Space matters! Maximum abdominal aortic aneurysm diameter is a rough surrogate for luminal volume

We have read with great interest the paper published by de Guerre et al.[1] The authors stressed the role of aneurysm diameter in late outcomes of endovascular aneurysm repair (EVAR). Patients with large abdominal aortic aneurysms (AAAs) (diameter >65 mm) undergoing EVAR had higher 5-year adjusted rate of reintervention, rupture, mortality, and loss to follow-up compared with EVAR patients with smaller AAAs or patients with large AAAs who underwent open surgery. The authors conclude that fit patients with large AAAs should be considered for open repair and emphasized the need for a rigorous long-term follow-up after EVAR.

This finding is not novel, but the study strongly consolidates the notion that large aneurysms fare worse after EVAR. The responsible mechanism has, however, been elusive. Our group has investigated the effect of luminal volume on outcomes after EVAR.[2] The rationale behind this idea is that a preexisting chronic thrombus in the sac may act as a supporting structure for the endograft, helping it to maintain its position over time. In contrast, aneurysms with little chronic thrombus may allow displacement forces to act, gradually leading to migration, disconnections, or other movements ultimately resulting in compromise of the seal zones (Fig). This change happens because the newly formed thrombus lacks the consistency of chronic wall thrombus.[3,4]

We have shown that patients with higher AAA luminal volumes were, in fact, at significantly greater risk of AAA-related complications, neck-related events, and secondary interventions, regardless of the total maximum diameter at baseline; in our multivariable model, luminal volume was a significant risk factor, whereas total diameter was not.

It is also worth mentioning that de Guerre et al[1] included patients treated long ago, and it is likely that many patients were implanted with devices without proximal fixation that are known to migrate. This factor would probably amplify the potential for displacement in patients with large lumen AAAs.

We are aware that manual measuring of luminal volume is impractical, but planning software tools now offer this feature automatically.[5] Our message is to consider luminal volume when deciding between endovascular and open surgery and when tailoring surveillance after EVAR; the maximum AAA diameter is likely to be no better than a rough surrogate.

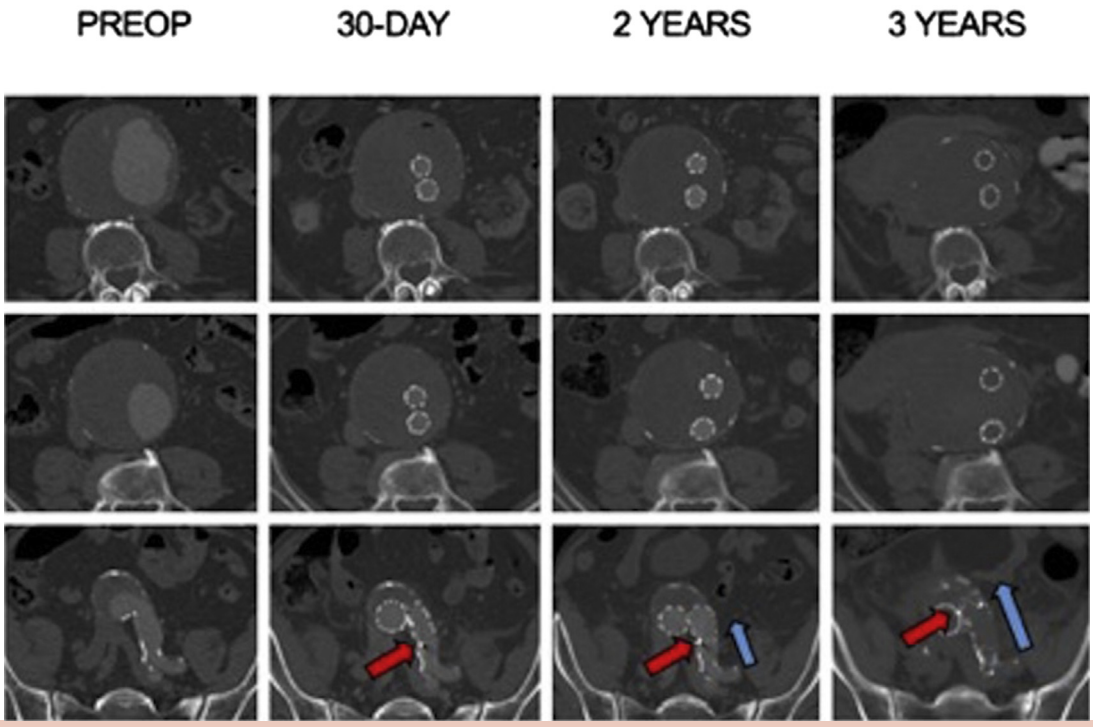

Fig. Large-lumen abdominal aortic aneurysm (AAA) resulting in endograft displacement over time with associated limb retraction and rupture from type Ib endoleak. The red arrow marks the distal limb marker, and the blue arrow shows the direction of limb retraction.

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REFERENCES

1. de Guerre LEVM, Dansey K, Li C, Lu J, Patel PB, van Herwaarden JA, et al. Late outcomes after endovascular and open repair of large abdominal aortic aneurysms. J Vasc Surg 2021;74:1152-60.
2. Oliveira-Pinto J, Ferreira RS, Oliveira NFG, Hoeks S, Van Rijn MJ, Raa ST, et al. Total luminal volume predicts risk after endovascular aneurysm repair. Eur J Vasc Endovasc Surg 2020;59:918-27.
3. Cornelissen SA, Verhagen HJ, van Herwaarden JA, Vonken EJ, Moll FL. Lack of thrombus organization in non-shrinking aneurysms years after endovascular abdominal aortic aneurysm repair. J Vasc Surg 2012;56:938-42.
4. Waasdorp EJ, Gorrepati ML, Rafii BY, de Vries JP. Sideways displacement of the endograft within the aneurysm sac is associated with late adverse events after endovascular aneurysm repair. J Vasc Surg 2012;55:947-55.
5. Caradu C, Spampinato B, Vrancianu AM, Bérard X, Ducasse E. Fully automatic volume segmentation of infra-renal abdominal aortic aneurysm computed tomography images with deep learning approaches versus physician controlled manual segmentation. J Vasc Surg 2021;74:246-56.e6.

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Reply

We appreciate the commentary from Ferreira et al and their work on the aortic aneurysm luminal volume. In our report, we described the 5-year mortality, reintervention, rupture, and loss to imaging follow-up rates after both endovascular aortic aneurysm repair (EVAR) and open repair comparing large abdominal aortic aneurysms (AAAs), defined as a diameter >65 mm, and smaller AAAs.[1] Our results suggest that for patients with large AAAs who are medically fit open repair should be strongly considered even for patients with anatomy suitable for EVAR.[1] Although our study included patients who had undergone EVAR between 2003 and 2016, 93% of our patients had undergone repair after 2010. Therefore, we believe that our results reflect contemporary practice.[1] In their commentary, based on the findings described in their recent report, the use of the luminal volume instead of the diameter was suggested as a risk predictor when considering AAA repair.[2] However, the study by Oliveira-Pinto et al[2] was designed to assess whether the luminal volume represents a risk factor for AAA-related complications. Therefore, although the results suggest that the luminal volume represents a risk factor for AAA-related complications, we cannot draw conclusions regarding the effects of the volume compared with the diameter.[2] Furthermore, as the authors reported, their study was the first to focus on the effect of the luminal volume on the outcomes after AAA repair and included patients who had undergone EVAR at a single tertiary center and was limited to studying the effects of the luminal volume on a composite end point. Therefore, we believe that further multicenter studies assessing the effects of the diameter and luminal volume on individual long-term outcomes, including overall survival, after both EVAR and open repair is essential before we can comment on the value of using the luminal volume.

However, although the diameter is easily accessible and has been extensively studied, we agree that a fixed diameter threshold is likely not the most accurate predictor of operative risk because other factors are likely to influence the risk of repair. The use of the aneurysm volume shows potential in increasing the sensitivity when predicting operative risk, especially when thrombus is present. However, although the aneurysm volume represents a promising research area and might replace the diameter in the future, we believe it is not ready for implementation. Because the volume is not currently captured in the Vascular Quality Initiative or any other registry we are aware of, we could not verify the utility of the aortic volume. When the volume calculation can be performed simply, it could be added to large registries, and the potential benefit could be assessed.

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