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An investigation into the applicability of customised charts for the assessment of fetal growth in antenatal population at Blackburn, Lancashire, UK

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Summary
The antenatal population at Blackburn, Lancashire, UK is diverse, with 35% non-Caucasian, mainly of Indo-Pakistani origin. The department currently uses standard growth charts, based on the Caucasian population for assessment of fetal growth. This study was designed to ascertain whether the use of customised growth charts (CGCs) in our antenatal population can improve the identification of true growth restriction and decrease the number of interventions for suspected growth restriction. CGCs were generated for 109 women induced for intrauterine growth retardation (IUGR) and fetal biometry plotted. The centile range on the CGC was compared with standard charts. Results showed that women of Indian and Pakistani origin were greatly over-represented in the study group. A total of 58% of the cases induced for IUGR had babies within the normal range on CGC. Had CGC been used 54.4% of growth scans and 53% of antenatal day unit (ADU) appointments for fetal monitoring would have been unnecessary. Our study shows that introduction of CGC in our practice could lead to a very significant reduction in interventions for suspected growth restriction.

Introduction

Small for gestational age (SGA) fetuses are a heterogeneous group comprising fetuses that have failed to reach their genetic growth potential (Steer 1998) and fetuses that are constitutionally small. Only 50–60% of SGA fetuses are actually growth restricted (Ott 1988). These growth restricted fetuses are at a greater risk of still birth (Cnattingius et al. 1998), birth hypoxia (McIntire et al. 1999), neonatal complications (hypothermia, hypoglycaemia, pulmonary haemorrhage, infection, encephalopathy and necrotising enterocolitis) and certain long-term sequelae such as diabetes and hypertension in adult life (Barker 1997). These complications emphasise the importance of accurate prediction of intrauterine growth restriction identifying those fetuses truly at risk.

Various methods have been used to construct prenatal growth charts to identify the SGA fetus. It is recognised that variations in birth weights occur in different populations. If growth charts are based on a standard population, these standard charts will not be applicable to a diverse population. Using standard charts may lead to high false positive rates of detection of intrauterine growth restriction, unnecessary anxiety and intervention. Hence, charts that incorporate physiological variables of fetal growth are required.

Gardosi et al. identified four such physiological variables of growth (Gardosi et al. 1992). They designed and introduced a computer generated growth chart (GROW: Gestation Related Optimal Weight) (GROW 1997) that can be customised for each individual pregnancy, taking maternal height, weight, parity and ethnicity into consideration and validated the use of these charts in several studies (Mongelli and Gardosi 1996; Gardosi and Francis 1999; De Jong et al. 1998; Clausson et al. 2001; McCowan et al. 2005).

At Queen's Park Hospital in Blackburn, Lancashire, the antenatal population is of diverse ethnicity. The two main groups are Europeans (66%) and women of Indo-Pakistani background (30%). The latter have been shown to have constitutionally smaller babies compared with the former (Mongelli and Gardosi 1995).

The induction rate for IUGR in the department is 17%. Once a fetus has been identified as possibly being growth restricted, increased surveillance is generally put in place. This may consist of regular scans for fetal growth, amniotic fluid volume and umbilical artery Doppler estimations and increased attendance at antenatal clinic and antenatal day unit (ADU) for assessment and fetal cardiotocography.

Currently the department uses the standard charts recommended by the BMUS (British Medical Ultrasound Society) which are based on Caucasian population. Our study was designed to compare the antenatal prediction of growth restriction using the current standard charts (SGC) with customised growth charts (CGC) and also to assess whether the use of these charts could lead to decrease in antenatal surveillance and induction of labour for IUGR.

Methods

The study was conducted in the department of Obstetrics and Gynaecology in Queens Park Hospital, Blackburn, Lancashire, UK.

The case notes of 120 women in whom labour was induced for IUGR or IUGR plus any other reason, from July 2001–May 2002 were reviewed. Eleven case notes

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were excluded from the final analysis because of missing data. All cases with diabetes, previous caesarean section, twins and any known congenital malformations in the fetus were excluded (Table I).

The centile range on the SGC of the last abdominal circumference measurement was recorded. A CGC was generated on the computer for each case by plotting the maternal variables (height, booking weight, ethnicity and parity). The estimated birth weight (EBW), required for the CGC, was calculated from the abdominal circumference (AC) measurements (using the Campbell and Wilkin's formula) from the last antenatal ultrasound scan (USS). This weight was then plotted on the CGC against the gestational age and a centile range recorded.

The following short-term outcomes were recorded: mode of delivery, birth weight, Apgar score at 1 and 5 min, cord pH, need for admission to the neonatal intensive care unit (NICU) and other neonatal complications, still births and neonatal deaths.

The total number of growth scans and antenatal day unit (ADU) visits were also recorded for each case. The information was collated and analysed using Microsoft Access.

Results

Maternal demographics are summarised in Table II. The average body mass index (BMI) in the 109 women induced for IUGR was 22.55 (50.5%) of these women were Caucasian (in contrast to 66% of the whole antenatal population) and 54 (49.5%) belonged to other ethnic groups, mainly Indians and Pakistanis (19.3% and 27.5% vs 8.4 and 21.4% of the whole population).

All these women were induced at a gestation range of 35–41 weeks. The majority (89%) were induced at or beyond 37 weeks. A total of 85 (78%) of these were induced for IUGR alone and the remaining 24 (22%) were induced for IUGR plus another reason (Table III).

In 102 (93.6%) of the 109 cases, the AC was below the 5th centile of the standard chart. In 44 (40.3%) of the 109 cases, the AC was below the 10th centile on the customised chart (Table IV).

A total of 371 antenatal growth scans and umbilical artery Dopplers were performed in these 109 cases. It was calculated that if customised charts had been used, 202 (54.4%) of these scans would not have been performed as growth would have been within the normal range. Similarly, a total of 507 Day Unit visits were conducted in these cases for increased surveillance. If customised growth charts had been used, 269 (53%) of these would have been unnecessary. Also the use of customised charts would have avoided unnecessary induction of labour in 58 (53.2%) of these cases, as these fetuses were within the normal range on customised charts (Figure 1).

Mode of delivery and short-term outcomes are summarised in Table V. All five babies admitted to NICU were SGA on both standard and customised growth charts.

Discussion

A higher than expected number of women from Indian and Pakistani origin, are induced for IUGR when standard growth charts are used. When customised growth charts are used, most of the fetuses are growing in the normal range.

The average BMI for the women included in the study was 22 (as compared with an average BMI of 24.5 for the total antenatal population), suggesting that this population of women induced for IUGR consists mainly of small women who were more likely to have smaller babies.

We found that 56% of the cases diagnosed as IUGR by SGC were actually within normal range on CGC, implying that they were constitutionally small and not growth restricted. Since there is no absolute cut off point where a fetus changes from a 'normal' to a 'growth restricted' fetus, different cut off centiles have been used in various charts. The use of 10th centile as a cut off in the CGC as

Table I. Cases

Total IOL for IUGR (July 01 – May 02)	152
Number of cases excluded (twins, DM, previous CS, anomalies)	32
Cases excluded for missing data	11
Total number included in study	109

IOL, induction of labour; DM, diabetes mellitus; CS, caesarean section.

Table II. Maternal demographics

Maternal variable	Range	Average
Height	147 – 181 cm	161 cm
Weight	40 – 97 kg	56 kg
BMI	15 – 35	22
Parity	0 – 5	1

Table III. Reasons for IOL

Reasons for IOL	Number of cases
IUGR	80 (73.4%)
IUGR + Oligohydramnios	14 (12.8%)
IUGR + Static growth	6 (5.5%)
IUGR + Abnormal Doppler	3 (2.8%)
IUGR + Calcified placenta (on USS)	2 (1.8%)
IUGR + Previous IUD	1 (0.9%)
IUGR + Suspicious CTG	1 (0.9%)
IUGR + Pre-eclampsia	1 (0.9%)
IUGR + Decreased fetal movements	1 (0.9%)

IOL, induction of labour; IUGR, intrauterine growth retardation; USS, ultrasound scan; IUD, intrauterine death; CTG, cardiotocograph.

Table IV. Centile range

Centile	Antenatal centile on SGC		Antenatal centile on CGC
Below 5th	102 (93.6%)	Below 10th	44 (40.3%)
Between 5th – 50th	6 (5.5%)	Between 10th – 50th	61 (56%)
Between 50th – 95th	1 (0.9%)	Between 50th – 90th	3 (2.8%)
Over 95th	0	Over 90th	1 (0.9%)

SGC, standard growth chart; CGC, customised growth chart.

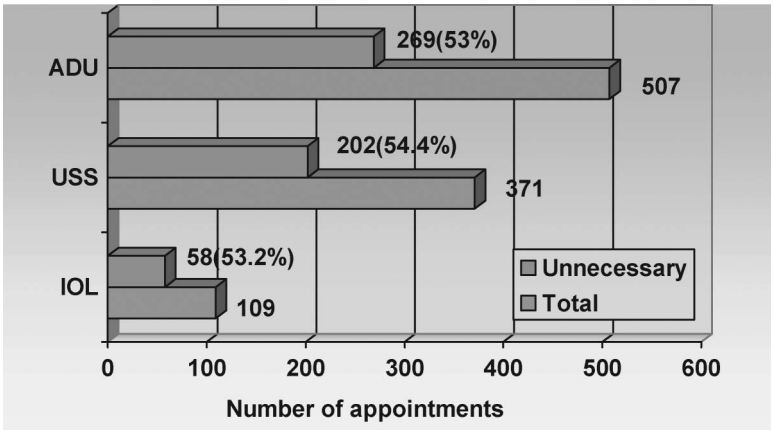

Figure 1. Interventions for IUGR. ADU, antenatal day unit; USS, ultrasound; IOL, induction of labour.

Table V. Short-term outcomes

Average birth weight	2,646 g (1,540–4,360 g)
Spontaneous vaginal deliveries	92 (84.4%)
Instrumental deliveries	4 (3.7%)
Emergency LSCS	13 (11.9%)
Low Apgar scores	0
NICU Admissions	5
Major neonatal complications	None

LSCS, lower segment caesarean section; NICU, neonatal intensive care unit.

Table VI. Mode of delivery

Mode of delivery	Total number in 2002	Study sample
Spontaneous	2,540 (71.3%)	92 (84.4%)
Instrumental	289 (8.2%)	4 (3.7%)
Emergency caesarean section	491 (13.8%)	13 (11.9%)

compared with 5th centile in SGC would mean that some fetuses which are normally grown (according to SGC) and between 5th and 10th centile will be included as IUGR in the CGC group.

In keeping with this finding, we also found that 53% of ultrasound scans and 54% of Day Unit visits were unnecessary. None of the constitutionally small babies had adverse perinatal outcome. All five admissions to the NICU were for truly growth restricted fetuses as identified by both SGC and CGC.

As a high risk group, this population of women undergoing induction of labour (IOL) for IUGR might have been expected to have a higher rate of caesarean section or operative vaginal delivery. Instead, the combined caesarean section and instrumental delivery rate in this group is less than the average for the total population during last year (Table VI). Again, this suggests healthy constitutionally small babies rather than growth restricted babies.

Since the introduction of customised charts in 1992, several studies have validated the use of customised charts to improve identification of true growth restriction and prediction of adverse neonatal events. We found that the use of customised charts is particularly relevant for units where antenatal population comprises of a large ethnic mix. Its use can lead to a decrease in unnecessary interventions and a significant decrease in the workload and cost savings.

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