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Application of cardiovascular virtual endoscopy: A pilot study on roaming path planning for the diagnosis of congenital heart diseases in children

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Aim: Planning of the roaming path plays a vital role in applying the virtual endoscopy (VE) system into clinical practice. This study aimed to investigate roaming paths planning for the diagnosis of congenital heart diseases (CHD) using a cardiovascular VE system based on computer tomography (CT).

Methods: 40 children with CHDs received diagnostic CT examinations before surgical operations. A VE system based on CT images with automatic path planning tools was applied to support in establishing a diagnosis, where targets were models as cavity objects. With surgical findings as proof, the performance in diagnosing CHDs by CT, VE using automatically planned roaming paths (VE-auto, objects were treated as left heart system and right heart system), VE using manually planned paths (VE-manual), and VE using automatically planned path for left heart system and manually planned path for right heart system (VE-combined) were studied and compared.

Results: For the overall diagnostic performance on CHDs, a comparable accuracy of 93%, 93%, 95% and 95% was found by CT, VE-auto, VE-manual and VE-combined. However, in diagnosing the tetralogy of Fallot, significantly higher performance was found by VEs (accuracy: 98%), as compared to CT (accuracy: 85%). For VE-auto, poor performance with an accuracy of 85% and sensitivity of 22% (2/9) was revealed in diagnosing muscular ventricular septal defect, when compared to VE-manual and VE-combined (accuracy: 98%, sensitivity: >78%). As compared to VE-manual, VE-combined illustrated comparable diagnostic accuracy on all CHDs; however, significantly smaller diagnostic time was utilized ($P < 0.05$).

Conclusions: The cardiovascular VE system demonstrated considerable clinical value in the diagnosis of CHDs. The left and right heart system should not be modeled as two cavity objects at the same time, and when one of two systems is treated as one object, the other system should be treated as three separate objects when using VE to diagnose CHDs.

Notes: