Accuracy of Fetal Transcerebellar Diameter in Estimation of Gestational Age in Small for Gestational Age Fetus

Thesis

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List of Contents

List of Abbreviations

Abbr.	Title
AC	Abdominal circumference
BPD	Biparietal diameter
CB	Cerebellum
CRL	Crown rump length
EDC	Estimated date of confinement
Fig	Figure
GA	Gestational age
GW	Gestational weeks
HC	Head circumference
IUGR	Intrauterine growth retardation
LMP	Last menstrual period
mm	Millimeter
MRI	Magnetic resonance imaging
OFD	Occipito-frontal diameter
P	Parity
SD	Standard deviation
SGA	Small for gestational age
Tab	Table
TCD	Trans-cerebellar diameter
TH	Thalami
WK	Week
2D	Two dimensional
3D	Three dimensional

List of Tables

List of Figures

Abstract

Background: Small for gestational age (SGA) is defined as an estimated fetal weight (EFW) or abdominal circumference (AC) less than the 10th centile. **Aim of the Work:** This study aims to evaluate the value of use of TCD in singleton gestations as a reliable predictor of GA in fetuses with SGA. **Patients and Methods :** Study design: This Cross-sectional study was conducted on 101 pregnant women clinically suspected to have SGA fetus in the special care center of the fetus, Ain Shams Maternity Hospital (Inpatient & Outpatient). The transcerebellar diameter, the biparietal diameter, the femur length and abdominal circumference were measured for determination of gestational age. **Results:** Table 4 shows: the table showed that TCD had the least discrepancy from dating by the LMP (only 2.02 weeks). All other measured parameters showed a discrepancy of more than 3 weeks. **Conclusion:** This study showed that transcerebellar diameter has an advantage in cases of growth restricted fetuses as it correlates well with gestational age compared to other growth parameters. TCD had the smallest SEest (±2.02weeks) whereas most of other measurements were consistently discrepant by more than 3 weeks. **Recommendations:** TCD is advised to be added as a routine measurement for the estimation of gestational age. Further studies to investigate its accuracy in estimation of GA in large of gestational age fetuses.

Key words: SGA, abdominal circumference, TCG, EFW

Introduction

Small for gestational age (SGA) is defined as an estimated fetal weight (EFW) or abdominal circumference (AC) less than the 10th centile ***(RCOG, 2013).*** Fetal growth restriction (FGR) is not synonymous with SGA. Some, but not all, growth restricted fetuses/ infants are SGA while 50–70% of SGA fetuses are constitutionally small, with fetal growth appropriate for maternal size and ethnicity ***(Alberry and Soothill, 2007)***. Fetal growth restriction (FGR) is defined as fetuses whose growth velocity slows down or stops completely because of inadequate oxygen and nutritional supply or utilization ***(Cardozo and Luckas, 2010).*** Low birth weight (LBW) refers to an infant with a birth weight < 2500 g ***(RCOG, 2013).***

Small for gestational age is a common and complex obstetric problem as this fetal condition is associated with significant perinatal morbidity and mortality ***(Kramer et al., 2006).*** SGA is noted to affect approximately10-15 % of pregnant women ***(ACOG, 2012).***

The screening and diagnosis of SGA is based on establishment of accurate early dating, assessment of risk factors, followed by ultrasound for fetal growth. Accurate gestational age can be estimated by menstrual history, clinical examination and ultrasound ***(Mongelli et al., 2005).***

Prediction of gestational age (GA) based on sonographic fetal parameters is perhaps the cornerstone in modern obstetrics and continues to remain an important component in the management of pregnancies with fetuses who have growth disturbances ***(Martin et al., 2007).*** Ultrasound has been used as a tool for determining fetal health and a variety of sonographic parameters have been used to screen and diagnose small for gestational age (SGA) including fetal biometry, fetal body proportions ***(Campbell et al., 1994),*** amniotic fluid volume ***(Owen et al., 1999)***, and estimated fetal weight (EFW)by Hadlock formula as it is preferable due to its low level of systematic error ***(Siemer et al., 2008).***

The four basic measurements, including biparietal diameter (BPD), head circumference (HC), femur length (FL), and abdominal circumference (AC), can be performed using standard AIUM guidelines ***(AIUM, 2013).*** The accuracy and reproducibility of various biometry measurements are variable as after 14 weeks, BPD is noted to be highly reproducible parameter; and its shape can affect BPD measurement ***(Benson and Doubilet, 1991).***

Malik and Waqar (2006) found that the fetal cerebellum exhibits a progressive growth throughout the gestation period. So it is an organ capable of providing information on the prediction of gestational age during the

pregnancy. Transcerebellar diameter (TCD) is one such fetal parameter that has remained consistently superior in predicting GA in both singleton and twin gestations ***(Chavez et al., 2004) (Chavez et al., 2006).*** TCD can predict GA in both the second and third trimesters ***(Chavez et al., 2004)***. Whether TCD remains a useful predictor of GA at the extremes of fetal growth (small and large fetuses) remains unclear ***(Snijders et al., 1994) (Lee et al., 1991).***

This study aims to evaluate the value of use of TCD in singleton gestations as a reliable predictor of GA in fetuses with SGA.

Aim of the Work

This study aims to evaluate the value of use of TCD in singleton gestations as a reliable predictor of GA in fetuses with SGA.

Chapter (1):
Normal & Abnormal Fetal Growth

The normal range of term birth weight is referenced to the mean birth weight for pregnancies delivered at 38-42 weeks' gestation (ie, mean term gestational age ±2 SDs). During this 4-week interval, the typical fetus gains approximately 12.7 ±1.4 g/day, with a difference of ±0.3 g/day depending on the sex of the fetus (male fetuses gain weight more rapidly than female fetuses ***(Nahum et al., 2013).***

The process of fetal growth comprises three consecutive and somewhat overlapping phases. The first phase is the phase of cellular hyperplasia and encompasses the first 16 weeks of gestation. The second phase, known as the phase of concomitant hyperplasia and hypertrophy, occurs between the 16th and 32nd weeks and involves increases in cell size and number. The third and final phase, called the phase of cellular hypertrophy, occurs between the 32nd week and term and is characterized by a rapid increase in cell size. Quantitatively, normal singleton fetal growth increases from approximately 5 g/day at 14 to 15 weeks of gestation to 10 g/day at 20 weeks and 30 to 35 g/day at 32 to 34 weeks, after which the growth rate decreases ***(Resnik, 2002).***

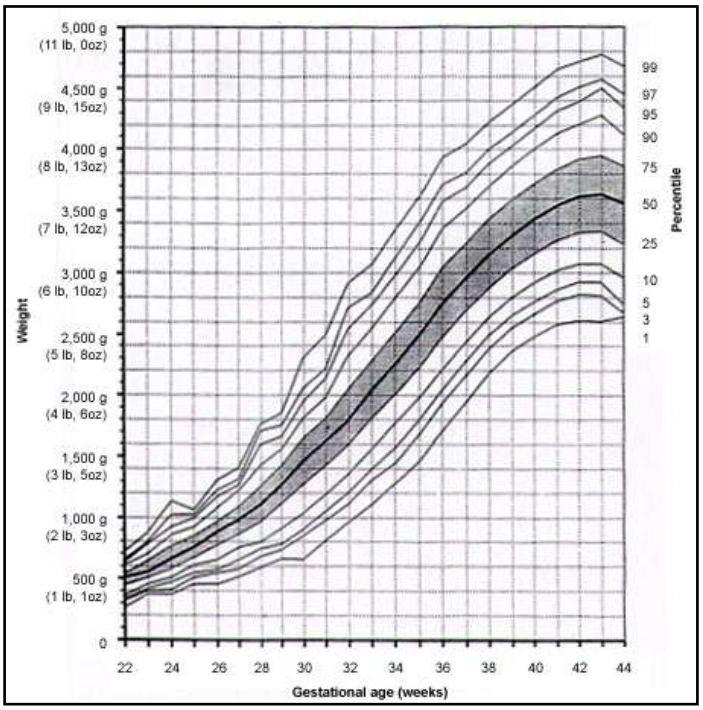

Figure (1): Fetal weight percentiles throughout gestation ***(Gruenwald et al., 1967).***

Abnormal Fetal Growth:

Intrauterine growth restriction (IUGR) is defined as a fetus with estimated weight < 10th percentile for gestational age.it is reported to occur in about 10% of pregnancies. IUGR may or may not result in the neonate being considered small for gestational age (SGA).it is often idiopathic, but types based on etiology include:

- Asymmetric (70% of cases), which occurs during the second or third trimester due to extrinsic factors such as placental insufficiency or maternal disease

- Symmetric (30% of cases), which occurs due to intrinsic factor such as aneuploidy, congenital infections in early pregnancy, or multiple gestation ***(Chisholm et al., 2016).***

Pathophysiology:

The causes of growth restriction are broadly described under three main categories: maternal, fetal, and placental ***(Hendrix & Berghella, 2008).***

Fetal factors:

Genetic factors

Population-based intergenerational studies of birth weight have found that genetic factors contribute 30 to 50 percent of the variation in birth weight, with the remainder due to environmental factors ***(Svensson et al., 2006).***

Maternal genes influence birth weight more than paternal genes, but both have an effect. Specific allelic variants associated with birth weight include mutations in GCK and HNF1beta, which have been associated with low birth weight, and mutations in HNF4 alpha, which have been associated with high birth weight. Variants in ADCY5 and loci near CCNL1 also appear to lower birth weight ***(Freathy et al., 2010).***

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