CNS 2018 ANNUAL MEETING
HOUSTON, TEXAS
OCTOBER 6-10, 2018

White Matter Tracts Fractional Anisotropy and Mean Diffusivity Changes Over Time in A Rodent Model of Chronic Communicating Hydrocephalus

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Introduction

The pathogenesis of idiopathic normal pressure hydrocephalus (iNPH) still unclear, although, alterations in the white matter secondary to mechanical forces due to the ventricular dilatation is believed to contribute to the patient's symptomatology. Diffusion tensor imaging (DTI) has been used to characterize microstructural alterations of the brain parenchyma. Given the difficulty to identify iNPH patients before their symptoms onset, we aim, in this study, to explore the fractional anisotropy (FA) and mean diffusivity (MD) in the white matter tracks (WM) during the development of communicating chronic hydrocephalus in a rodent model.

Learning Objectives

To identify the diffusion properties and dynamics in the brain parenchyma during the development of chronic communicating hydrocephalus.

Methods

Communicating chronic hydrocephalus was induced in five adults Sprague-Dawley rats weighing 250g by a bilateral kaolin injection into the subarachnoid space over the convexities. Five additional animals were used as a control. DTI data acquisition was obtained with a Bruker 11.7-Tscan. Regional FA and MD were measured at the corpus callosum (CC) and cortical-spinal tracts (CST) at days 15,60,90 and, 120 after injection. Statistical analysis was performed using Mann-Withney's-U, Spearman and Friedman's tests.

Results

Progressive ventricular enlargement was demonstrated in the injected group at all four-time points ($p<0.050$) when compared with control animals. MD at the corpus-callosum was significantly higher in animals with hydrocephalus: 14($p=0.0278$), 60($p=0.0143$), 90($p=0.009$), and 120 days ($p=0.0139$). CC-MD shows a positive correlation with the ventricular volume ($p=0.013$), as well as a significant progressive increase in value over time ($p=0.0070$). CC-FA was decreased in the hydrocephalic

Conclusions

Mean Diffusivity measurements at the corpus-callosum were significantly higher at all time points in the hydrocephalic animals. These values should be further studied and correlated with behavioral changes as well as its variations/recovery when treated the animals with CSF diversion at different time points.

FA and MD Values Between Injected Aanimals vs. Control

Group	FA-CC				
	PreOp.1	15Days1	60Days1	90Days1	120Days1
Injected	0.515	0.520	0.551	0.543	0.534
Control	0.534	0.516	0.551	0.568	0.539
	FA-CP				
	PreOp.2	15Days2	60Days2	90Days2	120Days2
Injected	0.620	0.653	0.672	0.666	0.687
Control	0.649	0.645	0.659	0.672	0.659
	MD-CC				
	PreOp.3	15Days3	60Days3	90Days3	120Days3
Injected	1.118	1.341	1.409	1.456	1.476
Control	1.118	1.103	1.144	1.043	1.147
	MD-CP				
	PreOp.4	15Days4	60Days4	90Days4	120Days4
Injected	1.089	1.180	1.142	1.102	1.108
Control	1.109	1.115	1.171	1.062	1.118
	LV				
	PreOp.5	15Days5	60Days5	90Days5	120Days5
Injected	2.550	66.000	177.700	240.000	273.000
Control	4.810	7.438	10.355	11.980	12.940

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