

## CASE REPORT

## The BeGraft Balloon Expandable Covered Stent as a Proximal Extension to an Iliac Branch Device for Endovascular Repair of Isolated Common Iliac Artery Aneurysms

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**Introduction:** Isolated common iliac artery aneurysms (CIAA) are rare and can be treated by endovascular exclusion using iliac branch devices (IBD). The use of a balloon expandable covered stent as a proximal extension to an IBD to allow adequate sealing in the proximal common iliac artery (CIA) for exclusion of isolated CIAA is demonstrated.

**Report:** Two patients with isolated CIAA of  $\geq 4.5$  cm with a proximal neck length of  $\geq 20$  mm (patient A: 26 mm; patient B: 24 mm) and a neck diameter of  $\leq 20$  mm (patient A: 16.4 mm; patient B: 15.6 mm) were treated by combining a Zenith IBD with an aortic BeGraft balloon expandable covered stent. After deploying the BeGraft covered stent at 12 mm a second balloon was used to further dilate the proximal part of the stent outside the IBD to allow adequate sealing in the CIA. Completion angiography and follow up computed tomography angiography 1 month post-operatively showed adequate sealing and no endoleaks.

**Discussion:** The feasibility of the application of a balloon expandable covered stent as a proximal extension to an IBD for isolated CIAA was demonstrated. It is not necessary to insert an aortic bifurcation endograft, thus reducing procedure time, radiation exposure, contrast use, and cost. A patent inferior mesenteric artery and lumbar arteries can be spared and procedures that require crossing over the aortic bifurcation remain possible. Comorbidity, prior interventions, and disease extension can make this endovascular approach preferred over open repair. Isolated CIAA can be efficiently treated combining the BeGraft balloon expandable covered stent and IBD, which allows proximal sealing in the CIA.

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### INTRODUCTION

Iliac artery aneurysms accompany abdominal aortic aneurysms (AAA) in 10–20% of cases.<sup>1</sup> Isolated iliac artery aneurysms, however, are rare and represent <2% of all intra-abdominal aneurysms.<sup>1</sup> Endovascular treatment has become the treatment of choice for most patients with aorto-iliac aneurysms.

Isolated common iliac artery aneurysms (CIAA) can be treated by endovascular exclusion using iliac branch devices (IBD) to preserve internal iliac artery perfusion and to prevent buttock claudication, erectile dysfunction, and the risk of colon ischaemia.<sup>2</sup> The common iliac artery (CIA) segment proximal to the CIAA is usually too wide to allow

adequate sealing by the IBD graft itself or too short to allow sealing by a tapered proximal iliac extension. In the latter case the length from the origin of the CIA to the proximal end of the IBD graft (12 mm) is too short to bridge the diameter mismatch between the CIA origin and the IBD graft with a standard endograft limb. A more conformable stent graft is needed. Therefore, proximal extension using a standard aortic bifurcated stent graft is generally performed, but in some patients this will be overtreatment, especially when the abdominal aorta is small.

Herein, the use of a balloon expandable covered stent (BeGraft, Bentley, Hechingen, Germany) as a proximal extension of an IBD to allow adequate sealing in the proximal CIA for exclusion of isolated CIAA, is demonstrated.

### CASE REPORT

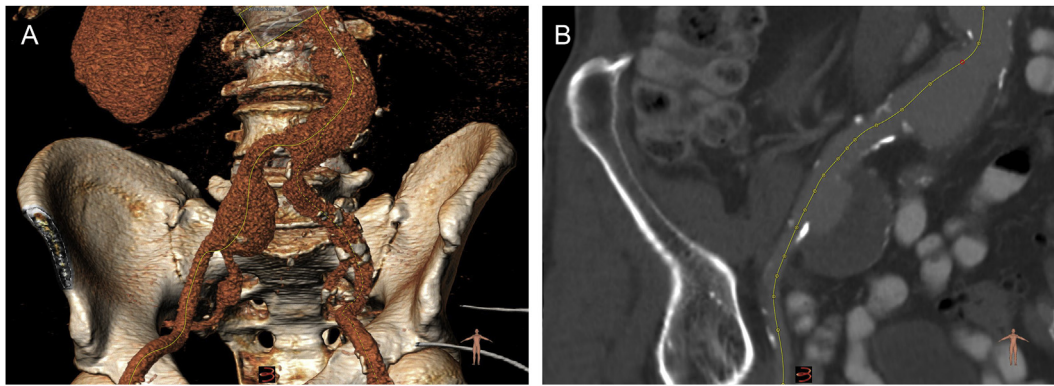
Two patients were treated for isolated CIAA. Patient A, a 61 year old man, had an asymptomatic CIAA on the right, with a maximum diameter of 4.5 cm. A small internal iliac artery aneurysm (<15 mm) was not treated, but will be monitored

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**Figure 1.** Pre-operative computed tomography angiography scans of (A) patient A and (B) patient B, demonstrating an isolated common iliac artery aneurysm (asterisk) with a proximal neck length (arrow) of  $\geq 20$  mm and a neck diameter of  $\leq 22$  mm.

during regular follow up after IBD treatment. The patient's medical history included a ruptured AAA 1 year earlier that had been treated by open repair using a Dacron tube interposition graft. This was complicated by abdominal compartment syndrome and bowel ischaemia, requiring low anterior resection, and a permanent colostomy was created. A left sided open nephrectomy had to be performed 1 week later because of an iatrogenic ureteric injury, leading to hydronephrosis.

Patient B, a 75 year old man, had an asymptomatic right sided CIAA of 4.9 cm. His medical history included cardio-pulmonary comorbidity and an AAA of 3.9 cm. The infrarenal neck was 9 mm long, conical, and judged not to be a good candidate for standard endovascular aneurysm repair.

The computed tomography angiography scans are shown in Fig. 1 (A, B). For both patients an isolated CIAA with a proximal neck length of  $\geq 20$  mm (patient A: 26 mm; patient B: 24 mm) and a neck diameter of  $\leq 20$  mm (patient A: 16.4 mm; patient B: 15.6 mm) was found.

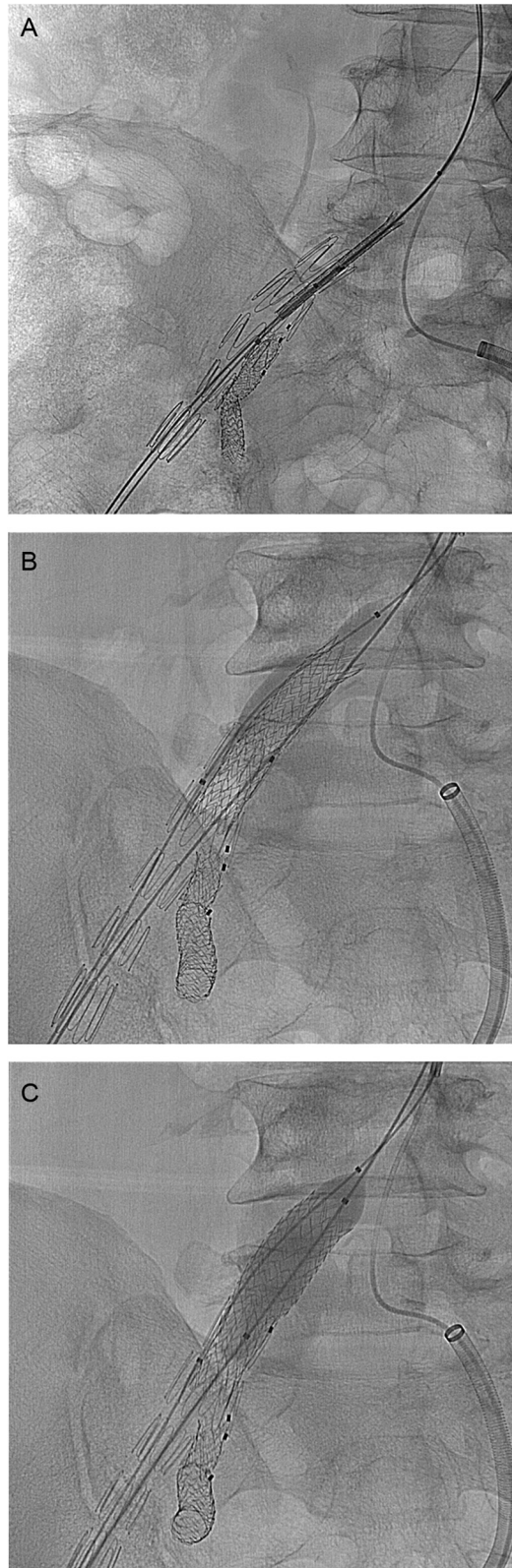
During pre-operative planning a centre lumen line reconstruction was made of the abdominal aorta and common, external, and internal iliac arteries. Length and diameter measurements were performed to select the proper IBD and to select the diameter and length of the covered stent for the internal iliac artery. Also, diameter and length measurements were performed from the origin of the CIA to the start of the inner branch of the IBD. Multiple lengths of the aortic BeGraft were ordered and during the procedure the right aortic BeGraft was selected after measurements with a calibrated pigtail catheter (length from the origin of the CIA to the proximal marker of the inner branch of the IBD).

For access, a right femoral cut down through a transverse incision was performed. First, the Zenith iliac bifurcation graft (Cook Medical, Bloomington, IN, USA) was introduced through the ipsilateral common femoral artery and deployed. A balloon expandable covered stent (BeGraft) for the internal iliac artery was advanced through a standard crossover technique and deployed. Normally, the next step would be to deploy the main body of the aortic endograft.

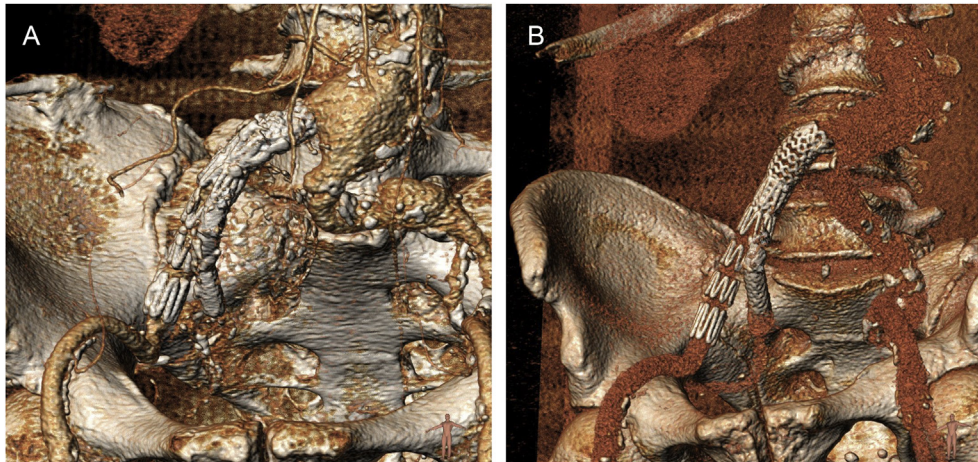
However, instead the aortic BeGraft balloon expandable covered stent was used for sealing in the proximal CIA. It is important to have enough overlap between the proximal BeGraft and the IBD. Therefore, the distance from the CIA origin to the marker just proximal to the internal iliac artery branch is measured to determine the required length of the BeGraft. The proximal end of the BeGraft is preferably positioned just at the CIA origin, and not protruding into the distal aorta. The BeGraft was introduced through the ipsilateral common femoral artery and positioned proximally in the CIA (Fig. 2A). First, the aortic BeGraft was dilated to a diameter of 12 mm with the standard BeGraft balloon, which achieves adequate sealing in the body of the bifurcated graft (Fig. 2B). At this point, the balloon was exchanged for a larger high pressure semi-compliant balloon (Cristal Balloon, Balt, Montmorency, France) that was used to dilate the proximal part of the BeGraft outside the IBD to obtain adequate sealing in the proximal CIA (Fig. 2C). A completion angiogram was performed to detect possible endoleaks and to confirm adequate position and patency of the stent grafts and iliac arteries. Post-operative recovery was uneventful for both patients. Follow up imaging 1 month post-operatively demonstrated patent iliac arteries and no endoleak, migration, or other complications in both patients (Fig. 3A and B).

## DISCUSSION

With the cases described above, the feasibility of the application of an aortic balloon expandable covered stent (BeGraft, Bentley, Hechingen, Germany) as a proximal extension for an IBD (Zenith Iliac Bifurcation) in patients with isolated CIAA has been demonstrated. This is the first report to describe this approach in the treatment of isolated CIAA. This simplified procedure obviates the need to insert an aortic bifurcation graft, thereby reducing procedure time, radiation exposure, contrast use, and cost. A patent inferior mesenteric artery and lumbar arteries can also be spared, preserving possibly relevant collaterals. Finally, endovascular procedures that require crossing over the aortic bifurcation remain possible; it cannot be done in a steep bifurcation of a bifurcated endograft.



**Figure 2.** Aortic BeGraft deployment in patient A. (A) Intra-operative fluoroscopy image demonstrating the positioning of the unexpanded aortic BeGraft in the proximal part of the IBD, (B) the dilatation of the balloon expandable covered stent graft (BeGraft, Bentley, Hechingen, Germany) to 12 mm inside the iliac branch device (Zenith Iliac Bifurcation, Cook Medical, Bloomington, IN, USA), followed by (C) inflation of the larger high pressure semi-compliant balloon (Cristal Balloon, Balt, Montmorency, France) in the proximal end of the BeGraft to obtain adequate sealing in the proximal CIA.



**Figure 3.** Computed tomography angiography scan at 1 month follow up demonstrating patent iliac arteries and no endoleak, migration, or other complications for (A) patient A and (B) patient B.

The approach with a balloon expandable covered stent as a proximal extension of the IBD can be performed in all isolated CIAA that have a proximal neck length of at least 20 mm and a maximum diameter of 22–24 mm, in combination with suitable anatomy for an IBD, according to the instructions for use. A possible risk is the occurrence of a type 1A endoleak in case of disease progression and further dilatation of the aorta or iliac arteries. However, the aortic BeGraft can be dilated up to a diameter of 24 mm in secondary procedures if necessary. Moreover, a proximal aortic bifurcation endograft can still be used to regain proximal sealing. Other possible limitations of this application of the aortic BeGraft are the fact that the graft has no anchoring pins that might make it more prone to migration, and the use of the stent graft for this application is off label. The follow up of the presented cases is insufficient to make any comments on the durability of the approach.

Open repair of CIAA remains a viable option, especially in young patients fit for surgery. However, favorable results with endovascular repair using IBD can be obtained with significantly lower mortality and morbidity,<sup>3</sup> and very acceptable patency rates versus open repair.<sup>2–4</sup> In the cases presented herein the comorbidity, prior interventions, and extent of the disease make an endovascular approach preferred. Simplifications of endovascular procedures, such as described here, might further reduce complexity and duration of the procedure and reconstruction. This might also improve patency and the re-intervention rate.

However, this assumption should be confirmed in future studies with larger sample size and longer follow up.

### CONCLUSIONS

Isolated CIAA can be efficiently treated combining the aortic BeGraft balloon expandable covered stent and IBD, which allows proximal sealing in the CIA and obviates the need for a proximal extension with a bifurcated aortic endograft.

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