INVITED COMMENTARY

Human *vs.* Machine – or with Machine?

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In their study, Adam *et al.*[1] eloquently demonstrate that artificial intelligence (AI) through training of a neural networks pipeline can automatically segment and measure the outer to outer diameter of the whole length of the aorta in computed tomography (CT) angiography (CTA). Their Augmented Radiology for Vascular Aneurysms (ARVA) software is a glimpse into the future of AI for vascular surgery as, conceptually, it promises a significant reduction in workload when measuring maximum aortic diameter (AD_{max}) in high volume centres.

While it is the case for thoracic and thoraco-abdominal aneurysms where CTA or magnetic resonance angiography is required,[2] a wider clinical application of ARVA for abdominal aortic aneurysm (AAA) AD_{max} assessment seems to be dampened by the "gold standard" role of ultrasound for this measurement in the decision to intervene and for follow up.[3]

However, as each aortic segment evolves and remodels independently before and after the repair (follow up), ARVA would be able to monitor effortlessly and precisely these segments independently between serial CT scans for the entire length of the aorta. In this manner, the value of the ARVA tool during pre-operative monitoring might be in the detection of focal diameter increases, perhaps allowing for identification of aortic weak spots (rapid expansion) and even in the prediction of rupture:[4] the "holy grail" of AAA imaging. Post-operatively, ARVA might provide detailed information on aorta remodelling following endograft implantation due to either endoleaks or sac regression.

An evidence gap exists for aortic remodelling after thoracic endovascular aneurysm repair and the natural history of subacute aortic dissection.[2] Adding to this active research field,[5] the ARVA tool could also be applied to the study of serial CTAs of dissection patients and provide insight into the way aortic segments remodel after the dissection event both for conservative treatment and intervention. However, caution should be exercised owing to the risk of radiation induced malignancies and contrast induced kidney injury,[6] especially in this young group of patients with aortic dissection. Perhaps a step forward for the ARVA tool researchers would be training the AI in determining diameters based on magnetic resonance angiography rather than CTA.

AI algorithms are being mentioned increasingly in many science fields and this paper is proof that vascular surgery is on the same track. Despite popular science fiction where machines take over control from humans, so far it seems that the way forward for vascular surgery is to team "with the machine".

CONFLICTS OF INTEREST

None.

REFERENCES

1 Adam C, Fabre D, Mougin J, Zins M, Azarine A, Ardon R, et al. Pre and post-surgical aortic aneurysm maximal diameter measurement: full automation by artificial intelligence. *Eur J Vasc Endovasc Surg* 2021;**62**:869–77.
2 Riambau V, Böckler D, Brunkwall J, Cao P, Chiesa R, Coppi G, et al. Editor's Choice – Management of descending thoracic aorta diseases: Clinical Practice Guidelines of the European Society for Vascular Surgery (ESVS). *Eur J Vasc Endovasc Surg* 2017;**53**:4–52.
3 Wanhainen A, Verzini F, Van Herzeele I, Allaire E, Bown M, Cohnert T, et al. Editor's Choice – European Society for Vascular Surgery (ESVS) 2019 Clinical Practice Guidelines on the Management of Abdominal Aorto-iliac Artery Aneurysms. *Eur J Vasc Endovasc Surg* 2019;**57**:8–93.
4 Raffort J, Adam C, Carrier M, Ballaith A, Coscas R, Jean-Baptiste E, et al. Artificial intelligence in abdominal aortic aneurysm. *J Vasc Surg* 2020;**72**:321–33.
5 Yu B, Li T, Liu H. Retrospective analysis of factors associated with aortic remodeling in patients with Stanford type B aortic dissection after thoracic endovascular aortic repair. *J Cardiothorac Surg* 2021;**16**:190.
6 Markar SR, Vidal-Diez A, Sounderajah V, Mackenzie H, Hanna GB, Thompson M, et al. A population-based cohort study examining the risk of abdominal cancer after endovascular abdominal aortic aneurysm repair. *J Vasc Surg* 2019;**69**:1776–85.

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