Best Practice & Research Clinical Obstetrics and Gynaecology 29 (2015) 320–327

Contents lists available at ScienceDirect

Best Practice & Research Clinical Obstetrics and Gynaecology

journal homepage: www.elsevier.com/locate/bpobgyn

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Obesity and the challenges of ultrasound fetal abnormality diagnosis

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Keywords:
obesity
obstetric ultrasound
fetal anomalies

Prenatal ultrasound has become an essential clinical tool for aneuploidy screening, detection of fetal congenital anomalies, and assessment of fetal growth and well-being. Maternal obesity, an increasing global problem, has been shown to decrease the accuracy of ultrasound examination in high-risk pregnancy. The purpose of this review is to provide an evidenced-based perspective on the challenges of performing fetal ultrasound in obese women and to provide a practical guide on how to care for these patients in the ultrasound suite.

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Introduction

Obesity continues to be a major public health problem, affecting >30% of reproductive-age women in the United States [1]. The incidence of morbid obesity (body mass index (BMI) >40 kg/m^2) in reproductive-age women exceeds 7%, which is 50% higher than the rate in men in the same age group [1]. Recent studies have shown that, when compared to normal-weight women, obese women have more pregnancy complications, such as congenital malformations [2–4], stillbirth [5], cesarean delivery [6,7], infection [8,9], preeclampsia, gestational diabetes, and macrosomic infants [10,11].

A meta-analysis of 18 articles noted that the rates of congenital anomalies are increased in obese women [4]. When compared to normal-weight women, obese women had increased odds of neural tube defect (odds ratio (OR) 1.87, confidence interval (CI) 1.62–2.15), cardiovascular anomalies (OR 1.39, CI 1.03–1.87), cleft lip and palate (OR 1.20, CI 1.03–1.40), anorectal atresia (OR 1.48, CI 1.12–1.97),

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http://dx.doi.org/10.1016/j.bpobgyn.2014.08.011
1521-6934/Published by Elsevier Ltd.

hydrocephaly (OR 1.68, CI 1.19–2.36), and limb reduction anomalies (OR 1.34, CI 1.03–1.73) [4]. Prenatal ultrasound diagnosis of these anomalies can be challenging in obese women due to multiple factors. Obese women have increased depth of abdominal adipose tissue. This affects visualization due to the increased distance of insonation [12]. Obese women have an increased risk of cesarean delivery compared to normal-weight women [6], and cesarean scars in subsequent pregnancies can affect the quality of the acoustic window. There is also evidence that obese women have increased rates of dizygotic twinning even without the influence of fertility drugs [13] and ultrasound evaluation of multiple gestation presents additional challenges.

The purpose of this review is to provide an evidenced-based perspective on the challenges of performing fetal ultrasound in obese women and to provide a practical guide on how to care for these patients in the ultrasound suite. In this review, obesity is defined using the World Health Organization (WHO) BMI categories that include normal (18.5–24.9 kg/m^2), overweight (25–29.9 kg/m^2), and obese ($\geq$30 mg/m^2). Obesity is further separated into class I (30–34.9 kg/m^2), class II (35–39.9 kg/m^2), and class III ($\geq$40 kg/m^2). Class III obesity is also defined as morbid obesity.

First-trimester ultrasound

First-trimester measurement of nuchal translucency (NT) has become a mainstay in aneuploidy screening. Obesity has been shown in several studies to affect this measurement. The First and Second Trimester Evaluation of Risk (FaSTER) trial, a National Institute of Child Health and Human Development (NICHD)-sponsored prospective multicentered study, found that maternal BMI significantly affected the ability to obtain first-trimester NT measurement [14]. The study found that the ability to obtain NT significantly decreased as BMI increased. The rate of enrollees without attainable NT was 1.0% for BMI <25 versus 3.2% for class I–III obesity and 7.8% for class III obesity ($P < 0.0001$).

In addition to the FaSTER trial, Thornburg et al. also noted similar findings in a retrospective study [15]. The study found that failure rates for NT screening at first attempt and subsequent attempts were higher in all three classes of obese women compared to normal-weight women. The study also found that the median time for NT measurement at first attempt was higher in class II obese women (14.1 min, interquartile range (IQR) 5.0–29.3) and class III obese women (12.3 min, IQR 4.6–22.7) versus normal-weight women (9.7 min, IQR 4.4–19.0). The total study time was also higher in obese women compared to normal-weight women.

In another retrospective study of first-trimester ultrasound, Gandhi et al. found an increased ultrasound examination time of 17.01 $\pm$ 7.97 min in obese women compared to 15.23 $\pm$ 8.09 min in normal-weight women [16]. Although the study did not find obesity to affect the completion rates of obtaining NT, it did find the need to perform transvaginal ultrasound examination to be significantly higher in obese women (41.8%) compared to normal-weight women (22.99%) ($P < 0.001$). In addition to NT measurement, Gandhi et al. also examined nasal bone assessment and found that obese women had higher rates of inadequate assessment compared to normal-weight women (12.7% vs. 3.0%, $P < 0.001$).

In summary, when performing first-trimester ultrasound, in particular NT measurement, obese women should be counseled that there may be a prolonged examination time and an increased failure rate, and other options of aneuploidy screening should also be discussed. The ultrasound suite needs to make necessary time allotment for the increased examination time and possible addition of transvaginal ultrasound examination for obese patients.

Second-trimester ultrasound

Fetal anatomic ultrasound, routinely performed in the second trimester, has become an essential tool in the diagnosis of congenital anomalies. It is also a recommended tool for aneuploidy assessment. Several studies have shown that maternal obesity affects the detection rate of congenital anomalies and aneuploidy by fetal anatomic ultrasound, mainly due to suboptimal visualization.

The FaSTER trial, as mentioned previously, also examined a subset of patients who underwent second-trimester genetic sonogram to evaluate for structural anomalies and soft markers for aneuploidy [14]. They found that maternal obesity decreased the sensitivity of certain aneuploidy soft markers (short femur, short humerus, and pyelectasis) while others (nuchal fold, echogenic bowel, and