Estimation of Fetal Birth Weight by Three-Dimensional Ultrasound Volume Measurements of the Fetal Upper-Arm and Thigh

Thesis

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بسم الله الرحمن الرحيم
قالُوا سُبْحَانَكَ لاَ عِلْمَ لَنَا إِلاَّ مَا
عَلَّمْتَنَا إِنَّكَ أَنتَ الْعَلِيمُ الْحَكِيمُ
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Wael El- Sherif

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List of Abbreviations

٢D US	:	Two-dimensional ultrasound
٣D US	:	Three-dimensional ultrasound
AC	:	Abdominal circumference
AFI	:	Amniotic fluid index
AFV	:	Amniotic fluid volume
BPD	:	Bi-parietal diameter
CRL	:	Crown-rump length
EBW	:	Estimated birth weight
FL	:	Femur length
FTV	:	Fetal thigh volume
HAPO	:	Hyperglycemia and Adverse Pregnancy Outcomes
HC	:	Head circumference
HL	:	Hummers length
IGF	:	Insulin like growth factor
IUGR	:	Intrauterine growth restriction
LBW	:	Low birth weight
LGA	:	Large for gestational age
LMP	:	Last menstrual period
MCA	:	Middle cerebral artery
OFD	:	Occipito-frontal diameter
SGA	:	Small for gestational age
SPSS	:	Statistical package for the social science
TTD	:	Transverse trunk diameter
U S	:	Ultrasound
VOCAL	:	Virtual Organ Computer Aided Analysis

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Introduction

The birth weight is an important factor in the outcome of a pregnancy. It is well known that prenatal morbidity and mortality increase in abnormal birth weight range fetuses. They also have poor developmental outcomes. In addition, marked birth traumas have been increased in macrosomic infants. The accurate antenatal measurement of fetal weight is very important. It gives useful information for fetal growth assessment, information that could help to decide the time of delivery, the need for specific obstetrical intervention and delivery at an equipped center ***(Schild et al., ٢٠٠١).***

Each year, approximately ٢٠ percent of the almost ٤ million infants in the United States are born at the low and high extremes of fetal growth. Although most low-birthweight infants are preterm, approximately ٣ percent are term. In ٢٠٠٦, ٨,٣ percent of infants weighed less than ٢٥٠٠ g at birth, whereas ٧,٨ percent weighed more than ٤٠٠٠ g. The proportion of those < ٢٥٠٠ g has increased by ٢٢ percent since ١٩٨٤ and by ٨ percent since ٢٠٠٠. At the same time,

the incidence of macrosomia-defined as birthweight > ٤٠٠٠ g- continues to decline as the distribution has shifted toward lower weights ***(Martin et al., ٢٠٠٩).***

Fetal macrosomia has been defined as a birth weight of greater than the ninetieth percentile for gestational age after correcting for neonatal ethnicity. Macrosomia is associated with many adverse outcomes, for example prolonged labor, preterm labor, increase risk of traumatic damage, increase risk of shoulder dystocia, increase risk of cesarean section, fetal distress, birth asphyxia, brachial plexus injury, stillbirth, cephalhaematoma, etc **.** These adverse outcomes may associate with high rate of perinatal morbidity and mortality ***(McLean et al., ٢٠٠٨).***

Intrauterine growth restriction and macrosomia are not uncommon in obstetrics and carry an increased risk of perinatal mortality and morbidity. Fetal growth restriction is the second leading contributor to the perinatal mortality rate. The incidence of intrapartum asphyxia in cases complicated by IUGR has been reported to be as high as ٥٠ percent. Identification of fetal weight is crucial because proper

evaluation and management can result in a favorable outcome ***(Chien et al., ٢٠١١).***

Both small-for-gestational-age (below the١٠th percentile) and low birthweight (<٢،٥٠٠g) infants are associated with an increased risk of complications during labor (attributable to preterm delivery, intrauterine growth restriction (IUGR), or both). Complications include intrapartum fetal distress, intrapartum asphyxia, meconium aspiration, hypoglycemia, hypocalcemia, hypothermia, and polycythemia. The consequent neonatal mortality rate for small-for-gestational-age infants born at ٣٨ weeks is one percent vs. ٠,٢ percent in infants with appropriate birthweights ***(Leveno and Gilstrap, ٢٠٠٩).***

Several methods that are commonly used to predict fetal weight include fundal height measurement and ultrasonography. To date, two-dimensional ultrasound (٢-D US) becomes an essential tool for fetal weight evaluation ***(Callen, ٢٠٠٧)***.

Since the development of three-dimensional ultrasound (٣-D US), many investigators use fetal volume for

improvement in birth weight prediction formula. Even though many studies have shown improvement in prediction, the use of three-dimensional ultrasound for calculated birth weight is not popular in general usage due to the technical difficulty such as obtaining the optimal plane for the measurement and it's time consuming process. The recent development of computer software has extended the capabilities of three-dimension ultrasound to gain more appropriate pictures ***(Schild et al., ٢٠٠١).***

Two dimensional sonographic estimation is an accurate way (mean error ٧,٦-٩,١٪) to measure various fetal parameters, particularly biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), transverse trunk diameter (TTD) and femur length (FL) however, most studies documented poor accuracy among small and excessive fetal weight populations ***(Leveno and Gilstrap, ٢٠٠٩).***

Now three-dimensional ultrasonography can be used for fetal weight estimation by measurement of the upper-arm and thigh volumes. Previous studies concluded that three-dimensional ultrasonographic estimation of fetal weight by upper-arm and thigh volume measurements were better than

two-dimensional ultrasonographic estimation ***(Marussi et al., ٢٠١٠).***

Aim of the work

Assessment of the role of Three-Dimensional Ultrasound in estimation of the fetal weight using arm and thigh volumes by VOCAL (Virtual Organ Computer Aided Analysis) program in comparison to regular standards.