Statistical Shape Clustering of Left Atrial Appendages

Fifteen percent of all strokes are caused by emboli formed in the left atrium (LA) in case of atrial fibrillation (AF). The most common site of thrombus formation is inside the left atrial appendage (LAA). The LAA is accounting for 70% to 90% of the thrombi formed in the LA in patients with non-valvular AF. Studies have shown there is a correlation between the LAA morphology and risk of ischemic stroke; Chicken Wing and Cauliflower LAA shapes are associated with lower and higher risk, respectively. These two LAA shape categories come from a popular classification in the medical domain, but it is subjective and based on qualitative shape parameters. In this paper, we describe a full framework for shape analysis and clustering of the LAA. Initially, we build a point distribution model to quantitatively describe the LAA shape variation based on 103 LAA surfaces segmented and reconstructed from multidetector computed tomography volumes. We are successfully able to determine point correspondence between LAA surfaces, by non-rigid volumetric registration of signed distance fields. To validate if LAA shapes are clustered, we employ an unsupervised clustering on the shape models parameters to estimate the natural number of clusters in our training set, where the number of shape clusters is estimated by validating the test log-likelihood of several Gaussian mixture models using two level crossvalidation. We found that the LAA surfaces basically formed two shape clusters broadly corresponding to the Chicken wing and non-Chicken Wing morphologies, which fits well with clinical knowledge.

General information
Publication status: Published
Organisations: Image Analysis & Computer Graphics, Department of Applied Mathematics and Computer Science, University of Copenhagen, Pompeu Fabra University
Pages: 32–39
Publication date: 2019

Host publication information
Title of host publication: Statistical Atlases and Computational Models of the Heart
Publisher: Springer
ISBN (Print): 978-3-030-12028-3
(Lecture Notes in Computer Science, Vol. 11395).
Keywords: Left atrial appendage, Point distribution models, Clustering, Gaussian mixture models
DOIs: 10.1007/978-3-030-12029-0_4
Source: PublicationPreSubmission
Source ID: 170357586
Research output: Chapter in Book/Report/Conference proceeding › Book chapter – Annual report year: 2019 › Research › peer-review