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Diagnostic Methods in Traumatic Brain Injury

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av

Johan Ljungqvist

Fakultetsopponent:
Professor Lars-Owe Koskinen
Norrlands Universitetssjukhus, Umeå, Sverige

Avhandlingen baseras på följande delarbeten

I. Ljungqvist J, Nilsson D, Ljungberg M, Sörbo A, Esbjörnsson E, Eriksson-Ritzén C, and Skoglund T. Longitudinal study of the diffusion tensor imaging properties of the corpus callosum in acute and chronic diffuse axonal injury. Brain Injury. 2011; 25(4): 370–378.

II. Ljungqvist J, Nilsson D, Ljungberg M, Esbjörnsson E, Eriksson-Ritzén C, and Skoglund T. Longitudinal changes in diffusion tensor imaging parameters of the corpus callosum between 6 and 12 months after diffuse axonal injury. Brain Injury. 2017; 31(3): 344-350.

III. Ljungqvist J, Zetterberg H, Mitsis M, Blennow K, and Skoglund T. Serum Neurofilament Light Protein as a Marker for Diffuse Axonal Injury: Results from a Case Series Study.
Journal of Neurotrauma. 2017; Mar 1;34(5): 1124-1127.

IV. Ljungqvist J, Candefjord S, Persson M, Jönsson L, Skoglund T, and Elam M. Clinical Evaluation of a Microwave-Based Device for Detection of Traumatic Intracranial Hemorrhage. In press: Journal of Neurotrauma. 2017 Mar 13. doi: 10.1089/neu.2016.4869.

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ABSTRACT

Background: Traumatic brain injury (TBI) is a major cause of death and disability worldwide. Early detection and quantification of TBI is important for acute management, for making early accurate prognoses of outcome, and for evaluating potential therapies. Diffuse axonal injury (DAI) is a distinct manifestation of TBI that often leads to cognitive and neurologic impairment. Conventional neuroimaging is known to underestimate the extent of DAI, and intracranial hematomas can usually be detected only in hospitals with radiology facilities. In this thesis, study I and II were longitudinal investigations using a magnetic resonance diffusion tensor imaging (MR-DTI) technique to quantify DAI. Study III tested whether a novel blood biomarker, neurofilament light (NFL), could identify DAI, and study IV tested whether a microwave technology (MWT) device, designed for use also in a prehospital setting, could detect intracranial hematomas.

Patients and methods: In study I, MR-DTI of the corpus callosum (an anatomical region prone to DAI) was performed in eight patients with suspected DAI in the acute phase and at 6 months postinjury. Clinical data and 6-month outcomes were also examined. In study II, MR-DTI was performed in 15 patients with suspected DAI, 6 and 12 months postinjury. Clinical data and 6- and 12-month outcomes were also examined. In study III, nine patients with DAI were tested for serum NFL-levels in the acute phase. The results were compared with those of healthy controls as well as with the DTI-parameters and outcomes of the patients at 12 months. In study IV, 20 patients with intracranial hematomas (chronic subdural hematomas, cSDH) and 20 healthy controls were tested with a MWT device.

Results: In studies I and II, differences were observed in the diffusion parameters (fractional anisotropy, FA, and diffusivity, here referred to as trace) of the patients. FA was decreased for patients in the acute phase and at 6 and 12 months compared with controls but did not change significantly between the investigations. Trace was unchanged in the acute phase compared with controls but increased at 6 months and continued to increase at 12 months. The findings correlated with clinical outcome as patients with worse outcomes had more evident changes in their diffusion parameters. In study III, the mean NFL concentrations among patients displayed a 30-fold increase compared with controls and NFL completely discriminated between them. There was also a relationship between NFL and the MR-DTI parameters. In study IV, the MWT device could identify all hematomas at a cost of 25% false positives.

Conclusions: The longitudinal MR-DTI studies (I-II) contribute to a growing body of knowledge about the natural course of DAI and the possible underlying pathophysiological mechanisms. MR-DTI can also quantify DAI which is important for making accurate early prognoses and prerequisite the evaluation of other diagnostic tools and potential therapies. A conspicuous finding was that the DTI parameters and the clinical outcomes changed between 6 and 12 months postinjury, which means that further studies are needed to determine if or when a stable state occurs. The serum marker NFL (study III) was found to be a potential early biomarker for DAI reflecting the severity of the injury. Finally, the results from a new approach to detect intracranial hematomas using a MWT device (study IV) yielded promising results for use in the early triage of patients with head injury.

Keywords: traumatic brain injury, diffuse axonal injury, diffusion tensor imaging, serum biomarkers, microwave technology.

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