# DIAGNOSIS OF THE SMALL-FOR-DATES FETUS BY SERIAL ULTRASONIC CEPHALOMETRY

by

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*Introduction*

The concept of placental insufficiency has become popular as a means of explaining retarded fetal growth, but it is by no means certain which precise function or functions of the placenta may be insufficient. The clinical syndromes associated with it include nutritional or chronic insufficiency in which fetal growth is retarded, and respiratory or acute insufficiency in which fetal oxygenation is jeopardized (Kubli *et al* 1969). The second report of the British Perinatal Mortality Survey (Butler and Alberman, 1969) showed that fetuses less than two standard deviations from the mean weight for gestation between 39 and 43 weeks' maturity had over eight times the mortality rate for both still births and neonatal deaths when compared with all fetuses of a similar gestational age. Early diagnosis of such cases would permit delivery of the fetus before antepartum hypoxia developed and thereby reduce perinatal mortality and morbidity.

*Methods and Material*

Diagnostic ultrasound was first applied to Obstetrics and Gynaecology by Donald *et al* (1958). Sound waves of a very high frequency (2.25 MHz) are sent from a piezo-electric crystal in short pulses through the maternal abdomen, and echoes reflected from the different tissue planes are detected by the same crystal, amplified and displayed on a Cathod ray tube. There are two display systems. In the A-scan the echoes are shown as vertical deflections on a horizontal time scale. The interval between any two deflections therefore represents the time taken for the sound wave to pass between the two tissue planes. If the velocity of sound in human tissue is known the actual distance between the two echoes can be determined. In B-scan the echoes are shown as dots of light and as they coalesce a two dimentional outline (echogram) of abdominal structures is produced.

Measurement of the biparietal diameter of the fetal head was done using Campbell's method (1968). The advantage of the combined A and B scan technique is that measurements of the fetal biparietal diameter are more accurate and can be made from 13 weeks onwards. The fetal head is examined by compound B-scan first longitudinally in order to determine the exact position of the head, and then transversely at the appropriate angle to obtain a transverse section of the fetal head at the level of the parietal eminences. When this has been successfully accomplished a midline echo is seen exactly bisecting the fetal head. The ultrasonic beam is then placed across the parietal eminences and an A-scan measurement is taken.

A normal growth curve for the fetal

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biparietal diameter was derived from 850 measurements made on normal patients with known maturity, who delivered within a week of the expected date of confinement and the babies weighed above the tenth percentile of weight for gestation, (Thompson *et al* 1968) correction being made for parity and fetal sex. Figure 1 shows the mean fetal biparietal diameter values for each week of gestation plus or minus two standard deviations. This shows that upto and including the 30th week of gestation growth is more rapid (mean 2.8 mm per week) than in the last 10 weeks (mean 1.8 mm per week).

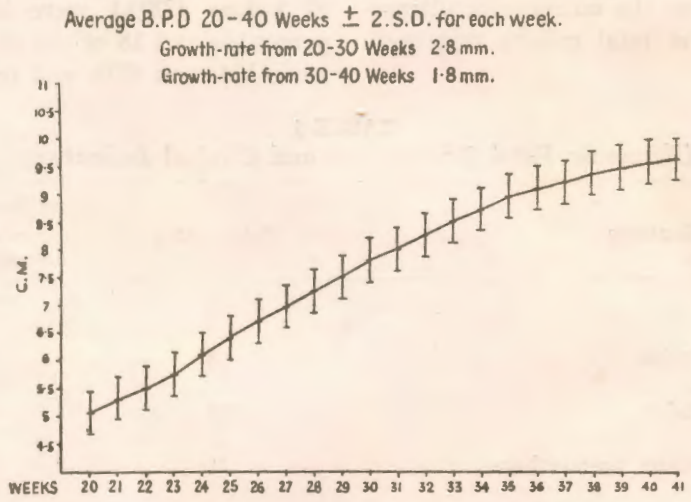


Fig. 1

Shows the mean fetal biparietal diameter valuesfor each week of gestation plus or minus two standard deviations.

An assessment of the value of serial cephalometry in the diagnosis of the Small-for-dates fetus was done in 300 patients who were thought to be at risk from placental insufficiency. If the maturity was known a diagnosis of "Small-for-dates fetus" was made when the biparietal diameter was below the two standard deviations for that particular week of gestation. When the head size was within normal range for the menstrual age of the fetus at the time of the first measurement then the maturity was assumed to be correct. The growth had to be below the two standard deviations in two successive measurements to put the baby in the 'retarded' fetal growth group.

When the head size was below the normal range for the menstrual age of the fetus at the time of the first measurement, then it was considered either that this was due to impaired fetal growth or that the maturity was less than that calculated from the last menstrual period. If the growth rate is normal in two successive measurements then it was assumed that the maturity was in error, and a new ultrasonic expected delivery date was determined.

*Results*

Of the 300 cases referred for assessment of fetal growth, 122 had a normal head

size for gestational age and showed a normal growth rate; 88 cases had a head size below the normal range but the subsequent growth rate was normal (i.e. maturity was in error); 90 cases showed ultrasonic evidence of impaired growth. The number of measurements in each case varied from 4 to 16.

Table 1 shows the clinical indications for assessment of fetal growth.

Table II shows the outcome of ultrasonic prediction of fetal growth and birth weight.

When ultrasonic growth was 'normal, 185 babies (88%) were of normal weight and 25 babies (12%) were small-for-dates. Ten of twenty-five small for dates were just below the tenth percentile and 15 were between fifth and tenth percentile. When the ultrasonic growth was 'retarded', 8 babies (8.9%) were just above the tenth percentile and 82 babies (91.1%) were below the tenth percentile; 64 of the 82 babies (78%) were below the fifth percentile and 18 of the 82 babies (22%) were between fifth and tenth percentile.

TABLE 1

*Ultrasonic Fetal Growth-rate and Clinical Indications*

| Clinical indications | Total cases | Ultrasonic growth-rate below two Standard deviations |
|---|---|---|
| Pre-eclampsia | 65 | 19 (29.1%) |
| Essential hypertension | 36 | 11 (30.5%) |
| Small-for-dates baby | 110 | 28 (25.4%) |
| Recurrent antepartum haemorrhage | 25 | 9 (36%) |
| Previous bad obstetric history | 25 | 10 (40%) |
| Poor weight gain | 27 | 10 (37%) |
| Elderly primigravida (Age over 35 years) | 12 | 3 (25%) |
| Total | 300 | 90 |

S.DS = Standard deviations.

TABLE II

*Ultrasonic Fetal Growth Rate and Fetal Weight*

| Ultrasonic growth-rate | Fetal weight | | Total cases |
|---|---|---|---|
| | Normal above 10% | small-for-dates below 10% | |
| Normal above 2 S.DS | 185 (88%) | 25 (12%) | 210 |
| Retarded below 2 S.DS | 8 (8.1%) | 82 (91.1%) | 90 |

Table III shows ultrasonic fetal growth rate and one minute Apgar score.

TABLE III

*Ultrasonic Fetal Growth-rate and one Minute Apgar Score*

| Ultrasonic growth-rate | Apgar normal (6-10) | Apgar low (1-5) | Total cases |
|---|---|---|---|
| Normal above 2 S.DS | 180 (86%) | 30 (14%) | 210 |
| Retarded below 2 S.DS | 54 (60%) | 36 (40%) | 90 |

The Apgar score was depressed (i.e. below 6) in 30 (14%) of the 210 babies who had a normal ultrasonic growth rate, whereas it was depressed in 36 (40%) of the 90 babies who had a retarded ultrasonic growth rate. If breech deliveries, difficult forceps deliveries, fetal abnormality, and still births are excluded the low apgar score in the 'normal' and 'retarded' growth rate groups are 8% and 25% respectively.

Table IV shows the ultrasonic fetal growth and perinatal mortality.

TABLE IV

*Ultrasonic Fetal Growth-rate and Perinatal Mortality*

| Ultrasonic growth-rate | Still births | Neonatal deaths | Perinatal deaths | Total cases |
|---|---|---|---|---|
| Normal above 2 S.DS | 2 | 2 | 4 (1.9%) | 210 |
| Retarded below 2 S.DS | 6 | 2 | 8 (8.8%) | 90 |

The two still births due to fetal abnormality are not included in this section. The corrected perinatal mortality in the 'normal' ultrasonic fetal growth group is 1.9%, whereas it was 8.8% in the group of 'retarded' fetal growth. The two neonatal deaths in the 'normal' growth rate group were due to prematurity and respiratory distress syndrome and the two still births were due to occult cord prolapse. The six still births in the 'retarded' fetal growth group were due to intrauterine anoxia due to placental insufficiency and the two neonatal deaths were due to respiratory distress syndrome. The gestational age of all the neonatal deaths was between 31 and 34 weeks and of all still births was between 33 and 38 weeks. The two cases of fetal abnormality were in the growth retarded group.

*Discussion*

The pattern of fetal growth is determined by two interacting factors, namely, the growth potential of the fetus and the growth support it receives from the placenta and the mother. The growth potential is affected by hereditary factors and fetal abnormalities, whereas the growth support is affected by maternal and placental factors. In uncomplicated pregnancies the growth curve is linear (Campbell and Newman 1971) as long as

the growth support exceeds the needs o. the growth potential. There is a physiological reduction of the growth support from 36th week of pregnancy onwards and the growth tends to fall off at the end of a normal pregnancy. When the reduction of growth support occurs earlier in pregnancy it produces chronic fetal distress leading to retarded fetal growth and this eventually passes on to acute fetal distress. In abnormal fetus the growth potential is low, hence growth is low all through the pregnancy instead of the terminal falling off. Placental function tests and cephalometry will assess the nutritive function of the placenta, whereas amnioscopy and fetal heart monitoring in response to contraction will assess the respiratory function of the placenta.

Serial cephalometry were used to study intrauterine fetal growth. Willocks (1962a, 1962b), Willocks *et al* (1967, 1971), Campbell and Dewhurst (1971) showed that there was a correlation between birth weight and biparietal diameter before birth. Taylor *et al* (1964), Thompson *et al* (1965) and Kohorn (1967) have also reported the value of cephalometry in assessing the fetal growth. The growth rate of the biparietal diameter of the fetal head was compared with the birth weight of the baby in an attempt to determine its relevance to the problems of placental insufficiency and retarded fetal growth.

All the biparietal diameter measurements were taken by one person, thus minimising observer error. Serial weekly biparietal diameter was done in all cases with retarded fetal growth until delivery. The number of measurements in each case varied from 4 to 16, the average being 5.6. The lower limit of normal growth was varied according to the size of the fetal biparietal diameter and maturity. A fixed lower limit, irrespective of maturity, will produce a high false positive diagnosis (57% Willocks *et al*, 1967). If the lower growth limits are allowed to vary either with maturity or head size the false positive diagnosis will be reduced (18% Campbell and Dewhurst, 1971). From this study it is clear that the two standard deviations limit for weekly growth rate is the most realistic indicator of fetal malnutrition. When ultrasonic growth was below this limit, 91% of babies were below the tenth percentile of weight and 78% were below the fifth percentile of weight for gestation Thompson *et al* (1968). The perinatal death rate was 8.8% in the growth retarded group compared to 1.9% in the normal group.

Sonar offers the only method by which repeated direct measurements can be obtained on the same fetus during intrauterine life without exposing the mother and fetus to any risks. Amniotic flluid cytology and biochemistry are not of much help in assessing fetal growth. Hyperflexion of the small-for-dates fetus was reported in 12 of 93 (13%) fetuses x-rayed-Croall and Grech (1970). But the above two procedures involve the risks of either irradiation or amniocentesis. Certainly in those maternity hospitals where ultrasonic equipment is available routine assessment of the fetal biparietal diameter would be practically feasible and the method is safe, causes no discomfort to the patient and rarely takes more than ten minutes.

*Summary*

Antenatal fetal growth was assessed by serial ultrasonic cephalometry in 300 patients whose fetus was considered to be at risk. When the growth rate of the fetal biparietal diameter was below the two standard deviations (third percen-

tile), 91% of babies were below the tenth percentile of weight for gestation and 78% were below the fifth percentile. Retarded ultrasonic fetal growth rates were associated with a significant increase in the number of low Apgar scores and perinatal deaths. Serial ultrasonic cephalometry is an important aid in the diagnosis and monitering of the fetus at risk from chronic placental insufficiency.

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