Segmentation-Free Estimation of Aortic Diameters from MRI Using Deep Learning

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Resumen

Accurate and reproducible measurements of the aortic diameters are crucial for the diagnosis of cardiovascular diseases and for therapeutic decision making. Currently, these measurements are manually performed by healthcare professionals, being time consuming, highly variable, and suffering from lack of reproducibility. In this work we propose a supervised deep-learning method for the direct estimation of aortic diameters. The approach is devised and tested over 100 magnetic resonance angiography scans without contrast agent. All data was expert-annotated at six aortic locations typically used in clinical practice. Our approach makes use of a 3D+2D convolutional neural network (CNN) that takes as input a 3D scan and outputs the aortic diameter at a given location. In a 5-fold cross-validation comparison against a fully 3D CNN and against a 3D multiresolution CNN, our approach was consistently superior in predicting the aortic diameters. Overall, the 3D+2D CNN achieved a mean absolute error between 2.2–2.4 mm depending on the considered aortic location. These errors are less than 1 mm higher than the inter-observer variability. Thus, suggesting that our method makes predictions almost reaching the expert's performance. We conclude that the work allows to further explore automatic algorithms for direct estimation of anatomical structures without

the necessity of a segmentation step. It also opens possibilities for the automation of cardiovascular measurements in clinical settings.

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