DIFFUSION TENSOR IMAGING OF COCAINE EXPOSED CHILDREN

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Introduction

Diffusion tensor imaging is finding wide application in basic research and clinical studies. Animal studies have shown structural brain changes arising from cocaine exposure but there have not been, until now, any studies in humans. Over the last three years we have examined a cohort of children that are right-handed and cocaine-exposed (n = 28) (i.e. born to cocaine addicted mothers) and compared them with sociodemographically similar non-exposed children (n = 25; mean age: 10.6 years) in order to determine if DTI can detect any structural changes in these developmentally challenged children.

Experimental

Data were collected on a 3T Siemens human head scanner in the AMRIS facility. Diffusion tensor imaging (DTI) was implemented using echo planar imaging and six diffusion encoding directions with b values of 0, 250, and 1000 seconds/mm², 3.5-mm slice thickness, 210 x 210 cm field of view, 128 x 128 matrix, 4200-ms repetition time, 90-ms echo time, and 4 excitations. Total acquisition time was 4 minutes. The data were processed using in-house software and semi automated image segmentation. DTI maps were generated and the average diffusion and fractional anisotropy were measured in the left and right frontal callosal (LFC, RFC) and frontal projection fibers (RFP, LFP) as shown in figure 1. Executive functioning was assessed using two well-validated neuropsychological tests (Stroop color-word test and Trail Making Test).

Results and Discussion

The cocaine-exposed children had higher average diffusion in the LFC and RFP fibers. They were also significantly slower on a visual-motor set-shifting task with a trend toward lower scores on a verbal inhibition task. Controlling for gender and intelligence, the average diffusion in the LFC fibers was related to prenatal exposure to alcohol and marijuana and an interaction between cocaine and marijuana exposure. Performance on the visual-motor set-shifting task was related to prenatal cocaine exposure and an interaction between cocaine and tobacco exposure. Additionally, significant correlations were found between test performance and fractional anisotropy in areas of the frontal white matter.

Conclusions

DTI techniques can detect changes in brain structure in prenatally cocaine exposed children. Prenatal cocaine exposure is associated with slightly poorer executive functioning and subtle microstructural changes suggesting less mature development of frontal white matter pathways. The relative contribution of postnatal environmental factors, including characteristics of the caregiving environment and stressors associated with poverty and out-of-home placement, on brain development and behavioral functioning in polydrug-exposed children awaits further research. We plan to improve the DTI techniques employed and examine a larger cohort of patients. This study has recently been published (1).

References.


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