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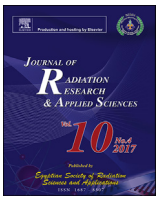

Effects of gestational hypertension in the pulsatility index of the middle cerebral and umbilical artery, cerebro-placental ratio, and associated adverse perinatal outcomes

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ABSTRACT

This paper reports the effects of gestational hypertension in the pulsatility index (PI) of umbilical artery (UA) and middle cerebral artery (MCA), cerebro-placental ratio (CPR), and associated adverse perinatal outcomes, after 20 to 40 weeks' gestation in singleton pregnancy. A total of 280 pregnant women, divided equally into control and gestational hypertension groups, were recruited prospectively. Alpinion Medical System ECUBE 7 ultrasound equipment was used to measure the UA-PI, MCA-PI, and CPR within the two groups. Data were analyzed to correlate the results with the presence of adverse perinatal outcomes. In gestational hypertension group, the UA-PI, MCA-PI, and CPR were associated with adverse perinatal outcomes after adjustment for gestational age. The increase in risk for lower birth weight, higher incidence of elective Cesarean section delivery, and preterm birth were statistically significant for UA-PI, MCA-PI, and CPR. Study of pulsatility indices of placental and fetal circulation in singleton pregnancy developed gestational hypertension can provide important information regarding fetal well-being, yielding an opportunity to improve fetal outcome.

1. Introduction

The hypertensive disorders affect approximately 6% of pregnant women and is one of the three leading causes of pregnancy-related deaths, which are embolism (20%), hemorrhage (17%) and pregnancy-induced hypertension (PIH) (16%) (Chang et al., 2003; Póvoa, Costa, Rodrigues, Patrício, & Cardoso, 2008). Hypertensive disorders of pregnancy are also associated with impaired utero-placental circulation and consequent intrauterine growth restriction (IUGR) (Miller, Turan, & Baschat, 2008). PIH affects 10–12% of pregnancies worldwide and includes, but not limited to gestational hypertension, preeclampsia, and severe preeclampsia (Magee et al., 2014; Irwinda, Surya, & Nembo, 2016).

Gestational hypertension is the development of new hypertension in a pregnant woman after 20 weeks gestation without the presence of protein in the urine or other signs of preeclampsia (Corton, Leveno, Bloom, Spong, & Dashe, 2014). It is defined as systolic blood pressure (SBP) > 140 mmHg and diastolic blood pressure (DBP) > 90 mmHg (Visintin et al., 2010). Meanwhile, pre-eclampsia was diagnosed by gestational hypertension with one or more of the following: significant proteinuria, or one or more adverse conditions, or one or more severe complications. Significant proteinuria was defined as ≥0.3 g/d in a complete 24-h urine collection or ≥30 mg/mmol urinary creatinine in a random urine sample or urinary dipstick proteinuria ≥1+. Some adverse conditions consisted of maternal symptoms, signs, and abnormal laboratory results, and abnormal fetal monitoring results impacts to the maternal and also the fetal condition (Irwinda et al., 2016; Magee et al., 2014). Actually, severe preeclampsia was still in the scope of preeclampsia, whereas it had one or more severe complications. Severe complications that warrant delivery consisted of eclampsia,

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retinal detachment, Glasgow coma scale (GCS) < 13, stroke, uncontrolled severe hypertension, oxygen saturation <90%, myocardial ischemia, platelet count <50 × 109/L, acute kidney injury, hepatic dysfunction, placental abruption, and stillbirth (Irwinda et al., 2016; Magee et al., 2014).

Doppler ultrasound velocimetry of uteroplacental umbilical and fetal vessels has become established method of antenatal monitoring, allowing the noninvasive assessment of fetal circulation. Its indices provide important information on the hemodynamics of the vascular area under study. Circulatory changes, reflected in certain fetal Doppler waveforms, predict adverse perinatal outcome (Dubiel, Breborowicz, Marsal, & Gudmundsson, 2000; Shahinaj, Manoku, Kroi, & Tasha, 2010). Umbilical arteries are the common vessels assessed by Doppler ultrasound (Fig. 1 and Fig. 2), but recent studies have shown the efficacy of the middle cerebral artery (MCA) Doppler assessment (Fig. 3 and Fig. 4). Today, with the advancement of pulsed and color coded Doppler ultrasound combined with better reproducibility, the MCA has emerged as the vessel of choice in the Doppler assessment of fetal intracranial as well as other organs perfusion (Bahlmann et al., 2002; Tarzamni, Nezami, Gatreh-Samani, Vahedinia, & Tarzamni, 2009). Consequently, Doppler measurement of umbilical artery (UA) and MCA pulsatility index (PI) plays a central role in the assessment and monitoring for fetal oxygenation in pregnancies with impaired placentation (Morris, Say, Robson, Kleijnen, & Khan, 2012). Recent evidence suggests that a high UA-PI and low MCA-PI, regardless of fetal size, is associated independently with intrapartum fetal compromise, low neonatal blood potential of hydrogen (pH) and neonatal unit admission (Morales-Roselló et al., 2014, 2015).

The cerebro-placental ratio (CPR) is a well-established predictor of unfavorable pregnancy outcomes (Simanaviciute & Gudmundsson, 2006). Numerous studies have reported higher sensitivities and specificities for CPR for the prediction of the fetal prognosis (Makhseed, Jirous, Ahmed, & Viswanathan, 2000; Sterne, Shields, & Dubinsky, 2001). CPR reflects not only the circulatory insufficiency of the umbilical velocimetry of the placenta manifested by alterations in the umbilical systolic/diastolic (S/D) ratio but also the adaptive changes resulting in modifications of the middle cerebral S/D ratio (Sterne et al., 2001).

The objectives of this study were to report the effects of gestational hypertension in the PI of MCA and UA, CPR, and associated adverse perinatal outcomes, after 20 to 40 weeks' gestation in singleton pregnancy.

2. Materials and methods

2.1. Study population

In this prospective cohort study, 280 pregnant women distributed equally for controls (140, 50%) and gestational hypertension (140, 50%) groups, with a sample size of 7 cases per each week of gestational age. Cases were recruited from the obstetric clinics of the Gulf Diagnostic Center Hospital in Abu Dhabi, United Arab Emirates, between April 2016 and July 2017. Sample size for each week of gestation age was determined on the basis of: a 5% margin of error, 95% confident level, 50% response distribution, and a population size of 1240 women visited annually the area of the study. All of these women were from a low-risk population and referred to receive routine prenatal care at our Radiology and Medical Imaging Department. The research protocol was approved

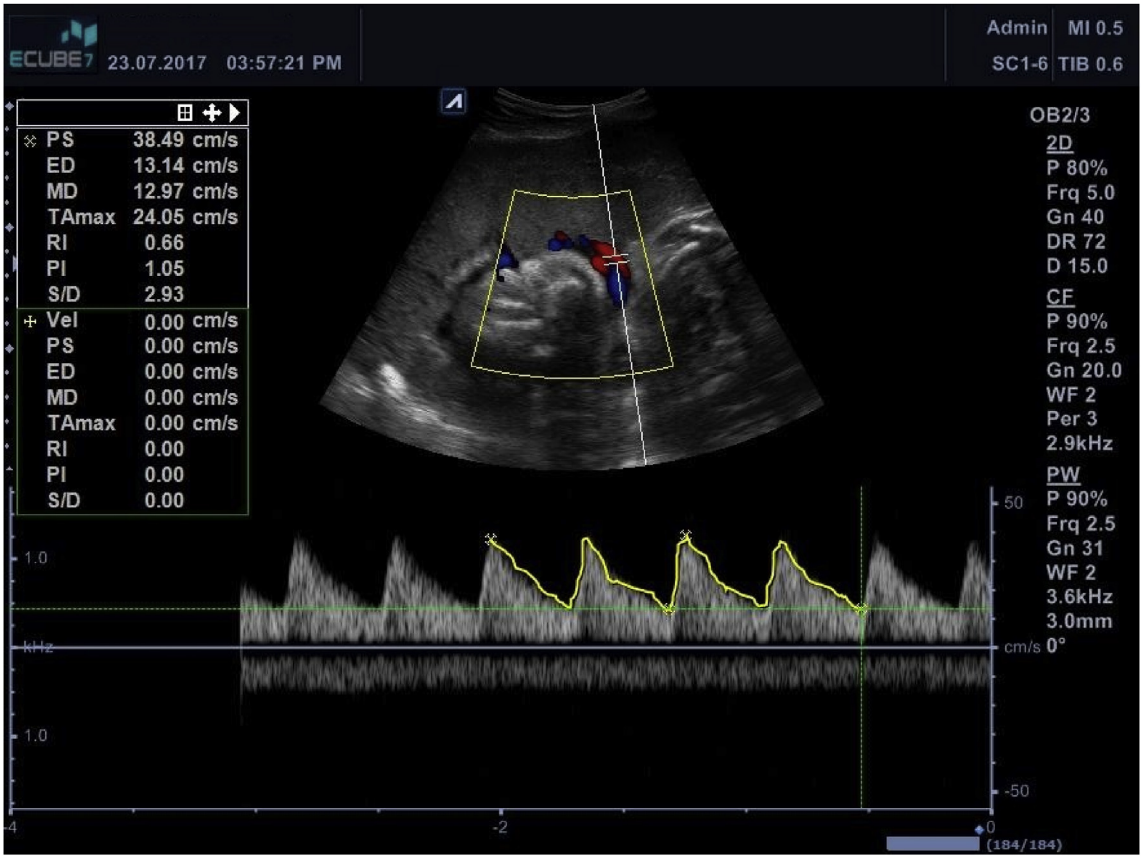

Fig. 1. Doppler velocimetry of the UA (PI = 1.05) in a normal singleton pregnancy of 26 weeks' gestation.

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