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Dr. Ambika S Patil
Assistant Professor,
Department of Obstetrics and
Gynaecology, Al Ameen Medical
College and Hospital, Vijayapur,
Karnataka, India

Dr. Vibhavaree Dandavate
Associate Professor,
Department of Obstetrics and
Gynaecology, Al Ameen Medical
College and Hospital, Vijayapur,
Karnataka, India

Dr. Vidya Thobbi
Professor and HOD,
Department of Obstetrics and
Gynaecology, Al Ameen Medical
College and Hospital, Vijayapur,
Karnataka, India

Correspondence
Dr. Vibhavaree Dandavate
Associate Professor,
Department of Obstetrics and
Gynaecology, Al Ameen Medical
College and Hospital, Vijayapur,
Karnataka, India

Clinical profile of pregnant women subjected for by transvaginal uterine artery Doppler

Dr. Ambika S Patil, Dr. Vibhavaree Dandavate and Dr. Vidya Thobbi

Abstract
Preeclampsia was identified in 1, 46,320 women or 3.7% of all pregnancies that ended in live births. Berg and colleagues (1996) reported almost 18% of 1450 maternal deaths in United States 1987 to 1990 were complications of pregnancy related hypertension. The syndrome complex of pre-eclampsia and fetal growth restriction have similar pathology of placental insufficiency. Here the blood supply to the fetus is inadequate because of defective placentation which can be part of syndrome of pre-eclampsia or can individually lead to defective growth of the baby i.e. small for gestational age baby. An observational study was done over a period of one year among women attending the out-patient department for antenatal care at Medical College and Hospital. About 52% of women are in the age group 21-30 years and 46% belong to teenage group. Mean gestation age at transvaginal USG is 14+1 and at transabdominal USG is 24+6 weeks.

Keywords: Pregnant Women, Transvaginal Uterine Artery Doppler, Preeclampsia

Introduction
Preeclampsia and intrauterine growth restriction are important causes of maternal morbidity and mortality [1, 2].

According to National center for health statistics in 1998, hypertension associated with pregnancy was common medical risk factor. Preeclampsia was identified in 1, 46,320 women or 3.7% of all pregnancies that ended in live births[3]. Berg and colleagues (1996) reported almost 18% of 1450 maternal deaths in United States 1987 to 1990 were complications of pregnancy related hypertension [4].

Hypertension in pregnancy is also responsible for fetal (more than 19 weeks of gestation) and infant mortality as well as 46% of infants born small for gestation [2].

Similarly it was estimated that 3-10% of infants are growth restricted. Fetal growth restriction is associated with substantive perinatal morbidity and mortality [5]. This is true for both preterm and term infants.

Pre-eclampsia is a pregnancy specific syndrome of reduced organ perfusion secondary to vasospasm and endothelial activation. Minimum criteria for pre-eclampsia are [6]

- BP 140/90mm Hg after 20 weeks gestation
- Proteinuria 300mg/24 hours or 1 + dipstick

Fetal growth restriction can be broadly defined as an intrauterine fetal growth, which results in the birth of an infant weighing less than its genetic potential to recognize this, various definitions of low birth weight based on percentiles of weight have been proposed for e.g.

- < 10th percentile by Battaglia and Lubchenco 1991
- < 5th percentile by Seeds, 1984 [7]

The syndrome complex of pre-eclampsia and fetal growth restriction have similar pathology of placental insufficiency. Here the blood supply to the fetus is inadequate because of defective placentation which can be part of syndrome of pre-eclampsia or can individually lead to defective growth of the baby i.e. small for gestational age baby.

During the first 12 weeks of pregnancy cytotrophoblast invade the spiral arterial walls in the decidua and replace the endothelium and muscular media with a matrix of cytotrophoblasts and fibrinoid and fibrous tissue. The fibrinoid material is a complex of maternal fibrin and other plasma constituents plus proteinaceous material derived from the trophoblastic cells. Beginning at about 12 weeks of gestation and continuing throughout the remainder of the second trimester, the endovascular trophoblast move in to the myometrial segments of spiral arteries.

Once again the trophoblast replaces the endothelium and establishes themselves in the muscular media. The elastic and muscular tissue of the myometrial segments of the spiral arteries is gradually lost and replaced with fibrinoid material. This condition, along with increase in blood flow and the associated haemodynamic forces convert the entire length of the spiral arteries from small muscular arteries to dilated, tortuous uteroplacental vessels. At term these changes can be seen at the distal portion of the radial arteries. In all, approximately 100-150 converted spiral arteries supply the placental bed. There is increase in flow from 100ml/min-800ml/min.

According to Brosen *et al*. Robertson *et al* and Khong *et al*. a lack of endovascular infiltration by trophoblast into the myometrial portion of the placental bed spiral arteries is a consistent finding in the presence of preeclampsia. Classically it is held that second wave of endovascular trophoblastic invasion that proceeds in myometrial segments of the spiral arteries from about 15 weeks does not occur in patients who will develop fetal growth restriction or pre-eclampsia. Lack of physiological conversion is not only apparent in the myometrial segments of spiral arteries, but also in the decidual parts of some of the vessels so that a proportion of spiral arteries completely fail to undergo trophoblastic invasion and physiological changes. Since unconverted vessels retain _high resistance / low capacitance properties, the effect on maternal blood supply to the placenta may be dramatically low. These may manifest as impaired growth of the baby or high BP with proteinuria i.e. pre-eclampsia with its complications [8].

Methodology
An observational study was done over a period of one year among women attending the out-patient department for antenatal care at Medical College and Hospital.

Inclusion criteria
All pregnant women between 12 to 16 weeks of gestational age with singleton pregnancy

Exclusion criteria
Multiple gestations
Patient with congenital anomaly of fetus, chronic hypertension, renal disease, cardiac disease

Sample size: **100**
Study design: An observational study.
When above criteria were met study group was subjected to Doppler study after dating and screening scan at 12-16 week of gestation.

Method of statistical analysis
Statistical analysis was done using descriptive statistical methods like mean, percentages and proportions.

Results:

Table 1: Age distribution in years

Age in years	Frequency	Percent
Less than 20	46	46.0
21-30	52	52.0
More than 30	2	2.0
Total	100	100.0

About 52% of women are in the age group 21-30 years and 46% belong to teenage group.

Table 2: Educational status

Schooling	Frequency	Percentage
Primary	11	11.0
Secondary	49	49.0
Intermediate	38	38.0
Graduate	2	2.0
Total	100	100.0

About 49% of women have got secondary education, 38% of intermediates, 11% studied till primary schooling and 2% were graduates.

Table 3: Socioeconomic status

Class	Frequency	Percentage
2	3	3.0
3	45	45.0
4	32	32.0
5	20	20.0
Total	100	100.0

About 45%, 32%, 20% of women belong to class 3, class 4, class 5 socioeconomic status respectively, as per Modified B. G. Prasad classification - 2012.

Table 4: Parity distribution

Gravida	Frequency	Percentage
1	54	54.0
2	37	37.0
3	6	6.0
4	3	3.0
Total	100	100.0

About 54% of women were primigravida.

Table 5: Statistical analysis of gestation age at scan

Gestation age at scan	No of subjects	Minimum	Maximum	Mean	Standard deviation
GA1	100	12+4	16+0	14+1	0.835
GA2	100	23+1	25+6	24+6	0.555

Mean gestation age at transvaginal USG is 14+1 and at transabdominal USG is 24+6 weeks.

Table 6: Systolic blood pressure in study group in third trimester

BP in mmHg	Frequency	Percentage
<130	77	77.0
130-139	1	1.0
140-149	12	12.0
>150	10	10.0
Total	100	100.0

About 78% are normotensive and 22% are associated with hypertensive disorders of pregnancy.

Table 7: Diastolic blood pressure in study group in third trimester

BP in mmHg	Frequency	Percentage
<80	57	57.0
80-89	21	21.0
90-100	22	22.0
Total	100	100.0

About 78% are normotensive and 22% are associated with hypertensive disorders of pregnancy.

Discussion
The Doppler effect is defined as the observed changes in frequency of transmitted waves when relative motion exists between the source of the wave and observer. The frequency increases when source and the Observer move closer and decreases when they move apart. This phenomenon bears the name of its discoverer Christian Andreas Doppler an Austrian

mathematician and physicist.

The first pulsed wave Doppler equipment was developed by the Seattle Research team. Donald Baker, Dennis Watkins and John Reid began working on this project in 1966 and produced one of the first pulsed Doppler devices. The Seattle team also pioneered the construction of Duplex Doppler instrumentation. Based on mechanical sector scanning head in which a single transducer crystal performs both imaging and Doppler functions on a time-sharing basis. The Duplex Doppler technique allowed the ultrasound operator to determine for the first time the target of Doppler insonation. This development is of critical importance in Obstetrics and Gynecological applications, as such range discrimination allows reliable Doppler interrogation of a deep lying circulation, such as that of the fetus and of the maternal pelvic organs [9].

Spectral Doppler Ultrasound interrogates along the single line of Ultrasound beam transmission. The haemodynamic information thus generated is limited to unidimensional flow velocity characterization from the target area. This limitation provided the impetus to develop a method for depiction of flow in a two dimensional planes in a real time.

The development of real time two-dimensional color Doppler ultrasonography therefore represents a major technologic breakthrough, which becomes possible because of introduction of two critical pieces of technology for processing the Doppler ultra sound signal. First were the Doppler sonographic applications by Angelsen and Kristofferson [10] of the sophisticated filtering technique of the ―moving target indicator‖ used in radar system. This filter allows removal of high amplitude low velocity clutter signals generated by movement of tissues structure and vessel walls. The second was development of auto correlation techniques by Namekawa *et al*[11]. The autocorrelator is capable of processing mean Doppler phase shift data from two dimensional scan areas in real time.

The first obstetrics application of Doppler ultrasonography consisted of detection of fetal heart movements originally developed for fetal heart rate detection. The technique was further developed for non-invasive continuous electronic monitoring of the fetal heart rate.

Currently they constitute the most common uses of Doppler sonography in Obstetrics. The system is based on utilizing relatively simple continuous wave Doppler ultrasound to determine the fetal heart rate from the fetal Cardiac wall or Valvular motion.

The first application of Doppler velocimetry in Obstetrics was reported by Fitzgerald and Drumm and McCallum *et al*. Gerard Albaiges[12] *et al* conducted a study on one-stage screening for pregnancy complications with Doppler assessment of uterine arteries. Women who had highest risk are those with bilateral notches and high mean pulsatile index. They have 40% chances of developing pre-eclampsia, 45% of developing infant birth weight less than 10% percentile.

Harrington *et al*. [13] (1991) reported on two mid pregnancies screening studies on 925 patients in predicting subsequent development of PIH and IUGR. There was a significant association between abnormal flow (RI higher than the 95th percentile) and subsequent development of hypertension and IUGR. There was no significant association with non proteinuric hypertension. To improve the sensitivity, color flow imaging and use of the Diastolic notch as well as elevated RI was introduced. In this study 2437 were patient studied at 20 weeks gestation, 16% had abnormal waveforms. 5.4% persisted at 24th week and 4.6% persisted at 26 weeks of gestation. Therefore the high sensitivity of 76% at 20 weeks was maintained at 24 and 26

weeks while the specificity improved from 86% to 97%. These screening studies may play important role in targeting population at risk.

Kurdie *et al*. [14] examined the uterine arteries by Doppler in 946 unselected women at 19-21 weeks. In 12.4 of cases, there were bilateral notches and in this group, the odds ratio for developing pre-eclampsia was 12.8, and for patients requiring delivery before 37 weeks, it was 52.6 When the uterine artery Doppler studies were normal, the odds ratio for developing pre-eclampsia was 0.11 and for fetal growth restriction (birth weight <5th percentile for gestational age), it was 0.3 in women with bilateral notches and a mean resistance index > 0.55, the sensitivity and for the complications requiring delivery before 37 weeks, the sensitivities were 88 for both. It was concluded that women with normal uterine Doppler study at 20 weeks constitute a group that have a low risk of developing obstetric complication related to uteroplacental insufficiency, whereas women with bilateral notches have an increased risk of subsequent development of such complications in particular to those requiring delivery before term. Consequently the results of Doppler studies of uterine arteries at time of routine 20 weeks anomaly scan may be of use in determining the type and level of antenatal care that is offered to these women.

Conclusion
About 78% are normotensive and 22% are associated with hypertensive disorders of pregnancy.

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