In vivo $T_2$ brain histogram in multiple sclerosis

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Introduction

MR images showing a measure of the transverse relaxation time of the tissues, rather than $T_2$ weighting alone could be useful in the evaluation of the progression of multiple sclerosis (MS). However, such images are very seldomly used in routine clinical imaging [1] as a large number of echoes are needed to generate accurate $T_2$ images [2]. The sequences usually provided by manufacturers are optimized to provide $T_2$ contrast but lead to a sequence dependant underestimation of the transverse relaxation times [3]. To circumvent these difficulties we propose a calibration of the clinical multi-echo sequence and the creation of $T_2$ histograms to help in the characterization of multiple sclerosis.

Methods

Calibration of the sequence:

A set of phantom of given $T_2$ was used to compare the theoretical "values" of their $T_2$ to the ones found using a 4-echo spin-echo sequence. From these measurements, $T_2$ independent correction factors were found and applied to the intensity of each pixel of each echo-image before the $T_2$ calculation [4] (Figure 1).

Image analysis:

75 subjects were studied: 14 normal control subjects (C), 14 with Relapsing Remitting MS (RRMS), 21 with Secondary Progressive MS (SPMS) and 26 with Primary Progressive MS (PPMS). They were scanned using a 1.5T magnet (GE LX, Milwaukee, Wisconsin). A Mask of the brain was then applied to the $T_2$ images and the $T_2$ histograms estimated after correction of the intensity of each pixel. The mask of brain parenchyma to the brain volume.

The lesion load was measured by an experimented neurologist and an Index of Brain Atrophy (IBA) was determined from the images as the ratio of the cerebrospinal fluid, rather than $T_2$ weighting alone could be useful in the evaluation of the progression of multiple sclerosis (MS). However, such images are very seldomly used in routine clinical imaging [1] as a large number of echoes are needed to generate accurate $T_2$ images [2]. The sequences usually provided by manufacturers are optimized to provide $T_2$ contrast but lead to a sequence dependant underestimation of the transverse relaxation times [3]. To circumvent these difficulties we propose a calibration of the clinical multi-echo sequence and the creation of $T_2$ histograms to help in the characterization of multiple sclerosis.

Discussion

When used in conjunction with an accurately calibrated clinical multi-echo spin-echo sequence, the study of $T_2$ brain histograms is an easy and efficient way to detect tissue changes in brain tissue of MS patients, and may be an effective way to characterize global changes in the brain. Furthermore, the 75th percentile value may be an alternative measure for increased ventricular volume and brain atrophy. The technique presented here has an added advantage as it may enable the standardization of longitudinal studies and permit multi-site cross-calibration of $T_2$ results.

References


Acknowledgement

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Table 1: Significance of the difference between populations according to the parameter tested

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