Tailor-made iliac branched device for preserving the internal iliac artery in patients with common iliac artery aneurysm

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Abstract

Background: Endovascular repair with stent-graft is a treatment option for patient with common iliac artery aneurysm (CIAA). However, the preservation of the internal iliac artery (IIA) is a concern. The commercially available iliac branched device (IBD) requires a common iliac length of at least 5 cm, which is usually too long for Asian people. Here, we report our medium-term results of using tailor-made IBD for patients with short common iliac artery (CIA) with and without abdominal aortic aneurysm (AAA).

Methods: A selected iliac limb of the AAA stent-graft was unloaded from the delivery system. A 6-mm fenestration hole was made at the length of the CIA from the proximal end. The edge of the hole was reinforced with the soft and radiopaque tip of a 0.014″ wire. Then, the iliac limb was reloaded into the introduced sheath as the tailor-made IBD. It was inserted from the selected side of the femoral artery and deployed. The ipsilateral IIA was cannulated through the fenestration hole. Then, a balloon-expandable or self-expandable covered stent with an appropriate size was deployed as the bridging stent-graft.

Results: Between March 2013 and March 2017, a total of 10 patients received the tailor-made IBDs. One patient died of systemic thromboembolism 2 days after the operation. The bridging stent-grafts remained patent in all patients, except one occluded at 1 year after operation.

Conclusion: A tailor-made IBD is an easy-to-apply, alternative option for preserving the IIA perfusion in short CIAA patients with and without AAA.

Keywords: Abdominal aortic aneurysm; Common iliac artery aneurysm; Endovascular aneurysm repair; Iliac branched device; Internal iliac artery

1. INTRODUCTION

Endovascular repair has become a therapeutic option for patients with common iliac artery aneurysm (CIAA). To achieve optimal distal fixation in patients with CIAA, the internal iliac artery (IIA) can be embolized and the endograft can be extended into the external iliac artery. However, sacrificing IIA flow may result in complications such as pelvic ischemia, buttock claudication, sexual impotence, and colonic ischemia.[1–3]

Branched iliac stent grafting is an alternative option to extend the distal landing zone and maintain the antegrade flow of the IIA. However, commercially available iliac branched devices (IBD) require at least 5 cm of the common iliac segment for implantation, which is generally too long and unsuitable for Asian patients. Since 2013, we have used a commercially available endograft to create a tailor-made IBD to treat patients with CIAA or a type Ib endoleak from a previous endovascular aneurysm repair (EVAR) to preserve IIA flow.

The purpose of this study was to describe the medium-term results of using the tailor-made IBD to treat patients with CIAA with and without abdominal aortic aneurysm (AAA) in our institute.

2. METHODS

2.1. Study design

A retrospective review of 10 consecutive patients who had received the tailor-made IBD for short CIAA or type Ib endoleak between March 2013 and March 2017 was conducted. The institutional review board at our hospital approved this retrospective study, and the requirement for informed consent from patients was waived because of its retrospective nature. All patients had either unilateral or bilateral CIAA with or without AAA, isolated CIAA, or type Ib endoleak from a previous EVAR.

Computed tomography (CT) scan was performed with 3-mm cuts and the digital imaging and communications in medicine (DICOM) data were analyzed using the 3mensio vascular workstation (3mensio Medical Imaging, Bilthoven, Netherlands). If a patient's common iliac artery (CIA) length was shorter than 50 mm, which precluded them from the use of a commercialized IBD, a tailor-made IBD was designed for administration.

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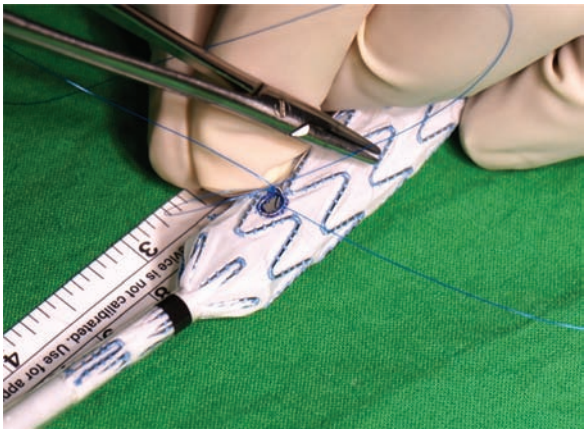

Fig. 1 Soft and radiopaque tip of a 0.014″ wire was sutured to the edge of the fenestration with 5-0 Prolene.

2.2. Technique description

An iliac limb of the AAA stent-graft with an appropriate diameter and length was modified to produce a tailor-made IBD. First, the stent-graft was unloaded from the delivery system and a 6-mm fenestration was cauterized at the selected length (approximately 5 to 10 mm shorter than the CIA length) from the proximal end of the stent-graft. The edge of the fenestration was reinforced with the soft and radiopaque tip of a 0.014″ wire to prevent the fabric tearing and to mark the fenestration area under fluoroscopy (Fig. 1). Then, the iliac limb was reloaded back to the introducer sheath with the help of a silk tape (Fig. 2). The tailor-made IBD was inserted from the selected side of the femoral artery before or after the deployment of the main body. It was oriented and partially deployed until the fenestration was fully opened above the IIA. A 7Fr 90-cm long sheath was placed into the tailor-made IBD from the left brachial artery access along a stiff wire. The IIA was catheterized from the long sheath through the fenestration hole (Fig. 3). Subsequently, a balloon-expandable (Advanta V12, Atrium Medical, Hudson, NH, USA or Lifestream, Bard, Tempe, AZ, USA) or self-expandable (Viabahn, W.L. Gore, Flagstaff, AZ, USA) covered stent with an appropriate

Fig. 2 Tailor-made IBD was resheathed with the assist of a silk tape. IBD, iliac branched device.

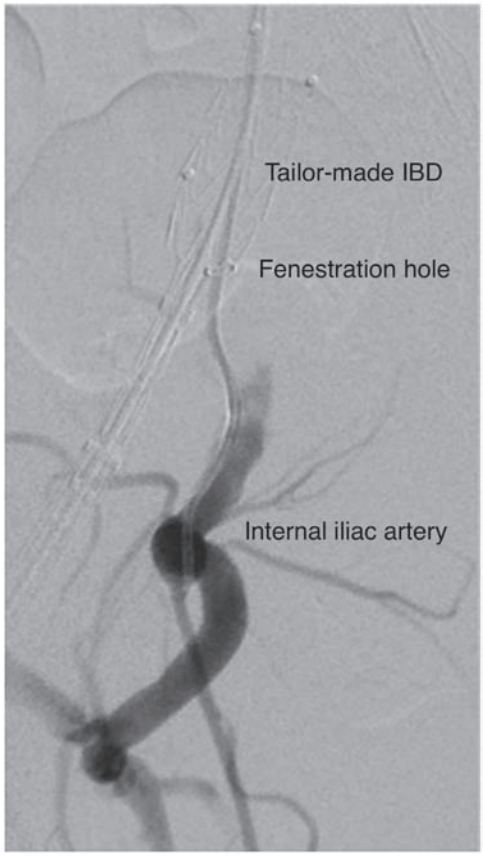

Fig. 3 The IIA was cannulated from the long sheath through the fenestration hole. IIA, internal iliac artery.

diameter and length was deployed as a bridging endograft with at least a 1-cm protrusion inside the fenestration. Then, the remaining part of the tailor-made IBD was deployed. The proximal portion of the bridging covered stent inside the IBD was further flared with a 12-mm balloon to prevent downward migration. Finally, a contralateral leg stent-graft was used to connect the main body stent-graft and the tailor-made IBD if necessary.

2.3. Study endpoint and definition

Technical success was defined as the successful deployment of the tailor-made IBD and bridging stent-graft with preservation of the IIA flow and without immediate endoleak. The primary outcomes were technical success, bridging stent-graft patency, aneurysm-related death, and any type of endoleak.

Table 1

Patient's demographics

Age, years	72.2 ± 9.9
Male	10
Smoking	6
Hypertension	9
Diabetes mellitus	3
Hyperlipidemia	4
Coronary artery disease	1
Carotid stenosis >70%	0
Stroke	0
Hemodialysis	0

Continuous data are presented as the means ± SD; categorical data are given as the counts.

Table 2

Procedure data

	Indication	Aneurysm diameter, mm	IIA bridging stent graft	Bridging stent graft size, mm
Patient 1	RCIAA	41	Viabahn	7
Patient 2	AAA + RCIAA	35	Advanta V12	10
Patient 3	RCIAA	32	Advanta V12	10
Patient 4	Left IB EL + LIIAA	35	Advanta V12	10
Patient 5	AAA + bilateral CIAA	39	Advanta V12	7
Patient 6	RCIAA	31	Bard Lifestream	8
Patient 7	AAA + bilateral CIAA	30	Bard Lifestream	8
Patient 8	LCIAA	45	Bard Lifestream	8
Patient 9	AAA + bilateral CIAA	61	Viabahn	9
Patient 10	RCIAA	35	Bard Lifestream	8

AAA = abdominal aortic aneurysm; CIAA = common iliac artery aneurysm; EL = endoleak; LCIAA = left common iliac artery aneurysm; LIIAA = left internal iliac artery aneurysm; RCIAA = right common iliac artery aneurysm.

Table 3

Results

Procedural complication	0
Death	1
Aorta-related death	1
Bridging stent graft occlusion	1
Aneurysm rupture	0
Endoleak	0

2.4. Follow-up protocol

All patients received 75 mg of clopidogrel per day as medication for at least 1 year if it was not contraindicated. CT scan was performed postoperatively at 6 and 12 months and then once yearly.

3. RESULTS

3.1. Procedure results

The demographic features and comorbidities of the 10 included patients (mean age: 72.2 years; all male patients) are listed in Table 1. Technical success was achieved in all patients. Procedural data are listed in Table 2.

3.2. Early experiences

All 10 patients were followed-up according to the study protocol, and no patients were lost to follow-up. The mean follow-up was 15 ± 11.9 months (range 0-42 months). All endpoint outcomes are presented in Table 3. One patient died from multiple organ failure 2 days postoperatively due to systemic thromboembolism (including cerebral, hepatic, intestinal, and bilateral renal infarctions) caused by a shaggy thoracic aorta. One IIA bridging stent-graft occluded 12 months after the procedure without complication.

4. DISCUSSION

AAA with unilateral or bilateral CIAA is challenging for performing EVAR due to unsafe distal fixation. Numerous techniques have been reported to obtain effective distal seal with either occluding the IIA (over endograft with or without IIA embolization) or preserving (IIA bypass or transposition, trifurcated endograft,[4] sandwich,[5] or crossover chimney technique[6]) blood flow to the artery. Because occlusion of one or both IIA is associated with substantial complications, such as buttock claudication and spinal or bowel ischemia, preservation of IIA perfusion is advocated whenever possible.

IBD is an appealing endovascular solution for IIA preservation with high technical success and an encouraging medium-term outcome.[7] However, anatomic constraints limit the use of IBDs. It has been reported that only 35% of aneurysm repairs involving common iliac arteries would have been candidates for COOK or Gore IBDs.[8] One of the morphological criteria for IBD is the length of the CIA. A length of 5 cm is required in most commercial devices, or 4 cm according to some experienced surgeons' criteria.[8–10] But CIAs in Asian populations are usually shorter.[11] The average CIA length is 25 to 30 mm. With this anatomical constraint, hand-made customization is required.

Our tailor-made IBD was inspired by the design of the fenestration endograft. Our procedure is more cost-effective than the others because less additional devices and preparation time are required. We used the iliac limbs of the Endurant II stent-graft (Medtronic Cardiovascular, CA, USA) in all patients due to its wide range of selection in size and length. Some technical steps should be addressed. In preprocedural planning, image analysis using CT angiography with the centerline of flow for measuring the abdominal aorta and iliac arteries were crucial. Obtaining anatomic characteristics of the aneurysm accompanied by appropriate technique consideration should not be neglected. In patients without an angulated or tortuous iliac artery route, catheterization of the IIA and delivery of the bridging endograft from the contralateral femoral access is feasible. Brachial access for deployment of the IIA bridging stent-graft should be avoided if the patient has severe atherosclerosis of the thoracic aorta. In patients with thick mural thrombus in the CIA, fenestration should be oriented away from the thrombus to ensure more working space for wiring or catheterization.

Finally, this treatment is still an "off-label" technique and its long-term efficacy must be confirmed through further follow-up.

In conclusion, unilateral or bilateral CIAA with or without AAA is challenging for performing EVAR due to concerns related to secure distal fixation. The use of a commercial IBD is an appealing technique for preserving IIA perfusion but the clinical applicability of this approach is often limited by anatomic prerequisites. Our tailor-made IBD alleviates the device restraints related to the length of the CIA and exhibits advantages regarding its preparation, delivery, and cost-efficiency. This technique is a promising approach, although its long-term efficacy is still under investigation.

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