Institutionen för molekylär medicin och kirurgi

Nerve Diffusion Tensor Imaging

AKADEMISK AVHANDLING
som för avläggande av medicine doktorsexamen vid Karolinska Institutet offentligen försvaras i Rolf Lufts auditorium, L1:03, Karolinska Universitetssjukhuset Solna

Fredagen den 9 november, 2012, kl. 13.30

av
Mikael Skorpil
M.D.

Huvudhandledare:
Professor Anders Sundin
Karolinska Institutet
Institutionen för molekylär medicin och kirurgi

Bihandledare:
Medicine doktor Veli Söderlund
Karolinska Universitetssjukhuset Solna
Röntgenkliniken Solna

Fakultetsopponent:
Docent Tomas Bjerner
Uppsala universitet
Institutionen för radiologi

Betygsnämnd:
Docent Stefan Skare
Karolinska Institutet
Klinisk neurovetenskap

Docent Göran Solders
Karolinska Institutet
Klinisk neurovetenskap

Docent Johan Wikström
Uppsala universitet
Institutionen för radiologi

Stockholm 2012

ABSTRACT

Diffusion tensor imaging (DTI) is a magnetic resonance imaging technique that *in vivo* visualises random translational movement of water molecules. DTI has inherent difficulties with low signal-to-noise ratio, sensitivity to patient motion, field inhomogeneities and fast T2 relaxation. It has been used in the central nervous system, although it has not been assessed in the peripheral nervous system. The aim of this thesis was to investigate if DTI in peripheral nerves was feasible, and if so, to investigate clinical implications.

Study I showed that in healthy volunteers the peripheral nerves, the sciatic nerves, could be visualised *in vivo* using DTI and fiber tracking. Study II showed that sciatic nerves, including their division into the tibial and common fibular nerves, have a characteristic diffusion pattern with most impaired diffusion perpendicular to the nerve direction. This allowed nerves, excluding other tissues and artifacts, to be visualised using a novel approach called diffusion-direction-dependent imaging and with a simple unidirectional diffusion maximum-intensity projection approach. Study III showed that the olfactory bulbs (OBs) and olfactory tracts could be visualised *in vivo* using DTI and fiber tracking. In Study IV, Parkinson's disease (PD) patients with impaired olfaction were evaluated with DTI of the OBs. A novel approach of DTI was used, taking advantage of the technique's inherent directional information, for region of interest placement and diffusion measurements in the OBs. In the PD patient group diffusion was altered in the OBs, compared to healthy controls. This was hypothesised, since α-synuclein inclusions and Lewy neurites interfering with nerve structure have been detected in the OBs. However, the coefficient of variation between two identical DTI series was high, due to the small size of the OBs and their location in an area susceptible to artifacts, and the difference between the groups was statistically significant only for the first of two series. In Study V, patients of the Swedish 'Huddinge Spinocerebellar ataxia (SCA) Family' with peripheral neuropathy, were evaluated with DTI of a peripheral nerve. Diffusion alterations were found in peripheral nerves in SCA patients, compared to healthy controls, which was statistically significant.

In conclusion, DTI in peripheral nerves is feasible and can be used to detect diffusion alterations in OBs in PD patients and in peripheral nerves in SCA patients with peripheral neuropathy.

ISBN 978-91-7457-904-8