EP13.02 - Noninvasive measurement of fetal aortic pulse pressure using by ultrasound phased-tracking method: an investigation using a fetal sheep model

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Introduction
We previously developed the new algorithm to measure fetal aortic pulse pressure (PP). Phased Tracking is an ultrasound-based technique that enables precise measurement of a target velocity. This study aims to verify the accuracy of our noninvasive measurement with a fetal sheep preparation.

Method
Fetal aortic pulse pressure was estimated by using pulse wave velocity (PWV) and blood flow velocity at fetal descending aorta. Each motion of the proximal and distal border of the lumen of fetal descending aorta was analyzed using Phased Tracking. The motions were analyzed at each point, and the time delay between them was measured. PWV was obtained by dividing the distance between the analyzed points by the time delay of the pulse wave. In the water-hammer equation, PP is given as follows;

\[ PP = \rho \cdot U \cdot PWV \]

where \( \rho \) is blood density and \( U \) is blood flow velocity.

We chose an artificial placenta as a fetus model (Figure. 1). Fetal lambs (90 or 137 days; term=147d) were used. Immediately after delivery of the lambs (n=3), the umbilical vessels were cannulated and connected to the pumpless artificial placenta, and the carotid catheter was inserted to measure aortic blood pressure. We compared the PP estimated by using the noninvasive ultrasound method with the PP measured directly by the carotid catheter.

Result
Three fetuses were available for comparing both fetal PP. Median estimated PP by the ultrasound was 17.4mmHg in comparison to 18.0mmHg by the carotid catheter. There was a strong correlation between both PP \( (R^2=0.95, p<0.01) \) (Figure.2).

Conclusion
Assessment of blood flow velocity and PWV of the descending aorta using Phased Tracking is an accurate non-invasive approach to evaluate fetal hemodynamics.