INTRODUCTION

Human placental development is asintriguing as fetal embryology.During its brief intrauterine passage, the fetus is dependent on the placenta for pulmonary, hepatic, and renal functions. These are accomplished through the unique placental anatomical association with the maternal interface.

The placenta links mother and fetus by indirect interaction with maternal blood to allow exchange of gases and nutrients with fetal capillary blood within connective tissue at the villous core. Fetal and maternal blood are not normally mixed in the placenta. There is also a paracrine system that links mother and fetus through the placenta. This is an important arrangement for communication between fetus and mother and for maternal immunological acceptance of the conceptus***(Guzeloglu-Kayisli and associate, 2009).***

In the first trimester, placental growth is more rapid than that of the fetus. But by approximately 17 postmenstrual weeks, placental and fetal weights are approximately equal. By term, placental weight is approximately one sixth of fetal weight. According to Boyd and Hamilton (1970), the average placenta at term is 185 mm in diameter and 23 mm in thickness, with a volume of 497 mL and a weight of 508 g. These measurements vary widely, and there are multiple variant placental forms and

several types of umbilical cord insertions***(Guzeloglu-Kayisli and associate, 2009).***

The placenta influences fetal growth through its functional size, capacity to transport oxygen and nutrients, and its own metabolism. Placental growth is crucial to fetal growth. This is supported by the fact that, throughout gestation, placental growth closely parallels fetal growth. In addition, it has been demonstrated recently that placental volume measured at 14 weeks was directly related to fetal anthropometric measurements at 35 weeks. Furthermore; placental villous area (the functional area) continues to increase throughout gestation along with vascularization of terminal villi and thinning of the syncytial layer, which optimizes exchange at the fetoplacental level ***(Thame et al., 2004).***

Large placentas are associated with hemolytic disease of newborn, maternal diabetes mellitus, severe anemia and intrauterine fetal infections ***(Benirschke and Kaufmann, 1990; Spirt and Gordon, 1996).***

Small placentas are associated with preeclampsia, chromosomal abnormalities, severe maternal diabetes mellitus, chronic fetal infections and intrauterine growth restriction ***(Kuhlmann and Warsof, 1996; Sadler, 2004).***

Fetal weight estimates are very important because a large proportion of perinatal mortality is related to birth-weight. Thus, birth-weight is the single most important parameter that determines neonatal survival***(Airede et al., 2009).***

Doppler ultrasonography is a noninvasive method of assessing fetal vascular impedance. Umbilical artery Doppler ultrasonography has been used to assess fetal well-being, based on observations that growth-restricted fetuses have different Doppler characteristics than normal fetus ***(Kingdom et al., 2007).***

In the normal fetus, the pulsatility index decreases with advancing gestation. This reflects a decrease in the placental vascular resistance. In fetuses with IUGR, there is an increase in the pulsatility index secondary to the decrease, absence, or reversal of end-diastolic flow. The changes in these waveforms are thought to be indicative of increased placental resistance. The absent or reversed end-diastolic flows are strongly associated with an abnormal course of pregnancy and a higher incidence of perinatal complications, when compared with fetuses with IUGR but characterized by the presence of end diastolic flow ***(Farine et al., 2007).***

Obstetric ultrasonography offers the tools to estimate fetal weight and assess placental size and umbilical artery Doppler.

At this study, we will try to find out is there a relationship between the fetal weight (EFW) and both umbilical artery Doppler and placental thickness (as estimated with trans-abdominal ultrasound) ***(Abu et al., 2009).***

AIM OF THE WORK

The aim of this study is to evaluate the correlation between the fetal weight (EFW) (as estimated with trans-abdominal ultrasound and as measured after birth by a scale) and both umbilical artery Doppler and placental thickness (as estimated with trans-abdominal ultrasound) in healthy pregnant ladies at term.

Such correlation if found might be used as a tool of fetal weight estimation, consequently, give an idea if there is any maternal or fetal abnormality, also about the preferred delivery mode.

NORMAL AND ABNORMAL FETAL GROWTH

Fetal growth

Key aspects of fetal growth include not only the rate of change in fetal body weight but also the change in body composition as gestation advances. This is particularly striking for the human fetus, which grows by approximately 1.5% each day. Accompanying this growth there is a reduction in total body water concentration, attributable largely to a decrease in extracellular fluid volume as a fraction of total body water, and large increases in white fat depots. Water has no caloric density, whereas fat has the highest caloric density of tissues; therefore, the human fetus has a relatively high caloric accretion rate. Also, because fat consists of 78% carbon but is nitrogen free, the human fetus has a relatively low nitrogen accretion rate in late pregnancy but builds up large carbon stores in fat and glycogen***(Sparkset al., 1980).***

The accumulation of large white fat depots in the human fetus has important nutritional implications. Fat depots are important storage sites for the fat-soluble vitamins and essential fatty acids, particularly the polyunsaturated, long chain fatty acids. Intrauterine growth-retarded and very preterm infants are born with depleted fat and glycogen stores and are at risk of developing essential fatty acid deficiency relatively quickly (i.e.,

within days) compared with term infants (i.e., within weeks), Similarly, IUGR and preterm infants are at risk of neonatal hypoglycemia. Fat also helps to insulate the term infant, reducing heat and water loss through the skin, all adaptations that the premature infant does not have***(Clandinin T et al., 1981).***

Establishing the standard for growth

Accurate assessment of fetal growth status requires the definition of 'normal', i.e. the optimal growth of each baby. This includes the consideration of four factors which affect the standard:

1. Accurate dating is a first prerequisite for any growth standard. Ultrasound dating is much more accurate that menstrual dating. Because the distribution of menstrual dating error is positively skewed, many birth weight points at term appear at later gestations than they actually should be, leading to an artificial flattening of the growth curve and apparent increase in 'post term' births. In reality, growth in utero in normal pregnancy continues without diminished velocity until birth. Dating error can also severely affect the accuracy of gestation in the preterm gestation range***(Gardosi et al., 1997).***

2. The growth standard also needs to be individually adjusted for physiological factors known to affect birth weight and growth. Adjustment is required for variables including maternal height, weight in early pregnancy, parity, and ethnic group, as well as the sex of the baby, There are an infinite number of combinations of these variables, and these can be calculated by computer to give an optimal weight value at the end of a normal pregnancy - (e.g. at the modal length of 280 days)***(Gardosiet al., 1995).***

   Paternal height also plays a role but this factor is relatively minor***(Wilcoxet al., 1995).***

3. The growth and birth-weight standard also needs to be free from pathology. Multivariate analysis of the constitutional variables mentioned above needs to exclude factors which are known to be associated with fetal growth abnormalities, such as smoking and diabetes***(Gardosiet al., 1995).***

4. The optimal weight at term is then combined with a 'proportionality growth curve' which is derived from an in-utero fetal growth formula***(Gardosiet al., 1995).***

Thus, the growth dynamics in a normal pregnancy ending with this predicted weight point are outlined by a 'Gestation Related Optimal Weight' - curve. As a consequence of using a

fetal rather than a neonatal weight based curve, the negative skewness of birth weight curves in the preterm period are also avoided. The skewed distribution exists because of the well-proven association between spontaneous preterm birth and fetal growth restriction***(Zeitlinet al., 2000).***

Because of this association, it is inappropriate to use a standard for preterm neonatal weight assessment which is derived from other preterm baby weights, as by definition these are abnormal. As there are an infinite number of possible combinations to produce an individual fetus' optimal growth curve, the method requires a computer***(Gardosiet al., 1998).***

Evidence for customised assessment

Application of such an individually adjustable standard for fetal growth allows better distinction between normal and abnormal smallness, and this applies both in the antenatal assessment of estimated fetal weight as well as in the postnatal assessment of birthweight***(Gardosiet al., 1998).***

a. Intrauterine weight:

Ultrasound based fetal weight curves reproduce differences between physiological or constitutional characteristics, in low risk as well as high risk populations***(Mongelliet al., 1995).***

The use of fetal weight instead of individual scan biometry parameters allows adjustment of normal intrauterine growth limits, as there is insufficient data to 'customize' ultrasound scan values by multivariate analysis of all the non-pathological factors which influence fetal growth.

The variables can be determined from larger,population based birth weight databases, and then applied to intrauterine growth curves***(de Jong et al., 1998).***

Customized limits reduce false positive 'IUGR' in a normal population***(Mongelliet al., 1996).***

Receiver-operator curves suggest that the 10th percentile is a suitable cut-off limit to detect those babies who will develop perinatal complications***(de Jonget al., 1998).***

b. Birth weight:

Whenassessing small-for-gestation age (SGA) birthweight,it is clear that a large proportion of the population is misclassified if an unadjusted standard is used. In a heterogeneous population, differences between ethnic groups can also be substantial***(Wilcoxet al., 1993).***

Individually adjusted birth-weight percentiles are better correlated with Apgar scores**(Gardosiet al., 1995)** and neonatal morphometric indices***(Sandersonet al., 1994).***

They also better reflect adverse pregnancy events, even across geographical boundaries. For example, SGA defined by a customized standard derived from an English population is better correlated with operative deliveries for fetal distress and admission to neonatal intensive care in a Dutch population, than the local Dutch population standard***(Gardosiet al., 1998).***

Analysis of a large Swedish dataset showed that SGA defined by a customized birth weight centile was more closely associated with stillbirths, neonatal deaths and low Apgar scores (<4) than the unadjusted population centile. In fact, babies considered small by the general Swedish population standard but not by customized standard did not have a larger risk of stillbirth, neonatal death or low Apgar scores than the average-for-gestational age group.The inference from these findings is that 'customized' SGA is equivalent to IUGR. Furthermore, this study confirms that small-normal babies are not at greater risk than normal size babies***(Clausson et al., 2001).***

Conclusions

For epidemiological analysis as well as for prospective assessment of fetal growth, individual adjustments of the weight limits reduce false positives and help to identify those babies who are pathologically small. This should lead to improved

screening and further investigation (especially by Doppler) of those babies who are at risk.

The timely detection of growth failure is important because of its ever-more apparent links to perinatal morbidity and mortality***(Maternal and Child, 2001).***as well as adverse effects in childhood and later life. Improvements in neonatal care and better surveillance methods of the at-risk fetus place emphasis on better screening and detection of antenatal growth problems. Fetal biometry continues to have an important role, and its most effective use in the third trimester is its provision of an estimated fetalweight which, plotted on customized charts, will give an indication of the growth status of the fetus***(Barker, 1997).***

PRENATAL SONOGRAPHIC ASSESSMENT OF FETAL WEIGHT

Monitoring fetal growth is a standard component of antenatal care. Investigators have developed several equations for estimating fetal weight in the late second and the third trimester. These equations involve a variety of sonographically obtained biometric measurements. The fetal weight derived from these equations is then compared to distributions normalized for gestational age to identify growth outside the norm. Since abnormalities of fetal growth are associated with an increased risk of adverse outcome, this information often affects how the pregnancy and delivery will be managed. Techniques for obtaining biometric measurements used in assessment of gestational age and fetal weight can be found separately***(Andrewet al., 2013).***

Formulas

Ultrasound examination typically involves measurement of multiple biometric parameters that are incorporated into a formula for calculating estimated fetal weight (EFW). Most commonly, a combination of biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL) is used. The two most popular formulas are Warsof's***(Warsofet al., 1977)***.with Shepard's

modification***(Shepardet al., 1982)***. and Hadlock's***(Hadlocket al., 1985).***These formulas are included in most ultrasound equipment packages. However, at least 30 formulas for estimating fetal weight have been published***(Andrewet al., 2013).***

Performance - A well-designed prospective study compared estimated and actual birth weight in 441 pregnancies delivered within 48 hours of ultrasonography***(Sciosciaet al., 2008).***

Twenty-nine different formulas were used to calculate EFW. All of the pregnancies were singletons and 99 percent of the mothers were Caucasian. For birthweights between 3.0 and 3.5 kg, 80 percent of EFWs were within 10 percent of birthweight. Formulas using head, abdomen, and femur measurements resulted in the lowest mean absolute percentage error (about 8 percent)***(Andrewet al., 2013).***

A retrospective cohort study of the accuracy of estimated fetal weight within one week of delivery using 23 fetal weight estimation models concluded the Sabbagha formula***(Sabbaghaet al., 1989).***which like Hadlock uses head, abdomen, and femur measurements but also incorporates gestational age, resulted in the lowest mean percentage error (-1.5 to 3.3 percent)***(Barelet al., 2013).***

A systematic review of studies that compared ultrasound estimated fetal weight (EFW) with birth weight included 11 different methods of fetal weight assessment***(Dudley, 2005).***

These studies consistently observed that in 5 percent of fetuses, the random error in fetal weight estimation exceeded 14 percent of birth weight. Both intra-observer and inter-observer variability was large. The authors concluded that volumetric methods had some advantages, but there was no consistently superior method of sonographic determination of fetal weight. In addition to the equation used, other factors potentially affecting the accuracy of fetal weight estimates include***(Dudley, 2005)***.

- Ethnicity, since birth weight distribution may vary in different populations
- Low quality image is related to factors such as oligohydramnios, maternal adiposity, multiple fetuses, and fetal position
- Operator experience
- Equipment
- Variability in fetal body composition
- Fetal anomalies (eg, gastroschisis, hydrocephaly) in which the biometric measurements are increased or decreased by the fetal malformation and do not truly reflect the fetal weight.