Generation of Normal Control Data for the Evaluation of Myocardial Perfusion Studies

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A new mathematical method will be presented. The goal is to generate a normal circumferential profile curve which can be considered as normal control data for the evaluation of myocardial perfusion images.

The imaging methods of nuclear medicine are frequently used in cardiology. One of the most important imaging procedure is the myocardial perfusion (MP) study, which provides quantitative and qualitative data about the functionality of the human heart. The defects of myocardial functions (low perfusion), both the pre-infarction state and the infarction itself, can be detected by this kind of study. The evaluation of the circumferential profile curve (CPC) is used for representing some features of the left ventricle (LV). The CPC is the polar-curve of a planar image of the LV. In the evaluation of quantitative studies in nuclear medicine it is a general step to compare the parameters of the actual study with normal control data. So it is in the case of applying CPC.

The simplest way to collect normal parameter values is to determine them on the base of studies performed on a group of healthy persons (e.g. volunteers). If the study is risky or involves some hazard, like in the case of nuclear medicine studies, where radioactivity is used, then this kind of data collection raises ethical problems.

During the development of our software for evaluating MP studies there were no normal data. The question was how to get normal control CPC data. There were sets of patient studies available, but they could not be considered as a normal population s data. All the methods published previously required input data of a normal population.

Our study images were taken as the starting point of our iterative method to create normal CPC. Normal CPC was created from the patients' ones independently from the physician's diagnosis. Mathematical statistics, image analysis and understanding were applied during the development of our generation method. Some hypotheses about the available sample of the data in the original population:

Hypothesis 1. There are only few CPCs in which the total length of the low perfusion intervals is greater than 180^o.

Hypothesis 2. The distribution localisation of MP defects is approximately uniform in $[0^o, 360^o]$.

The basic idea is to take all the available CP curves of the population and to leave out those intervals of the curves that show probably low perfusion. All other parts were considered as the data of a normal population. The normal CPC is the mean of the normal population's CPCs.

The starting population of our method consisted of 83 patients śtudies. 57% of the population had MP defect. The result of the method was considered as the normal CPC for MP study.

The clinical evaluation software which uses our normal data was tested. The scoring of the software and the results of a physician were compared. The sensitivity of our results is 79%, the specificity is 95%, and the accuracy is 92% as opposed to the physician's scores.

The method for generation of normal CPC, the results and our future plans will be presented. The steps of the evaluation of a MP study will be overviewed.