Assessment of fetoplacental and uteroplacental blood flow using duplex pulsed Doppler ultrasound in complicated pregnancies.

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Waveforms from fetal (1,2,3,4) and maternal (6) side of the placental circulation can readily be obtained using a duplex pulsed Doppler system (4). Quantative measurement of blood flow may be subject to large errors (4) but useful information may be gained by study of the flow velocity waveforms (FVW). To remove the effect of the angle of insonation it is necessary to relate one part of the waveform to another. Maximum information is obtained by use of the frequency index profile (4,6) but this is complex and we are awaiting automatic computer analysis of this parameter.

For the purposes of this initial report we have used the resistance index (7) to characterise the arcuate arteries. The upper limit (mean - 2SD) for our reference range was 0.55. Figure 1(a) illustrates a 'normal' FVW from the arcuate artery whilst 1(b) illustrates the abnormal FVW.

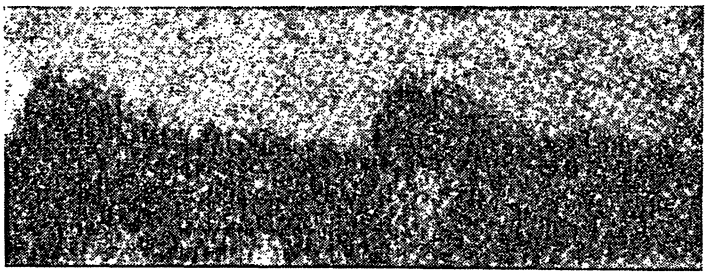

Figure 1(a)

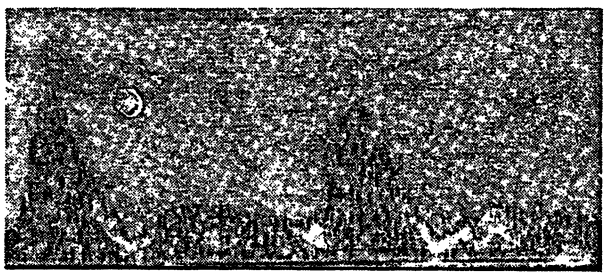

Figure 1(b)

The fetal descending aorta was categorised as normal if there were Doppler shifted frequencies recordable in end-diastole with angles of insonation between 20° and 60°. Figure 2(a) illustrates a 'normal' FVW from the fetal descending aorta in the third trimester. Figure 2(b) illustrates the abnormal FVW with loss of frequencies in end-diastole.

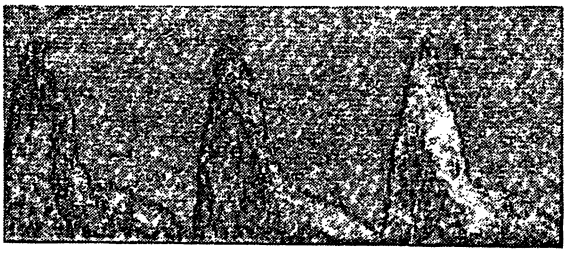

Figure 2(a)

Figure 2(b)

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Results were available for analysis on 53 patients, all of whom had gestational age confirmed by ultrasound examination before 20 weeks gestation. These patients all had hypertension or an antenatal diagnosis of growth retardation or both as a complication of the pregnancy. Hypertension was defined as readings of 140/90 or more on two occasions at least four hours apart. Significant proteinuria was considered to be more than 500 mg/24 hours. Growth retardation was considered to be present when the measurement of the fetal abdominal circumference fell on or below the 10th centile for the week of gestation.

Results:

The results were not available to the clinicians and therefore did not influence management of the patients. Most patients were studied serially but for this analysis only the last recording was considered. This was always within three days of delivery. We also studied velocities in the fetal descending aorta and the results are shown below. The results obtained allowed patients to be placed in one of four groups.

Normal arcuate (NU) RI = 0.39 ± 0.08 Normal fetal (NF) Ao.vel. = 33±6 cm/s (n = 29)	Normal arcuate (NU) RI = 0.41 ± 0.03 Abnormal fetal (LF) Ao.vel. = 17±2 cm/s (n = 3)
Abnormal arcuate (LU) RI = 0.70 ± 0.14 Normal fetal (NF) Ao.vel. = 31±4cm/s (n = 10)	Abnormal arcuate (LU) RI = 0.70 + 0.07 Abnormal fetal (LF) Ao.vel. = 17±4cm/s (n = 12)

The group of patients with normal arcuate (NU) and abnormal fetal flow (LF) contained only three patients and was not used in subsequent analysis although it is shown in the figures.

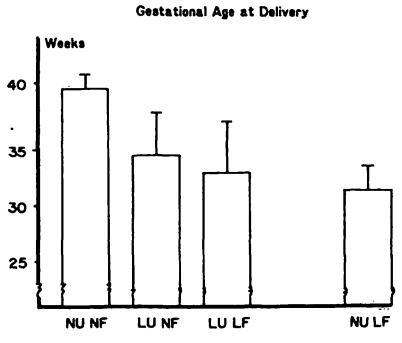

Figure 3

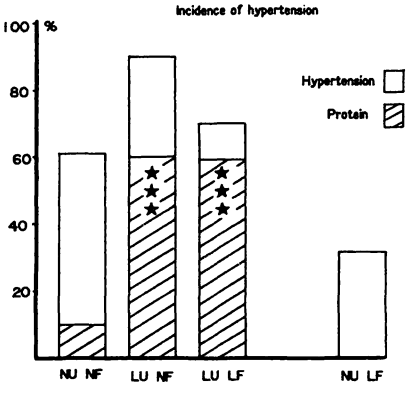

Figure 4

There was no significant difference in gestational age at delivery between the remaining three groups (fig.3) although there is a trend towards early delivery in the groups with abnormal uterine blood flow (LU). The incidence of hypertension is not significantly different between these three groups (fig.4) but there is a highly significant ($P<0.001$) increase in proteinuric hypertension in both groups with LU. Birthweight ratio (actual birthweight/mean expected birthweight) shows a trend to smaller infants in groups with LU. There was a significantly higher ($P<0.05$) incidence of growth retarded babies in the LULF group compared with the NUNF (fig.5).

We have defined 'asphyxia' as an umbilical vein pH of less than 7.25 and/or a one minute Apgar score of less than 5. In the three groups available for analysis asphyxia is significantly ($P<0.001$) more common when fetal flow is impaired (fig.6).

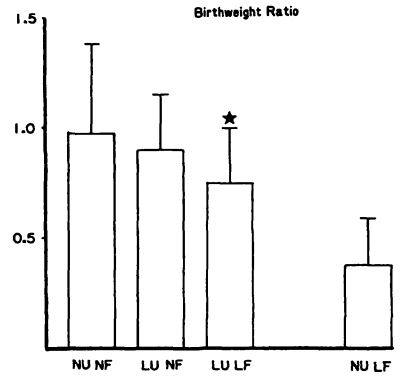

Figure 5

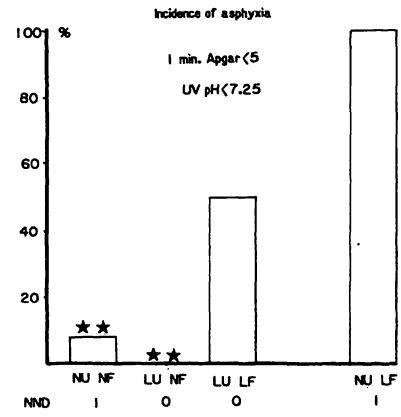

Figure 6

Discussion:

Study of FVWs allows the separation of high risk pregnancies into four groups. In the group with NULF there were only three patients. One of these had congenital rubella, one is strongly suspected of having had a virus infection and the other had unexplained fetal growth retardation. All three of these infants had marked impairment of fetal growth antenatally and all were delivered by Caesarean section before 34 weeks gestation. We believe that this group represents a primary disturbance in the fetus and/or the fetal villus circulation.

The group of patients with normal bloodflow (NUNF) tended to be delivered of term babies of normal weights. The biggest complication in this group was non-proteinuric hypertension that rarely required intervention.

In the two groups of patients with impaired arcuate blood flow (LU) there was a high incidence of proteinuric hypertension which confirms our previous findings (6). It is interesting to note, however, that several patients who were studied serially moved from the LUNF to the LULF group but we have not observed interchange between the other groups.

This suggests that uteroplacental ischaemia is present before the onset of impaired fetal bloodflow in the majority of cases.

The categorisation of high risk pregnancies into these groups may allow a more logical approach to the management of both the mother and the fetus in high risk pregnancies. Hypertensive patients with normal arcuate FVWs appear to carry little added risk to either themselves or their fetus. Patients with abnormal arcuate FVW need careful observation but as long as the fetal FVW remain normal the risk of fetal asphyxia is low.

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