STRUCTURAL AND FUNCTIONAL REORGANIZATION OF LANGUAGE FUNCTIONS IN YOUNG CHILDREN WITH PERINATAL ISCHEMIC STROKE

Clément François, Pablo Ripollés, Laura Ferreri, Laura Bosch, Alfredo García-Alix, Jordi Muchart, Joanna Sierpowska, Carme Fons, Jorgina Solé, Monica Rebollo & Antoni Rodriguez-Fornells

University of Barcelona

Grant 244/14

Background: Despite a rather large body of literature on typically developing children, little is known on the effect of early brain lesion on the stepwise acquisition of linguistic functions in young children. Patients who have suffered from early left hemisphere injury during the perinatal period are of great interest, as they present individual differences in their degree of language recovery. Only few fMRI data collected in children with perinatal left-hemisphere brain lesions have brought evidence that the undamaged right hemisphere is able to take over language functions as revealed by near to normal linguistic processing, thus supporting a model of recovery based on inter-hemispheric transfer of function. More recent studies have detected subtle language processing deficits on these children. As a consequence, it is still an open question to which extent the nature and extent of language reorganization and plasticity after an early brain insult is enough for normal language development.

Aims: The aims of the project were (i) to better understand how functional and structural white-matter connectivity during brain maturation is reorganized after perinatal ischemic stroke and (ii) to evaluate to which extent language functions in these children are associated with functional and structural brain changes occurring due to the large plasticity of the underlying neural networks.

Method: Nine patients with pre- or perinatal stroke (3 with lesion over the right hemisphere and 6 with lesions over the left hemisphere) took part in the present study. Neurocognitive development was assessed at 42 months of age. Language outcomes were extensively evaluated with measures on receptive vocabulary, phonological whole-word production and linguistic complexity in spontaneous speech. Word learning abilities were also assessed using a fast-mapping task designed to assess immediate and delayed recall of the mapped words.

We also acquired functional and structural imaging data as well as a measure of intrinsic connectivity.

Results:
1) We found converging functional and structural evidence for a right reorganization of the language network in the sub-group of children with a left perinatal stroke. Specifically, BOLD activations during the passive listening task were found to be clearly right lateralized with significant clusters over the right Inferior frontal and right middle temporal gyri.

2) We found converging evidence from both DTI tractography and rs-fMRI data that a greater structural-functional reorganization to the right hemisphere was related to better outcomes in several productive language related tasks.
Conclusions: To our knowledge, no previous studies have provided a 3D reconstruction of the dorsal and ventral language white-matter pathways in a homogeneous group of young 4-year old children with perinatal ischemic stroke. Our results suggest that the amount of right lateralized reorganization induced by early left lesion is may predict productive and receptive aspects of language at this age.

Keywords: Perinatal stroke, Brain plasticity, Language development, NeuroImaging data, functional and structural connectivity

Publications:

E-mail contact: arfornells@gmail.com