliac system (BAO-G) technique in thoracoabdominal aortic aneurysm endovascular repair

Jiang Shao, MD, Yiyun Xie, MD, Zhichao Lai, MD, and Bao Liu, MD, Beijing, China

From the Department of Vascular Surgery, Peking Union Medical College Hospital, Chinese Academy of Medical Science, Beijing, China.

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Drs Shao, Xie, and Lai contributed equally to this article and should be noted as co-first authors.

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Address for reprints: Bao Liu, MD, Department of Vascular Surgery, Peking Union Medical College Hospital, Chinese Academy of Medical Sciences, No. 1, Shuaifuyuan, Dongcheng-qu, Beijing, 100730, China (E-mail: liubao72@aliyun.com).

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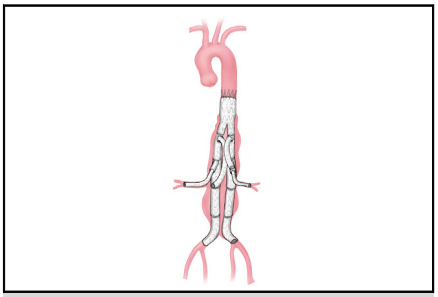


Morphology of all stent grafts after reconstruction using BAO-G technique.

CENTRAL MESSAGE

BAO-G technique is a novel technique using iliac-branched devices in endovascular reconstruction for visceral vessels in thoracoabdominal aortic aneurysm.

Video clip is available online.

Total endovascular therapy for thoracoabdominal aortic aneurysms (TAAAs) remains a significant challenge because of the complex anatomical involvement of both the thoracic and abdominal cavities, including the lumbar and visceral arteries.[1] Here, we introduce multi-Branch AOrtic reconstruction of thoracoabdominal aortic aneurysm with G-iliac system (BAO-G) technique, which uses off-the-shelf iliac-branch devices (IBDs) to reconstruct visceral arteries in a patient with Crawford IV extent TAAAs.

SURGICAL TECHNIQUE

Preoperative measurements method and devices used in BAO-G technique are shown in the Appendix E1. In the BAO-G technique, bilateral femoral and left brachial arteries are accessed (Figure 1, *A*). The modified aortic endograft is released in the predetermined position (Figure 1, *B*). The first IBD device is introduced via right femoral access to the right limb of aortic endograft, overlapping 3 cm with the aortic endograft limb, and the extending stent graft is inserted though brachial access to reconstruct the superior mesenteric artery (Figure 1, *C*). The second IBD for celiac artery is rebuilt in the same way as superior mesenteric artery but via contralateral femoral access and left brachial artery (Figure 1, *D*). In addition, 2 IBDs for reconstruction of bilateral renal arteries are accessed via bilateral femoral arteries, respectively (Figure 1, *E* and *F*). The endografts are extended to the bilateral iliac arteries (Figure 1, *G*). Postdilation and angiography are performed after each branch reconstruction.

CASE PRESENTATION

A 78-year-old female patient was admitted for a 7-cm asymptomatic Crawford extent IV TAAA with a severely tortuous aneurysm neck (Figure 2, *A* and *B*). After detailed measurement on computed tomography angiography, total endovascular repair using BAO-G technique was performed because of high surgical risk considering her age and previous coronary artery bypass surgery 2 months before (Figure 2, *C*). Because of her previous history of lumbar spinal stenosis surgery, preventive cerebrospinal fluid drainage was not performed. Successful reconstruction of 4 visceral arteries was achieved (Figure 2, *D*). No spinal cord ischemia, visceral ischemia or endoleak was observed at 1-year follow-up (Figure 2, *E* and *F*, Video 1). The institutional review board of the Peking Union Medical College Hospital

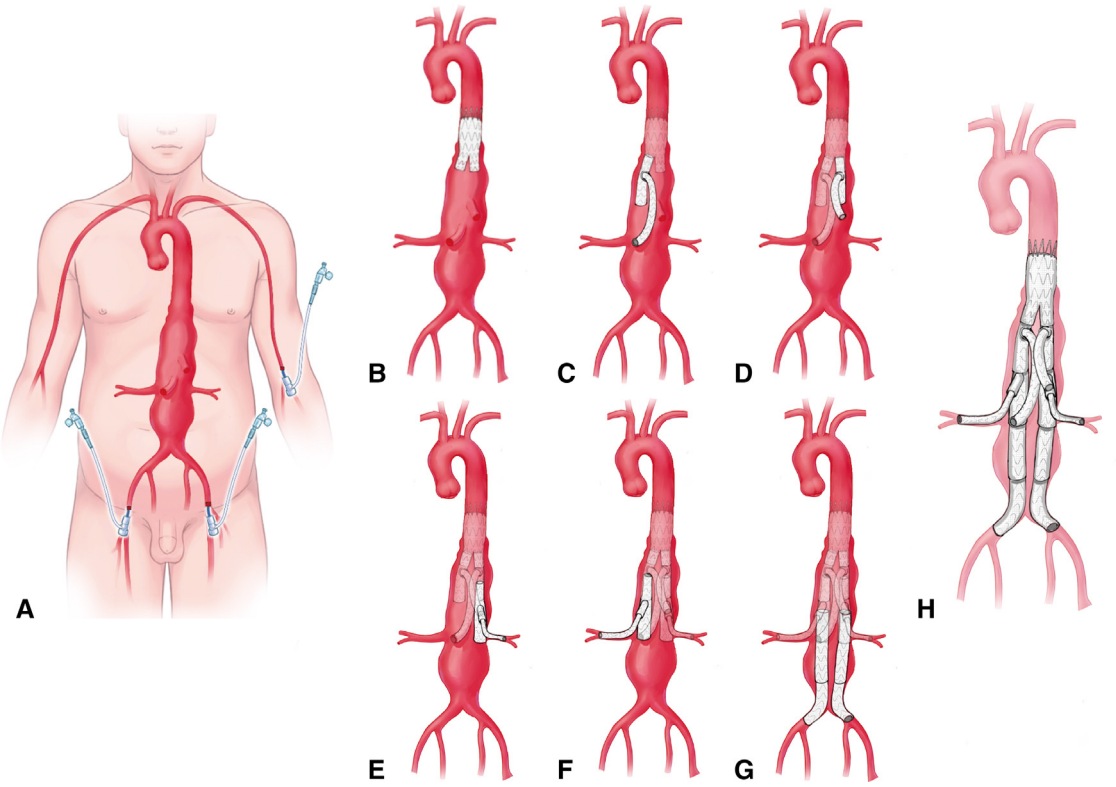


FIGURE 1. The BAO-G technique. A, Bilateral femoral arteries and left brachial artery are accessed. B, Release of modified aortic endograft, which is adjusted by trimming the long limb to match the short limb's length. C, The first IBD device is introduced via right femoral access, overlapping 3 cm with the aortic endograft limb, and the superior mesenteric artery is reconstructed. D, Reconstruction of the celiac artery. E, Reconstruction of the left renal artery. F, Reconstruction of the right renal artery. G, Extension of the stent graft to bilateral iliac arteries. H, Overview of all stent grafts. *BAO-G*, Multi-Branch AOrtic reconstruction of thoracoabdominal aortic aneurysm with G-iliac system.

approved the study protocol and publication of data (No. I-24PJ0687; approval date: March 28, 2024). The patient provided informed written consent for the publication of the study data.

DISCUSSION

Available total endovascular repair for TAAA still face problems, such as stent graft accessibility, time-consuming, squeezing, gutter leak between stent grafts, and high

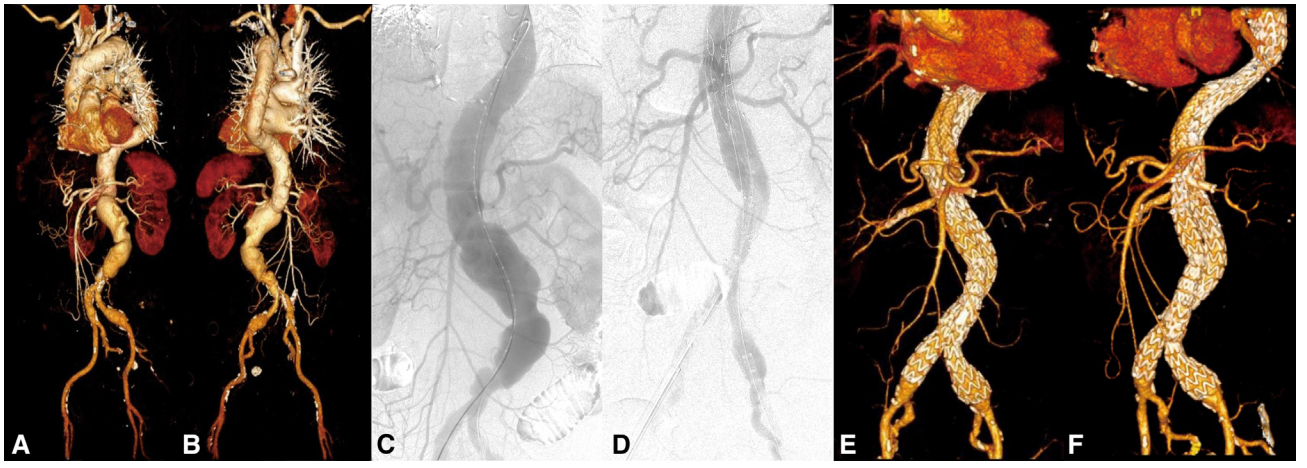
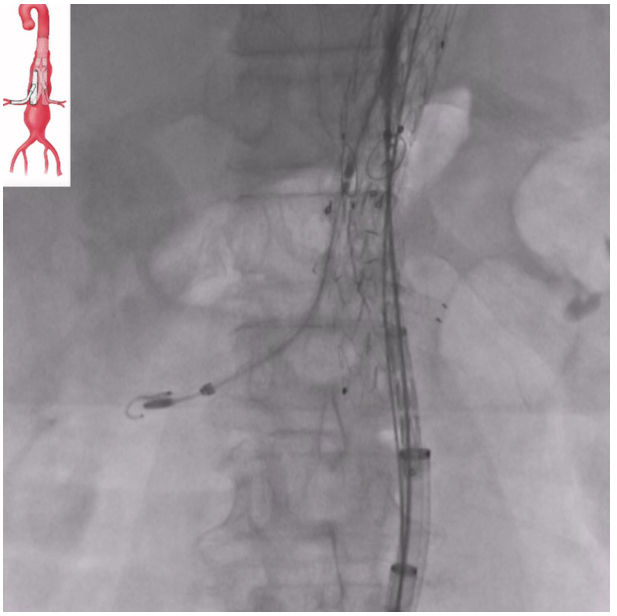


FIGURE 2. Preoperative and postoperative images. A and B, Crawford extent IV thoracoabdominal aortic aneurysm with severely tortuous aneurysm neck and severe stenoses of superior mesenteric artery and bilateral renal arteries. C, Preoperative angiogram. D, Postoperative angiogram. E and F, One-year follow-up computed tomography angiography.



VIDEO 1. Surgical procedure of current patient using the BAO-G technique. Video available at: https://www.jtcvs.org/article/S2666-2507(24)00319-5/fulltext.

requirements of endovascular techniques for cannulation to visceral branches.[1-5]

The BAO-G technique provides a novel solution to these problems. First of all, it uses an off-the-shelf aortic and iliac-branched devices and only requires slight modification, and it also provides a feasible solution with multiple remedial ways for a wide extent of anatomy in TAAAs, which increases the accessibility of suitable devices and shortened time cost. Second, the visceral vessels are reconstructed via one side, providing continuous blood flow to abdominal organs and the spinal cord during the operation, which prevents long-term intraoperative ischemia. Third, it avoids extrusion of stent grafts and gutter leak and provides an overlap of at least 3 cm to prevent type III endoleak. In addition, visceral branch cannulation along the blood flow improves the success rate of reconstruction, which shortens the learning curve. This technique has been performed in 5 patients, and so far all patients survived. Except for this patient, the other 4 patients received protective cerebrospinal fluid drainage routinely before the procedure, and no spinal cord ischemia was recorded in these 5 patients.

CONCLUSIONS

The BAO-G technique could be a novel choice for TAAA endovascular therapy. It is easy to reconstruct visceral branches and is available using off-the-shelf IBDs. Long-term results need to be confirmed in a larger sample size cohort.

Conflict of Interest Statement

The authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

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APPENDIX E1. PREOPERATIVE MEASUREMENTS

In the multi-Branch AOrtic reconstruction of thoracoabdominal aortic aneurysm with G-iliac system (BAO-G) technique, preoperative measurements involve extrapolating back to the lowest renal arteries. The first step is to position the distal end of the last iliac-branch device (IBD) branch at least 1 cm above the lowest renal artery opening. The proximal IBD branch should be greater than the openings of the superior mesenteric artery (SMA) and celiac artery (CA). Size and landing level of the aortic endograft are determined on the basis of visceral branch measurements and the diameter of the descending aorta, with an overlap of at least 3 cm between each device.

DEVICES

The BAO-G technique uses a modified aortic endograft and IBD. The aortic stent graft is adjusted by trimming the long limb to match the short limb's length (Figure E1, *A*, and E2). The IBD devices and the inner iliac artery device used in the BAO-G technique are shown in Figure E1, *B* and *C*. The VIABAHN stent graft (Gore Medical) could be an alternative choice for extending stent graft in the aortic branches.

TECHNIQUE DETAILS AND PROTOCOL

Anesthesia and Access

General anesthesia was administered. Bilateral common femoral arteries were punctured, Perclose sutures were placed using double ProGlide devices (Abbott), and the left brachial artery was accessed by surgical cutdown and a 6-Fr sheath was inserted. Then, a wire was introduced through the left brachial sheath to descending aorta, followed by exchange of a 7-Fr 90-cm sheath (Cook Medical).

Aortic Device Introduction

A preoperative angiogram was performed using a centimeter-sizing pigtail catheter (Cook Medical) to confirm the location of the aortic device. Then, the modified aortic branch device was introduced though the right femoral artery and placed at the level of 9 cm proximally to bilateral renal arteries' openings.

Reconstruction of the SMA

The first IBD (IBD_1) was introduced through right femoral artery to the right limb of aortic endograft, overlapping 3 cm with the endograft limb, turning the branch opening facing to the front of the patient. Then, IBD_1 was partially released until the branch was deployed. A guidewire was introduced via left brachial access, selectively cannulating through the branch combining with a 5-Fr vertebral catheter (Cook Medical) into the SMA. In addition, an inner iliac artery system (7-mm lumen distally, 100 mm in length; SilverFlow; LifeTech) was released into the SMA trunk. Then an 8- to 40-mm balloon (PowerFlex; Cordis) was used to expand the distal end and the joint of SMA stent graft and IBD_1.

Reconstruction of the CA

The second IBD (IBD_2) was introduced through the left femoral artery to the left limb of aortic endograft, overlapping 3 cm with the endograft limb, turning the branch opening facing to the front of the patient. IBD_2 was partially released as IBD_1, and the CA was reconstructed using the inner iliac artery system (8-mm lumen distally, 100 mm in length, SilverFlow; LifeTech). Postdilation was performed using a 6- to 40-mm balloon (PowerFlex).

Reconstruction of the Left Renal Artery

The left renal artery was reconstructed by another IBD (IBD_3) combining the SilverFlow device (6-mm lumen distally, 80 mm in length) and VIABAHN stent grafts (6-50 mm; Gore Medical) through the left femoral artery to the distal end of IBD_2, overlapping 4 cm. Postdilation was performed using a 6- to 40-mm balloon (PowerFlex) at each joint and distal landing zone.

Reconstruction of the Right Renal Artery

The right renal artery was reconstructed by another IBD (IBD_4) through right femoral artery to the distal end of IBD_1 with 4-cm overlap, using G-iliac graft (14-mm lumen proximally, 12-mm distally, 120 mm in total length) and SilverFlow device (6-mm lumen distally, 80 mm in length). Postdilation was performed using a 5- to 60-mm balloon (PowerFlex).

Extension of the Stent Grafts to the Iliac Arteries

The stent grafts were extended to the bilateral iliac branches.

Postdilation of the Aortoiliac Stent-Grafts

Postdilation of the aortoiliac stent grafts was performed using a compliant balloon (CODA; Cook Medical) at the landing zones and every joint of the stent grafts in the aorta.

Final Angiogram

Aortic angiogram confirmed all visceral branches were patent, and no endoleak was found.

Postoperative Care

The patient was sent to intensive care unit for postprocedure care.

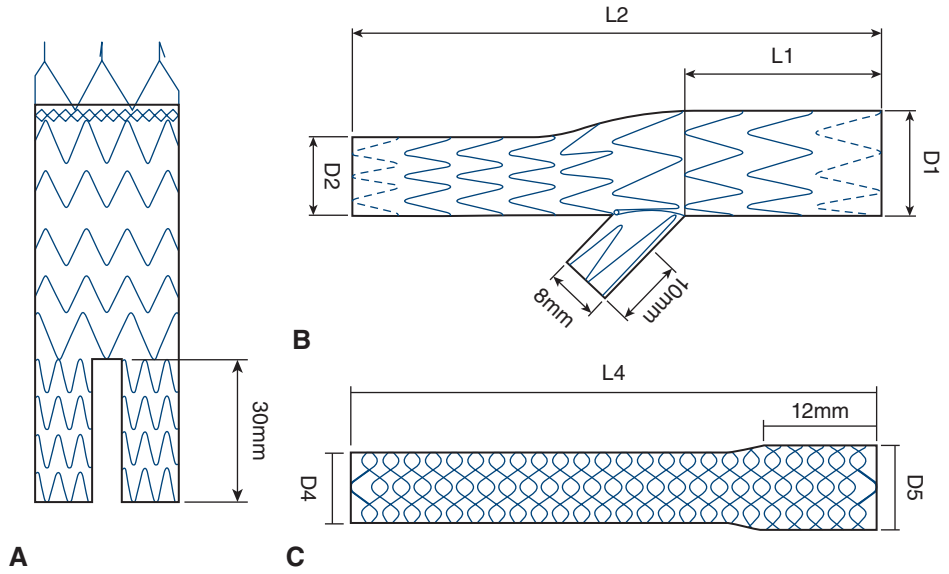

FIGURE E1. Devices used in the BAO-G technique. A, Modified aortic endograft. B, G-iliac iliac-branch device (*IBD*) (LifeTech). D1: proximal lumen diameter, D2: distal lumen diameter, L1: distance between proximal end and the opening of the branch, L2: total length. The branches of all size models of IBD are 10 mm in length and 8 mm in distal diameter. C, Inner iliac artery device (SilverFlow; LifeTech). D4: distal lumen diameter, D5: lumen diameter of proximal 12 mm, L4: total length. (Products diagrams were provided by LifeTech.) *BAO-G*, Multi-Branch AOrtic reconstruction of thoracoabdominal aortic aneurysm with G-iliac system.

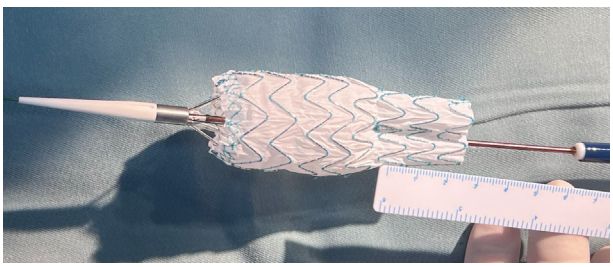

FIGURE E2. Modified aortic endograft.