

Short-term fetal cardiovascular adaptation to an artificial placenta in sheep

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Objective

To describe the short-term fetal hemodynamic response and early adaptation to an artificial placenta (AP) system.

Methods

Experimental study in 6 fetal lambs (105-115 days) transferred to an AP system (pumpless circuit with umbilical cord connection and low resistance oxygenator). Arterial and venous intravascular pressures were monitorized via femoral artery and umbilical vein catheters. Echocardiographic-derived anatomical and functional measurements were collected at baseline (in utero), 30 mins and 2-6 hours after connection.

Results

Transition to AP resulted in increased peak velocities and reduced pulsatility index of the umbilical artery: in utero median 1.26 (IQR 1.1-1.48) vs. 30min 0.42 (0.34-0.52) vs 2-6h 0.42 (0.36-0.45), $p=0.004$) and ductus venosus, together with increased arterial and venous pressures (mean arterial pressure in utero 44 mmHg (35-54) vs. 30min 72 mmHg (64-80) vs. 2-6h 56 mmHg (50-70), $p=0.007$) and increased fetal heart rate (in utero 144 bpm (141-157) vs. 30min 198 bpm (176-222) vs. 2-6h 175 bpm (165-190), $p=0.004$). Fetal heart structure and function was mainly preserved (combined cardiac output in utero 452 ml/kg/min (431-502) vs. 30min 495 ml/kg/min (450-632) vs. 2-6h 447 ml/kg/min (446-459), $p=0.337$).

Conclusion

Connection to AP results in an acute response that may partially reflect fetal stress with adaptation to a low resistant circuit, and which tends to normalize over hours. Longer-term data will help understanding the fetal cardiovascular adaptive response and potential remodeling, and help refining the extracorporeal circulation settings accordingly.