Investigation of language networks in children with congenital heart disease: preliminary data of resting-state functional imaging

S. Fourdain1,2, P. Vannasing1, J. Goulet1, J. Tremblay1, A. Gallagher1,2

1Laboratoire d’imagerie optique en neurodéveloppement (LION’s lab), CHU Sainte-Justine Research Center, Montreal, Quebec, Canada, 2Centre de Recherche en Neuropsychologie et Cognition (CERNEC), University of Montreal, Montreal, Quebec, Canada

Background: Children with congenital heart disease (CHD) exhibit a well known pattern of motor and cognitive delays, and seem to be at higher risk of developing language disorders. Indeed, literature point out that 15 to 34% of children with CHD present language delays, in both receptive and expressive domains. Several clinical and socio-demographical factors have been identified as predictors of developmental delays in this population. However, it is not clear if language delays are underlain by altered developmental patterns of brain networks during early childhood. The aim of the present study is thus to investigate language networks in 4-month-old infants with CHD using resting-state functional connectivity in near infrared spectroscopy (rs-fcNIRS).

Methods: We acquired NIRS data in 6 healthy infants and 2 infants with CHD, at 4 months of age. Hemodynamic concentration changes were recorded at rest for 15 minutes in fronto-central and temporal regions using a tissue oximeter provided with 38 sources (690 and 830 nm) and 8 detectors. Pearson correlations were applied to oxy-hemoglobin concentration changes between our previously segmented regions (fronto-temporal, including Broca’s area; median temporal, including Wernicke’s area; temporal posterior; premotor; and motor cortex). Laterality indices were calculated for pairs of homologous channels using the following formula: LI=(LL-RL)- (RR-LR)/ |LL|+|LR|+|RR|+|RL|. Correlation matrixes and laterality indices were projected on a 4 month-old MRI template in order to obtain functional connectivity maps of language networks.

Results: Preliminary data reveals in most healthy infants and all infants with CHD strong correlations between hemodynamic changes in frontal inferior and temporal median regions, in both left and right hemispheres. In addition, laterality indices show a left dominance in fronto-central and temporal regions for all participants.

Conclusions: Our preliminary results suggest that rs-fcNIRS can identify language networks in healthy infants and young babies with CHD. By adding neuropsychological assessment during the child’s development, rs-fcNIRS could eventually allow to identify predictive markers of language delays in children with CHD.