

P01.04
Three-dimensional (3D) pixelwise fetal volume flow measurements (PixelFlux-method): a novel way to quantify global fetal blood supply

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Objectives: Fetal volume flow measurements are hindered so far by the complex spatial arrangement of the umbilical vessels and varying shape of the umbilical vein. We developed a novel method to quantify automatically spatially angle corrected volume flow measurements from three dimensional data of the umbilical vein. The principles and output as well as certainty of defining the measurement site in the horizontal plane within 3D datasets with the PixelFlux-method are explained.

Methods: Three-dimensional data of color Doppler sonograms of the umbilical cord are recorded under standardized conditions. Within the horizontal plane (hp) a transection (ts) site of the umbilical vein is defined by parallel shifts of the sagittal and horizontal planes to find a venous segment which is not curved and running with an angle below 30° towards the hp. This ts is evaluated by the PixelFlux-software to decode the color of the Doppler signal and the area of the vein pixel by pixel to quantify the spatially angle corrected umbilical flow volumes. The distortion of the true shape of the vein and the diminishment of the true flow velocity is corrected automatically. From the ts plane true flow volumes are calculated by the PixelFlux-software. Reproducibility calculations were done in 39 women in 135 datasets. 945 measurements (seven per dataset) were done, three above and below the ts plane in 0.5 mm distances, to define the accuracy of defining the measurement site.

Results: For the first time true fetal volume flow measurements become feasible. Measurements around the ts measurement plane show an average scattering of 2%. Measurements from repeated recordings show variations which point to true umbilical vein pulsation.

Conclusions: The PixelFlux-method is the first three-dimensional fetal volume flow measurement. Errors due to varying shape and angle of the umbilical vein, obstacles of earlier methods, are now ruled out. Definition of the measurement plane is reliably accomplished with a low grade of uncertainty.

P01.05
The ductus venosus: anatomical sphincter at its inlet?

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Objectives: To define the morphology and development of the ductus venosus in mouse and human embryos from embryonic day (E) 11.5–15.5 and carnegie stage (CS) 13–23, respectively. Doppler flow velocities of the ductus venosus are increasingly used for assessment of fetuses with increased nuchal translucency, growth-restriction, monozygotic twins and contribute to screening for cardiac defects. It is disputed if the ductus venosus has an active regulation system at its inlet.

Methods: Embryos were examined using immunohistochemistry for smooth muscle actin (SMA), nerve tissue (neun; neuronal nuclei, NCAM; neural cell adhesion molecule), endothelium (vWF; von Willebrand factor, PECAM-1; platelet/endothelial cell adhesion

molecule-1) and elastic fibers (LvG; Lawson van Gieson). Three-dimensional reconstructions of the ductus venosus of mouse and human embryos were built at all embryonic stages.

Results: Mouse embryos showed positive SMA staining from E12.5 on and PECAM-1 expression from E11.5–15.5 in the ductus venosus. Nerve tissue, LvG and vWF expression were absent in all stages. Human embryos (CS 16, 19, 23) demonstrated positive SMA, vWF and PECAM-1 expression in the ductus venosus. NCAM positive nerve bundles – showing increased expression with gestation – were identified adjacent to the ductus venosus. LvG was not expressed in the ductus venosus.

Conclusions: In human – but not in mouse – embryos the ductus venosus might act as a nerve innervated shunt, as nerve fibers were identified. Contracting elements were, however, not visualised.

Supporting information can be found in the online version of this abstract.

P01.06
The effects of chronic intrauterine hypoxia on endothelium vascular relaxation and serum ox-LDL and CRP in adult rabbit offspring

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Objectives: To investigate the effects of chronic intrauterine hypoxia on endothelium vascular relaxation and serum oxidized low-density lipoprotein (ox-LDL) and C-reactive protein (CRP) change in adult offspring rabbit.

Methods: Sixteen New-Zealand rabbits were assigned randomly to 2 groups: chronic intrauterine hypoxia group (CIH, 12% O₂, n = 8) and normal oxygen group (NO, 21% O₂, n = 8). After delivery, two male offspring rabbits per litter were selected and breast-fed for 3 months, and randomly assigned to high-fat diet or normal diet respectively. Finally, 4 groups were included as follow: Chronic Intrauterine Hypoxia with High Fat Diet (CIH&HFD, n = 8), Non-Chronic Intrauterine Hypoxia with High Fat Diet (NCIH&HFD, n = 8), Chronic Intrauterine Hypoxia with Normal Diet (CIH&ND, n = 8) and Normal Control (NC, n = 8). At six months of age, endothelium vascular relaxation of the abdominal aorta from the offspring rabbits were evaluated by ultrasonography, and blood-lipid, serum ox-LDL and CRP were examined.

Results: CIH resulted an elevation of serum total cholesterol, triglyceride level, serum ox-LDL and CRP (all $P < 0.05$), and an attenuation of endothelial dependent vasodilation (EDV) of abdominal aorta ($P < 0.05$) in adult rabbit offspring. All of these effects caused by CIH were aggravated significantly when hyperlipemia was imposed (all $P < 0.05$).

Conclusions: CIH causes impaired EDV in adult offspring, which might serve as an important factor that can induce atherosclerosis. Impairment of EDV may be attributed to a fetal inflammatory programming triggered by CIH with a sign of increased express of ox-LDL and CRP.