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INVITED COMMENTARY

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Anatomical feasibility of the total endovascular aortic arch repair—and what lies beyond

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The frozen elephant trunk (FET) is regarded as the gold standard for the treatment of aortic arch pathologies [1]. In the last years, the treatment standardization including novel perfusion and operation strategies, new monitoring and perioperative care techniques and the evolution of the next-generation hybrid prostheses led to a considerable reduction in mortality for acute and elective operations. The co-morbidities, which increase considerably the perioperative risk for FET, are summarized in the current EACTS recommendations for the treatment of aortic arch pathologies: patients with poor cardiac, pulmonary or liver function and those with previous sternotomy and patent internal mammary artery bypass grafts may be better candidates for the less invasive total endovascular arch procedure [1]. The latter is performed with predominantly custom-made, branched thoracic endovascular aneurysm repair (B-TEVAR) endograft, whose various feasibility criteria need to be met by the patient-specific aortic anatomy.

The impressive study by Benfor *et al.* focuses on this landmark of the preoperative patient evaluation for the B-TEVAR [2]. The colleagues performed a thorough preoperative CT scan assessment of patients, who had been treated with FET for various aortic arch pathologies, and evaluated the anatomical feasibility of the 2 most common two-branched B-TEVAR endografts: Cook Zenith (Cook, Bloomington, IN, USA) and Relay Branch (Terumo Aortic, Inchinnan, UK) and found a comparable feasibility rate of 36% and 34%, respectively. The Cook Zenith three-branched endograft was anatomically feasible in 32% of the patients and 47% of the total cohort were eligible at least for one of the 3 B-TEVAR endografts. Moreover, this study demonstrated that the key to the feasibility lies predominantly in the diameter and the length of the proximal landing zone. Those 2 parameters determined the ineligibility in 50% of the patients and, thus, constituted the main hurdle for the total endovascular arch repair in this cohort.

The published work offers excellent insights into the anatomical pre-requirements and the feasibility rates of a real-world cohort ($n = 90$) with various arch pathologies. Since the anatomy of the proximal landing zone, in particular, may differ significantly between the specific pathologies, future studies on greater cohorts are needed to evaluate the disease-specific feasibility rates. The eligibility of patients with surgical grafts after ascending aneurysm or post-type A dissection surgery, who were underrepresented in this study, may be of interest for such evaluation, due to the increased operative risk associated with the re-do aortic surgery [3, 4], on the one hand, and the postoperative aortic anatomy, on the other hand. Among post-type A dissection, the rate of residual dissection in the aortic arch and the supra-aortic trunks and the length of the surgical graft may additionally affect the feasibility rates of double and triple branched endografts. Thus, the evaluation of the single-branched endografts in combination with supra-aortic debranching may be of deeper interest, also given that a single-branched off-the-shelf alternative already exists (Nexus, Artivion, Hechingen, Germany) [5].

Furthermore, the anatomical feasibility is only the first step of the B-TEVAR treatment evaluation, considering the stroke risk rates of >10%, which have been reported for the evaluated endografts [6, 7]. The presence of thrombus and calcified plaques in the proximal landing zone, the aortic arch or the supra-aortic trunks were not evaluated in this study. Patients with those pathoanatomical characteristics may meet the anatomical criteria for the technical success of B-TEVAR; however, the intervention bears a tremendous risk of major strokes with the consecutive loss of quality of life or the fatal outcome. In addition, in the absence of long-term data, the life expectancy of the patients and the presence of connective tissue disorders are further patient variables, which must be included in the decision-making process once the anatomical feasibility criteria have been confirmed.

In conclusion, it is expected that the further evolution of the branched and fenestrated aortic arch endografts will increase the feasibility rates in the coming years, and thus, this minimally invasive treatment modality will become available for more patients. Nevertheless, beyond the short-term technical success, the sustainability and the clinical results of the B-TEVAR systems will continuously need to be evaluated and benchmarked against the results of the FET.

Conflict of interest: Mario Lescan is a consultant and proctor for Terumo Aortic and Artivion.

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