CLASSIFYING STROKE ETIOLOGY USING MRI ANALYSIS

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INTRODUCTION

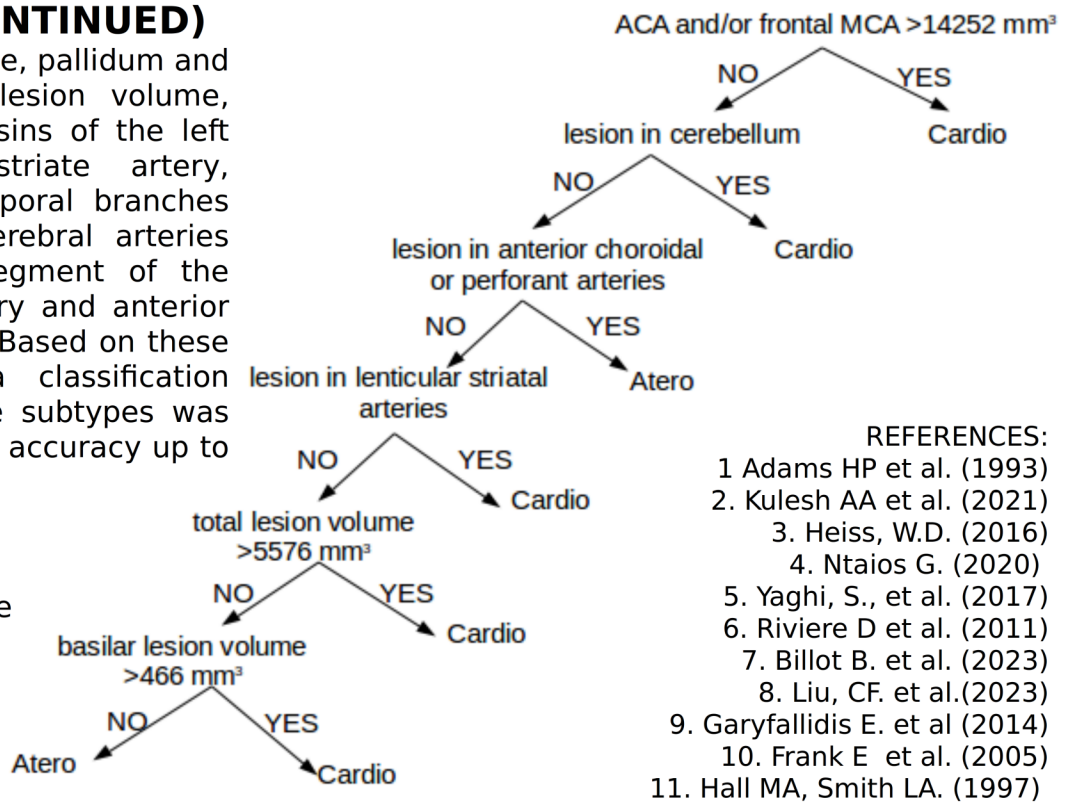
The etiology of stroke is very diverse, with special role given to atherosclerosis and cardiac embolism [1,2]. The severity of the disease, recovery prognosis, and the probability of repeated stroke differ for different etiological stroke subtypes [3]. Thus, it is important to develop personalized strategies for prevention of the secondary strokes based on the information about the pathogenetic subtype of stroke. However, almost every third cas is cryptogenic, i.e. it is not possible to establish its etiology using standard medical examination methods [4,5]. Thus, finding biomarkers of the ischemic stroke subtypes is an crucial task for the prevention of the secondary cerebrovascular accidents. In this study, we have analyzed MRI data to identify the promising biomarkers for distinguishing between atherosclerotic and cardioembolic subtypes of stroke.

METHODS

56 MRI images of patients with acute ischemic stroke were acquired at the Perm City Clinical Hospital No.4: 29 cases were cardioembolic and the rest of the atherosclerotic subtype. For each patient, the lesion was manually delineated on DWI images using Anatomist software [6]. Analysis of the lesion localization w.r.t the affected anatomical structures was performed using SynthSeg v.2.0 software [7]. A digital 3D Brain MRI Arterial Territories Atlas was used to analyze the localization of the lesion w.r.t. the involved arterial territories [8]. To do this, the segmented MRI images were co-registered with the atlas using affine transformation from DIPY package [9]. The obtained lesion characteristics were loaded into the WEKA software [10] to build a classification model using the J48 decision tree algorithm. The most relevant characteristics were selected using the *CfsSubsetEval* function [11].

RESULTS

Lesions characteristics most likely associated with the stroke subtype were the following: white matter lesions in the left hemisphere, lesions in the left cortex, lesions in deep brain structures (caudate, pallidum and putamen), total lesion volume, lesions in the basins of the left medial lenticulostriate artery, anterior and temporal branches of the middle cerebral arteries (MCA), insular segment of the MCA, basilar artery and anterior cerebral arteries. Based on these characteristics, a classification model for stroke subtypes was proposed with the accuracy up to 92.5%.



Fugure 1. Schema of the proposed classification model

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Table 1. Detailed information on the model performance

Type	TP Rate	FP Rate	Precision	Recall	F-Measure	ROC Area
Atherosclerotic	0.833	0	1	0.833	0.909	0.975
Cardioembolic	0.925	0.091	0.934	0.925	0.924	0.975

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