

Original Article

Assessment of placental volume and vascularization at 11–14 weeks of gestation in a Taiwanese population using three-dimensional power Doppler ultrasound

Hsing-I Wang^{a,b,c}, Ming-Jie Yang^{d,e}, Peng-Hui Wang^{d,e}, Yi-Cheng Wu^{e,f}, Chih-Yao Chen^{c,d,e,*}

^a Department of Ophthalmology, Mackay Memorial Hospital, Taipei, Taiwan, ROC

^b Mackay Medicine, Nursing and Management College, Taipei, Taiwan, ROC

^c Institute of Clinical Medicine, National Yang-Ming University, Taipei, Taiwan, ROC

^d Department of Obstetrics and Gynecology, Taipei Veterans General Hospital, Taipei, Taiwan, ROC

^e School of Medicine, National Yang-Ming University, Taipei, Taiwan, ROC

^f Department of Obstetrics and Gynecology, Branch for Women and Children, Taipei City Hospital, Taipei, Taiwan, ROC

Received February 6, 2014; accepted March 18, 2014

Abstract

Background: The placental volume and vascular indices are crucial in helping doctors to evaluate early fetal growth and development. Inadequate placental volume or vascularity might indicate poor fetal growth or gestational complications. This study aimed to evaluate the placental volume and vascular indices during the period of 11–14 weeks of gestation in a Taiwanese population.

Methods: From June 2006 to September 2009, three-dimensional power Doppler ultrasound was performed in 222 normal pregnancies from 11–14 weeks of gestation. Power Doppler ultrasound was applied to the placenta and the placental volume was obtained by a rotational technique (VOCAL). The three-dimensional power histogram was used to assess the placental vascular indices, including the mean gray value, the vascularization index, the flow index, and the vascularization flow index. The placental vascular indices were then plotted against gestational age (GA) and placental volume.

Results: Our results showed that the linear regression equation for placental volume using gestational week as the independent variable was $\text{placental volume} = 18.852 \times \text{GA} - 180.89$ ($r = 0.481$, $p < 0.05$). All the placental vascular indices showed a constant distribution throughout the period 11–14 weeks of gestation. A tendency for a reduction in the placental mean gray value with gestational week was observed, but without statistical significance.

Conclusion: All the placental vascular indices estimated by three-dimensional power Doppler ultrasonography showed a constant distribution throughout gestation.

Copyright © 2014 Elsevier Taiwan LLC and the Chinese Medical Association. All rights reserved.

Keywords: gestational week; placental volume; three-dimensional power Doppler ultrasound; VOCAL

1. Introduction

Conflicts of interest: The authors declare that there are no conflicts of interest related to the subject matter or materials discussed in this article.

* Corresponding author. Dr. Chih-Yao Chen, Department of Obstetrics and Gynecology, Taipei Veterans General Hospital, 201, Section 2, Shih-Pai Road, Taipei 112, Taiwan, ROC.

E-mail address: zachary.joyce@gmail.com (C.-Y. Chen).

<http://dx.doi.org/10.1016/j.jcma.2014.03.005>

1726-4901/Copyright © 2014 Elsevier Taiwan LLC and the Chinese Medical Association. All rights reserved.

The size of the placenta is significant in the assessment of problems in pregnancy, such as pre-eclampsia, small-for-gestational-age fetuses, placental abruption, maternal diabetes, hydrops fetalis, chromosomal abnormalities, placental insufficiency, and congenital viral infection.¹ The ultrasonographic appearance of both thick heterogeneous and small placentas

can give information about possible adverse outcomes in pregnancy. Recent advances in ultrasonography allow the combination of three-dimensional (3D) ultrasound with power Doppler ultrasound, making it possible to quantify Doppler signals in a volume obtained by 3D scanning and therefore to assess the whole placental circulation.^{2,3} A few placental volume nomograms and vascular indices have been described and these reference values were obtained in pregnancies at early gestational ages, generally in the first trimester. Shaw et al⁴ used 3D ultrasound to measure the nuchal volume in the first trimester screening for Down's syndrome. This was the first study to use a 3D technique during the first trimester of pregnancy in a Taiwanese population. However, there are no reports on the placental volume (PV) and vascular indices in relation to gestational age (GA) between the late first trimester and early second trimester in a Taiwanese population. Therefore the objective of this study was to prospectively evaluate the distribution of the PV and vascular indices using 3D power Doppler ultrasonography in normal pregnancies in relation to GA at 11⁺–14⁺ weeks in a Taiwanese population.

2. Methods

Patients were recruited from the low-risk prenatal care unit of Department of Obstetrics and Gynecology, Taipei Veterans General Hospital, Taipei, Taiwan from June 2006 to September 2009. All the women received a nuchal translucency measurement and volunteered to undergo 3D power Doppler ultrasound examination after being fully familiarized with the study protocol and the technique. The inclusion criteria were healthy women with singleton normal pregnancies, normal fetal morphological ultrasound examinations, reliable pregnancy dating as established by the date of the last menstrual period and sonographic measurement of the crown–rump length in the first trimester, and GA from 11 weeks to 14 weeks. The exclusion criteria were fetal congenital abnormalities, abnormal nuchal translucency, absence of a nasal bone, reverse A-wave of the ductus venosus, and patient absence during follow up. Patients with a history of any medical disease or with a history of smoking were excluded from the study. Each patient was scanned once during pregnancy with informed consent. Every patient recruited into this study had a good postnatal outcome and no neonatal disease was noted. The prospective study protocol was approved by the hospital's Institutional Review Board and Ethics Committee (IRB number 98-01-64A).

2.1. Acquisition and measurement of PV and vascular indices

A Voluson 730 ultrasound machine (GE Medical Systems, Milwaukee, WI, USA) equipped with a 4–8 MHz transducer was used for the 3D power Doppler scanning. Using the same pre-established instrument power settings (angio mode, cent; smooth, 4/5; FRQ, low; quality, 16; density, 6; enhance, 16; balance, GO150; filter, 2; actual power, 2 dB; pulse repetition frequency, 0.9) for all patients, independent of GA,

3D power Doppler was applied to obtain images of the PV and vasculature. The longest view of the placenta was identified by 2D ultrasound and the volume box was adjusted to scan the entire placenta. After scanning the entire volume, the longest view of the placenta on the A plane of the three orthogonal ultrasound sections was chosen as the reference image. The volume was then measured by the rotational technique using VOCAL software (GE Medical Systems), which consists of outlining the contour of the placenta repeatedly after rotating its image six times by 30°. After finishing the complete 360° rotation, the PV was automatically provided by the software (Fig. 1A). After estimation of the PV, the 3D-power Doppler histogram was used to determine the vascular indices from computer algorithms (Fig. 1B). The mean gray value (MGV) represents the placental echogenicity, which may be interpreted as placental density. The vascular indices determined were: (1) vascularization index (VI), which refers to the color voxel/total voxel ratio (vascularity); (2) the flow index (FI), which refers to the weighted color voxel (on a scale of 0–100) divided by the total color voxel ratio and provides an amplitude value for the color signal; and (3) the vascularization flow index (VFI), which refers to the weighted color voxel/total voxel ratio, combining the information of the presence of vessels (vascularity) and amount of transported blood cells (blood flow). For each patient, the placental vascular indices were measured by a single doctor (C.Y.C.).

2.2. Statistical analysis

The placental vascular indices (VI, FI, and VFI) were plotted against GA and PV. The distributions were evaluated by regression modes. The Pearson correlation coefficient test was used to evaluate the correlation between the placental vascular indices and GA. All calculations were performed using Excel and SPSS 15.0 programs (Microsoft, Redmond, WA, USA). Differences were considered to be significant at $p < 0.05$.

3. Results

A total of 222 women with a normal singleton pregnancy between 11 weeks and 13⁺6 weeks of gestation were examined. All the measurements were completed during examinations and were also reviewed from the Taipei Veterans General Hospital (Taipei, Taiwan) picture archiving and communication system by one obstetrician (C.Y.C.). Poor quality images were excluded. The birth records of each fetus were reviewed. No small (or large) for GA or neonatal anomaly was identified. After reviewing by one obstetrician (C.Y.C.), the data for the PV and vascular indices were analyzed. The mean maternal age was 31 (range 19–45) years, corresponding to a gestational age of 12⁺4 (range 11⁺0–13⁺6) weeks. Linear correlation exists between GA and PV ($p < 0.05$, $r = 0.481$, $PV = 18.852 \times GA - 180.89$; Fig. 2). However, other flow indices showed no significant correlation with GA (p for MGV, VI, FI, and VFI were 0.668, 0.297, 0.864, and 0.474, respectively; Figs. 3–6).

Download English Version:

<https://daneshyari.com/en/article/3475898>

Download Persian Version:

<https://daneshyari.com/article/3475898>

[Daneshyari.com](https://daneshyari.com)