

Summary

Background and Purpose: Ischemic stroke is the 3rd most common cause of death and most common cause of permanent disability in developed countries. Rapid diagnostic work-up with reliable assessment of infarcted brain tissue and potentially salvageable brain tissue is critical for acute stroke management. The first aim of this study is to assess delineation of infarct core in acute stroke patients using whole brain perfused blood volume (PBV) maps. These maps are calculated by automatic processing from computed tomography angiography source images (CTA-SI) and non-contrast computed tomography (NCCT) data. The second aim is to determine optimal quantitative threshold of PBV for infarct core identification in acute stroke setting.

Material and methods: PBV maps were constructed using prototype software from NCCT and CTA-SI data in 37 acute ischemic stroke patients with angiographically proved recanalization after intravenous thrombolytic treatment. These PBV maps were automatically compared with final infarct extension on follow-up NCCT. The anatomic pixel-by-pixel correlation was assessed using Matthew's correlation coefficient (MCC) for infarct core delineation using different critical values of PBV. The optimal threshold with the best correlation was used for infarct volume computation. Minimal PBV values were determined in patients without final infarction. Logistic regression analysis was used to create a probability curve as a function of critical PBV threshold in patient with final infarction and minimal PBV value in patient without completed infarction. The ischemic core volume and the final infarct volume were compared using Spearman rank correlation coefficient and Wilcoxon-rank sum test.

Results: The absolute PBV thresholds for infarct core delineation in 25 patients with completed infarction varied in wide range 1.2 – 2.0 ml/100 g with the best overall correlation for PBV 1.6 ml/100 g (MCC = 0.57), sensitivity (0.50; 0.90) and specificity (0.98; 0.99). The minimal PBV values in patients without completed infarction varied in the range 1.8 - 2.6 ml/100 g. These values were significantly different ($p < 0.0001$, Spearman-rank). The absolute PBV at which the probability of completed infarction reached 0.5 was 1.95 ml/100 g (MCC = 0.82), sensitivity (1.0) and specificity (0.50; 0.99). The volumes of infarcted tissue were highly correlated with the volumes of the infarct core with the threshold PBV 1.6 g/100 ml ($\rho = 0.936$, $p < 0.00001$, Spearman-rank) without any significant difference of mean ($p = 0.35$, Wilcoxon). Also there was high correlation of the volumes with the threshold PBV = 2.0

ml/100g ($\rho = 0,940$, $p < 0.00001$, Spearman-rank), but with a significant overestimation of the infarct core volumes ($p \leq 0.0001$, Wilcoxon).

Conclusion: PBV map can be used for the prediction of the infarct core in patient with acute stroke with whole brain coverage.