Brain abnormalities are present before birth in many children with congenital heart disease

childhood disability LINK

Summary

Children with congenital heart disease (CHD) often face neurodevelopmental challenges Congenital heart disease (CHD) is defined as a heart defect present at birth. Children born with CHD often face neurological and developmental challenges as they grow. Conventionally, these neurodevelopmental effects have been attributed to a possible interruption in blood flow during cardiac surgery. While studies of risk minimization during cardiac surgery are continuing, it has become apparent that neurological abnormalities are present even before birth in these children. Using fetal magnetic resonance techniques, this study compared prenatal brain size and metabolism between subjects with and without CHD. CHD is associated with a smaller brain and abnormal metabolism before birth For this study, fetal 3D magnetic resonance imaging (MRI) and proton magnetic resonance spectroscopy (H-MRS) were performed on 55 subjects with echocardiogram-diagnosed CHD and 50 subjects with no sign of CHD. 3D-MRI was used to quantify brain volume and H-MRS was used to quantify cerebral N-acetyl aspartate (NAA), choline, and lactate to assess brain metabolism. Subjects' fetal age ranged from 25-37 weeks of gestation at the time of testing. After adjusting for gestational age, smaller brain volume during the third trimester was significantly associated with CHD. Subjects with CHD also displayed a slower rise in the ratio of NAA:choline compared to normal fetuses. A low NAA:choline ratio was also associated with reduced antegrade aortic arch flow and evidence of cerebral lactate.

What families should know

This study adds to emerging evidence of a prenatal origin of brain abnormalities in children with CHD. This new knowledge may allow practitioners to target neurodevelopmental therapies at a very early age, thus improving long-term outcome among children with CHD. This study highlights a low NAA:choline ratio and high lactate levels as two potential prenatal markers of neurological abnormalities. The former likely reflects delayed neuronal development while the latter likely reflects low oxygen levels. However, further investigation will be required to confirm the significance of these markers for long-term neurodevelopment.

What practitioners should know

While the causes of the brain abnormalities observed in this study are unknown, they are likely either genetic or secondary to CHD. The second possibility seems probable because abnormal heart development likely causes insufficient blood flow to the brain, leading to oxygen deprivation and impaired neural development. The association found here between CHD and increased cerebral lactate, indicative of anaerobic metabolism as well as reduced antegrade aortic flow, further supports this possibility. Nonetheless, definitive conclusions are elusive because there is currently no way to measure

oxygen or glucose in fetal blood. Importantly, this study will follow patients over the long term, which will allow a better understanding of the implications of the prenatal neurological profile observed here.

Reference

Limperopoulos, C., Tworetzky, W., McElhinney, D., Newburger, J., Brown, D., Robertson, R., et al. (2010). Brain volume and metabolism in fetuses with congenital heart disease: Evaluation with quantitative magnetic resonance imaging and spectroscopy. Circulation, 121, 26-33.