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## Full Length Article

# Uterine artery Doppler screening as a predictor of pre-eclampsia



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## ARTICLE INFO

## Article history:

Received 16 August 2015

Accepted 13 June 2016

## Keywords:

High risk pregnancy

Pre-eclampsia

Uterine artery doppler

Uterine artery notching

Pulsatility index

## ABSTRACT

Hypertensive disorders represent the second most common cause of maternal death, affecting 5–10% of pregnancies worldwide and accounting for 19% of maternal deaths in South Africa. Pre-eclampsia is believed to develop from inadequate trophoblast invasion of the maternal spiral arteries. Doppler imaging permits non-invasive evaluation of the uteroplacental circulation and is invaluable in the management of high risk pregnancies.

A prospective quantitative experimental study tested the hypothesis that uterine artery (UA) spectral Doppler screening is able to identify patients at risk for developing pre-eclampsia.

Convenience sampling allowed for the recruitment of 144 patients (11–14 weeks gestation) who attended the antenatal clinic at Rahima Moosa Mother and Child Hospital between November 2008 and July 2010. A complete record of 121 participants was available for the final analysis.

The results of this study revealed that 7 (5.8%) participants developed pre-eclampsia. Race was identified as the most significant independent variable with an odds ratio of 1.5; 26 and 9 to 1 for developing PET in the 1st, 2nd and 3rd trimesters respectively.

Uterine Artery Doppler is promising. An ultrasound screening programme in high risk pregnant women would offer clinicians the opportunity to pre-empt the disease before it manifests clinically.

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Peer review under responsibility of Johannesburg University.

<http://dx.doi.org/10.1016/j.hsag.2016.06.004>

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## 1. Introduction

A key aim of antenatal care is to identify and manage pregnancies at risk for complications (Kurdi, Campbell, Aquilina, England, & Harrington, 1998). Hypertensive disorders represent the second most common cause of maternal death, affecting 5–10% of all pregnancies worldwide (Wolde, Segni, & Woldie, 2011), and accounting for 19% of maternal deaths in South Africa (Moodley, 2010).

Normal placentation is achieved through successful trophoblast invasion of the maternal decidua and myometrium via the dilated spiral arteries. In the process, a low resistance vascular bed with a high blood flow is created (Ozkaya, Ozkan, Ozeren, & Corakci, 2007). Physiological changes during pregnancy convert the spiral arteries from small muscular arteries to dilated uteroplacental vessels, which are able to accommodate the hemodynamic forces of pregnancy (Swanepoel, 2004). Unsuccessful trophoblast invasion, with consequent under perfusion of the placenta, leads to the release of hormones into the maternal circulation which is believed to be the underlying mechanism for the development of pre-eclampsia (Yu, Papageorghiou, Parra, Palma Dias, & Nicolaidis, 2003).

Doppler ultrasound is an invaluable tool in the management of high-risk pregnancies. Direct assessment of trophoblast invasion in human pregnancy is not possible; however, the use of Doppler imaging permits non-invasive evaluation of the uteroplacental circulation by comparing systolic and diastolic waveforms (Ghidini, Locatelli 2008), (El-Hamedi, Shillito, Simpson, & Walker, 2005). In recent years the question whether uterine artery (UA) spectral Doppler analysis could be used as a screening tool to predict pre-eclampsia before the clinical onset of the disease has thus been asked. In previous studies the clinical value of UA Doppler has been promising (Harrington, Fayyad, Thakur, & Aquilina, 2004, p. 50) in the prediction of severe adverse outcomes in patients at high risk for pre-eclampsia (El-Hamedi et al., 2005).

There is evidence to support the belief that trophoblast invasion is maximal in the first trimester (Melchiorre, Leslie, Prefumo, Bhide, & Thilaganathan, 2009, p. 524) and that pre-eclampsia, deriving from a relative failure of this event, validates Doppler evaluation of the UA as from the first trimester of pregnancy (Melchiorre, Wormald, Leslie, Bhide, & Thilaganathan, 2008). This screening test, performed as an adjunct to routine ultrasound examinations, does not involve significant extra costs and can identify a cohort of patients who will benefit most from increased surveillance during pregnancy (Papageorghiou & Leslie, 2007).

The aim of this article is to document our experience in demonstrating the sensitivity of UA spectral Doppler screening in the prediction of pre-eclampsia.

## 2. Materials and methods

A prospective quantitative experimental study was conducted to test the hypothesis that UA spectral Doppler screening is able to identify patients at risk of developing pre-eclampsia.

A convenience sampling method was applied by recruiting all patients (between 11 and 14 weeks gestation) who attended

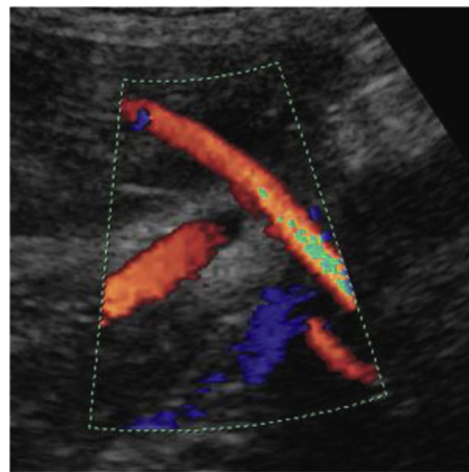
the antenatal clinic at Rahima Moosa Mother and Child Hospital between November 2008 and July 2010. Patients with the following conditions were excluded from the study:

- Multiple gestations, as these pregnancies are known to have a higher incidence of placental insufficiency.
- Fetal abnormalities, as the possibility that those patients might opt for a pregnancy termination existed and data collection would thus be incomplete.
- Patients on treatment for hypertensive disorders - results from those patients would not provide a true reflection as the patients were already on medication.

After explaining the objectives of the study, written informed consent was obtained from the women who agreed to participate. Once a viable intra-uterine pregnancy had been confirmed, UA spectral Doppler assessment was performed on a GE Vivid 3 ultrasound unit, using a transabdominal approach. To ensure consistency of results, the researcher was the only person performing the scans and the ultrasound unit was serviced and calibrated on a regular basis.

The probe was placed lateral to the uterus and the transducer gently tilted medially until the UA was identified where it crossed over the external iliac artery (Fig. 1). The sample gate was placed over the entire diameter of the artery and pulsed wave Doppler was used to obtain three consecutive UA waveforms. The pulsatility index (PI) was then measured bilaterally.

The Doppler assessment was repeated during the 22–24 week scan and again between 28 and 32 weeks gestation. Ultrasound criteria for demonstration of high resistance flow were guided by Gomez et al. (2008, Table 1, p. 130). and current practice in the Fetal Medicine unit at Chris Hani Baragwanath Hospital (Nicolaou (personal communication), 2012). The presence of UA notching and a PI > 1.5 during the first trimester were considered indicative of increased vascular resistance in the placental bed. Even though notching may be considered normal in the first and early second trimester, it was recorded to facilitate the comparison of variables (Table 2).



**Fig. 1 – Uterine artery where it crosses the external iliac artery ([www.fetalmedicine.com/fmf/Doppler%20in%20Obstetrics.pdf](http://www.fetalmedicine.com/fmf/Doppler%20in%20Obstetrics.pdf)).**

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