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Accuracy of fetal weight assessment by clinical method versus sonographic method

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List of Abbreviations

ABB.	Full-term
AC	Abdominal circumference
AUC	Area under the curve
BMI	Body Mass Index
BW	birth weight
CPR	cerebro-placental ratio
EFW	estimated fetal weight
FGR	fetal growth restriction
FL	femur length
IGF-1	Insulin-like growth factor 1
IGF-2	Insulin-like growth factor 2
IGFBP3	IGF-binding protein 3
LGA	large-for-gestational age
MCA	middle cerebral artery
PlGF	Placental growth factor
PPI	placental pulsatility index
SFH	Symphyseal-fundal height
sFlt-1	Fms-like tyrosine kinase-1
SGA	small for gestational age
T3	Triiodothyronine
T4	Thyroxine
UA	Umbilical artery
UtA	uterine artery
VEGF	vascular endothelial growth factor
WHO	World Health Organization

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Abstract

Background:

Sonographic fetal weight estimation is an important component of antenatal care. It was found to be more reliable method to establish fetal weight at term and more consistent in various period of gestation

Aim of the study :

To compare clinical and sonographic methods for assessment of fetal weight regarding sensitivity, specificity and accuracy.

Subjects and methods:

The study recruited 100 women scheduled for delivery from antenatal care clinic with 38 weeks or more of gestation. Fetal weight was asessed clinically and by ultrasound. Both techniques were compared and analyzed.

Results:

Ultrasound assessment of fetal weight showed better performance than the clinical method regarding absolute errors and error percentages. ultrasound assessment showed better sensitivity and specificity in detecting fetal weight > 3500 gm. Moreover, it showed less bias on Bland-Altman plot analysis.

Conclusions:

Ultrasound assessment of fetal weight is safe, reliable and sensitive method of fetal weight estimation.

Keywords:

Fetal weight, Ultrasound assessment of fetal weight, clinical assessment of fetal weight.

Introduction

The estimation of the fetal weight is of major interest in many situations when the route of delivery has to be determined including breech presentations, diabetes and suspected macrosomia (*Perdriolle-Galet et al., 2014*).

In fact, delivery of a macrosomic fetus can be linked with significant maternal and perinatal morbidity. Detection of the macrosomic fetus prior to delivery could have a significant impact on reducing that morbidity (*Phillips et al., 2014*).

On the other hand, in imminent preterm birth at the limit of viability between 23(0/7) and 26(0/7) weeks of gestation, it is crucial to determine fetal weight to help manage expected complications (*Huber et al., 2014*). Moreover, estimation of fetal weight proved to be useful in prediction of future events including childhood obesity (*Parker et al., 2012*).

Clinical estimation and ultrasonographic fetal weight estimation are the 2 methods commonly used to predict fetal weight. Clinical estimation of fetal weight is a routine practice in the delivery room. It has an

important role in the assessment and planning of the delivery progress, it allows the clinician to predict possible complications such as macrosomia and plan for obstetric interventions where needed (*Levin et al., 2011*).

For sonographic assessment of fetal weight, many formulas are used. However, they differ in accuracy. In addition, accuracy differs according to the day of weight estimation (*Gabbay-Benziv et al., 2016; Paganelli et al., 2016*).

However, it should be noted that high maternal weight, height, body mass index, multiparity, older maternal age, diabetes, and fetal male sex were associated with underestimation of sonographic assessment of fetal weight (*Barel et al., 2014*).

In a recent study, comparison between clinical and sonographic methods showed significantly better sensitivity, specificity and accuracy of sonographic methods when compared with clinical tools (*Ugwa et al., 2015*).

However, in another study no significant differences were found between clinical and sonographic methods for assessment of fetal weight during labor (*Perdriolle-Galet et al., 2014*).

Aim of the Work

Research Hypothesis

In pregnant women at term clinical method may be accurate as sonographic method in assessment of fetal weight.

Research Question

In pregnant women at term do clinical method for assessment of fetal weight accurate as sonographic method ?

Aim of work

The present study aims to compare clinical and sonographic methods for assessment of fetal weight regarding sensitivity, specificity and accuracy.

Fetal Growth

Introduction

Conception signifies the fusion of a female (ovum) and a male (sperm) gamete, usually in the ampulla of the uterine tube. The result of this process is the production of a zygote, or fertilized ovum, which migrates down the fallopian tube to reach the uterus. The phases following conception include: implantation; placentation; embryonic period and fetal period (*Zabransky, 2013*).

Implantation

Implantation of the zygote into the wall of the uterus takes place approximately 9 days (ranging from 6-12 days) after ovulation. The blastocyst is created, which is composed of an inner cell mass called an embryoblast (made up of embryonic stem cells that will go on to form all of the body structures), an outer layer of cells and a trophoblast (which becomes the placenta) (*Wilcox et al., 1999*). Insulin-like growth factor 1 (IGF-1) regulates the differentiation of cytotrophoblasts into syncytio-trophoblasts, which secrete progesterone and promote uterine lining integrity and extra villous cell formation (*Lacey et al., 2002*).

Placentation

Development of the placenta (or placentation) starts with the invasion of the syncytiotrophoblasts into the

maternal endometrium and the reconfiguring of uterine spiral blood vessels to ensure blood supply to the blastocyte. This results in blood perfusion to the placenta because of the decreased resistance of these vessels. Placentation is regulated by local oxygen supply as well as immunological and growth factors (eg, IGF-1 and IGF-2), which act as endocrine, autocrine, and paracrine regulators. The placentation process typically occurs 7–8 days after fertilization (*Roberts et al., 2008*).

Embryonic period

The embryonic period lasts 56 days (8 weeks from fertilization). During this time, 90% of the body's organ systems are established and the embryo divides into three distinct layers. Due to the rapid pace of differentiation, the embryo is very vulnerable during this phase and within the first 8 weeks the incidence of deformities that lead to miscarriages is approximately 10% (decreasing to 1% by the end of the embryonic period), while the frequency of neural tube defects is 2.5% (later decreasing to 0.1%). After the eighth week, the fetus starts to show recognizable human features, although the head is still relatively large in appearance (*O'Rahilly and Müller, 2010*).

Fetal period

During the fetal period (which lasts from the ninth week until birth), the organs that began to form during the embryonic period continue to grow and begin to differentiate during a process called organogenesis. During this period, major organs such as the brain, lungs, and liver grow isometrically in relation to the fetal body, while smaller organs like the thymus and spleen grow three to five times faster. The largest increase of length occurs during the second trimester, while weight tends to increase during the third trimester (*Mullis and Tonella, 2008*).

Regulation of fetal growth

Normal fetal growth is regulated by the intrauterine and placental environment, the fetal genome, and several maternal (e.g. hormonal, nutritional) and environmental factors. Especially in utero, the environment determined by maternal and placental function is important for fetal growth (*Gluckman and Pinal, 2003*).

This is true not only for the development of the organs but also for metabolic processes where genetic factors play an important role (eg, diabetes). Throughout pregnancy, the placenta is crucial for transport and exchange of nutrients, trace elements, vitamins, and oxygen from the mother. The

estimated influence of the maternal genome on the birth weight of the children is 20%, while environmental factors account for 60%; other factors account for the remaining 20%. The genetic influence is almost entirely maternal in origin, with low paternal genetic correlation (**Polani, 2008**). As such, maternal height is an important determinant of birth size as shown by the recent studies (**Azcorra et al., 2016; Inoue et al., 2016; Pölzlberger et al., 2016**).

Placental regulation of fetal growth

Altered maternal environment during pregnancy such as hypoxia, stress, obesity, diabetes, toxins, altered nutrition, inflammation, and reduced utero-placental blood flow may influence fetal development, which can predispose to diseases later in life. The placenta being a metabolically active tissue responds to these perturbations by regulating the fetal supply of nutrients and oxygen and secretion of hormones into the maternal and fetal circulation (**Dimasuay et al., 2016**).

The predominant binding protein in placental tissue is IGF-binding protein 3 (IGFBP3) and it is expressed in high levels by trophoblasts and fibroblasts of the villous stroma (**Forbes and Westwood, 2008**).