

The Influence of Alcohol on In Utero Brain Development: A Structural Fetal MRI Study

PURPOSE

Alcohol consumption during pregnancy affects brain development leading to a variety of behavioral and cognitive disorders. However, early structural alterations of fetal brain development have not yet been systematically studied. This prospective single center fetal MRI study aims to assess the effects of alcohol exposure on brain development.

METHODS AND MATERIALS

After inclusion of 20 fetal MRI studies of fetuses with prenatal alcohol exposure (PAE, 22+1 - 36+4 weeks of gestation (GW)) due to the standardized systematic questionnaires (TACE and PRAMS). These cases were 1:1 age matched to a healthy control case. Brain maturation was assessed by using the fetal total maturation score (fTMS) (Vossough et al. 2013) based on superresolution-postprocessed T2-weighted/SSFP sequences in 3 planes (1.5T). In addition, the depth of temporal and occipital sulci and the expression of fetal brain asymmetry in the temporal lobe were quantified.

RESULTS

In PAE fetuses, the fTMS score was significantly lower ($p=0.007$) and the right superior temporal sulcus (STS) was shallower ($p<0.001$). Delayed fetal brain development could be specifically related to an age inappropriate/delayed stage of myelination and less distinct gyration in the frontal and occipital lobes ($p=0.04$).

CONCLUSIONS

This fetal MRI study revealed an early impact of PAE on structural fetal brain maturation and development. In addition to alterations of the periventricular zone and the corpus callosum detectable by atlas-based analysis (Stuempflen et al. RSNA 2021), this study emphasizes early and diffuse alterations to fetal structural brain development and delayed brain maturation in fetuses affected by maternal alcohol consumption.

CLINICAL RELEVANCE/APPLICATIONS

Identification of the teratologic toxic effects on human brain development opens new diagnostic opportunities for fetal neuroradiology, allowing early postnatal support programs in these cases and stimulating the discussion of alcohol prevention during pregnancy to promote public health.