

The application of Doppler Ultrasound to the study of fetal blood flow
in perinatal medicine

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Continuous wave (C/W) Doppler ultrasound is a non-invasive and inexpensive method of assessing both the fetal circulation in utero and the cerebral circulation of the newborn. We have used spectrum analysed C/W Doppler signals to study the feto-placental circulation in utero and the cerebral circulation of the newborn particularly in relation to the development of intraventricular haemorrhage (IVH).

In normal pregnancy umbilical arterial blood flow was found to be continuous with a significant diastolic flow component, indicating that placental vascular resistance was low. Analysis of the ratio of peak systolic flow (A) to end diastolic flow (B) at various gestational ages showed that there was a progressive fall in placental resistance with advancing gestational age (I). The mean A/B ratio at 16 weeks (5.3, SD+1.1) was significantly different ($P < 0.001$) from that obtained at term (2.1, SD = 0.3).

Fetal blood velocity waveform analysis in cases of retarded intrauterine growth (RIUG) demonstrated that in 77% of instances there was no diastolic flow in the umbilical arteries indicating increased placental resistance and this phenomenon was noted to be present in all cases where fetal death occurred in utero.

The cerebral circulation in the newborn was studied by spectrum analysing C/W Doppler signals from the common carotid and anterior cerebral arteries. Cerebral vascular resistance was assessed by calculating the Pulsatility Index (PI) of the waveform (2). The PI at six hours after birth was noted to be higher in both arteries than at 12 to 24 hours ($P < 0.001$) and there was no significant change over the next 7 days (3).

Thirty two preterm infants with IVH were studied. There was no change in the PI in the anterior cerebral artery prior to IVH though studies at 24 to 60 hours after haemorrhage showed a significantly elevated PI ($P < 0.05$). This finding is thought to be due to vasospasm and may be an important prognostic sign to the development of ischemic brain damage and subsequent neurological handicap. There was a significantly lower PI in the common carotid arteries prior to IVH ($P < 0.01$) but not subsequent to the haemorrhage. Most cases of IVH are thought to be due to an increase in blood flow through the sub-ependymal germinal matrix of the lateral ventricles but analysis of C/W Doppler signals from the anterior cerebral artery, from which Heubner's artery arises, did not show this.

Bibliography

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