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DEVELOPMENT OF AN ATRIAL PHANTOM MODEL FOR PLANNING AND TRAINING OF INTER-ATRIAL INTERVENTIONS

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Summary: Background: Several researchers have presented cardiac phantoms to mimic the particularities of the heart in order to assist the medical training and surgical planning. Although the initial models were mainly focused on the ventricles, atrial phantoms were recently proposed. However, such models are typically rigid, the atrial wall is not realistic and it is not compatible with ultrasound, being sub-optimal for planning/training of several interventions [1].
Methods: In this work, we propose a strategy to build a patient-specific atrial phantom model. Specifically, this model is built from a 3D computed tomography (CT) dataset, by manual delineation of the atria and inter-atrial septal (IAS) wall. The obtained surfaces are then used to generate a mold that is physically materialized using a 3D-printer. The flexible phantom is built through the pouring of a flexible material inside the mold, followed by the elimination of the inner structures. Two phantoms were built using different flexible materials (silicone and polyvinyl alcohol-PVA), which were then compared to assess their appropriateness for ultrasound imaging and for the generation of complex anatomies.
Results: Two experiments were set up to validate the phantom model. First, the ultrasound imaging of each model was performed and the acquired images visually compared. Both models showed a similar performance, with easy detection of the left and right atria (LA|RA) and the IAS. Secondly, the accuracy of the manufacturing approach was assessed through the comparison between a post-production CT dataset and the virtual model. The results proved that the silicone-based phantom was more accurate than the PVA-based one, with an error of 1.68±0.79, 1.36±0.94, 1.45±0.77 mm for the LA, RA and IAS, respectively.
Conclusions: The proposed strategy proved to be accurate and feasible for the correct generation of personalized atrial models.
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