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ORIGINAL ARTICLE

Diffusion tensor magnetic resonance imaging in assessment of prognostic outcome of stroke patients

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KEYWORDS

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Abstract *Purpose:* The purpose of this study was to assess the utility of diffusion tensor MR imaging as a prognostic imaging technique to detect the clinical outcome in patients presenting with cerebrovascular stroke.

Subjects and methods: The study was conducted on 50 cases presenting with different types of stroke between May 2012 and November 2013. We assessed our patients according to the size of stroke, NIHSS score, degree of reduction of FA and pattern of WM tract affection. Patients presenting with acute ischemic stroke were followed up clinically after 3 months for residual neurological deficits.

Results: We found good association between tractography findings and clinical score at admission as well as the clinical recovery on the follow-up after 3 months. Patients with disruption of white matter tracts had residual deficits on follow-up, whereas patients with displaced and preserved tracts had near complete neurological recovery.

Conclusion: DTI can visualize the changes in the integrity and orientation of the white matter tracts that are affected by cerebrovascular lesions which cannot be detected by conventional MRI. By MR tractography, we can detect the pattern of white matter tract affection that offers a potential tool for correlating the clinical outcome with the imaging findings.

1. Introduction

Stroke is one of the leading causes of death worldwide, especially in the elderly population. As a broad clinical term, it includes patients with arterial ischemic infarcts, intracranial hemorrhage, subarachnoid hemorrhage, and venous infarction (1).

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Recent advances in MR methodologies now enable rapid identification of ischemic tissue in acute stroke. Techniques such as diffusion weighted imaging (DWI) appear to delineate infarcted tissue. Abnormalities demonstrated using MR perfusion imaging potentially identify areas at risk of infarction in the ischemic penumbra. The challenges in imaging of very early stroke are centered on the identification of potentially salvageable tissue and the assessment of whether there is a major vascular occlusion or not, the aim being to give appropriate targeted therapy to identifiable subtypes of stroke. A less well addressed problem relates to the use of imaging to provide prognostic information regarding clinical outcome (2).

Conventional MR imaging cannot provide reliable information about the integrity of white matter tracts, thereby limiting the ability to predict clinical outcome (1).

Diffusion imaging is an MRI imaging technique that is sensitized to the Brownian motion of water molecules in biological tissues. White matter in the brain is anatomically present in different directions, so diffusion in the brain is not uniform but anisotropic, along the direction of the various fiber tracts. Therefore, the measure of diffusion cannot be represented as a single quantity but is modeled by estimation of a diffusion tensor (D), which is the measurement of water diffusion in different directions (3).

DTT is promising for stroke mapping to predict motor outcome. Diffusion tensor imaging and MR tractography techniques can be used to evaluate the structural degeneration of white matter tracts following stroke (1,4).

The ability to identify white matter tract disruption in acute stroke may be a useful index of stroke severity and may allow insight into likely recovery and long-term disability (2).

2. Subjects and methods

2.1. Patients

This study was conducted on 50 patients (30 males and 20 females) between May 2012 and November 2013. Age range between 24 and 80 years referred from the neurology department to the radiology department. Written consents were obtained from all patients. Patients presented with stroke including 48 patient with ischemic stroke (24 acute nonhemorrhagic, 6 acute with hemorrhagic conversion and 18 chronic stroke) and 2 primary intracerebral hemorrhage.

The time of imaging varied from less than one week to more than eight weeks after the onset of acute symptoms.

Clinical neurological deficits were evaluated by a neurology specialist using the National Institutes of Health Stroke Scale (NIHSS) on admission.

The patients presenting with acute ischemic stroke (hemorrhagic or nonhemorrhagic) were followed up clinically after 3 months for residual neurological deficits.

The interval changes of the NIHSS scores were assessed and neurological improvement was defined as a decrease of points in the NIHSS score

2.2. MR examination

MRI was done without prior preparation or anesthesia and after the exclusion of MRI contraindications as cardiac pacemaker, claustrophobia, etc.

2.3. Technique

2.3.1. Acquisition

Technique was performed using a standard 1.5 Tesla unit (Intera and Achieva, Philips).

- A standard head coil was used.
- The sequences obtained were axial T1 W, T2 W, FLAIR, DW and Diffusion tensor.
- Diffusion tensor consisted of the following:
  - A single shot, spin-echo echoplanar sequence in 12 encoding directions.
  - A diffusion weighting factor of 800 s/ mm^2.
  - TR 8000 ms.
  - TE 67 ms.
  - Flip 90°.
  - Matrix 112×110.
  - FOV 210×236 mm.
  - Number of excitations: 2.
  - Slice thickness: 2.0/00.

- All the images were transferred to the workstation (Philips Extended MR Workspace, 2.6.3.5, Netherlands) for postprocessing.

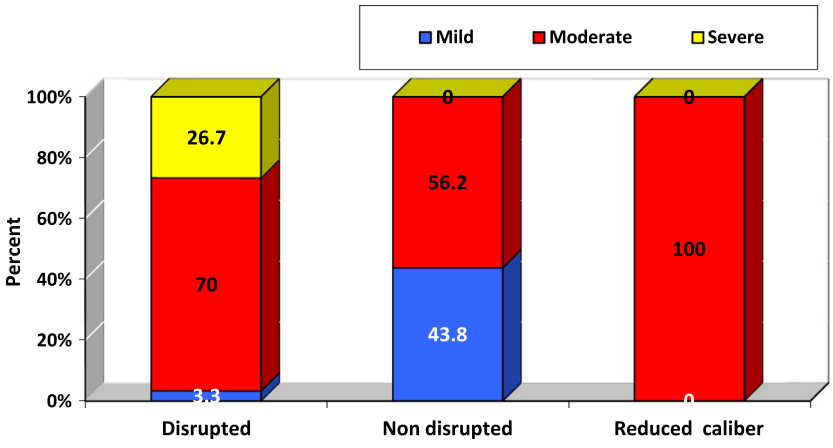

Fig. 1 Association between pattern of WM tracts involvement detected by FT and NIHSS on admission in the studied group.