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The influence of maternal body mass index on fetal anomaly screening

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ABSTRACT

Objectives: Maternal obesity is increasing and affects the quality of ultrasound images. The aim of this study was to examine the relationship between maternal body mass index (BMI) and requirement for repeat fetal anomaly scans and to determine whether gestational age at the initial scan affects the completion rate.

Study design: This was a retrospective cohort study of BMI and ultrasound scan data from 1000 women with singleton pregnancies delivering over a two month-period in a tertiary obstetric unit. Statistical analysis was used to determine the correlation between BMI and number of scans for completion and between gestational age and number of scans for completion. Women were classified into four groups according to BMI for comparison of the need for repeat scans using t test and relative risk.

Results: The number of scans required to complete the anomaly scan was directly related to increasing BMI ($r = 0.243$, $p < 0.001$). 52.1% of obese women required more than one scan to complete the anomaly scan compared to 27.4% of non-obese women (RR 1.90, 95% CI 1.60–2.27, $p < 0.001$). 12.5% of obese women require more than two scans to complete the anomaly scan compared to 2.35% of non-obese women (RR 5.32, 95% CI 2.97–9.50, $p < 0.001$). Completion of the initial anomaly scan was not related to gestational age at the time of the scan.

Conclusions: Obese women required more attempts to complete the anomaly scan and the number of scans required to complete was directly related to booking BMI. There was no relationship between gestation and completion of the scan, suggesting that delaying the anomaly scan to 20 + 6 weeks (or even beyond) would not provide a solution to reducing the requirement for repeat scans. The results provide important information for pre-screening counselling of obese women. Further work is needed to optimize the methods and timing of ultrasound screening to reduce the burden on sonography provision and improve screening outcomes.

Introduction

Body mass index (BMI) is commonly classified as follows: BMI <30 Non-obese, BMI 30.0–34.9 class 1 obesity, BMI 35.0–39.9 class 2 obesity and BMI 40 and over class 3 or morbid obesity (Table 1) [1]. Prevalence of maternal obesity is increasing and has become one of the most commonly occurring risk factors in obstetric practice [2,3]. Obstetric complication rates in obese women, including incidence of congenital anomalies, are higher than in non-obese women and these rates of complication increase with increasing BMI [4–6].

Routine antenatal care in the UK includes a fetal anomaly ultrasound scan performed between 18 + 0 weeks (126 days) to 20 + 6 weeks (146 days) of gestation [7]. Ultrasound examination in obese pregnant women can be challenging due to attenuation of ultrasound in adipose tissue and sub-optimal views of fetal structures and a relationship between obesity and requirement for repeat anomaly scans has been demonstrated [8,9].

As maternal obesity has increased over recent years, the increasing requirement for repeat anomaly scans and impact on sonography service provision has been noted within our unit. Initial and first repeat anomaly scans are allocated 30 min appointment time in accordance with current guidelines [7]. If the anatomical survey is still incomplete after the second scan, local guidelines direct women to the fetomaternal unit for further imaging. With many obese women requiring repeat imaging for completion of this scan there is a clear implication for the service in terms of sonographer hours and cost. There is evidence that

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adequate ultrasound visualization of specific fetal structures is improved at later gestations within the anomaly scan 'window' period [10] but whether this equates to a significant effect on completion of the anatomical survey in practice is not known.

The aim of this study is to examine the relationship between maternal BMI at the booking appointment, requirement for repeat anomaly scans and gestational age and to examine the impact that this has on our fetal anomaly screening service.

Materials and methods

We performed a retrospective analysis of routinely collected data from the electronic maternity database (PROTOS) and imaging results reporting (ICE) systems at the Jessop Wing of the Royal Hallamshire Hospital in Sheffield, a tertiary maternity unit in a large teaching hospital with around 7800 deliveries per year.

All women delivering over a two-month period from 1st June to 31st July 2011 were identified (1200). Two hundred cases were excluded (incomplete data 184, multiple pregnancies 8, fetal anomalies identified at first anomaly scan 7 and anomaly scan performed prior to 126 days gestation 1), leaving 1000 for the final analysis (Fig. 1).

Statistical analysis was performed with Excel and SPSS Statistics v21. Spearman rank correlation coefficient was calculated to determine whether a direct relationship exists between BMI and the number of scans required to complete the anomaly scan and also between gestational age at the initial anomaly scan and completion of this scan. Completion of the anomaly scan was defined according to the standards set out in the NHS Fetal anomaly screening program [7]. In some cases the scan could not be completed due to poor image quality and/or fetal position.

Women were divided into four groups according to the WHO BMI classification in order to compare the number of scans required to complete the anomaly scan for each group using Student *t* test and calculate relative risk for requirement of repeat scans. Ninety-five percent confidence intervals were calculated where appropriate and statistical significance was assigned where *p*-value was less than 0.05.

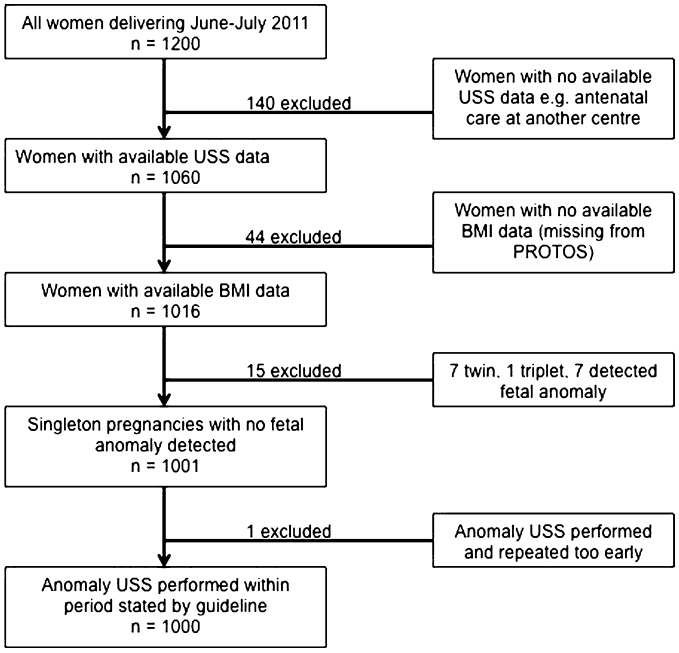

Fig. 1. Case selection flow chart.

Results

Of the 1000 women included in the analysis, mean (SD) BMI at booking was 25.8 (5.55) kg/m^2 (95% CI 25.48–26.17, range 15.2–50.8). This included 808 (80.8%) non-obese and 192 (19.2%) obese women. Of the obese group, 115 (11.5%) had Class 1, 51 (5.1%) Class 2 and 26 (2.6%) Class 3 or morbid obesity (Table 1).

The mean number of scans required to complete the anatomical survey for all women was 1.36 (95% CI 1.33–1.40). Overall, 321 (32.1%) women required two or more scans to complete the anomaly scan. 278 (27.8%) required two scans to complete and the remaining 43 (4.3%) required a third ultrasound scan. The mean (SD) number of scans to complete increased for each class of obesity from 1.43 (0.61) for Class 1 to 1.88 (0.65) for Class 2 to 2.15 (0.73) scan for Class 3. With increasing BMI there was a significant increase in the mean number of scans required up to BMI 35 (two sample *t*-test, $p < 0.02$) (Table 2 Fig. 2).

The number of scans required to complete the anatomical survey was directly related to BMI (Spearman $r = 0.243$, 95% CI 0.18–0.30, $p < 0.001$). One hundred (52.1%) of the 192 obese (BMI ≥ 30) women required more than one scan compared to 221 (27.4%) of the 808 non-obese women (RR 1.90, 95% CI 1.60–2.27, $p < 0.001$). Twenty-four (12.5%) of the 168 obese women still did not have the anomaly scan completed after two attempts compared to 19 (2.4%) of the non-obese group (RR 5.32, 95% CI 3.0–9.5, $p < 0.001$). Twenty-one (80.7%) of the 26 women with Class 3 obesity required more than one scan (RR 2.95, 95% CI 2.37–3.67, $p < 0.001$). Nine (34.6%) of the 26 women with Class 3 obesity required more than two scans to complete (RR 14.72, 95% CI 7.4–29.4, $p < 0.001$). The mean (SD) gestation at the first anomaly scan was 137.2 (5.02) days (95% CI 136.9–137.5, range 126–179) with 59 (5.9%) women having the first anomaly scan later than the recommended in the guideline. Gestation at first anomaly scan was not related to completion of the initial scan. Gestation at first scan was directly related to BMI (Spearman $r = 0.205$, 95% CI 0.14–0.27, $p < 0.001$). Mean gestation at first scan increased significantly for each class of obesity from 136.5 days for non-obese women days to 145.0 days for Class 3 obesity (Table 3).

Comments

Obesity rates in our study population reflected national figures, with approximately 20% of women classified as obese at the time of booking [4]. Our results demonstrate the negative effect of increasing maternal BMI on the fetal anomaly screening program in our unit. Increasing BMI resulted in increasing numbers of scan appointments required to complete the anatomical survey with the effect being most pronounced for women in the Classes 2 and 3 obesity groups.

The rate of repeat scans determined in this study can be used to demonstrate the impact of maternal obesity on scanning resources. Based on our results for all women requiring a second scan, we estimate the annual number of repeat scans in our unit to be around 2500 or around 24 additional hours per week of

Table 1
The BMI characteristics of the study population ($n = 1000$).

BMI (kg/m^2)	WHO classification	Number of women (%)
≤29.9	Non-obese	808 (80.8)
30.0–34.9	Obesity class 1	115 (11.5)
35.0–39.9	Obesity class 2	51 (5.1)
≥40	Obesity class 3	26 (2.6)