

Effects of fetal activity on umbilical venous blood flow in the fetal lamb.

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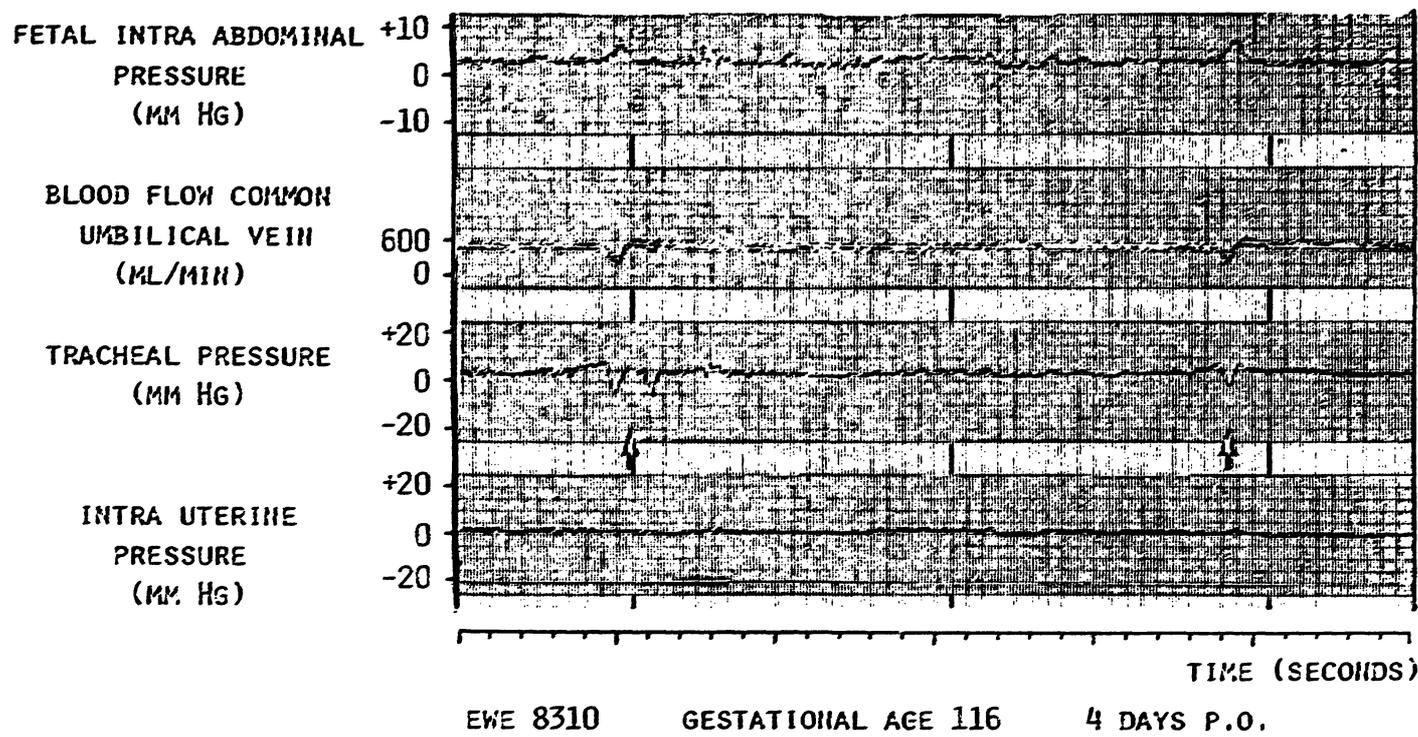
Introduction : Recording of blood flow in fetal vessels, using a combination of a real time echo scanner and a pulsed Doppler instrument is one of the methods recently introduced in perinatology (1,2,8). One of the aspects in the results of such investigations is the wide range in normal and abnormal findings which makes the applicability of this method doubtful. This inaccuracy is caused by technical factors and physiological factors. The technical factors cause a calculated inaccuracy of approximately 15-25% (7). This aspect of the inaccuracy can be partly circumvented by using spectral analysis of the recorded signal instead measuring blood flow. The influence of fetal physiological processes on the recorded signals is however still present.

Material and methods : Venous umbilical blood flow was measured in the common umbilical vein by an electromagnetic flow probe in eight chronic sheep preparations. Simultaneously intratracheal pressure (6 lambs) and fetal intra-abdominal pressure (2 lambs) was recorded. It concerned singleton pregnancies between 106-143 days gestation. Recordings were performed after a 72 hour recovery period.

Results : Blood flow in the common umbilical vein shows no or only very small pulsations without a distinct pattern in the absence of fetal breathing. During rapid fetal breathing movements (amplitude 3-12 mm Hg, > 1 Hz) the non pulsatile pattern changed in a pulsatile one in line with the breathing movements. The changes in the tracheal pressure and umbilical venous blood flow were out of phase in the recording with a lag time of approximately 100 msec. This can be explained by the delay caused by the pulse wave propagation time in the tracheal pressure measurement system as well as by the high compliance of the fluid filled tracheal system. During inspiration (decrease in tracheal pressure) umbilical venous blood flow decreases. The flow returns to its baseline at the start of the expiration. Incidentally an overshoot in the umbilical flow was observed at the end of the expiration. The pulsations in venous umbilical blood flow varied with the magnitude of the breathing amplitude. During the decrease in tracheal pressure (inspiration), intra-abdominal pressure increased and reverse (fig.). Fetal expiration efforts resulted in an increase in both the tracheal and intra-abdominal pressure while umbilical venous blood flow decreased (4,5). This phenomena can be explained by the paradoxical aspect of fetal breathing movements. Fetal hypoxaemia was caused in the same type of experiment by occlusion of the common iliac artery in the pregnant ewe, from 30-340 seconds simulating late decelerations (3). Fetal pH and pO₂ decreased significantly and fetal bradycardia and increase of fetal arterial pressure was observed. During the decelerations biphasic pulsations in line with the fetal heart action occurred in the umbilical venous blood flow. The pulsations consisted of two forward surges : one simultaneously with the ventricular systole and a greater one during ventricular diastole (5).

Conclusions : Fetal physiological processes can influence the results of measurements of fetal blood flow, substantially. This holds especially for changes in fetal thoracic and fetal abdominal pressure, and the influence

of these changes on umbilical venous blood flow (5). This means that such measurements must be performed during well defined fetal activity states and by preference during periods without fetal breathing movements.



EFFECT OF ISOLATED INSPIRATORY MOVEMENTS
(ARROWS) ON INTRAABDOMINAL PRESSURE
AND UMBILICAL VEIN BLOOD FLOW.

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