Fetal anterior abdominal wall thickness in diabetic pregnancy

Mary F. Higgins, Noirin M. Russell, Cecilia H. Mulcahy, Mary Coffey,
Michael E. Foley, Fionnuala M. McAuliffe *

National Maternity Hospital, University College Dublin, Dublin, Ireland

Abstract

Objective: The purpose of this study was to investigate whether third trimester fetal anterior abdominal wall (AAW) thickness in diabetic pregnancy reflects glycaemic control and predicts macrosomia.

Study design: Prospective cohort study in a tertiary level maternity unit. One hundred and twenty-five diabetic mothers (71 pre-gestational and 54 gestational diabetics on insulin) underwent routine serial third trimester ultrasound examination with the additional measurement of AAW thickness. Pregnancy outcome was obtained.

Results: 335 fetal AAW measurements were recorded in diabetic pregnancy from 30 to 38 weeks gestation. Third trimester AAW was significantly higher in macrosomic babies (5.4 ± 1.4 mm vs. 4.7 ± 1.4 mm, $p < 0.05$). ROC derived cut off for AAW in the prediction of macrosomia was 3.5 mm at 30 weeks, 4.5 mm at 33 weeks and 5.5 mm at 36 weeks gestation. Using either a raised AAW measurement or an AC > 90th centile, the prediction of birth weight greater than the 90th centile was better (88%) than with AC alone (70%). This improvement in sensitivity held even at earlier gestations in the third trimester.

Conclusion: Measurement of AAW in diabetic pregnancy may have a role in the prediction of macrosomia.

© 2008 Elsevier Ireland Ltd. All rights reserved.

Keywords: Anterior abdominal wall; Diabetes; Macrosomia; Fetus

1. Introduction

Despite recent advances in obstetrics, prediction of fetal weight, especially at the extremes of growth, remains challenging. Estimated fetal weight (EFW) forms an important part of clinical decisions in the management of high-risk groups. In particular, it is important to assess EFW in infants of diabetic mothers as they are at increased risk of macrosomia and its associated complications, including labour dystocia, instrumental delivery, shoulder dystocia and perineal tears, including third degree tears. Macrosomic infants are predisposed to childhood obesity [1] and to further morbidity in adult life, including increased insulin resistance, hypertension and diabetes [2]. However in assessing EFW, even experienced sonographers may estimate a fetal weight which may differ from the true fetal weight by 10–15%. At the extremes of birth weight, EFW variation may be as much as 20% [3,4].

The fetal anterior abdominal wall (AAW) measurement is a simple measurement which can be taken at the time of measurement of the abdominal circumference. Previously researchers have assessed its role in infants with growth restriction [5] and its ability to predict macrosomia in a general population [6]. However, there are only a few studies, with relatively small numbers of patients, in its use to predict macrosomia in a diabetic population [7–9].

In this prospective study we assessed whether third trimester fetal AAW thickness could predict fetal macrosomia.

2. Materials and methods

This is a prospective cohort study with institutional ethics approval from September 2005 and June 2007 at the National Maternity Hospital, Dublin.

* Corresponding author at: UCD School of Medicine and Medical Science, Obstetrics and Gynaecology, National Maternity Hospital, Holles Street, Dublin 2, Ireland. Tel.: +353 1 6373296.

E-mail address: fionnuala.mcauliffe@ucd.ie (F.M. Mc Auliffe).

The National Maternity Hospital is one of three tertiary level units serving the city of Dublin and surrounding areas. It has an annual delivery rate of approximately 8000 and cares for about 30 pre-gestational and 100 gestational diabetic pregnancies per annum. Women with pre-gestational diabetes attend a dedicated multidisciplinary clinic staffed by obstetricians, diabetologists, dieticians and a specialised diabetic midwife. Patients are seen every 2 weeks during pregnancy. A first trimester dating ultrasound and second trimester fetal anomaly ultrasound including fetal echocardiography is routine. In the third trimester ultrasound evaluation of fetal growth and wellbeing are performed at 30, 33 and 36 weeks with weekly ultrasound assessment thereafter until delivery. Induction of labour at 38 weeks gestation is indicated if glycaemic control is poor or there is evidence of macrosomia or polyhydramnios. Otherwise induction of labour is performed at 40 weeks' gestation.

Screening for gestational diabetes is based on risk factors; universal screening for gestational diabetes is not currently performed. Women with either historical risk factors (previous macrosomic infant, first degree relative with diabetes mellitus, previous unexplained stillbirth, previous cardiac or sacral abnormality, prolonged steroid use, maternal age $\geq$40 years or maternal weight $\geq$100 kg) or risks unique to the current pregnancy (glycosuria, polyhydramnios or suspected macrosomia), were identified as high-risk patients. Screening for GDM was performed on this high-risk group, using a 50-g oral glucose challenge test (GCT) at 29–30 weeks, and continuing to formal 3-h glucose tolerance testing (GTT) in that subset with an abnormal GCT at 1 h post-prandial (>8.2 mmol). Diagnosis of GDM (two raised values) was made only at GTT, using the criteria outlined by the National Diabetes Data Group [10]. Treatment commenced with a low glycaemic diet. Glycemic control was monitored by weekly or bi-weekly fasting and post-prandial sugars and considered abnormal if greater than 5 and 7 mmol, respectively. Patients with abnormal glucose values while on diabetic diet were admitted for a 24-h blood sugar series, deemed abnormal if greater than 5 mmol fasting and/or pre-prandial or >7 mmol post-prandial. The diagnosis of gestational diabetes is based on two abnormal values on a GTT. In this center women with a history of gestational diabetes (GDM) in any previous pregnancy are encouraged to present early in any next pregnancy when a low glycaemic diet is introduced. Glycaemic control is monitored by weekly or bi-weekly fasting and post-prandial blood sugars and treatment with insulin is introduced when dietary control is inadequate.

Women with gestational diabetes treated with insulin, have the same ultrasound monitoring as detailed for the pre-gestational diabetic patients.

From 30 to 38 weeks gestation ultrasound measurement of fetal AAW was performed by two operators (FMcA and CM). All examinations were performed transabdominally using either a Toshiba Xario (Toshiba Medical Systems Corporation, Japan) or Voluson 730 Expert (GE Medical Systems, Germany) equipped with curved array transducers. Measurement of the abdominal circumference was performed having obtained a transverse axial section of the portal umbilical venous complex [10] and then plotted on a standard chart [11] provided on a computerised database in use in our institution (Viewpoint version 5.5.5.163, Viewpoint Bildverarbeitung GmBH, GE Healthcare). A measurement of the fetal AAW was taken at the traditional abdominal circumference view, 2–3 cm lateral to the cord insertion, and included fetal skin and subcutaneous tissue (Fig. 1). Three measurements were obtained and the mean recorded. Clinicians were blinded to the AAW measurements.

Diabetic pregnancy outcomes included pre-natal and third trimester HbA1c measurement, White classification of diabetes and fetal biometry. Delivery outcomes included gestation, birth weight, gender and birth weight centile. The gestation and gender appropriate centile was determined using the growth charts (Child Growth Foundation, London, 1996) used in this institution. Macrosomia was diagnosed as birth weight greater than the 90th centile for gestation and gender.

2.1. Statistical methods

Continuous variables were assessed using Pearsons correlation co-efficient if normally distributed, and with *t*-test for comparison. Continuous variable and binomial outcomes were assessed with ROC curve. All statistical analysis was performed using SPSS version 12.

3. Results

During this time 335 fetal AAW measurements were taken in 125 pregnant women. Of these, 217 measurements were in the fetuses of 71 pre-gestational diabetic mothers (65 Type 1 diabetes, 6 Type 2 diabetes) and 118
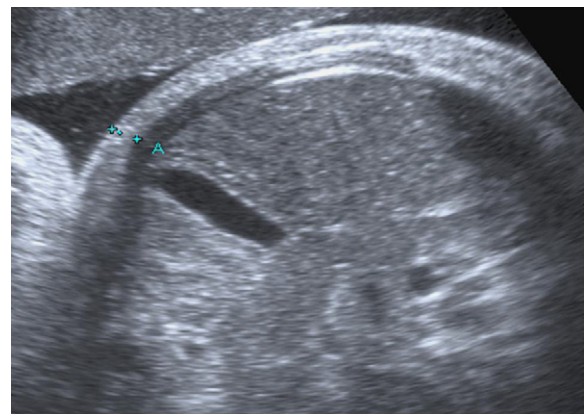

Fig. 1. AAW: measurement of anterior abdominal wall thickness as obtained from the abdominal circumference view.