

## INVITED COMMENTARY

## Commentary on 'A Comparison of Accuracy of Image- versus Hardware-based Tracking Technologies in 3D Fusion in Aortic Endografting'

S. Lepidi \*

Division of Vascular and Endovascular Surgery, Department of Cardiac, Thoracic and Vascular Sciences, University of Padova, Padova, Italy

Rolls et al. present an interesting paper on a new peri-operative fusion imaging technology that could facilitate the endovascular treatment of complex abdominal aortic aneurysms (AAA) in the future.<sup>1</sup> Fusion imaging is based on merging pre-operative computed tomography (CT) angiography and intra-operative digital subtraction angiography (DSA) or fluoroscopy images to create a three dimensional (3D) mask of the aorta and its branches in order to improve accuracy of complex aortic endograft delivery, facilitate branch vessel catheterization, and at the same time reduce the amount of contrast and radiation. Initially proposed by Penney et al. in 1998,<sup>2</sup> this fusion imaging technique is based on a series of digital images reconstructed from pre-operative CT data that mimic fluoroscopic images, and referred to as digitally reconstructed radiographs (DRRs). DRR series are analyzed for pixel distribution. Pixel distribution is utilized to match the most appropriate DRR images to the live fluoroscopic images throughout the procedure and to provide the best 3D vascular mask. The authors therefore called this system "image tracking" (IMT). Based on this approach, in 2010 Carrell et al. described the initial clinical use of a fully automated, image based two dimensional/3D registration system for endovascular (EV) AAA treatment.<sup>3</sup> The technology has been further developed and commercialized by the Cydar Medical Company (Cambridge, UK).

Rolls et al. compare the new Cydar EV system with a commercially available one from Siemens, called Hardware Tracking (HWT) because the 3D masks generated by merging pre-operative CT data with intra-operative DSA require tracking the position of the C-arm and the operating table.<sup>1</sup> On a consecutive series of 12 patients undergoing standard and complex EV aneurysm repair

for AAA, Rolls et al. measured the distance between pre-operative IMT and HWT "fusion" markers and the corresponding reference points (ostia of the renal arteries) on the fluoroscopy screen.<sup>1</sup> The aim of the study was to evaluate the overlay accuracy of both systems when an automated protocol is applied during the procedure. The authors found that the overlay was significantly ( $p = .001$ ) more accurate in the IMT (median error 3.9 mm) versus the HWT (median error 8.64 mm). However, the instructions for use of the Siemens system clearly recommend manual adjustment of the overlay following any manipulation or movement of the patient, and this limitation could account for the lower accuracy of the HWT system. The study design clearly highlights one major advantage of the IMT system, which is the automated adjustment of the 3D mask. The more cumbersome manual adjustments required for the HWT could be avoided but at the price of a 10–15 s delay in order to obtain the appropriate overlay. Other major advantages of the image based fusion are the possibility of working with any type of X-ray fluoroscopy set (mobile or fixed, image intensifier, or flat panel detector) and to avoid the intra-operative cone beam CT. Unfortunately, use of the IMT system is currently limited by the extensions of the available C-arm angulations ( $\leq 30^\circ$  cranio-caudal and  $\leq 40^\circ$  anterior-oblique). Therefore, as supported by the results of this preliminary study, the image based fusion technology should be further implemented and more clinical evidence should be collected.

### REFERENCES

- 1 Rolls AE, Maurel B, Davis M, Constantinou J, Hamilton G, Mastracci T. A comparison of accuracy of image- versus hardware-based tracking technologies in 3D fusion in aortic endografting. *Eur J Vasc Endovasc Surg* 2016;**52**:323–31.
- 2 Penney GP, Weese J, Little JA, Desmedt P, Hill DL, Hawkes DJ. A comparison of similarity measures for use in 2-D-3-D medical image registration. *IEEE Trans Med Imaging* 1998;**17**:586–95.
- 3 Carrell TWG, Modarai B, Brown JRI, Penney GP. Feasibility and limitations of an automated 2D-3D rigid image registration system for complex endovascular aortic procedures. *J Endovasc Ther* 2010;**17**:527–33.

DOI of original article: <http://dx.doi.org/10.1016/j.ejvs.2016.05.001>

\* Division of Vascular and Endovascular Surgery, Department of Cardiac, Thoracic and Vascular Sciences, University of Padova, Via Giustiniani, 2, 35128, Padova, Italy.

E-mail address: [slepidi@unipd.it](mailto:slepidi@unipd.it) (S. Lepidi).

1078-5884/© 2016 Published by Elsevier Ltd on behalf of European Society for Vascular Surgery.

<http://dx.doi.org/10.1016/j.ejvs.2016.05.015>