

Automatic Segmentation of Myocardial Infarction in Rats Subjected to Regional Ischemia

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Introduction: In the experimental and preclinical studies, the determination of the extent of the myocardial ischemic injury is essential in ischemia/reperfusion studies. Indeed, precise determination of area at risk (AR) of infarction and infarct area (IA) size is fundamental for the evaluation of the degree of ischemic injury and potency of cardioprotective interventions. As IA or AR segmentation in images of histological slices is often challenging, the subjective segmentation might provide biased, expert- and software-dependent results. Here, we describe a new approach for automatic IA and AR segmentation with a detailed description of the proposed algorithm.

Methods: The proposed approach consists of segmentation of individual histological slices using a Random Forest classifier with a vector of nine image features. The second part consists of two-step pixel-wise k-means classification. First, the AR tissue is separated from the normally perfused (NP) tissue and in the second step, the viable area (VA) and IA tissue are separated.

The developed software also contains two possibilities for manual correction. The freehand pen, which can be used for simple sketching of closed contours and the colour-based homogeneous adding/removing tool based on the watershed algorithm applied on gradient image. Methods were implemented in Matlab, and the final application is available at:

<https://www.mathworks.com/matlabcentral/fileexchange/66902-cardiac-ischemia>.

Results and Conclusion: The set of 16 images from 8 rat hearts was used for evaluation. We compared sizes of NP, VA and IA (normalized to percent of total area) obtained by our method with manual segmentation by the biologist. We achieved mean absolute error of 2.59% with a mean standard deviation of 1.61%. Considering that the inter-observer variability can lead to differences up to 5% (heuristically estimated by biologists), the achieved results are reasonable and the software is applicable in the real-world scenario.