Screening for Intrauterine Growth Restriction

Panagiotis Benardis
Fetal Medicine Unit 1st, Department of Obstetrics and Gynecology
University of Athens, Greece
Alexandra Hospital

INTRODUCTION
Fetal chromosomal and structural anomalies, prematurity and poor placentation account for 90% of poor perinatal outcome. The first two causes are discussed elsewhere in this issue. Poor placentation is responsible for developing of preeclampsia and/or intrauterine growth restriction (IUGR). As preeclampsia is also discussed elsewhere in this issue, in this article we will focus on screening for IUGR particularly with ultrasound.

IUGR is defined by failure of the fetus to achieve its genetically predetermined growth potential.1 In clinical practice neonates with a birthweight at or below the 10th percentile and fetuses with an ultrasound estimated weight at or below the 10th percentile for gestational age are considered small (small for gestational age-SGA). The vast majority of these fetuses are not malnourished and do not show increased perinatal morbidity and mortality. A small number of SGA fetuses will be malnourished and IUGR.2

IUGR complicates approximately 5 to 10% of pregnancies (depending on the definition used) and is a major contributor of poor perinatal outcome and long-term consequences.3-6

CAUSES AND ASSOCIATIONS
IUGR can be attributed to poor placentation and is associated with maternal, fetal and placental causes.7 Maternal causes include systematic diseases (e.g. preeclampsia), thrombophilias,8,9 smoking, severe malnourishment, drugs, alcoholism and consumption of substances. Fetal causes include chromosomal and structural anomalies, multiple gestations and viral infections. Finally, placental causes may include circumvallated placetas and tumors (e.g. chorioangiomata).10

PATHOPHYSIOLOGY
IUGR and preeclampsia are thought to be the consequence of impaired trophoblastic invasion of the maternal spiral arteries and the pathophysiological reduction in vascular resistance in the uteroplacental circulation.

The majority of IUGR cases are associated with uteroplacental insufficiency which is the common pathway of any of the specific causes. Placental insufficiency, if not treated, leads finally to a state of hypoxemic hypoxia.11 In this situation the fetus initially tries to compensate by increasing the blood flow to its vital organs (e.g. brain, heart, adrenals) but when this goes on beyond a point, it decompensates and leads to tissue hypoxia, brain damage and/or death.

SCREENING TESTS
Screening for IUGR could be done using clinical, biochemical and ultrasound tests.11 Clinical tests like small symphysis-fundal height12 or less than expected maternal weight gain have low sensitivity. The same stands for biochemical tests measuring placental hormone levels (e.g. AFP). Therefore in everyday clinical practice the most useful screening test is ultrasound. Fetal measurements (biometry) and Doppler of the uterine arteries are used for screening purposes, biometry and Doppler of the umbilical artery for discriminating SGA from IUGR and Doppler of fetal vessels to monitor IUGR fetuses.

BIOMETRY
Standard measurements include biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC) and femur length (FL). There are several formulas to estimate fetal weight from these measurements with a typical deviation of approximately 15%.11

In order for fetal measurements to be accurate and reliable the doctor/sonographer should be experienced and the ultrasound equipment modern and in good condition. Use of updated software is also important. Accurate determination of gestational age, use of appropriate charts and time intervals between examinations is the cornerstone of measuring biometry.

Gestational age determination is more accurate when done in the first or early second trimester. Nowadays the incorporation of nuchal translucency assessment in everyday practice, offers a great opportunity for measuring the crown-rump length (CRL) which has been shown to be an accurate measurement for determining gestational age.

A lot of discussion has been made regarding the use of appropriate growth charts. Use of custom made charts, taking into account demographic characteristics for specific
populations, is gaining ground lately. Most authors use the 10th percentile as the lower cut-off point when estimating fetal weight alone or in combination with abdominal circumference in order to define SGA fetuses. The same standards should be used in every examination in order to compare results. In addition there should be enough time between examinations for a meaningful comparison of differences in biometry. This has been estimated as a time interval of approximately two weeks.

Uterine artery Doppler assessment

Screening for IUGR is done by uterine artery Doppler assessment as a one (23 weeks gestation) or two stage procedure (18 to 20 and 24 weeks) using either the transabdominal or transvaginal route. Different indices (e.g. pulsatility index-PI, resistance index-RI) and/or assessment of waveform notching are used in order to diagnose increased vessel resistance indicating uteroplacental insufficiency.

Over the last 20 years a number of Doppler ultrasound studies have confirmed the original observation that increased impedance to flow in these vessels is associated with an increased risk for subsequent development of IUGR and/or preeclampsia. However, in these studies the number of patients examined was relatively small and methodology and definitions varied widely.

In 2001 a multicenter study of 8000 unselected women, the largest of its kind, was published by Papageorghiou et al showing that a one-stage color Doppler screening program at 23 weeks gestation identifies most women who subsequently develop severe IUGR requiring delivery before 34 weeks.

Therefore in singleton pregnancies there is now extensive literature in both high-risk and unselected populations, which suggest that uterine artery velocimetry can predict the development of subsequent IUGR with a sensitivity of around 30% for a 5% screen-positive rate.

In twins things are less clear though. Two studies were published in 2002 by Yu et al and Geipel et al on the use of uterine artery Doppler velocimetry at 18 to 24 weeks of gestation in relation to prediction of preeclampsia and IUGR in a total of 616 twin pregnancies. These studies report screening sensitivities of 6 to 29% for a 14 to 24% screen-positive rate, depending on the definitions used.

Conclusions

IUGR complicates approximately 5 to 10% of singleton pregnancies and is a major contributor of poor perinatal outcome and long-term consequences.

Ultrasound screening for IUGR is done by uterine artery Doppler assessment. Increased impedance to flow in the uterine arteries in both high-risk and low-risk pregnancies is associated with increased risk for subsequent development of intrauterine growth restriction. Women with normal impedance to flow in the uterine arteries constitute a group that have a low risk of developing obstetric complications related to uteroplacental insufficiency. Increased impedance to flow in the uterine arteries at 23 weeks of gestation is found in about 5% of pregnancies attending for routine antenatal care and identifies about 30% of those that subsequently develop intrauterine growth restriction. Abnormal Doppler is better in predicting severe (birth weight below the 3rd percentile or growth restriction requiring delivery before 34 weeks) rather than mild growth restriction.

Implementation of a uterine artery screening program into routine antenatal care perhaps at the time of the 2nd trimester anomaly scan would help stratify the intensity of subsequent surveillance. The questions to be answered by future research is whether there could be any useful intervention in order to reduce poor perinatal outcome. Further research is also warranted for screening in twin pregnancies.

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