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SEMI-AUTOMATIC SEGMENTATION OF NEONATAL STROKE LESIONS ON ADC MAPS: A MULTI-DISCIPLINARY APPROACH

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Introduction

Diffusion weighted (DWI) magnetic resonance imaging (MRI) is an important diagnostic tool for neonatal ischemic stroke. The apparent diffusion coefficient (ADC) is a quantitative measure of DWI that provides a measurement of water diffusion in biological tissue. Ischemic stroke lesions have a signature abnormal hypointensity on ADC maps that can be quantified soon after the injury onset by identifying and segmenting the hypointense region. Using a multi-disciplinary approach we examined two semi-automated methods of lesion segmentation, ADC thresholding and hierarchical region splitting, and compared them with manual segmentation results.

Methods

A group of five neonates with arterial ischemic stroke (AIS) and two controls underwent routine 1.5T MRI acquisition within 3.75 ± 1.5 days of presumed injury (birth). Each patient's ADC map was segmented with the following methods: 1) For the ADC threshold method, a delimiting value based on a percentage the ADC in normal appearing tissue was used to segment lesion from normal appearing brain matter (NABM); 2) A hierarchical region splitting algorithm was used to segment the ADC maps using objectively selected thresholds to recursively split the image into smaller sub-images; 3) Lesion hypointensities were manually segmented from NABM.

Results

We found that the ADC threshold method accurately defined the ischemic tissue but in most cases it reported a smaller volume compared to the manual method. Overall, the hierarchical region splitting method reported smaller lesion volumes compared to the other two methods.

Conclusion

ADC threshold definition and hierarchical region splitting methods can accurately segment ischemic lesions from NABM on ADC maps in neonatal AIS patients. Hierarchical region splitting is objective and because it is not dependent on the presence of NABM it can be used to differentiate a wide range of lesion patterns. Such semi-automated methods will be useful to accurately define bilateral or diffuse brain lesions, such as those characteristic of neonatal hypoxic-ischemic encephalopathy.