Exploring structural brain connectomes and its impact on sensorimotor function in children with unilateral cerebral palsy

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Introduction

We explored structural brain connectomes in children with unilateral cerebral palsy (uCP) and its relation to sensorimotor function using graph theory.

Patients and methods

We assessed in 44 children with spastic uCP (mean age 10y7m±2y9m; Manual Ability Classification System I=14; II=16; III=14) upper limb sensorimotor function. We collected multi-shell diffusion-weighted, T1-weighted and T2-FLAIR MRI and performed transcranial magnetic stimulation. Structural connectomes were constructed using Desikan-Killiany parcellations based on Virtual Brain Grafting and MRTrix3 CSD-tractography. Graph metrics (characteristic path length, global/local efficiency and clustering coefficient) were calculated for ipsilesional/contralesional hemisphere and sensorimotor network (SMN), and were compared between lesion types (white matter (WM)=27; grey matter (GM)=17) and corticospinal tract (CST) wiring patterns (ipsilateral=14; bilateral=14; contralateral=11; unknown=5) using ANCOVA with age-correction. We used elastic-net regression to investigate how graph metrics, lesion volume/type and CST-wiring pattern predict sensorimotor function.

Results

In WM-lesions, the ipsilesional hemisphere and SMN have a lower cluster coefficient ($p<0.01$), and the contralesional hemisphere and SMN respectively showed lower global and local efficiency ($p<0.008$) compared to GM-lesions. No differences were found between CST-wiring patterns. Elastic-net regression predicted moderate to high values for sensorimotor function (R^2=0.48-0.87). For motor function, the CST-wiring pattern was identified as the strongest predictor. No strong predictors were revealed for somatosensory function for which all variables contributed to a limited extent.

Conclusion

Structural connectomes across both hemispheres differ between lesion types. For predicting motor function, the CST-wiring pattern still seems to outweigh structural connectomes, while for somatosensory function a strong predictor could not be identified.

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