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ORIGINAL ARTICLE

Validity of umbilical artery Doppler waveform versus umbilical vein Doppler waveform in the prediction of neonatal outcome in intrauterine growth restriction cases



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KEYWORDS

Intrauterine growth restriction;
Venous, arterial Doppler

Abstract Objective: To assess the neonatal outcome in relation to umbilical vein Doppler compared to umbilical artery Doppler in growth restricted fetuses.

Methods: A total of 72 pregnant women with singleton pregnancy between 28 and 38 weeks of gestation with risk of developing intrauterine growth restriction (IUGR) were recruited to the study. All women were subjected to full assessment via detailed history, clinical examination, obstetric assessment, routine laboratory assessment and ultrasonography examination for fetal assessment. Doppler examination of umbilical artery (UA) and umbilical vein (UV) was performed. Absent or reversed UA end diastolic flow (EDF) and pulsatile flow in the umbilical vein were examined for their efficacy to predict critical outcomes (still birth, neonatal death, IUGR).

Results: A total of 13 deaths (18%) were reported; 13.9% were neonatal deaths and 4.2% were stillbirths. Fetuses were grouped according to Doppler parameters: those with normal Doppler finding ($n = 35$), those with resistance index (RI) ($n = 20$), those with Absent UA EDF ($n = 10$) and those with reversed UA EDF ($n = 7$). Pulsatile UV waveform was reported among 9.7% of patients all of them had reversed UA EDF. Patients with absent/reversed EDF have significant association

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with critical neonatal outcomes as lower birth weight, perinatal deaths, and lower Apgar score. UV Doppler was abnormal in patients with more severe deterioration (patients with reversed UA EDF) while it was normal in all patients with increased RI and absent UA EDF. All cases with Pulsatile UV Doppler have shown higher incidence of critical neonatal outcomes.

Conclusion: UV Doppler assessment can aid in detection and prediction of critical perinatal outcomes however, it required further evaluation and assessment.

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1. Introduction

The Doppler effect which was first reported by Christian Doppler in 1842 describes the apparent variation in frequency of a light or sound wave as the source of the wave approaches (1). Examination of venous Doppler waveforms was first reported in the early 1980. Clinical utilization of this technique began in the 1990s and has since emerged as the primary means of assessing forward function of fetal heart in many fetal disease states (2,3).

Although flow velocity waveforms have been reported for many venous vessels, the precordial veins and umbilical vein are the vessels predominantly used in clinical practice (4). The clinical utility of venous Doppler velocimetry is therefore greatest in fetal conditions with cardiac manifestations and/or marked placental insufficiency. These conditions include fetal growth restriction markedly due to placental insufficiency (5). Increasing venous Doppler indices are the hallmark of advancing circulatory deterioration since they document the decreasing ability of the heart to accommodate venous return. Elevations of placental blood flow resistance and venous Doppler indices frequently progress in parallel (6,7).

The recognition of venous Doppler changes has led to re-examination of the relationship between prenatal Doppler findings in growth restricted fetuses and perinatal outcome (8).

There are previous studies done in Berlin (Germany) and Doha (Qatar) said that preterm growth restricted fetuses with elevated umbilical artery Doppler resistance and positive end-diastolic velocity have an overall perinatal mortality rate of 5.6%. This rate increases to 11.5% when end-diastolic velocity is absent or reversed, but venous Doppler indices are still normal, and rises to 38.8% when venous Doppler indices become abnormal (9). This study was conducted to prove the importance of umbilical venous Doppler to predict an appropriate outcome in intra uterine growth restricted fetuses in comparison to the standard umbilical artery Doppler and to prove that the use of venous Doppler appears to significantly improve the prediction of stillbirth and acidemia over the use of umbilical artery Doppler alone.

2. Patients and methods

After approval of our ethics committee, this prospective study was conducted in the Obstetric and gynecology department of Port Said General Hospital from May 2010 to February 2013 among seventy-two pregnant women 20–35 years of age who have singleton pregnancies at third trimester of their pregnancies between 28 and 38 weeks of gestation and are at risk of developing intrauterine growth restriction (IUGR) (Gestational hypertension, Diabetes Mellitus, Preeclampsia). A sample size was calculated based on the sensitivity of umbilical

Doppler vein and artery in prediction of IUGR (10). Assuming $\alpha = 0.05$ and power = 0.80, the total sample size was 72 pregnant women. Patients with IUGR due to fetal anomalies diagnosed by ultrasound were excluded from the study.

After obtaining an informed written consent from all participants they were subjected to full assessment via full history taking including personal, medical, family, menstrual and obstetric history, general and obstetric examination, routine laboratory investigations including CBC, blood grouping, kidney and liver function tests and fasting and 2 h post prandial blood sugar. Ultrasonography examination was done to all participants with woman lie in a supine position using convex electronic probe 3–5 MHz for abdominal examination. US examination was done for assessment of fetal position, presentation and biometric indices including biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), and femur length (FL), expected fetal weight (EFW), amount of liquor and site and grade of placenta. Intrauterine growth restriction defined as fetal weight estimated below the gestational age mean – 2SD.

Doppler examination was done using color pulsed wave Doppler electronic probe 3–5 MHz on umbilical artery and umbilical vein using the following machine, GE PRO-V (USA). Absent or reversed UA end diastolic flow and pulsatile flow in the umbilical vein were examined for their efficacy to predict critical outcomes (still birth, neonatal death, APGAR score < 5).

Outcome: All patients were followed till their delivery and neonatal assessment was carried out (1 min Apgar score, birth weight). The number of death cases (neonatal death and stillbirths) was recorded.

2.1. Statistical analysis

Gathered data were processed using SPSS version 15 (SPSS Inc., Chicago, IL, USA). Quantitative data were expressed as means \pm SD while qualitative data were expressed as numbers and percentages (%). Student's *t* test was used to test significance of difference for quantitative variables and Chi Square was used to test significance of difference for qualitative variables. A probability value (*p*-value) < 0.05 was considered statistically significant. Data were analyzed and appropriately presented in tables and figures.

3. Results

Mean age of the studied patients was 26.9 ± 5.07 years. 13.9% of them were smokers. Nulliparous women represented 31.9%. Gestational age at presentation ranged from 28 weeks and 6 days to 34 weeks and 2 days. 4.1% have DM, 27.7% have gestational hypertension, 5.5% have chronic hypertension

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