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ORIGINAL ARTICLE

Effects of antenatal dexamethasone administration on fetal and uteroplacental Doppler waveforms in women at risk for spontaneous preterm birth

Elwani Elsnosy, Omar M. Shaaban, Ahmed M. Abbas*, Heba H. Gaber, Atef Darwish

Department of Obstetrics & Gynecology, Faculty of Medicine, Assiut University, Assiut, Egypt

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KEYWORDS

Corticosteroids;
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Abstract Objective: Maternal administration of synthetic corticosteroids is essential to improve fetal lung surfactant production and hasten the fetal lung maturity in women at risk for preterm birth. The current study aimed to investigate the effects of dexamethasone exerted on fetal and uteroplacental circulation as measured by Doppler in pregnancies at risk for preterm birth after 24 h of its administration.

Materials and methods: A prospectively registered study at www.ClinicalTrials.gov (NCT02662790) was conducted in Women Health Hospital, Assiut, Egypt, included 50 pregnant women with singleton pregnancies. Doppler studies were performed on the umbilical artery, fetal middle cerebral artery (MCA), fetal descending aorta and maternal uterine arteries just before dexamethasone administration and repeated 24 h after completion of the dexamethasone course.

Results: The mean age of the study group was 27.7 ± 4.5 years. There was a statistically significant difference between all Doppler indices in umbilical artery, fetal MCA and aorta in comparison before and 24 h after maternal dexamethasone administration. Also uterine artery Pulsatility index was significantly different ($p = 0.001$).

Conclusion: Maternal dexamethasone administration to pregnant women at risk of preterm labor improves the blood flow of the maternal uterine artery, fetal MCA, descending aorta and umbilical artery 24 h after its administration.

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* Corresponding author at: Women Health Center, Assiut University, Assiut, Egypt.

E-mail address: ans111leg@gmail.com (A.M. Abbas).

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1. Introduction

Respiratory distress syndrome (RDS) as a consequence of immature lung development is the principal cause of early neonatal morbidity and mortality and contributes significantly to high costs of neonatal intensive care (1).

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Maternal administration of synthetic corticosteroids (betamethasone or dexamethasone) has been used for long time to improve fetal lung surfactant production and hasten the fetal lung maturity in women at risk for preterm birth (2). Corticosteroids also reduce the occurrence of RDS, intraventricular hemorrhage, necrotizing enterocolitis and overall neonatal mortality in preterm infants (3). No serious side effects have been reported after administration of corticosteroids during pregnancy, but some studies reported reduction in fetal body movements, fetal breathing movements and heart rate variation after betamethasone administration (4,5). These effects are more obvious with betamethasone than dexamethasone. Repeated courses of steroids have been associated with increased risk of fetal growth restriction (6).

Evaluation of fetal well-being with Doppler examination of blood flow velocity waveforms after maternal corticosteroid administration is therefore essential to investigate the fetal hemodynamic effects of exogenous corticosteroids. Previous studies showed conflicting results regarding this important subject and most of them were focusing on the effect of steroids on pregnancies complicated with intrauterine growth restriction (IUGR) (7–10). Also, most of previous studies investigated the effect of betamethasone on fetal and uteroplacental blood flow (4,5,11,12), and few studies only thoroughly investigated the effect of dexamethasone (13).

Thus, the current study aimed to investigate the effects of dexamethasone exerted on fetal and uteroplacental circulation as measured by Doppler ultrasonography in pregnancies at risk for preterm birth after 24 h of its administration.

2. Materials and methods

2.1. Study setting and design

The current study was a prospective cross sectional registered study at www.ClinicalTrials.gov (NCT02662790). The study was conducted in Women Health Hospital, Assiut, Egypt, during the period from January to December 2014.

2.2. Study participants

Eligible participants were pregnant women with gestational age from 24 to 34 weeks and at risk for preterm birth. Gestational age was calculated according to the date of the last menstrual period and confirmed by first trimester ultrasound. Patients at risk of preterm labor to be included were those with preterm uterine contractions, placenta previa, and mild preeclampsia. Meanwhile, Patients who were actively in labor, presented with premature rupture of membranes, intrauterine growth restriction (IUGR), and those who had received corticosteroids in their pregnancies and/or fetuses with suspected structural abnormalities were excluded from participation. Women who had any contraindication of corticosteroids administration had also been excluded.

A written consent has been taken from all participants after reading the patient information sheet and describing the non-interventional nature of the study. Assiut Faculty of Medicine Ethical Review Board approved the study.

2.3. Study intervention

Eligible participants were evaluated through full history taking and detailed anatomical scan by level II sonographer before inclusion to confirm their gestational age and exclude any structural anomalies.

Each woman received the recommended course of corticosteroids to induce fetal lung maturity consists of two doses of 12 mg dexamethasone (Dexamethasone 8 ml, Sigma) intramuscularly 12 h apart.

Doppler studies were performed just before dexamethasone administration and repeated 24 h after completion of the dexamethasone course using a SonoAce X8 machine (Medison, Korea) with 3.75 MHz curvilinear transabdominal probe. All patients underwent Doppler examination by 2 different sonographers (E.E. and A.M.A), both of them are level II experienced sonographers. The second one was completely blinded to the Doppler results obtained before dexamethasone administration by the first sonographer to exclude any operator bias.

Doppler examination was done with the fetus in a quiet state, in the absence of fetal movements and fetal breathing movements. The angle of insonation was optimized to be as low as possible, never exceeding 45°. The sweep speed was 2.5 cm/s and the pulse repetition frequency ranged from 3.5 to 5.5 kHz. The Doppler spectrum was recorded during maternal voluntary apnea.

Blood flow velocity waveforms were obtained from the umbilical artery, fetal middle cerebral artery (MCA), fetal descending aorta and maternal uterine arteries. Spectral pulsed wave Doppler analysis was done after that; RI and PI were calculated for each vessel. The formulas used for PI and RI were $PI = (S-D)/\text{mean}$ and $RI = (S-D)/S$ respectively, when S is the peak Doppler frequency shift and D is the minimum. At least 5 uniform waveforms of the spectrum were recorded and analyzed.

Blood flow velocity waveforms were recorded from the umbilical artery in the free floating mid-portion of the umbilical cord (14). Doppler signals were registered from the fetal MCA in its proximal third. For an accurate measurement, the fetal head was in the transverse plane. The MCA vessels were located with color Doppler ultrasound overlying the anterior wing of the sphenoid bone near the base of the skull (15).

Doppler signals were obtained from the uterine arteries in the region of the lower uterine segment. Insonation of the uterine artery was done at its crossover iliac artery (16). Velocity waveforms from the fetal descending aorta were recorded at the lower thoracic level just above the diaphragm, keeping the angle of insonation of the Doppler beam below 45°.

The primary outcome of the study was detection of changes in Doppler indices before and after dexamethasone administration.

2.4. Statistical analysis

Collected data were reviewed and analyzed using the Statistic Package for Social Science Version 18 (SPSS 18.0) for windows. Qualitative data were expressed as frequency and percentage. Chi-square (X^2) test was used to examine the relation between qualitative variables. Quantitative data were presented in terms of mean and standard deviation, and 2 inde-

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