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Uterine artery Doppler at 30 – 33 weeks of gestation and pregnancy outcome

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Abstract
Aim: To find out the importance of uterine artery pulsatility index (PI) at 30–33 weeks gestation in detecting high risk pregnancy developing hypertension and SGA at advanced gestational age.
Methodology: The study carried out in Srinivas Institute of Medical Sciences and Research Centre and Mangalore Fetal Medicine Centre, from Dec 2016 to Nov 2017 and at 30–33 weeks gestation uterine artery Doppler performed in 952 singleton primigravida pregnancies and outcome recorded by follow up.
Results: Out of 952 pregnancies 920 patient were normal. 32 developed hypertension in pregnancy. Whereas 6 women developed PE requiring delivery 34- 37 weeks and 10 developed PE requiring delivery at or after 38 weeks 16 women developed Gestational hypertension.49 women developed SGA in absence of Hypertension.
Uterine artery mean PI> 1.10 detects high risk pregnancy developing intermediate, late PE and SGA.
Conclusion: Uterine artery PI at 30–33 weeks could effectively identify women at high risk for subsequent development of PE and SGA.

Keywords: Preeclampsia, uterine artery Doppler, pulsatile index (PI), SGA (small for gestational age)

Introduction

Preeclampsia (PE), which affects 2–3% of pregnancies, is a major cause of maternal and perinatal morbidity and mortality [1, 3]. The prevalence of the disease increases with gestational age but the incidence of adverse fetal and maternal short- and long-term consequences of PE is inversely related to the gestational age at onset of the disease [4, 7]. Several recent studies have proposed the introduction of first-trimester screening for PE by a combination of maternal demographic characteristics, including medical and obstetric history, uterine artery pulsatility index (PI) and a series of other biophysical and biochemical markers [8, 11]. Such early combined screening is effective in identifying pregnancies that subsequently develop early-PE, requiring delivery before 34 weeks, but less so for intermediate-PE with delivery at 34–37 weeks and late-PE delivering at or after 38 weeks [10]. The value of early screening for PE is derived from the evidence that the prophylactic use of low-dose aspirin can result in a major reduction in the prevalence of preterm PE and the associated perinatal mortality, provided the onset of treatment is before rather than after 16 weeks gestation [12, 14]. There is good quality evidence that induction of labour for term PE results in a significant reduction of perinatal complications [15] and therefore, in the case of intermediate- and late-PE the objective of antenatal care is the identification of women at high-risk leading to intensive maternal monitoring for earlier diagnosis of PE and timely delivery with the potential for mitigating an adverse outcome. Previous uterine artery Doppler studies during the third trimester were confined to the investigation of high-risk pregnancies. Essentially, Doppler studies were carried out in pregnancies presenting with PE or fetal growth restriction reported that the outcome was worse if there was increased, rather than normal, impedance to flow in the uterine arteries [16, 22]. Similarly, studies investigating pregnancies with abnormal uterine artery Doppler at 20–24 weeks' gestation reported that outcome was worse in those with persistence of high impedance to flow during the third trimester compared to those with normalization in flow [23, 25].
The objective of this screening study is to investigate the importance of uterine artery PI at 30–33 weeks gestation and subsequent women developing hypertension and small for gestational age (SGA).

Methodology

The data for this study were derived from women attending antenatal checkup at Srinivas Institute of Medical Sciences & Research centre and Mangalore Fetal medicine center between

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Dec 2016 Nov 2017. The visit, was held at 30–33 weeks gestation, included recording of maternal characteristics and medical history, estimation of fetal size from transabdominal ultrasound measurement of fetal head circumference, abdominal circumference and femur length, and transabdominal colour Doppler ultrasound to visualize the left and right uterine arteries at the apparent crossover with the external iliac arteries [26, 27]. Pulsed-wave Doppler was then used to obtain waveforms and when three similar consecutive waveforms were obtained the PI was measured, and the mean PI of the two vessels was calculated. Written informed consent was obtained from the women agreeing to participate in a study on adverse pregnancy outcome.

Gestational age was determined by the measurement of fetal crown-rump length at 11–13 weeks or the fetal head circumference at 20–24 weeks [28, 29].

Patient Characteristics

Patient characteristics including maternal age, maternal weight, maternal height, family history of PE in mother, history of chronic hypertension and history of preexisting diabetes were recorded.

Outcome Measures

Data on pregnancy outcome were collected from the hospital records of the women. The obstetric records of all women with preexisting or pregnancy associated hypertension were examined to determine if the condition was chronic hypertension, PE or non-proteinuric gestational hypertension (GH).

The definitions of GH and PE were those of the International Society for the Study of Hypertension in Pregnancy [30]. In GH, the systolic blood pressure should be 140 mm Hg or more and/or the diastolic blood pressure should be 90 mm Hg or more on at least two occasions 4 hour apart developing after 20 weeks of gestation in previously normotensive women. In PE, there should be GH with proteinuria of 300 mg or more in 24 h or two readings of at least ++ on dipstick analysis of midstream or catheter urine specimens if no 24-hour collection is available. In PE superimposed on chronic hypertension, significant proteinuria (as defined above) should develop after 20 weeks of gestation in women with known chronic hypertension (history of hypertension before conception or the presence of hypertension at the booking visit before 20 weeks of gestation in the absence of trophoblastic disease). PE requiring delivery at 34–37 weeks was defined as intermediate PE and PE requiring delivery at or after 38 weeks was defined as late PE. The newborn was considered to be small for gestational age (SGA) if the birth weight was less than the 5th percentile after correction for gestation at delivery [31].

Statistical analysis

All analyses were done using ADaMSoft (Java Software) statistical package estimates were expressed as mean ± standard deviation. To compare adverse pregnancy outcomes Chi-square tests were used to test differences in proportions. P<0.05 was considered statistically significant.

Results

Third-trimester assessment was carried out in 1130 singleton pregnancies. We excluded 178 cases because they had missing outcome data (n = 154), they had PE at the time of screening or before 34 weeks (n = 11), the pregnancy resulted in delivery before 34 weeks' gestation (n =7) or the birth of babies with major defects (n = 6).In the remaining 952cases there were 920 that were unaffected by PE, GH or SGA (normal group), Hypertension in pregnancy 32 (3.36%) in that PE developed in 16 pregnant women. In that developed PE, with 6 cases requiring delivery at 34– 37 weeks (intermediate-PE) and 10 cases delivering at or after 38 weeks (late-PE), 16 that developed GH and 49 (5.15%) that were SGA in the absence of PE.

The maternal characteristics and history in the outcome groups are presented in table 1. In the PE group, compared to the normal group, there was a higher median maternal weight and personal history of PE and chronic hypertension. In the GH group, compared to the normal group, there was a higher median maternal weight and prevalence of family history of PE.

Table 1: Characteristics of the Study Population

Characteristics	Normal (n=920)	PE (n=16)	GH(n=16)	SGA (n=49)
Maternal age (years)	25.4	29.2	28.4	26.1
Maternal wt (Kg)	58.8	72.7	70.6	62.9
Maternal Ht (cm)	151	154	157	149
Family h/o PE	35(3.804%)	7 (43.75%)	8 (50.00%)	17(34.69%)
History of chronic hypertension	1 (0.11%)	7 (1.12%)	-	15 (30.61%)
History of diabetes mellitus	5 (0.543%)	2 (12.5%)	-	9 (18.36%)

As shown in the Table 2 uterine artery mean PI was > 1.10 in 32 pregnant women and all developed hypertension at later gestational age and all developed SGA.

Table 2: Uterine artery PI and outcome

Uterine artery mean PI	< 1.10	>1.10
Hypertension at later gestation	0	32
SGA	17	32

Incidence of hypertension in pregnancy was 32(3.36%) in study group whereas incidence of SGA was 49 (5.15%). In 49 cases of SGA mean PI was > 1.10 in majority of the cases (n=32, 65.31%) and in 17 cases (34.69%) mean PI was < 1.10.

Discussion

Pregnant women attending for routine care in 30 – 33 weeks of gestational age range which is widely used for the assessment of fetal growth and wellbeing considered for the study, uterine artery mean PI is measured by single operator according to standard protocol. In screening for intermediate- and late-PE by uterine artery mean PI at 30–33 weeks' gestation is better and this appears to be superior to that achieved by screening at 11–13 weeks' gestation [8]. Future studies will determine whether the increase in uterine artery PI observed at 30–33 weeks in association with intermediate- and late-PE is apparent from the first and second trimesters, reflecting impaired placentation in early pregnancy, or they become apparent only in the third trimester as a consequence of vasoconstriction in the uteroplacental circulation soon before the clinical onset of the disease. Alternatively, the improved performance of screening at 30–33 weeks, compared to 11–13 weeks, may be the consequence of normalization with advancing gestational age in

the high PI observed in early pregnancy in some of the unaffected pregnancies. The objectives of screening for early- and intermediate- or late-PE are different. In the case of severe PE presenting at 20–33 weeks, which is commonly associated with fetal growth restriction [4], early diagnosis and delivery may not improve perinatal outcome which is essentially dependent on gestational age and birth weight. A strategy for avoidance of adverse outcome in this group should focus on the identification of high-risk pregnancies at 11–13 weeks and the use of low-dose aspirin or other pharmacological interventions started in early pregnancy to improve placentation [12, 13]. In the case of intermediate or late disease the primary objective of prenatal care should be directed at effective identification of the high-risk group, close monitoring for early diagnosis of PE and iatrogenic delivery at the appropriate time to minimize the adverse effects on the mother and baby.

Limitations of the study is small sample size and requires large group future studies with additional biomarkers which can give more information.

Conclusion

Uterine artery PI at 30–33 weeks could effectively identify women at high risk for subsequent development of intermediate and late PE and SGA with beneficial outcome in relation to reduced perinatal and maternal morbidity and mortality.

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