Bell-bottoms, trouser grafts and crossovers: Maintaining pelvic perfusion with endovascular repair of aorto bi-iliac aneurysms

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Learning objectives

This educational exhibit will:

1. Explain the need for endovascular management of aorto-bi-iliac aneurysms while maintaining pelvic perfusion.
2. Illustrate the different methods of endovascular treatment of aorto-bi-iliac aneurysms while maintaining pelvic perfusion.
3. Discuss the relative advantages and disadvantages of these methods and in which cases they are effective.
Background

Twenty percent of patients with abdominal aortic aneurysms have common iliac artery aneurysms. To achieve an adequate distal seal of the iliac limb(s) of an endograft, the presence of common iliac artery aneurysms makes endovascular abdominal aortic aneurysm repair much more challenging. The complex anatomy of aorto-bi-iliac aneurysms means that the common iliac arteries often cannot be used as a distal landing zone and that one or both internal iliac arteries have to be embolised to achieve exclusion of the aneurysm. These methods occlude flow to the internal iliac artery and impair pelvic perfusion. Unilateral and bilateral internal iliac artery occlusion is associated with risks of complications including buttock ischaemia, parasthesia, incontinence, and even acute limb ischaemia. Complications following occlusion of both internal iliac arteries are more likely and more serious and include non-healing decubitus ulcers, ischaemia to the lumbosacral plexus and sloughing of the scrotal skin. Preservation of flow to at least one iliac artery is recommended if this is possible.

Various methods to preserve flow to the pelvis from at least one internal iliac artery have been described.

Here we illustrate the methods available for management of aorto-bi-iliac aneurysms while maintaining pelvic perfusion from at least one internal iliac artery.
Imaging findings OR Procedure details

ENDOVASCULAR/COMBINED SURGICAL AND ENDOVASCULAR TECHNIQUES FOR REPAIR OF AORTO-BI-ILIAC ANEURYSMS

HYBRID OPEN AND ENDOVASCULAR METHOD

- Relocation of origin of internal iliac artery Bifurcated stent graft
- External iliac artery-to-internal iliac artery endograft (Reverse-U stent graft)

ENDOVASCULAR METHOD

- 'Bell Bottom' graft
- Iliac branch device

Relocation of internal iliac artery origin

This technique involves deployment of a bifurcated endograft into the external iliac arteries sealing the internal iliac artery ostia bilaterally. Both internal iliac arteries are isolated and ligated proximally to stop backflow into the iliac aneurysms. A bridging graft is sutured from the common femoral or external iliac arteries to the internal iliac artery remnants (Fig. 1).

Advantages:

- Effective in preserving flow to the internal iliac arteries
- Expands the subset of patients who may undergo endovascular aneurysm repair

Disadvantages:

- Significant retroperitoneal exposure with risk of venous, ureteric and collateral vessel injury
- Increases morbidity and recovery time
- Increases hospital length of stay

Bifurcated stent graft

Following embolisation of the ipsilateral internal iliac artery, an endograft main body is deployed via the femoral route with the ipsilateral distal end of the graft in the external iliac
artery. Through a brachial approach and through the stent graft, the patent contralateral internal iliac artery is cannulated. The contralateral limb of the stent graft is then deployed into the patent internal iliac artery to exclude the aneurysm sac. The now unperfused external iliac artery is then ligated or embolised to avert backflow into the aneurysm sac and a femoro-femoral cross over graft fashioned to restore flow down the contralateral lower extremity (Fig. 2).

**Advantages:**

- Perfusion to the internal iliac artery is anatomic
- Performed via groin incisions only, maintaining the advantages of the less invasive approach for aorto-uni-iliac endovascular abdominal aortic aneurysm repair

**Disadvantages:**

- Depends upon the aorto-uni-iliac graft and femoro-femoral cross-over graft as conduits for pelvic and lower limb perfusion; thrombotic or infective complications of either component would lead to devastating consequences for the patient
- The origins of the ipsilateral external iliac artery and contralateral internal iliac artery must be normal or suitable for balloon angioplasty, and must not be aneurysmal or contain thrombus

**External iliac artery-to-internal iliac artery endograft/Reverse-U stent graft:**

Following coil embolisation of the ipsilateral internal iliac artery, an aorto-uni-iliac endograft is deployed into the ipsilateral external iliac artery (EIA) covering an embolised internal iliac artery. A contralateral external iliac artery-to-internal iliac artery stent graft is deployed and pelvic perfusion is restored using femoro-femoral bypass grafting (Fig. 3-6).

**Advantages:**

- Performed via groin incisions only, maintaining the advantages of the less invasive approach for aorto-uni-iliac endovascular abdominal aortic aneurysm repair
- The endografts seal in normal arteries, the internal iliac artery proximally and the external iliac artery distally

**Disadvantages:**
• Depends upon retrograde flow from the femoro-femoral cross-over graft as conduits for pelvic and lower limb perfusion
• The origins of the contralateral external iliac artery and internal iliac artery where the reverse U stent graft is deployed must not be aneurysmal or contain thrombus

Bell-Bottom Aorto-iliac Endografts

This technique involves deployment of a flared cuff within the common iliac artery that preserves the internal iliac artery. A short aortic extension cuff can be used in the distal common iliac artery attachment zone to achieve a complete seal if required (Fig. 7-10).

Advantages:

• Performed via groin incisions only
• Procedure time is similar to a standard bifurcated stent graft insertion - no additional embolisation (for bilateral flares) or stenting is required

Disadvantages:

• Only suitable in ectatic (<26mm) common iliac artery aneurysms
• Like all other endovascular procedures, long-term evaluation is necessary to determine durability because the risk of rupture as the result of potential expansion of the excluded iliac artery or late failure is unknown

Iliac Branch Device

An iliac branch device is an endograft iliac extension limb that is characterised by a short side branch that is used to perfuse the internal iliac artery. The device is deployed in conjunction with the main body of an aortic stent graft and a bridging stent to exclude the aorto-iliac aneurysm (Fig. 11-15).

Advantages:

• Preserve internal iliac artery perfusion, whilst preserving the benefits of minimally invasive endoluminal surgery
• Ability to treat aneurysms that extend into the internal iliac arteries

Disadvantages:
Anatomic factors limit the applicability of the iliac branch device. To accommodate such a device the target common iliac artery must have a diameter of at least 20mm and a length of 50mm.

Technical issues with respect to the complexity of the procedure, added equipment, and the potential for destabilizing the overall aortic repair with the addition of modular components and sealing zones, must be balanced against the benefit of avoiding claudication.

Increased cost of the branch graft compared to conventional EVAR, plus the additional cost of the bridging stent.
Fig. 0: A schematic diagram illustrating a bifurcated stent graft. (1) embolisation of ipsilateral internal iliac artery, (2) bifurcated stent graft with extension into ipsilateral external iliac artery and contralateral internal iliac artery, (3) femoro-femoral cross over graft, (4) ligation of contralateral internal iliac artery.

**Fig. 0:** A schematic diagram illustrating relocation of the origins of the internal iliac arteries in a combined open and endovascular method. A bifurcated stent graft is present covering the origins of the internal iliac arteries bilaterally. The internal iliac arteries are ligated proximally and bridging grafts are sutured from the common femoral or external iliac arteries to the internal iliac artery remnants.

Fig. 0: A schematic diagram illustrating the external iliac artery-to-internal iliac artery endograft. (1) stent from external iliac artery to internal iliac artery, (2) Embolisation of ipsilateral internal iliac artery, (3) Aorto-uni-iliac stent graft, (4) femoro-femoral crossover graft.

**Fig. 0:** A volume rendered reformat from a CTA in a 77 year old male with an aorto-bi-iliac aneurysm.

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Fig. 0: A completion angiographic after insertion of an aorto-uni-iliac stent graft deployed in the right external iliac artery with occlusion of the right internal iliac artery, a right-to-left femoro-femoral crossover surgical graft and a reverse-U left external-to-internal iliac artery covered stent in the same patient.

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**Fig. 0:** A volume rendered reformat from a CTA after repair of the aneurysm in the same patient.

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**Fig. 0**: A schematic diagram to illustrate bell-bottom procedure, unilateral and bilateral.

Fig. 0: A volume rendered reformat from a CTA of a 66-year old male with an abdominal aortic aneurysm and a right common iliac artery aneurysm.

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**Fig. 0:** A completion angiographic image in the same patient following a bifurcated stent graft insertion with a flared right iliac limb.

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**Fig. 0:** A plain abdominal radiograph taken after the stent graft insertion in the same patient.

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Fig. 0: A Helical branch device (Cook).

**Fig. 0:** An iliac custom sized branch device (Cook).

**Fig. 0:** An image showing an Amplatzer 2 occluder in the left internal iliac artery taken during an aorto-bi-iliac aneurysm endovascular repair in a 73 year old male.

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Fig. 0: Deployment of a helical branch device into the right iliac system in the same patient.

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**Fig. 0:** A native image and the completion subtracted angiogram after deployment of the bifurcated aortic stent graft, right iliac branch device and bridging stent.

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Conclusion

Different approaches to the management of aorto-bi-iliac aneurysms while maintaining pelvic perfusion have been described. The different methods have different merits in terms of the invasive nature of the technique, cost, technical difficulty, screening and operating time and the anatomy of the cases in which they can be applied. The method of treatment must be chosen on a patient-by-patient basis to ensure that the correct technique is used.
Personal Information

We hope you have enjoyed this presentation. Thank you for your time.
References


