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Automatic Assessment of ASPECTS using Diffusion-Weighted Imaging in Acute Ischemic Stroke using Recurrent Residual Convolutional Neural Network

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The early detection and rapid quantification of acute ischemic lesions play pivotal roles in stroke management. We developed a deep learning algorithm for the automatic binary classification of the Alberta Stroke Program Early Computed Tomographic Score (ASPECTS) using diffusion-weighted imaging (DWI) in acute stroke patients. Three hundred and ninety DWI datasets with acute anterior circulation stroke were included. A classifier algorithm utilizing a recurrent residual convolutional neural network (RRCNN) was developed for classification between low (1−6) and high (7−10) DWI-ASPECTS groups. The model performance was compared with a pre-trained VGG16, Inception V3, and a 3D convolutional neural network (3DCNN). The proposed RRCNN model demonstrated higher performance than the pre-trained models and 3DCNN with an accuracy of 87.3%, AUC of 0.941, and F1-score of 0.888 for classification between the low and high DWI-ASPECTS groups. These results suggest that the deep learning algorithm developed in this study can provide a rapid assessment of DWI-ASPECTS and may serve as an ancillary tool that can assist physicians in making urgent clinical decisions.

Keywords: deep learning, diffusion magnetic resonance imaging, stroke