Impact of fetal development on neurocognitive performance of adolescents with cyanotic and acyanotic congenital heart disease (CHD)

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Purpose: Our aim was to evaluate the neurocognitive performance in adolescents with CHD and to determine whether parameters of fetal development evaluated in neonates, such as head circumference, length, weight and Apgar scores, are somehow related to their neurocognitive performance.

Methods: 77 CHD patients (43 males) aged from 13 to 18 years old (mean=15.04 ± 1.86), 46 cyanotic (23 Tetralogy of Fallot, 23 Transposition of the Great Arteries) and 31 acyanotic (Ventricular Septal Defect) enrolled in this study. The control group included 16 healthy children (11 males) ages ranging from 13 and 18 (mean=15.69 ± 1.44). All assessment measures for CHD patients were once obtained in a tertiary hospital; the control group was evaluated in school. Demographic information and clinical history were collected. Neuropsychological assessment included Wechsler's Digit Test, direct and reverse (WDD, WDR) and Symbol Search (WSS), Rey's Complex Figure (RCF), BADS’s Key Searching Test (BKS), Color-Word Stroop Test (CWS), Trail Making Test (TMT) and Logical Memory Task (LMT).

Results: CHD patients compared to control group showed lower scores in WDD (u=262.500; p=0.000) and WDR (u=166.500; p=0.000) versions, in RCF, copy (u=152.500; p=0.000) and memory (u=149.000; p=0.000), in WSS (u=852.000; p=0.016), in BADS’s Key Searching Test (u= 160.500; p=0.000) in CWS, words (u=147.000; p=0.000), colors (u=225.000; p=0.000) and interference (u=133.500; p=0.000) and in TMT, A (u=1140.500; p=0.000) and B (u=1101.500; p=0.000). Cyanotic patients, when compared to acyanotic, showed lower scores in all neuropsychological tasks, although the only differences that were significant were in RCF, copy (u=935.500; p=0.020), memory (u=989.000; p=0.004) in CWS, interference (u=903.000; p=0.048). Several correlations were apparent between fetal/ neonatal parameters and neuropsychological abilities in each type of CHD. However, head circumference at birth stands as a main correlation with cognitive development later on in all kinds of CHD (WDD: rho=0.339, p=0.011; RCF, copy: rho=0.297, p=0.027; BKS: rho=0.264, p=0.051; CWS, interference: rho=0.283, p=0.036; TMT A: rho=−0.321, p=0.036; LMT: rho=−0.263, p=0.052).

Conclusion: Adolescents with CHD have worse neuropsychological performance than the control group, mainly the cyanotic patients. Fetal circulation seems to have impact on cerebral and somatic growth, predicting cognitive impairment in adolescents with CHD.