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Pathology of the placenta during pregnancy: VSASL placental imaging in CHD pregnancies

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DESCRIPTION

During pregnancy, the placenta is a crucial organ for the growth and development of the foetus. The leading cause of morbidity and mortality in new-borns is congenital heart disease. Despite the parallel development of the placenta and foetal heart in the early stages of pregnancy, few studies have suggested a link between placental dysfunction and foetal CHD. In this study, they report measurements of placental perfusion made using cutting-edge foetal MRI methods during healthy pregnancies and pregnancies complicated by foetal CHD. They looked at 48 pregnant women who had foetal MRIs in the second or third trimester of their pregnancies. Utilizing velocity-selective arterial spin libeling and 3D image acquisition with whole-placenta coverage, placental perfusion imaging was carried out.

In pregnancies with foetal CHD, global placental perfusion decreased and regional variation of placental perfusion increased with increasing gestational age; however, no such correlation was found in healthy pregnancies. Furthermore, when patients were lying on their sides rather than supine, and when the placenta was in the posterior rather than anterior position, global placental perfusion was significantly higher in patients with foetal CHD compared to controls. The non-invasive whole-placenta perfusion imaging described in this study is described for the first time in utero. These findings imply that placental VSASL may function as a possible biomarker of placental dysfunction in foetuses with CHD.

The placenta is a crucial organ that supports the health of the foetus during pregnancy by supplying it with oxygen and nutrients, eliminating waste, and acting as an immune barrier. The spiral arteries remodel early in pregnancy, increasing blood flow in the maternal-placental circulation to support the foetus' quick growth and development. When this remodeling fails, the foetus does not receive enough oxygen and nutrients through the feto-placental circulation, resulting in placental insufficiency.

While preeclampsia and foetal growth restriction are known to be common outcomes of placental insufficiency, little is known about the relationship between placental function and congenital heart disease in fetuses. Despite the fact that the foetal heart and placenta develop concurrently early in pregnancy, very few studies have found a link between the placenta and infant CHD. It's noteworthy that impaired placental growth in CHD has been linked to gestational age and birth weight at delivery, indicating that abnormal placental development may be a factor in the increased morbidity in this high-risk population.

Based on placental pathology after delivery, it has also been reported that the vascular density, vascular area, and number of terminal villi of the placenta are small in CHD. But because there are no non-invasive tools for measuring and monitoring placental function *in utero*, the vascular function of the placenta during pregnancy is poorly understood. The powerful MRI technique known as "arterial spin labelling," which has been widely used on the brain, allows for direct, quantitative measurements of regional tissue perfusion. ASL uses the water molecules in arterial blood as an endogenous contrast agent, unlike conventional perfusion MRI techniques, which rely on contrast agents. Given that ASL is completely non-invasive, does not call for the use of contrast agents, and does not expose the patient to ionizing radiation, it is a particularly appealing technique for early and secure monitoring during pregnancy. Furthermore, ASL provides precise quantitative measurement, allowing patients' absolute perfusion to be compared.

Only two groups have used ASL to image the placenta to date, and they have shown limited ASL image quality and coverage; this may be largely because the libeling paradigm they used has technical limitations. Placental perfusion in fetuses identified as having CHD using ASL has not been studied. In order to increase the sensitivity of placental perfusion and the signal-to-noise ratio, they used a novel placental perfusion imaging technique that

our group had previously described. This technique used velocity-selective ASL and 3D image acquisition. No matter where they are, VSASL enables the labeling of all flowing arterial spins with a particular range of velocity. They assessed total placenta perfusion, which accounts for maternal and foetal contributions, using VSASL. They quantified both global and regional perfusion variation in the placentas of pregnancies complicated by foetal CHD and healthy controls to see if placental perfusion changes are visible *in utero* in the context of foetal CHD.