Evaluation of the Sonographic Measurement of Cerebro-Placental Doppler Ratio and Amniotic Fluid Index in Post-term Pregnancies and its Relation to the Fetal Outcome

Submitted for Partial Fulfillment of
Master Degree in Obstetrics and Gynecology

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2013

Acknowledgement

At first and foremost, thank you to"ALLAH", who gave me the power to finish this work.

I find no words by which I can express my deepest gratitude to my honored ***Professor Dr .Omar Farag Rizk Hassan*** *, Professor of Obstetrics and Gynecology, Faculty of Medicine, Cairo University, for the continuous kind encouragement, support guidance and paternal advice throughout the entire work. It has been an honor and privilege to work under his generous supervision.*

I would like to express my deepest and to Prof ***Dr. Maha Yousef Soliman****, Professor of Obstetrics and Gynecology,Faculty of Medicine, Cairo University, for energetic help spending long hours in careful review of this work following its details with constructive advice and criticism.*

Also, I would like to express my deepest thanks and appreciation to ***Dr. Rana Mohamed Abdel Samie,*** *Lecturer of Obstetrics and Gynecology, Faculty of Medicine, Cairo University, for his great support, careful supervision and continuous advice which helped me to overcome numerous difficulties.*

To my family, colleagues and to everyone who participated in a way or another in this work I owe my thanks and appreciation.

Last but not least, I would like to thank my patients, who were the corner stone of this study.

List of Abbreviations

AFI.....Amniotic fluid index
AFV.....Amniotic fluid volume
BPP.....Biophysical profile
CPR.....Cerebro placental ratio
CS.....Caesarean Section
CW .....Continous wave Doppler
EDD .....Expected date of delivery
FR.....Frequency received
FT.....Frequency transmitted
FVWs.....Flow velocity wave forms
LMP .....Last menstrual period
MAS .....Meconium aspiration syndrome
MCA.....Middle cerebral artery
MDV.....Minimum diastolic velocity
MPSV.....Maximum peak systolic velocity
MSL .....Meconium stained liquor
NICU.....Neonatal Intensive Care Unit
PI.....Pulsatility index
PRF.....Pulse repetition frequency
PSV .....Peak systolic velocity
PW.....Pulsed wave Doppler
RC/RP.....Resistance brained/resistance placenta
RI .....Resistance index
S/D .....Systolic/diastolic ratio
SGA.....Small for gestational age
UA.....Umbilical artery

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Abstract

Objective. To study the role of Doppler velocimetry of the umbilical and middle cerebral arteries, represented by the cerebroplacental ratio, and amniotic fluid volume in the prediction of adverse fetal outcome in post-term pregnancies. Design. A prospective case control study. Setting. Cairo University Teaching Hospital for Obstetrics and Gynecology. Egypt. Subjects. 50 pregnant patients divided into two groups; Group1: This group included 25 pregnant ladies with gestational age of 41 weeks attending the casuality department in labour or in prodroma of labor. Group 2: This group included 25 pregnant ladies with gestational age of 41 weeks not in labor and reaching the hospital for ANC, who were selected for termination based on the biophysical profile and poor Doppler indices or CTG changes. Interventions. All patients were submitted to antenatal fetal surveillance tests including modified biophysical profile (MBPP) which consists of the non-stress test (NST), amniotic fluid index (AFI), and color Doppler velocimetry of fetoplacental and fetal vessels including MCA PI, UA PI, and CPR. *Main outcome measures.* The accuracy of cerebroplacental ratios (the middle cerebral artery PI divided by the umbilical artery PI) and amniotic fluid volume as a means of predicting intrauterine fetal distress and adverse perinatal outcome in post-term pregnancies. *Results.* Cerebroplacental ratio show highest sensitivity (95%) in comparison with other parameters, so it is a good test to reassure the obstetricians of the fetal well being. Prominent changes in AFI (i.e. <50% increase or decrease) is not associated with adverse perinatal outcome irrespective of the rate of change provided that the final value remains >5.0 cm. A significant association with FHR decelerations and presence of meconium is proved to exist when AFI is <5.0 cm. *Conclusion.* The addition of cerebral/umbilical ratios to antenatal surveillance protocols is expected to improve the perinatal outcome. It should be tried in the various high risk pregnancies whenever uteroplacental insufficiency is suspected

Keywords: Doppler ultrasound; Post-term; Pregnancy; Perinatal outcome

Contents

Introduction

The terms post-term, prolonged, postdates and post mature are often loosely used interchangeably to signify pregnancies that have exceeded a duration considered to be the upper limit of normal ***(Cunningham et al., 2007).***

The standard internationally recommended definition of prolonged pregnancy accepted by both the World Health Organization (WHO) and the International Federation of Gynecology and Obstetrics (FIGO) is 42 completed weeks (294 days) or more from the first day of the last menstrual period (LMP), assuming valid dates and a regular 28 day cycle ***(Luckas et al., 2004).*** This definition was endorsed by the American College of Obstetricians and Gynecologists (1997) (***Cunningham et al., 2005***).

Postdate pregnancies account about 5 – 10 % of the deliveries and are known to be associated with increased risk for perinatal complications ***(Lam et al., 2005a).***

Incidence of subsequent post term birth increases from 10 to 27% if first birth was post term up to 39% if there had been two previous successive post term deliveries ***(Bakketeig et al., 2000).***

The mechanism of fetal complications associated with postdate pregnancy has attributed to progressive placental insufficiency, particularly in the presence of decreased amniotic fluid ***(Lam et al., 2005a).***

Placental dysfunction is considered to be the pathophysiologic event leading to intrapartum asphyxia and meconium aspiration. However, the principal mechanism leading to intrapartum fetal distress is umbilical cord compression due to oligohydramnios ***(Dasari et al., 2007***).

Prepartum meconium aspiration is the potential danger in postdate pregnancy. Meconium staining of amniotic fluid serves as a primary ingredient in the lower APGAR scores and higher incidence of meconium aspiration syndrome and fetal distress encountered in the postdate group ***(Boisselier et al., 2001).***

Postdate infants, particularly those with macrosomia and post maturity, are at increased risk for hypoglycemia because post mature infants has decreased storage of glycogen and subcutaneous fat and also possibly an increased metabolic rate. It is important that postdate infants with macrosomia or signs of post maturity have glucose evaluations especially during the first 12 hours ***(Sims et al., 2001)***.

Postdate pregnancies are also associated with maternal risks namely discomfort, anxiety and increased cesarean delivery due to cephalopelvic disproportion. Also, there is a risk for cervical tears due to the fetal macrosomia ***(Olesen et al., 2003)***.

Ultrasound examination plays a very important role in the diagnosis of postdate pregnancies which is used for assessment of both gestational age and amniotic fluid volume. The amniotic fluid index (AFI) and biophysical profile (BPP) have both been used to assess fetal well-being ***(Magann et al., 2004).***

Doppler information may play a role in the surveillance of uncomplicated prolonged pregnancies. Data from reliable, well-constructed normal curves during this gestational age are lacking ***(Palacio et al., 2004).***

A few studies had looked into the Doppler blood flow changes in postdated pregnancies and came up with varying results. Some demonstrated redistribution of blood flow in the fetal cerebral circulation in postdated pregnancies with adverse perinatal outcome, and such brain-sparing phenomenon is thought to result in oligohydramnios ***(Selam et al., 2000).***

However, others reported insignificant difference in Doppler indices for postdated pregnancies with and without oligohydramnios ***(Lam et al., 2005a)***.

Evaluation of the cerebral blood flow in the fetus has become an integrated part of the assessment of high-risk pregnancies. The middle cerebral artery (MCA) has been studied extensively, and its Doppler recordings are incorporated regularly into the management of fetuses at risk of developing placental compromise and fetal anemia ***(Ebbing et al., 2007).***

Combining the Doppler waveform analysis of the middle cerebral artery (MCA) with that of the umbilical artery (UA) by a common cerebro-placental ratio, i.e. the ratio of their pulsatility indices has been suggested as a useful clinical simplification ***(Ebbing et al., 2007).***

A low cerebroplacental ratio reflects redistribution of the cardiac output to the cerebral circulation and has been shown to improve accuracy in predicting adverse outcome compared with MCA or UA Doppler alone ***(Vergani et al., 2005).***

Aim of the Work

The aim of this study is to determine the role of Doppler velocimetry of the umbilical and middle cerebral arteries, represented by the cerebroplacental ratio, and amniotic fluid volume in the prediction of adverse fetal outcome in post-term pregnancies.

Epidemiology of Post Term Pregnancy

DEFINITION

The expression of post-term, postdate and post mature are often loosely used interchangeably to signify pregnancies that have exceeded a duration considered to be the upper limit of normal ***(Cunningham et al., 2007).***

The standard internationally recommended definition of prolonged pregnancy accepted by both the World Health Organization (WHO) and the International Federation of Gynecology and Obstetrics (FIGO) is 42 completed weeks (294 days) or more from the first day of the last menstrual period (LMP), assuming valid dates and a regular 28 day cycle ***(Luckas et al., 2004).*** This definition was endorsed by the American College of Obstetricians and Gynecologists (1997) ***(Cunningham et al., 2005).***

Epidemiological studies have shown that after 41 weeks, the rate of fetal, maternal and neonatal complications increase. As such, management of this condition remains a matter of concern for most clinicians. Many national scientific societies have produced guidelines that are likely to be influenced by the characteristics of the local health systems ***(Giampaolo Mandruzzato et al., 2010).***

Although all these terms were officially accepted by the World Health Organization 1994, post mature should be used to describe the infant with recognizable clinical features indicating a pathologically prolonged pregnancy, while postdates probably should be abandoned, because the real issue in many post-term pregnancies is post what dates?

Therefore, post-term or prolonged pregnancies are the preferred expressions for extended pregnancies ***(Cunningham et al., 2005).***

The term "Postmaturity", "Dysmaturity" and "Placental dysfunction syndrome" all refer to a condition that result in infants with late onset wasting and manifestations of intrauterine nutritional deprivation, which are not unique to prolonged pregnancy. "Postmaturity syndrome" is the best expression to be used when one is referring the postdate infant with this problem ***(Sims et al., 2001).***

INCIDENCE

The incidence of postdating varies according to the definition used, and more important to the dating criteria. The stricter the dating criteria used in confirmation one's due date, the lower is the probability that a post-term pregnancy will be encountered ***(Phelan et al., 2001).***

The prevalence of PT is commonly reported as 4-10%. In Europe, the prevalence estimates range from 0.8% to 8.1% ***(Zeitlin et al., 2007)***.

This wide variation is likely to be the consequence of different policies of labor induction and methods for assessing gestational age (GA). Ultrasound (US) dating of pregnancy is more accurate than that based upon the last menstrual period (LMP) and the use of routine US dating significantly reduces the rate of PT. When pregnancies are routinely dated by US, and in the absence of a policy of induction only 7% of the pregnancies progress beyond 294days and 1.4% beyond 301 days ***(Meir et al., 1999)***.

ETIOLOGY

The etiology of PT is largely unknown, but both fetal abnormality (e.g., anencephaly) and placental sulphatase deficiency can be associated with prolongation of pregnancy ***(Laursen et al., 2004)***.

Various theories have been advocated to explain the pathogenesis of the postdate pregnancies as the actual physiologic mechanism responsible for a prolonged pregnancy has not been elucidated and until the mechanisms for the initiation and maintenance of labor are defined more clearly the etiology of the postdate pregnancy will probably remain obscure ***(Ahn et al., 2002).***

Maternal risk factors:

- Inaccurate dating of pregnancy:

It is clear that the most common cause of prolonged gestation is an error in determining the patient's due date. Patient's failure to recall accurately the date of the first day of their menstrual period (LMP) combined with the varying duration of the luteal and follicular phases of the menstrual cycle may result in an overestimation of gestational age ***(Smith, 1999).***

Accuracy of dating depends on seeing the patient early in pregnancy, careful menstrual history and several dating tests that all agree ***(Spellacy, 1994).***

Several investigations have demonstrated that an estimated gestational age determined sonographically is more accurate than one based on LMP. This alone allows the reduction in the number of labor induction for post-term pregnancy ***(Cunningham et al., 2005)***.