Evaluation of the fetal circulation using Doppler ultrasound method in patients with pre-eclampsia and intrauterine growth retardation

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Several investigators have demonstrated that the circulation of the mother is affected both in pre-eclampsia (PE) and in intrauterine growth retardation (IUGR) (7,1).

The main abnormality in both conditions is a considerable reduction of maternal plasma volume and in PE an elevated peripheral resistance. The reduction of plasma volume is accompanied by reduced perfusion of maternal organs as demonstrated concerning the kidneys, where the reduced plasma volume leads to reduced kidney perfusion and fall in creatinine clearance. Expansion of the reduced plasma volume results in a rise in, or even normalization of the creatinine clearance.

The utero-placental perfusion is decreased during IUGR (8) and probably during PE, and it seems logical to suppose that also the fetal circulation is affected.

Using a combination of linear array and pulsed Doppler technique several investigators have demonstrated a reduction up to 50 per cent of the flow in the umbilical vein during IUGR (2,4,6,9) whereas changes in PE are less clearly demonstrated.

It has not yet been possible to demonstrate consistent changes in the flow in the fetal descending aorta in either condition, but GRIFFIN et al. (5) have demonstrated thoracic aorta velocities in the lower end of or below the normal range in fetuses with IUGR.

Patients and methods

We investigated the fetuses of 22 normal pregnant women, 9 women with PE (BP $\geq$145/95 mm Hg) and 5 women with IUGR (estimated fetal weight below the 10th percentile) using combined real-time linear array and pulsed Doppler ultrasound technique (10). We measured blood flow in the descending thoracic fetal aorta and calculated the "pulsatility index" (PI) as the ratio of the peak to trough to the mean deviation from the base line (GOSLING and KING (3)). In some of the patients we measured flow in the umbilical vein.

Results

Flow in descending fetal aorta

In nine patients with untreated PE we observed a flow of 179 $\pm$ 54 ml/min/kg (mean $\pm$ 2 SD). In three patients the flow

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was less than normal mean - 2 SD (224 ± 58 ml/min/kg). In five patients with IUGR we observed a flow of 165 ± 72 ml/min/kg (mean ± 2 SD). In two of these patients the flow was less than normal mean - 2 SD.

Pulsatility index

In all nine patients with untreated PE we calculated a PI higher than mean normal + 2 SD (1.56 ± 0.44). The PI in patients with PE was 2.33 ± 0.26 (mean ± 2 SD). In all five patients with IUGR we calculated a PI higher than normal mean + 2 SD. The PI in these patients was 2.48 ± 0.24 (mean ± 2 SD).

Flow in the umbilical vein

We measured flow in the umbilical vein in 5 normal pregnant women, in five patients with untreated PE and in four patients with IUGR. In normals we observed a flow of 138 ± 32 ml/min/kg (mean ± 2 SD). In PE the flow was 91 ± 24 ml/min/kg and in IUGR 88 ± 56 ml/min/kg.

Effect of treatment of pre-eclampsia

In three patients with severe proteinuric PE (blood pressure ≥ 170/110 mm Hg) before 35th week of pregnancy we measured reduced flow in fetal aorta and a very high pulsatory index in the untreated condition. After treatment with plasma expansion, oral methyldopa and labetalol we observed a normalization of flow and PI, which was maintained during the rest of pregnancy.

Conclusion

Until now we have only investigated small numbers of patients but it seems that both the flow in the descending fetal aorta and the umbilical vein is reduced compared to normals both in PE and IUGR. These preliminary results are in good accordance with the findings of GRIFFIN et al. (5) concerning the flow in descending aorta and with earlier findings concerning the flow in the umbilical vein (2,4,6,9).

Most significant are the findings of high PI in both patients with PE and IUGR, as also demonstrated by GRIFFIN et al. (5) concerning IUGR.

Our preliminary results with normalization of PI and the flow in fetal aorta during treatment of PE seem to indicate that the method can be used to evaluate and control treatment of PE. It might also be useful in further attempts to find a treatment against IUGR.

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