

Images in Cardiovascular Medicine



Merging CT on Fluoroscopic Imaging Using the Trachea as a Reference Without Contrast

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Previously, the utility of computed tomography (CT) merged imaging-guided cerebral protection system insertion has been reported. However, the exact optimal reference for merging CT images with the patient remains unclear. Although aortography allows for accurate merging, it requires imaging from two views, which may involve excessive use of radiocontrast.¹⁾ Conversely, merging based on the patient's bones can reduce accuracy because of poor image quality during merging, and the patient's posture may be different from that of during the CT scan.²⁾ However, using the trachea as a reference in CT image merging overcomes radiocontrast and positioning issues. Furthermore, the trachea's bifurcation structure leads to notable shape variations if viewed from different angles, enhancing the precision of merging. The trachea, located in the upper thoracic area, has minimal movement with respiration and is enclosed to important vessels and organs. Therefore, it can serve as an effective reference during cardiovascular procedures. The HeartNavigator - Structural Heart Disease (Philips Healthcare, Amsterdam, Netherlands) system uses automatic segmentation programs and its own drawing tools to generate segmented volume-rendered images of the aortic arch anatomy and trachea (**Figure 1, Supplementary Video 1**) can be easy and beneficial for the procedure. This merged CT imaging using the trachea as a reference without radiocontrast can be easily and effectively employed in cases involving tortuous anatomy and in which safety is of utmost importance, such as in using cerebral protection systems (**Figure 2, Supplementary Video 2**).

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Conflict of Interest

The authors have no financial conflicts of interest.

Data Sharing Statement

The data generated in this study is available from the corresponding authors upon reasonable request.

Author Contributions

Conceptualization: Lee CH; Data curation: Lee CH, Lee HJ; Investigation: Lee CH, Lee HJ; Methodology: Lee CH; Supervision: Lee CH, Yoon HJ, Hur SH; Visualization: Lee CH, Kim JY; Writing - original draft: Lee CH; Writing - review & editing: Lee CH, Hur SH.

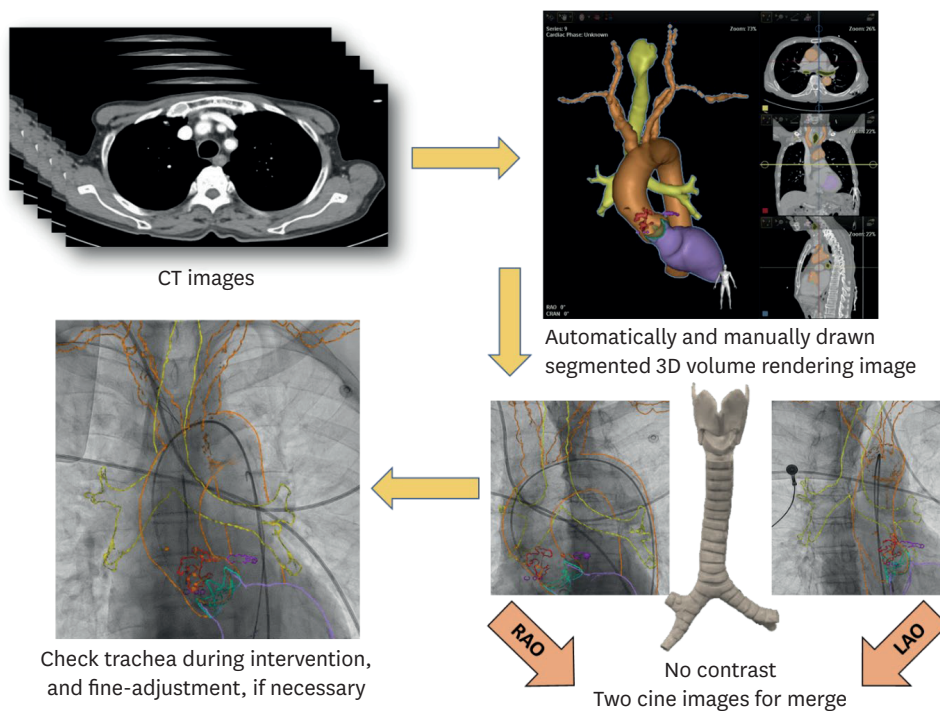


Figure 1. Procedural process of computed tomography merged imaging with the trachea as reference. After uploading the raw CT images to the HeartNavigator - Structural Heart Disease system, a segmented volume rendering image is created. The RAO and LAO view cine images are used to focus the patient and CT images for the procedure. If minor deviations are observed, fine adjustment can be considered perioperatively. CT = computed tomography; LAO = left anterior oblique; RAO = right anterior oblique.

SUPPLEMENTARY MATERIALS

Supplementary Video 1

Procedural process video during cerebral protection system insertion using computed tomography merged imaging with the trachea as reference

[Click here to view](#)

Supplementary Video 2

Video demonstrating cases of cerebral protection system insertion using computed tomography merged imaging with the trachea as reference

[Click here to view](#)

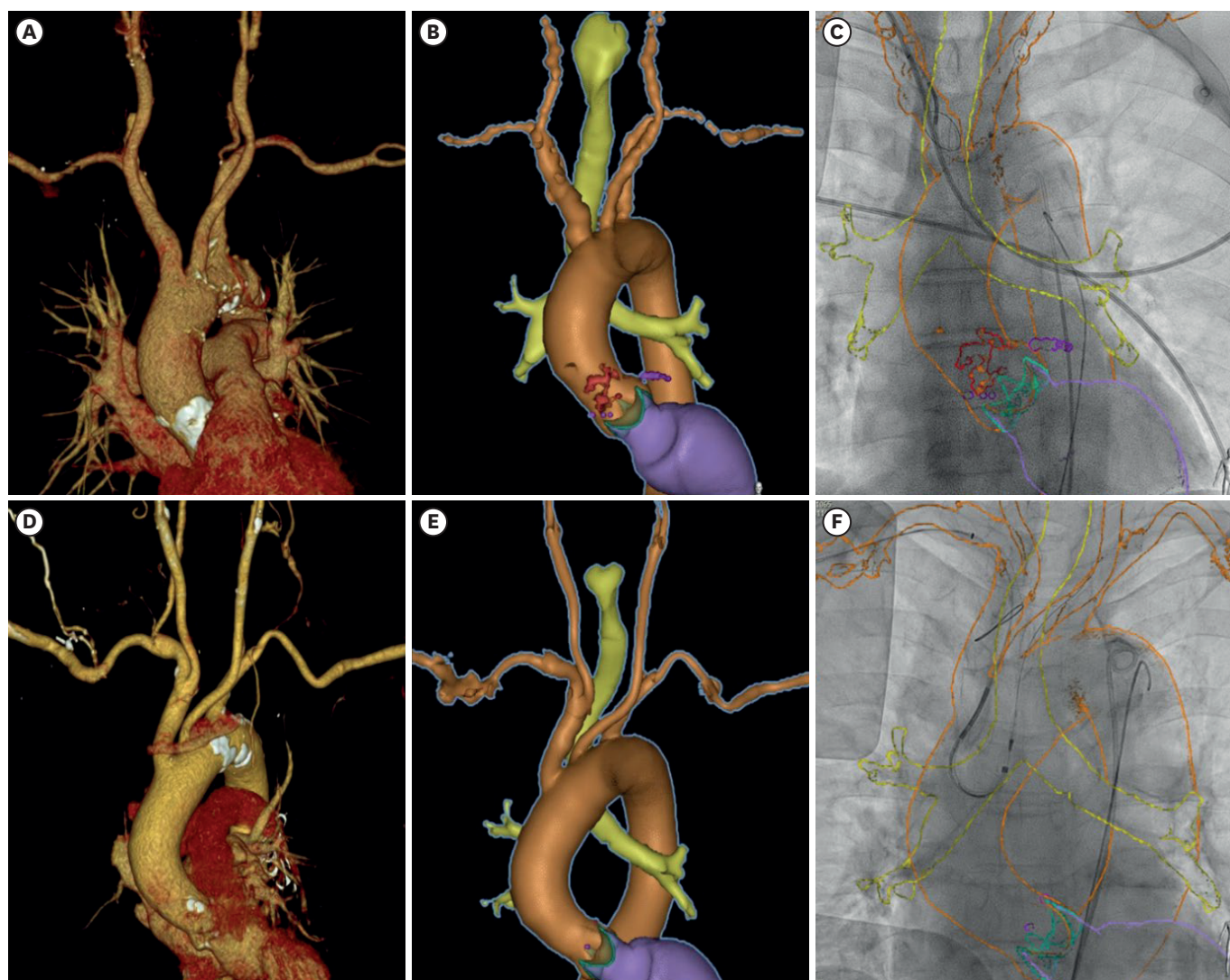


Figure 2. Images of CT merged with cerebral protection system insertion. Conventional volume rendering images of cerebral protection system candidate patient (case 1) (A), automatically and manually drawn segmented volume rendering image by HeartNavigator - Structural Heart Disease system (B), procedural CT merged image (C), CT images of case 2 (D, E, and F). CT = computed tomography.

REFERENCES

1. Vernikouskaya I, Rottbauer W, Gonska B, et al. Image-guidance for transcatheter aortic valve implantation (TAVI) and cerebral embolic protection. *Int J Cardiol* 2017;249:90-5.
[PUBMED](#) | [CROSSREF](#)
2. Vasudev R, Altabaqchali S, Dudy Y, Lim M, Jelnin V, Pasala TKR. CT fusion imaging guidance for transcatheter aortic valve replacement in a patient with left ventricular thrombus. *JACC Cardiovasc Interv* 2022;15:e77-9.
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