Utility of diffusion tensor imaging in the acute stage of mild to moderate traumatic brain injury for detecting white matter lesions and predicting long-term cognitive function in adults.

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Source

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Abstract

OBJECT:

Traumatic brain injury (TBI) often impairs cognitive function. Diffusion tensor (DT) imaging, a novel modality, permits evaluation of the effects of head trauma on white matter nerve fibers. The objectives of the current study were to investigate where the white matter injury following mild to moderate TBI is specifically located on DT imaging in the acute disease stage and to examine the relationship between the severity of the white matter lesion on DT imaging in the acute stage of TBI and future cognitive function in the chronic disease stage.

METHODS:

Twenty adult patients with mild to moderate TBI (Glasgow Coma Scale score between 9 and 15) underwent conventional MR and DT imaging a median of 3.5 days after injury, and 27 matched healthy controls also underwent both imaging modalities. The patients with TBI were further subdivided into 2 groups, that is, mild and more severe TBI groups, based on clinical (mild or moderate TBI), CT (diffuse brain injury [DBI] I or II), or MR imaging (normal or pathological appearance) classification. Fractional anisotropies (FAs) were compared between patients and controls using the region of interest method. Regions of interest were located in 8 different areas including the genu, stem, and splenium of the corpus callosum and the corona radiata (CR), anterior limb of the internal capsule (ALIC), posterior

limb of the internal capsule (PLIC), frontal white matter (FWM), and occipital white matter (OWM) of the periventricular white matter. Eleven patients with TBI also underwent neuropsychological testing, which included the Trail Making Test, Wisconsin Card Sorting Test, Wechsler Adult Intelligence Scale-Revised, and P300 testing in the chronic disease stage (median 364 days).

RESULTS:

Region of interest analysis demonstrated significantly lower FA values in the genu, stem, and splenium of the corpus callosum in more severe TBI groups (moderate TBI on clinical classification, DBI II on CT classification, and pathological appearance on MR imaging classification) than in controls. A significant difference was also observed in the FA of the splenium between controls and the mild TBI group of the clinical classification. No significant difference was observed in the FA of the CR, ALIC, PLIC, FWM, and OWM between controls and any of the TBI groups of clinical or imaging classifications. No significant difference was observed in the FA of any regions between mild and more severe TBI groups of the clinical or imaging classifications. Multiple regression analysis showed a statistically significant positive linear relationship between FA in the splenium and total IQ ($r = 0.79$, $p = 0.004$). A significant negative linear relationship between FA in the FWM and P300 latency was also observed ($r = 0.62$, $p = 0.04$).

CONCLUSIONS:

Fractional anisotropy reductions in the splenium and FWM in the acute stage of mild to moderate TBI may be a useful prognostic factor for long-term cognitive dysfunction.

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