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Implementation of 3D segmentation imaging and 3D printing in the clinical practice

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Background: 3D segmentation imaging and 3D printing have become a valuable tool for the preoperative preparation and decision making. In particular with complex CHDs in which it is difficult to represent specific and complicated 3-dimentional intra-cardiac and vascular relations via conventional echocardiography or CT/MRI. The method also provides aid in the communication with the patient/parents and the education of personnel and students.

Objective: To examine and verify the benefits of the method in the preoperative preparation. To explore the patients/diagnoses which would be indicated for this form of advanced imaging. To implement the method in the clinical practice of our center.

Method: 3D segmentation was performed in 9 cases during 2017 and 2018. 5 cases of Double aortic arch(DAA), 1 case of Pulmonary atresia, VSD and MAPCAs, 1 case of Common arterial trunk, 1 case of Tetralogy of Fallot, 1 case of Superior sinus venosus ASD with PAPVR. Segmentation was achieved via “3D slicer” software on data from contrast CT performed on the patients. 3D printing was performed in 4 of the above mentioned cases – 3 cases of DAA, 1 case of pulmonary atresia, VSD and MAPCAs. The models were printed on a generic FDM 3D printer, and in 1 case of DAA the model was printed on “Ultimaker 3” in PLA plastic. All models were compared to the intraoperative findings, the original imaging study and for the case of pulmonary atresia, VSD and MAPCAs – with the post-mortem anatomic specimen.

Results: There is a clear overlap between primary imaging, segmented image, printed model and the intra-operative/post-mortem findings and dimensions.

Conclusion: 3D segmentation imaging and printing is a useful method which provides in-depth imaging of complex anatomical relations. 3D models are useful in the preoperative preparation and planning of operative strategy. The method is beneficial in cases of complex or rare CHDs where conventional imaging is difficult.