Objectives:

This chapter will enable the reader to
Define fetal growth restriction (FGR)
List the parameters used in establishing FGR
Differentiate the two types of growth retardation

INTRODUCTION

About 10% of pregnancies develop fetal growth restriction (FGR). FGR is a major cause of fetal and neonatal long-term morbidity and mortality, with implications for obstetricians, neonatologists, and pediatricians. The children born with FGR are at a special risk of subsequent growth and neurodevelopmental impairment.

Birth weight is the strongest known indicator of perinatal mortality, with which it carries an inverse relationship. In the past, all children with birth weight less than 2500 gm were labeled as premature, despite the fact that many were born at the normal gestation. In 1961, the WHO acknowledged that many small babies were not really premature. It therefore reclassified birth weight below 2500 gm as “low birth weight”.

This chapter defines fetal growth restriction (FGR), lists parameters used in establishing FGR, and differentiates symmetric from asymmetric growth retardation.

DEFINITIONS FOR GROWTH IMPAIRMENT

The terms used for growth impairment are many. Unfortunately, they are used interchangeably and incorrectly. These terms include “premature”, “low birth weight”, “small for gestational age”, “small for date”, “fetal growth retardation”, “intrauterine growth retardation”, and “intrauterine growth restriction” (Table 1.1)

The word premature is applied to the baby born before 37 completed weeks.

<table>
<thead>
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<th>Table 1.1: Terms and abbreviations</th>
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<tr>
<td>Premature: a baby born before 37 weeks.</td>
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<td>Low birth weight: a baby with birth weight less than 2500 gm</td>
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<td>Small for gestation age: a baby with birth weight below the 10th percentile</td>
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<td>Fetal growth restriction: a pathological decrease in the rate of fetal growth. This term is synonymous with intrauterine growth retardation (IUGR).</td>
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A **low birth weight** (LBW) baby is one whose weight is less than 2500 gm at birth.

A **small for gestation age** (SGA) baby is one whose birth weight is below the 10th percentile for the gestation. Another term for this is “small for date”.

**Fetal growth retardation** is said to exist when there is a pathological decrease in the rate of fetal growth. This term is synonymous with intrauterine growth retardation (IUGR). Thus, FGR is SGA in whom a physiological derangement has been documented or is strongly suspected. This derangement may be observed on Doppler testing or on biochemical tests.

A growth restricted newborn is an infant who has not reached its genetic growth potential *in utero*. The term **“intrauterine growth retardation” (IUGR)** is used for the fetus who suffers morbidity and/or mortality associated with the failure to reach the growth potential, while the term “small for gestational age” (SGA) is the more general term for the small fetus where no pathology has yet been recognized. **Fetal growth restriction (FGR)** means IUGR, but avoids the use of the word retardation, which, to the child’s parents, is associated with impaired mental functions. Fetal growth restriction is therefore a more acceptable term, and will be used throughout the book.

Infants of **low birth weight** can be further classified into three groups:

- preterm with appropriate weight for gestational age,
- preterm and growth retarded,
- term and growth retarded.

The causes of low birth weight and subsequent management differ in the three groups.

**PARAMETERS THAT ESTABLISH FGR**

Which parameters predict infants at risk for short and long term impairment?

Many measures are available. In severe cases only a few parameters may be used, while doubtful cases of FGR will require use of more parameters. The parameters are

- (a) Gestational age
- (b) Birth weight
- (c) Fetal weight/size
- (d) Ultrasound
- (e) Fetal growth ratio
- (f) Developmental pediatric assessment

**Gestational age.** Before a fetus can be defined as normal or SGA, gestational age must be known. The instruments used to determine gestational age are the last menstrual period (LMP), fundal height measurements, and ultrasonography.

Estimates based on the LMP are unreliable. The LMP and fundal height have an accuracy of only 40-60%. In *utero*, the infant cannot be measured physically, and gestational age is therefore best confirmed by ultrasound.

**Birth weight/Fetal size.** A birth weight below the 10th percentile for gestational age (according to appropriate population-based growth charts) defines SGA. The same definition is used for ultrasound diagnosis.

By using the 10th percentile cut-off, 70% of the infants identified as growth restricted are actually constitutionally small (“light” for gestational age) and represent one end of the spectrum of normal neonatal size. Thus, the use of the 10th percentile results in monitoring of...
several normal infants. These babies should be followed up during pregnancy with serial ultrasound, Doppler studies, or, when Doppler is not available, by biochemical tests.

A cut-off birth weight of 2 SD below the mean includes only infants below the 3rd percentile. Unfortunately, using this cut-off, a large number of FGR's are excluded. Nevertheless, the definition using the 3rd percentile is most meaningful, since most poor outcomes are found in these infants.

Birth weight is a retrospective criterion that requires charts corrected for maternal size, race, and fetal sex. Fetal size is a more valuable prognosticator of prenatal and postnatal outcomes.

**Ultrasound.** The most precise dating and fetal size evaluation is by ultrasound. Obstetricians use ultrasound for establishing gestational age, and fetal size for diagnosing growth retardation. Ultrasound parameters include body indices, ratios, and other measures that help identify growth-restricted fetuses (Table 1.2).

Ultrasongraphy is used in conjunction with the LMP. When the LMP is not known, fetal size and age can be estimated by growth adjusted sonographic age (GASA). Size can also be estimated by ultrasound standards utilizing the multiple parameter technique. Serial testing increases accuracy.

The use of ultrasound has resulted in fewer babies being classified as SGA, as compared to assessment by clinical methods alone.

**Fetal growth ratio.** Since many births may be growth restricted (though normal according to clinical methods, birth weight or gestational age), a new method focuses on the maturity parameter. The fetal growth ratio is used to develop a classification system based on combinations of weight, gestational age, and maturity. It is used for a comparative analysis. The results show large differences in the division of compromised births across racial and ethnic groups and in the risk of infant mortality.

**Developmental pediatric assessment.** Neonatal growth may be assessed by developmental characteristics. The Neonatal Growth Assessment Score (NGA) can be used as an independent confirmation of the diagnosis of *in utero* FGR. Mechanical deliveries, abnormal fetal heart patterns, and meconium-stained labors seen in growth retardation, are more likely to result in abnormal NGA Scores.

**LIMITATIONS IN THE USE OF VARIABLES THAT DEFINE FGR**

Gestational age-based definitions are used for the diagnosis of FGR at birth. The standards and study methodology are several and variable. The variables include type of population, area of study (sea level, high altitude), race, ethnicity, and others (Table 1.3). The difficulty in establishing the 10th percentile is thus obvious. The suggested solution is to define cut-offs

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Table 1.2: Parameters of fetal size and age

| (a) Body indices (BPD, AC, HC, FL others) |
| (b) Body ratios and proportions |
| (c) Amniotic fluid volume |
| (d) Placental grading |

Table 1.3: Variables that affect the definition of the “10th percentile” cut-off value

- Type of population
- Area of study (sea level, high altitude)
- Race, ethnicity
- Single/multiple pregnancy
- Methods of rounding off gestational age
- Fetal sex
- Smoking
- Presence of congenital malformations
- Poverty
- Infection
that predict morbidity and mortality, or evaluate practices that improve outcome, for example one that uses a single standard that applies to all racial groups living in a particular geographic area.

**SYMМЕTRIC VERSUS ASYММЕTRIC FGR**

FGR babies are classified as symmetrical and asymmetrical. Symmetric retardation usually comprises infants who are small all over, while babies with asymmetric retardation generally have a normal head size and fetal length but reduced weight. Classification is useful in determining etiology and predicting outcome.

The normal small fetus or the symmetrically ‘retarded’ baby is one that has all growth parameters below the 2SD or 10th percentile. Approximately 2.5-10% are identified to have this type of fetal size, where the growth velocity is parallel to the standard charts. It results from early insult that impairs fetal cellular hyperplasia leading to a proportionate decrease in all fetal organs.

Asymmetric FGR, in contrast, may be caused by later insults leading to a smaller abdominal size as compared to the head of the fetus. 70% of growth-retarded babies are identified as having asymmetrical retardation.

The perinatal problems associated with the two differ, and an attempt to identify type is thus useful. Overlap between the two groups makes clear distinction difficult sometimes.

**CONCLUSIONS**

- Fetal growth restriction exists when there is a pathological decrease in the rate of fetal growth. This term is synonymous with intrauterine growth retardation (IUGR).
- Six parameters are used to establish the definition: gestational age, fetal weight, ultrasonic measures, fetal growth ratios and neonatal growth scores. The most common cut-off values used are the 10th and 3rd percentiles of birth weight and ultrasonic values. Infants below these percentiles are abnormally small. Variables like population type, fetal sex, study area, parity, race, ethnicity, gestational age and malformations all affect the parameters defining growth retardation.
- There are two types of growth restriction: symmetrical and asymmetrical. The symmetrically restricted baby is one that has all growth parameters below the 2SD or 10th percentile. It results from early insult that impairs fetal cellular hyperplasia leading to a proportionate decrease in all fetal organs. Asymmetric FGR, in contrast, may be caused by later insults leading to a smaller abdominal size as compared to the head of the fetus.

**REFERENCES**