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Imaging the Long-Term Effects of Drug Exposure in Utero

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The teratogenic impact on the Central Nervous System (CNS) of prenatal exposure to drugs and alcohol has been recognized for many years. Evidence has come from a variety sources including animal models, post mortem anatomical studies, and altered neurobehavioral outcomes in offspring. With the advances in neuroimaging methods over the last two decades, it is now possible to observe these effects in the living human brain. In this presentation, the current status of work in this area will be reviewed with particular emphasis on the effects of prenatal exposure to alcohol and stimulants (i.e., cocaine/methamphetamines) (1,2), which have the most extensive literature at the present time. Factors that influence research on these topics will be discussed including poly drug exposure, post natal diagnosis and confirmation of maternal use and gestational exposure.

Alcohol exposure and a diagnosis of fetal alcohol syndrome are associated with the reductions in brain volume (3) as well as in specific areas in brain, particularly in the corpus callosum (4) and relative deficits in white versus grey matter (5). On a microstructural level, Diffusion Tensor Imaging (DTI) studies indicate significant attenuation of white matter integrity (4,6). Functional MRI studies find alterations in BOLD responses during cognitive tasks in alcohol-exposed individuals (7,8); however, correlation of these observations with specific behavioral effects are rare (but see, 9,10). Studies of effects of prenatal cocaine exposure are more limited than those of alcohol (11) and are not as likely to report reductions in brain volume or other structural deficits. Some studies of cocaine-exposed youth find no evidence of cognitive alterations in this group (12); however, examination of arousal regulation or responses to effects of negative stimuli suggest that there are specific functional changes that can be attributed to prenatal stimulant effects (13). More recently, studies of functional and effective connectivity have been done which suggest that prenatal exposure is associated with alterations in brain connectivity which can be observed during the resting state (14, 15). Thus, this still limited body of existing effects of prenatal alcohol exposure in young adults using structural and functional MRI and DTI

- a. Reduced white matter in Occipital lobe.
- b. Transcollosal Conductivity on a motor task.
- c. Decreased fractional anisotropy.

studies on prenatal exposure indicates that there are both structural and functional effects that can be observed using a variety of imaging techniques. However, while there is good experimental evidence of effects of drugs and alcohol, it is not clear that these measures can, as yet, be used for diagnosis of individual patients in the absence of other information. Most reported studies have been of group data that have experimental significance but whose specific clinical utility has not been demonstrated. In this context, an approach that examined the specificity and sensitivity of behavioral, imagining and connectivity measures in the categorization of individuals exposed to cocaine will be reviewed (16).

References