An advancing solution for narrow aortic pathologies in thoracoabdominal endovascular repair

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The advance of endovascular therapy for pararenal and thoracoabdominal aortic pathologies has significantly broadened the range of treatment options for complex aortic diseases [1]. However, it has also introduced challenges, particularly in selecting the appropriate device types for different clinical scenarios. The fundamental feature of all devices designed for this aortic segment is the revascularization of visceral and renal target vessels, which may originate from diseased portions of the aorta or proximal and distal sealing zones. Bridging stent grafts provide a connection of fenestrated (FEVAR) or branched (BEVAR) endografts to target vessels and play a critical role in the sealing of the pathology.

Fenestrated endografts are characterized by supported fenestrations aligned with the origins of target vessels in vertical and horizontal directions within a maximum transition distance of 5 mm to the target vessel origin [2]. A longer trajectory or a horizontal misalignment of more than 15° can lead to bridging stent graft failure and target vessel instability [2]. Therefore, the planning and deployment of FEVAR in tortuous aortic anatomies remain technically challenging, with risks of fenestration misalignment, increased likelihood of endoleaks, or worsened target vessel outcomes [2]. Additionally, over-dilatation (flaring) of bridging stent grafts may present further complications in narrow anatomy, even though short PTA balloons (20 mm) are available. Despite these challenges, FEVAR has been successfully employed in narrow aortic anatomy, including pararenal repairs, juxtarenal aneurysms, failed EVAR with type Ia endoleaks, and thoracoabdominal dissections as a standalone procedure or in combination with BEVAR [3, 4]. A key limitation, however, is the unavailability of commercially manufactured FEVAR devices for emergency scenarios, restricting their use in urgent cases.

Conversely, the BEVAR platform was originally developed to address thoracoabdominal aneurysms and utilizes outer branches to revascularize the visceral and renal vessels. While this design has been effective for broader anatomical settings, challenges may be expected in narrow anatomies due to branch compression and complex target vessel cannulation [5]. These challenges have been addressed by subsequent design innovations, such as a more vertical orientation of the outer branches and the development of inner-branched endografts

[6]. Inner-branched endografts integrate branches entirely within the main graft, provide sealing with bridging stent grafts, and offer greater flexibility during the implantation [7, 8]. These advancements have culminated in the development of CE-certified off-the-shelf endografts featuring both outer and inner branches, providing practical solutions for emergent juxtarenal and pararenal pathologies [6, 9]. Nevertheless, a significant drawback of the BEVAR platform remains its longer proximal length due to the accommodation of the branches, which increases the coverage of the healthy descending aorta, sacrificing more intercostal artery segments and raising the risk of paraplegia compared to FEVAR in pararenal pathologies [9].

The mind moves to new things—"in nova fert animus"—capturing a profound sense of exploration and innovation. The study by Zaca et al., which introduces a novel modification of an inner-branched off-the-shelf endograft for treating narrow pararenal and thoracoabdominal pathologies, exemplifies this phrase perfectly [10]. This device incorporates four inner branches, with outlets oriented to match the most common angles of target vessel origins. A key innovation lies in its tapered design, which reduces the endograft's diameter at specific levels—from 33 or 36 mm in the proximal landing zone to 22 mm at the celiac trunk and superior mesenteric artery, and further to 16 mm at the renal artery outlets. This tapering simplifies cannulation of target vessels, particularly in patients with chronic aortic dissections and narrow true lumen as it offers more space between the branched endograft and the aortic wall.

However, the design retains certain limitations. The proximal landing zone of 85 mm is only slightly shorter than in the existing off-the-shelf devices, maintaining a risk of paraplegia, particularly when its distal part is placed on the bifurcation of a failed EVAR. However, mono-iliac deployment strategies may be proposed to mitigate the risk of paraplegia by reducing the aortic coverage length in acute failed EVAR settings.

The device's utility is enhanced by its ability to serve as a standalone procedure with direct apposition to the aortic wall or in conjunction with other abdominal and thoracic endografts. This versatility is particularly relevant in urgent settings, where fenestrated devices may not be readily available or indicated.

The clinical scenarios presented by Zaca et al. underscore the device's adaptability. In one example, the stent-graft was successfully employed to treat a symptomatic aortic pseudoaneurysm located between the origins of the celiac trunk and the superior mesenteric artery. In another case, the device was used to address a ruptured type Ia endoleak following EVAR. These examples highlight the device's versatility in managing complex aortic pathologies, particularly in urgent or life-threatening situations.

Despite these promising attributes, further clinical studies are needed to validate the device's performance in diverse patient populations. Key areas of investigation should include long-term target vessel patency, rates of endoleak, and the overall durability of the endograft in various anatomical and pathological settings. Additionally, comparisons with existing off-the-shelf solutions and custom-made devices will provide valuable insights into its advantages and limitations.

In conclusion, Zaca et al. present a noteworthy advancement in inner-branched endograft technology. Their novel design addresses the critical limitations of current platforms, offering a tailored solution for narrow pararenal and thoracoabdominal pathologies. While its potential as an off-the-shelf device for urgent scenarios is particularly promising, its role alongside existing technologies warrants further exploration. As the field of endovascular therapy continues to evolve, innovations like this will play a vital role in expanding the therapeutic options for complex aortic diseases.

Conflict of Interest

Mario Lescan is a consultant and proctor for Terumo Aortic and Artivion.

Martin Czerny is a consultant and proctor for Terumo Aortic, Consultant for Endospan and Medira, and a shareholder of TEVAR Ltd. and Ascense Medical.

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