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REVIEW ARTICLE

Complex solutions to minimise vascular access complications during iliac branch device implantation after EVAR: a narrative review focusing on planning and technical aspects

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ABSTRACT

INTRODUCTION: Secondary implantation of iliac branch devices (IBDs) after endovascular aortic repair (EVAR) for type Ib endoleak poses unique technical challenges due to altered aortoiliac anatomy and prior femoral access. Selecting an optimal access strategy is critical to minimize complications and ensure procedural success. This review summarizes contemporary transfemoral and upper extremity access techniques, with a focus on modern endovascular solutions that facilitate safe and effective reinterventions.

METHODS: A narrative review of the literature published between 2010 and 2025 was conducted using PubMed, focusing on studies reporting technical strategies, outcomes, and complications of secondary IBD implantation after EVAR. Only original research, including technical notes, was included.

RESULTS: Across the reviewed studies, upper extremity access was associated with neurologic events, longer operative times, and higher access-site complication rates. Transfemoral "up-and-over" techniques consistently demonstrated technical success rates over 95%, shorter procedural times, and reduced complication rates. Steerable sheath systems enable complete IBD implantation from a single femoral access, with promising safety and efficacy. Technical refinements, including special attention to the prior graft bifurcation and meticulous technique, appear to be key elements to optimising immediate and late outcomes.

CONCLUSION: Transfemoral strategies, particularly "up-and-over" techniques using steerable sheaths, appear to be safe and effective alternatives to upper-extremity access for secondary IBD implantation following EVAR. Access strategy should be tailored to patient anatomy and prior graft configuration, with emphasis on minimising vascular trauma, neurologic risk, and procedural complexity.

Keywords: Iliac branch device; endoleak; vascular access; brachial access; steerable sheath; endovascular; abdominal aortic aneurysm

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INTRODUCTION

Secondary interventions after endovascular aortic repair (EVAR) are more frequent than those after open aortic abdominal aneurysm (AAA) surgery.[1] Type Ib endoleak is a relevant failure mode post-EVAR, occurring in up to 8% of patients, usually due to progressive enlargement of the common iliac artery (CIA), short distal landing zones (<20 mm), and iliac tortuosity.[1] Its management requires precise distal sealing and preservation of hypogastric flow, particularly in patients with prior extensive aortic coverage.[1] Current international guidelines recommend the use of Iliac Branched Devices (IBD) for the management of distal seal zone failures involving the iliac bifurcation. These devices allow exclusion of aneurysmal iliac segments while preserving antegrade blood flow to the hypogastric artery (HA), thereby reducing the risk of buttock claudication, erectile dysfunction, pelvic ischemia, and spinal cord injury in cases of extensive aortic coverage. Long-term patency rates for IBDs exceed 90%, supporting their routine use in anatomically appropriate patients.[2-7]

Despite demonstrated benefits, secondary IBD implantation in patients with prior EVAR introduces additional technical complexity. Standard IBD deployment involves bilateral femoral access with crossover to the HA via a through-and-through wire. However, the steeper angulation of the new aortic bifurcation after prior EVAR may hinder crossover access, often necessitating upper extremity access—which carries a risk of cerebrovascular events—or complex transfemoral "up-and-over" techniques, which may risk endograft migration.[8-11]

An added layer of difficulty in these secondary interventions arises from the need to insert large-bore sheaths through previously accessed, potentially scarred femoral arteries. Large-calibre access, particularly in redo groins, is associated with higher risks of bleeding, pseudoaneurysm, hematoma formation, and limb ischemia, with reported complication rates approaching 10% in complex endovascular procedures.[12]

This review aims to summarise key technical aspects of secondary IBD implantation, focusing on access-site techniques, with particular emphasis on modern transfemoral approaches and advanced wire and sheath techniques.

METHODS

A narrative review was conducted to examine and synthesise current strategies for secondary IBD implantation due to type Ib endoleak after infrarenal EVAR or fenestrated/branched EVAR (f/bEVAR). The focus was on transfemoral and upper-extremity access approaches, particularly the single transfemoral access and the "up-and-over" technique and its modifications.

A comprehensive literature search was conducted using PubMed to identify relevant articles published between January 2010 and May 2025. The search strategy combined Medical Subject Headings (MeSH) and free-text terms, including: "iliac branch device", "EVAR," "type Ib endoleak", "vascular access complications", "up-and-over technique", "brachial access", and "steerable sheath". The reference lists of selected articles were manually screened to identify additional studies of interest.

Studies were included if they reported on technical approaches, clinical outcomes, or procedural complications related to secondary IBD placement. Eligible study designs included original research papers reporting on ≥3 patients and technical reports. Case reports were only included if they provided novel or clinically relevant technical insights. Studies not focused on secondary IBD placement (e.g., primary IBD use or unrelated vascular procedures), review articles, editorials, and non-English publications were excluded.

Study quality assessment was based on study design, sample size, clarity of outcome reporting, and relevance to procedural technique. Procedural insights were further supplemented by the authors' institutional experience with complex aorto-iliac reinterventions, which highlighted access planning, device selection, and complication-avoidance strategies.

RESULTS

Access Techniques and Technical Approaches

Upper extremity access remains the most frequently used technique for secondary IBD implantation following prior EVAR.[13-17] Typically involving surgical cutdown or percutaneous puncture of the brachial or axillary artery, this approach facilitates direct antegrade catheterisation of the HA using a combination of hydrophilic guidewires and directional catheters. Once the branch is accessed, the system is exchanged for a stiff wire to support delivery of a bridging stent.[14,16-18] While advantageous in patients with significant iliac tortuosity, upper extremity access carries well-documented risks including stroke, arterial dissection, pseudoaneurysm, and brachial plexus injury. In recent series, neurologic complications occurred in 3.6% of patients, and prolonged operative times were also noted.[14]

To reduce the risks associated with upper extremity access, transfemoral "up-and-over" techniques have become increasingly favoured, particularly in patients with suitable iliac and aortic anatomy.[19,20] This technique was employed in 7% to 61% of cases across studies.[13,16,17,19,21] It involves bilateral femoral access and the creation of a through-and-through guidewire from one femoral artery across the flow divider of the prior endograft into the contralateral limb.[17,19,20] A 10-12F sheath is typically docked with a 7F sheath to form a coaxial unit, facilitating stable navigation over the neo-aortic bifurcation.[21] This approach allows precise HA catheterisation with technical success rates up to 100%, while avoiding the neurological and vascular risks associated with upper extremity access.[13,16,19,21] Additionally, it is associated with reduced operative times and more ergonomic procedural flow.[19] A third technique, albeit less commonly employed, involves the use of steerable sheaths introduced from a single femoral access site. This approach relies on directional sheath systems, stiff, hydrophilic guidewires, and snaring techniques to achieve branch-vessel cannulation in challenging anatomies.[16,17,22] In some centres, steerable sheath access has enabled full IBD deployment from a single groin, including simultaneous kissing balloon angioplasty of

the main and branch components.[14,23,24] Table 1 summarises vascular access techniques and key messages from each study.

Preoperative Planning and Imaging

All patients undergoing secondary IBD implantation were evaluated with high-resolution computed tomography angiography (CTA), including three-dimensional reconstructions and centerline measurements. Key anatomical parameters assessed included iliac angulation, vessel diameter, tortuosity indices, and the presence of anatomical markers such as the "double iliac sign."[13,14,16,19]

Procedural Considerations

Several technical factors were consistently reported as critical to minimising complications. Sheath size and manipulation were key considerations, particularly in tortuous anatomy, where larger sheaths (≥ 12F) and coaxial techniques improved stability and reduced trauma.[14] Bridging stent selection played an important role in HA branch durability, with balloon-expandable covered stents (e.g., Bentley BeGraft [Innomed, Hechingen, German], Gore VBX [Flagstaff, AZ, USA] Advanta V12 [Getinge AB, Göteborg, Sweden]) associated with significantly lower rates of branch instability compared to self-expanding alternatives. [13] Bare-metal stent relining of the external iliac artery was frequently performed in transition zones to mitigate kinking and disconnection, especially in angulated iliac segments.[18,24] Kissing balloon angioplasty of the IBD trunk and HA branch was employed in stenotic or calcified landing zones, improving apposition and sealing.[18] Selective coil embolisation of HA side branches was reserved for cases with type II endoleak risk or suboptimal distal landing zones.[13,21]

Outcomes and Complications

Recent multicenter studies have demonstrated uniformly high technical success rates over 95% across all access techniques.[13,16-18] There were no reported 30-day mortalities. The incidence of major adverse events (MAEs) within 30 days ranged from 3.8% to 5%, most related to renal function deterioration (1.9% – 3.8%) or access site complications (2.7% – 4%).[14,16,19,24] Early reinterventions occurred in 3% to 9% of cases, primarily for type I endoleak or branch-related issues.[16,17]

Table 1. Summary of iliac branched device access techniques after prior endovascular aneurysm repair

Author (Year)	Access Type	Device Used	Access related take-home message
Bisdas et al. (2014)[18]	Upper limb	ZBIS	High technical success
Oberhuber et al. (2015)[22]	Bilateral femoral (steerable sheath + through-wire)	ZBIS	Stable access, no graft migration
Ferrer et al. (2017)[23]	Bilateral femoral (Steerable sheath + through-wire)	ZBIS	Stable access, no graft migration
Dawson et al. (2018)[20]	Bilateral femoral (Up-and-over + through-wire with coaxial sheaths)	Gore IBE	Very stable platform
Tadros et al. (2018)[21]	Bilateral femoral (Up-and-over + through-wire sheath "marriage")	Gore IBE	No graft displacement, high technical success
Tenorio et al. (2019)[16]	Bilateral femoral (Up-and-over + through-wire with coaxial sheaths)	Gore IBE	No mortality, low rate of complications, high technical success
Vaccarino et al. (2021)[24]	Bilateral femoral (Steerable-sheath, no through-wire)	ZBIS	Stable access; avoids upper limb access complications
Mesnard et al. (2022)[19]	Mixed (Brachial vs. up-and-over)	ZBIS	Low MAEs with any access type; up-and-over" technique as alternative to brachial access
Spath et al. (2023)[17]	Mixed (All access types)	ZBIS, Gore IBE	No difference between access techniques
Mastrorilli et al. (2023)[13]	Mixed (Brachial vs. up-and-over)	ZBIS, Jotec, Gore IBE	Upper limb access may be better in patients with previous f/bEVAR
Gittinger et al. (2024)[14]	Unilateral femoral (Steerable sheath)	Gore IBE	Useful if contralateral ilio-femoral occlusive disease

ZBIS: Zenith Iliac Branch (Cook Medical); **IBE:** Iliac Branch Endograft (Gore); **MAE:** Major Adverse Events; **f/bEVAR:** fenestrated or branched endovascular aortic aneurysm repair.

DISCUSSION

Secondary IBD implantation following EVAR for type Ib endoleak presents a distinct set of anatomical and technical challenges. Prior aortic endografts often elevate the native aortic bifurcation and alter the angulation of the iliac limbs, complicating navigation and increasing the risk of wire prolapse, sheath kinking, and endograft displacement.[18,22] These anatomical modifications are further compounded in redo femoral access sites, which may be scarred or narrowed from prior interventions. The combination of these factors makes stable, atraumatic access to the HA a critical determinant of procedural success.

Upper limb access has traditionally been the preferred route for HA catheterisation, particularly in cases of extreme iliac tortuosity or contralateral iliac occlusion. This technique offers a favourable angle for antegrade cannulation and greater catheter stability.[18] However, it is not without risk, with complications including brachial artery pseudoaneurysm, nerve injury and embolic stroke due to aortic arch manipulation.[21] Moreover, brachial access increases both operative time and radiation exposure. In response to the drawbacks of upper extremity access, the transfemoral "up-and-over" approach has emerged as a preferred technique in anatomically favourable patients. Comparative studies between upper-extremity and transfemoral access methods favour the latter in terms of neurological outcomes and procedural efficiency.[19,21] By establishing a through-and-through wire across the flow divider, this strategy allows for coaxial sheath advancement and controlled access to the HA with high technical success, without aortic arch manipulation, and with less radiation exposure. This method is particularly effective in the absence of marked tortuosity. Nevertheless, care must be taken to prevent tension or displacement of the existing aortic endograft during sheath advancement.[25]

The incorporation of steerable sheath technology represents another major advance in transfemoral IBD implantation. By enabling precise directional control, steerable sheaths allow operators to cannulate the HA from a contralateral femoral access site without the need for upper-extremity entry or even a through-and-through wire.[17,21-24] This may even be achievable in tortuous anatomies with low complication rates.[21-13] Newer steerable sheath stabilisation and further refinements of previously described techniques allowed for IBD placement from a single femoral access.[14,26]

Device and Anatomy-Specific Considerations

Selection of the appropriate IBD platform is guided by anatomical parameters and device specifications. The Cook Zenith Branch Iliac Stent (ZBIS) remains the most widely used device, with high long-term patency but requires a ≥ 16 mm iliac bifurcation diameter and a ≥ 50 mm CIA length. The Gore Iliac Branch Endoprosthesis (IBE) offers a lower delivery profile and is suitable for wider CIAs, though it requires a proximal CIA diameter > 17 mm. The Jotec E-Iliac, while flexible in certain configurations, has shown higher rates of branch instability and is best reserved for anatomies with generous bifurcation angles.[22] Bridging stent choice is equally critical. Balloon-expandable covered stents, such as BeGraft, VBX, and iCast, provide controlled deployment and high radial force, which are beneficial in calcified or angulated anatomies. Relining with bare-metal stents is often necessary in tortuous iliac segments to prevent kinking or disconnection.

Outcomes and Durability

Across the studies reviewed, technical success rates for secondary IBD implantation exceed 95%, regardless of access route. Thirty-day mortality is virtually absent, and major adverse event rates remain low. Anatomical risk factors for adverse outcomes include HA calcification > 50%, severe tortuosity, and prior thoracoabdominal or fenestrated aortic repair. Device-related factors such as improper sizing or suboptimal bridging stents also contribute to complications.

CONCLUSION

Secondary IBD implantation after EVAR is a technically demanding but effective solution for managing type Ib endoleaks. Transfemoral strategies, particularly the "up-and-over" and steerable sheath techniques, offer high technical success while minimizing neurologic risk. Optimal outcomes rely on careful anatomical assessment, appropriate device selection, and refined access techniques. As technology advances, streamlined, single-access approaches are becoming increasingly feasible, improving safety and efficiency in complex reinterventions.

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