International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018

Role of Doppler studies in Gestational hypertension and it's perinatal outcome.

Dr Neha P S, Dr. Anuradha B S, Dr. Muralidhar Kanchi, Dr Pravin Kumar Ms, Mch

Department Of Obstetrics And Gynaecology Narayana Hrudayalaya Institute Of Medical Sciences, Bangalore
HOD, MS DNB FNB, Senior Consultant, Department of Obstetrics, Gynaecology and Reproductive Medicine Mazumdar Shaw Medical and Cancer Centre , Narayana Hrudayalaya Institute of Medical Sciences, Bangalore-560099
MD, FIACTA, FICA, MBA , Director (Academic) , Professor & Head of Department , Department of Anaesthesiology and Intensive care , Mazumdar Shaw Medical centre and Narayana Hrudayalaya Institute of Medical Sciences, Bangalore -560 099
Medical Director, Senior Consultant Cardiac Surgeon, Department of Cardio-Thoracic Surgery, Narayana Hrudayalaya Institute of Medical Sciences, Bangalore

Submitted: 04-03-2024 Accepted: 13-03-2024

I. INTRODUCTION:-

Every year about six million neonatal deaths including stillbirths occur worldwide ,out of these, preterm complications and intrapartum conditions have led to 10 and 7 lakh deaths respectively. Nearly three-fourths of the neonatal deaths occur in the first week of life thereby magnifying perinatal deaths rates.(1) Despite the rising global concern over maternal and newborn health, the burden of preventable mortality is still significant in lower and middle income countries.(2) . Therefore it is essential to address this for reaching the targets of reducing neonatal deaths to 12 per 1000 live-births or under-5 deaths to 25 per 1000 live-births by the year 2030 as set by United Nations Development Program (UNDP) in order to achieve Sustainable Developmental Goal-3.(3) In a multi-centre study carried out by World Health Organization (WHO), the analysis of 7993 deliveries has characterized 'Eclampsia or Pre-eclampsia' being the primary obstetric cause of nearly 25% of perinatal deaths and significant stillbirths or newborn deaths.(4) Hypertensive disorders of pregnancy (HDP) comprising of, chronic hypertension , pregnancy-induced-hypertension (PIH) or gestational hypertension, eclampsia or pre-eclampsia and chronic hypertension with super-imposed pre-eclampsia have accounted for nearly one-fifths of overall maternal deaths that translates to about 70,000 maternal deaths annually. Although the overall incidence of pre-eclampsia (2.16%), eclampsia (0.28%) and chronic hypertension (0.29%) seems lesser, they contribute significantly to larger denominations of maternal near-miss cases (8 times & 60 times), increased risk of fetal deaths [aOR=3.12 & 3.92], early neonatal deaths [aOR=2.71 & 6.58], perinatal deaths [aOR=3.02 & 4.91], preterm births [aOR=4.51 & 6.57] and NICU admissions [aOR=3.45 & 7.83] (5)

In our country, one in fourteen pregnancies has been diagnosed with HDP and 7.4% was the prevalence of gestational hypertension as concluded by recent studies.(6,7) The Nationwide cross-sectional study by Agarwal S et al., have added valuable inputs divulging the modifiable risk factors in cases of HDP which when addressed appropriately can further diminish the incidence or may halt the disease progression.(8) Moreover, results from systematic reviews and meta-analysis have synthesized evidences supporting measures of mean arterial pressure in predicting pre-eclampsia in the first and second trimesters.(9) However, with only 51.6% of pregnant women completing four or more antenatal visits,(10) India trails behind the high-income countries that has rightly applied Goldenberg's recommendations ensuring systematic early identification of pre-eclampsia, timely delivery and effective management of the same as well.(2)

Nevertheless, diagnosing this disease is more complex as some mothers having underlying placental pathology are devoid of clinical features, while others may have endothelial dysfunction along with maternal pre-eclampsia but without placental dysfunction. The heterogeneity extends further in the variability of its presentation observed in early and late onset disease and that the

fetal growth restriction is obvious in the former type than the latter.(11) In this paradigm, the screening test that would detect abnormal placentation and the resultant utero-placental perfusion defects with increased sensitivity would assist us in predicting adverse feto-maternal outcomes. All these have fancied the invasion of Doppler Ultrasonography (DUS) to aid the obstetrics world in surveillance of these beneficiaries. On analyzing the uterine artery waveforms in first trimester mothers has provided greater insights in prognostication of early or late onset pre-eclampsia rather than figuring out fetal growth restrictions.(12) However, the role of second trimester Doppler in discovering intra-uterine growth restriction (IUGR) is more reassuring in both low risk and high risk patients.(13). However , there is a large lacunae in studies demonstrating the utility of Doppler being carried out in third trimester especially those that allow comparisons between uterine artery and the umbilical artery blood flow plus exploring their associations with fetal hypoxemia or growth restrictions. Being a country with inadequate ANC utilization rates,(14) amalgamated with contracted time of intervention this study attempts to establish the benefits of Doppler in tracking adverse feto-maternal outcomes and incorporating Doppler studies for the betterment of maternal and child health.

Research Questions

What is the perinatal outcome in gestational hypertension and preeclampsia depending on the gestational age and correlation of Doppler and its significance in fetal outcome.

II. REVIEW OF LITERATURE:-

For this review, the procedure followed was to access and identify the references of full text articles, abstracts including review articles that were published in PubMed up to August 2020. We specifically searched for studies describing "Hypertensive Disorders of Pregnancy", "perinatal deaths", "neonatal mortality" using the search terms “Gestational Hypertension”, “Pre-eclampsia”, “Eclampsia”, “Doppler Ultrasonography”, “Fetal hypoxemia”, "Intra-uterine growth restriction", “NICU admissions”. Relevant articles published in English that identified from the searches through Mesh terms along with the references cited therein, were reviewed and highlighted in the following order:

2.1) Disease burden & Epidemiology
2.1.1. Perinatal mortality
2.1.2. Pregnancy induced hypertension
2.2) Pathophysiology of pre-eclampsia and eclampsia
2.3) Diagnosis of pre-eclampsia and eclampsia
2.4) Risk factors & Clinical features
2.6) Embryology
2.7) Doppler Ultrasound waveforms
2.7.1. Basic principles
2.7.2. Umbilical artery
2.7.3. Uterine artery
2.8) Relevant articles

2.1. DISEASE BURDEN AND EPIDEMIOLOGY:

2.1.1. Perinatal mortality and its burden:-

Perinatal deaths refer to infant deaths that occur less than seven days of birth inclusive of fetal deaths happening at 28 weeks of gestational age or more. This indicator represent the causes in late fetal and early neonatal period that are mostly preventable in nature.(15)

Worldwide burden of neonatal deaths were reported to be happening at an annual rate of 2.9 million per year. Of these, the most common causes identified were complications associated with preterm births (1 million), intra-partum conditions (0.7 million) and infections (0.6 million). Male babies possesses higher genetic risk while their female counterparts are at increased social risk of dying during this period. As far as the birth weight is concerned, small babies resulting from preterm or small-for-gestational age (SGA) babies contribute to 80% of the neonatal deaths, and amplifying the neonatal mortality rates besides putting them at risk of future neurological impairments or non-communicable diseases (NCDs). Lower-middle income countries from South Asia and Sub-Saharan Africa harbors majority of such instances as they have poor health care infrastructures for preventing such events. Still-births and neonatal deaths in South Asia had twice the occurrence than that in sub-Saharan Africa and the most common causes reported in these regions were perinatal asphyxia (40% & 34%), neonatal infections (35% & 37%), and preterm complications (19% & 24%) respectively.(16) Correcting these occurrences might reduce the estimated 116 million deaths, 100 million persons with disability that are projected incidences by the year 2035 besides faltering the upcoming pandemic of NCDs,(17)

International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018

Although the neonatal mortality rates (NMR) have declined from 52 to 28 per 1000 live births in India from 1990 to 2013, a whooping 0.75 million deaths occur every year with the babies in first 28 days of life having 30 fold increased than those aged 1-59 months. The disparity in socio-demographic characteristics plus educational and health care seeking behaviors have all led to slower decline of these rates. The million death study from India declared birth complications resulting from pre-term (43.7%) and infections (20.8%) to be the two major cause in our country.(18)

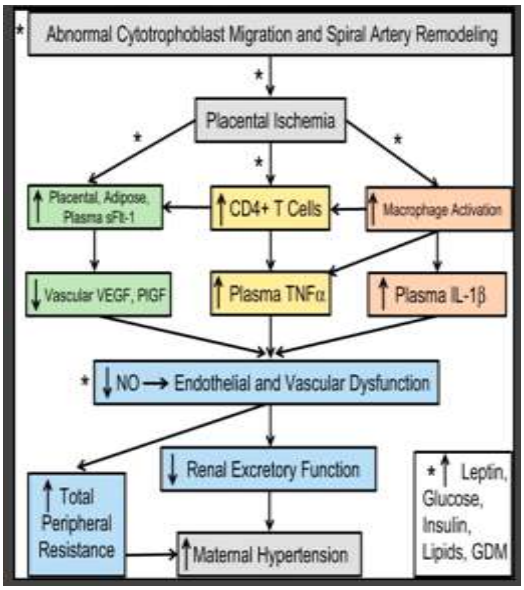
2.1.2. Pregnancy Induced Hypertension and its burden:-

Hypertensive disorders of pregnancy (HDP) comprises of, chronic hypertension , pregnancy-induced-hypertension (PIH) or gestational hypertension (GH), eclampsia or pre-eclampsia (PE) and chronic hypertension with super-imposed pre-eclampsia. The word eclampsia dates back to 17th century. It is derived from a Greek word that mean "to shine forth or flash of lightening" that relates to the visual phenomena accompanying this condition. The associated seizures were believed to be due to blood poisoning or toxins derived from pregnancy, thereby terming this condition as "toxemia of pregnancy". Alexander Hamiliton described Eclampsia as a condition associated with seizures in the year 1781. Bright (1827), recognized Eclampsia had a strong association with albuminuria. Later with the advancement of science, the emphasis was laid more on genetic, haematological, biochemical hormonal and immunological explanations. Studies suggest that Mendelian pattern of inheritance was seen in few pre-eclampsia patients while most have complex genetic mechanisms.(19)

PIH occurs in nearly 6% pregnancies which develop in later half of pregnancy and devoid of proteinuria or other systemic features. It advances to PE in about 15-45% patients which was also reported in first week postpartum. Any new onset hypertension diagnosed later than 20 weeks of gestation associated with proteinuria (1+ in urine dipstick test or ≥300 mg in 24 hour urine sample) is considered as Pre-eclampsia syndrome that affects 5-8% of all pregnancies. Hypertension with SBP above 140 mmHg and DBP above 90 mmHg diagnosed prior to pregnancy or before 20 weeks of gestation plus persistence of these values beyond three months postpartum without normalization could be 'Chronic hypertension" which complicates nearly 3% of the pregnancies. If these patients develop PE later on, then its termed "Chronic hypertension with super-imposed pre-eclampsia" that complicates about 25% of pregnancies.(20) All of these have accounted for nearly one-fifths of overall maternal deaths that translates to about 70,000 maternal deaths annually. Although the incidence of pre-eclampsia (2.16%), eclampsia (0.28%) and chronic hypertension (0.29%) seems lesser, they contributed significantly to larger denominations of maternal near-miss cases (8 times & 60 times), increased risk of fetal deaths [adjusted odds ratio or aOR=3.12 & 3.92], early neonatal deaths [aOR=2.71 & 6.58], perinatal deaths [aOR=3.02 & 4.91], preterm births [aOR=4.51 & 6.57] and NICU admissions [aOR=3.45 & 7.83] for pre-eclampsia and eclampsia patients respectively.(5)

2.2. PATHOPHYSIOLOGY OF PRE-ECLAMPSIA/ECLAMPSIA:

The incidence of GHT has tripled to 25% (2003) from the baseline 1988 worldwide although the research still continues to find the exact pathophysiology underlying this disease. However, it was proposed that the utero-placental perfusion defects caused by poor cytotrophoblast invasion into the spiral arterioles and the resultant placental ischemia would initiate the inflammatory cascade impairing the maternal endothelial function (Fig 1 & 2)(21)



International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018

2.3. DIAGNOSIS OF PRE-ECLAMPSIA/ECLAMPSIA:

The diagnosis of this disease is more complex as some mothers having underlying placental pathology are devoid of clinical features, while others may have endothelial dysfunction along with maternal pre-eclampsia but without placental dysfunction. The heterogeneity extends further in the variability of its presentation observed in early and late onset disease and that the fetal growth restriction is obvious in the former type than the latter.(11) The National High Blood Pressure Education Program (NHBPEP) working group report on High BP in pregnancy has classified BP during pregnancy as follows:

Normal	
Mild hypertension	SBP 140-159 or DBP 90-109 (in mmHg)
Severe hypertension	SBP ≥ 160 or DBP ≥ 110 (in mmHg)

The ACOG guidelines for diagnosing pre-eclampsia has been shown in the below figure.(22)

Hypertension (Measure BP 6 hours apart on 2 occasions)

SBP > 140 mmHg

DBP ≥90 mmHg

Proteinuria ≥ 300 mg in a 24 hour urine specimen

The definition of "Mild pre-eclampsi" includes:

- Proteinuria (identified by two or more occurrences of protein on dipstick or else >300 mg total protein in a 24-hour urine collection)
- Protein to Creatinine ratio of >30 mg/mmol

The definition of "Severe pre-eclampsia" includes:

- Maternal neurological disorders such as persistent headaches, phosphene signals, tinnitus, and brisk, diffuse, polykinetic tendon reflexes, eclampsia, acute pulmonary edema
- Oliguria <500 cc/day,
- Creatinine >120 μmol/L,
- HELLP syndrome, thrombocytopenia <100,000/mm^3, and
- Fetal criteria, especially intrauterine growth retardation, oligohydramnios, or fetal death in utero
- The definition of "Eclampsia" includes:
- Symptoms of pre-eclampsia plus
- Episode of convulsions or signs of altered consciousness

2.4. RISK FACTORS & CLINICAL FEATURES OF PRE-ECLAMPSIA/ECLAMPSIA:-

Dekker GA et. al., (1999) have reported that primi mothers are at increased risk of PE than multi and added that as the gap between pregnancies increase, the risk further exaggerates in such candidates.(23)

In a study by **Duckitt K et. al., (2005)** the risk factors unveiled were age above 40 years (Relative risk or RR=1.96), previous history of PE (RR=7.2), obese women getting pregnant (RR=2.5), pre-existing diabetes (RR=3.6), hypertension (RR=1.4), family history of PE (RR=2.9), anti-phospholipid antibody syndrome (RR=9.7) and those who have conceived by In-vitro fertilization (IVF) methods.(24)

In a genetic study by **Skjaerven R et. al., (2005),** the search for impact of maternal and paternal genes on causing pre-eclampsia was done. The results hypothesized that, daughters who got delivered by their pre-eclamptic mothers had twice the risk of developing pre-eclampsia as compared to their counterparts who were given birth by mothers of normal BP. Similarly, sons who were born after pre-eclampsia delivery when fathering had one and half times increased chances of getting their spouses to this disorder. It was also noted that, sisters of those affected, in spite of being delivered by mothers who were not diagnosed to have PIH, have had two times increased risk of developing this condition. Hence, it was concluded that either mother or father's genes had a trigger effect on development of this condition in their next generation.(25)

Stone JL et al., (1994) in their study have identified maternal obesity had 3.5 times increased risk of contributing to PE in the current pregnancy and a past history of PE had increased the odds of PE by seven times in the present pregnancy.(26)

Mendilcioglu I et al., (2004) have enrolled multi-gravida mothers and compared the incidence of pre-eclampsia in the present with their previous pregnancies. The results revealed that the women have had recurrent PE have succumbed to higher fetal loss (19%) than those who had prior

International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018

normotensive pregnancies (4.7%) and the adjusted OR was 5.8 with 95% confidence interval (CI) between 0.8 & 39.5 when recent onset was taken as the reference.(27)

Dempsey JC et al., (2003) have documented that women who were multiparous with history of abortion had 60% lower chances of developing PE and those without history of abortion had 71% decreased chances of developing PE when compared to the nulliparous women however further studies lacked in proving the mechanism.

Sibai BM et al., (1995) have performed a multicenter prospective study by enrolling 2947 healthy pregnant mothers and followed them up till the termination of pregnancy. The incidence of PE was reported to be 5.3% and the history of smoking, pre-pregnancy weight, systolic BP and previous abortions have had significant predictions of developing PE in the course of current pregnancy.(28)

The PRECOG study have made recommendations for screening of PE in a community and they highlighted that multiple pregnancy (2.9 times), nulliparity (2.9 times), multi-para (1.9 times), raised BMI at booking (1.6 times), inter-pregnancy gap of more than 10 years, those with pre-existing hypertension, diabetes, renal disease, antiphospholipid antibodies were significantly linked to this condition which made them to include these risk factors in the antenatal care screening plan. If these risk factors were identified,, the mothers would be referred to specialist before 20 weeks, serially assessed and the thresholds for stepping-up of the care would be applied to such patients.(17)

2.4.2.Clinical features

Clinical features and lab tests might give clue regarding the severity of pre-eclampsia and are discussed below.

Any episode of convulsions or signs of altered consciousness in a pre-eclampsia setting hints the progression to stage of eclampsia.

The essential clinical investigations include:

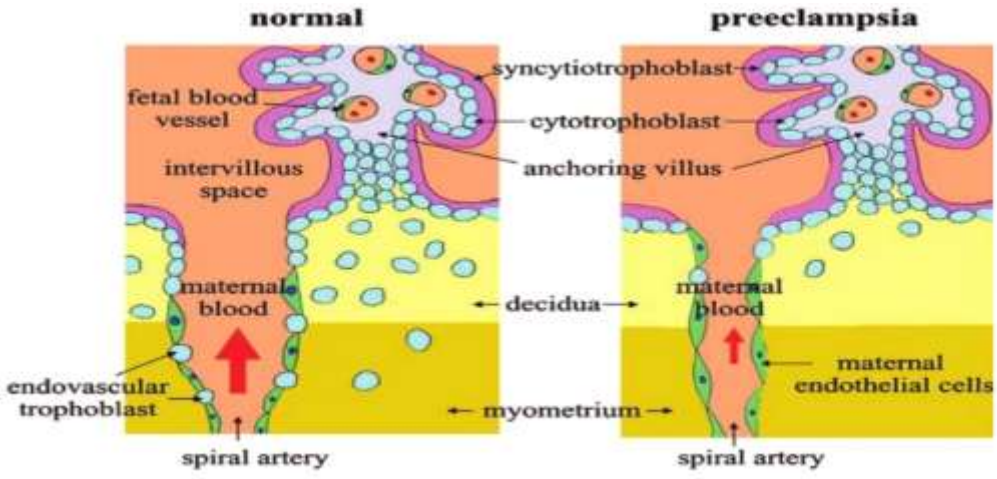
- BP measurement with appropriate cuff
- Weight gain screening
- Signs of edema (Cerebral edema & Pulmonary edema)
- Signs of cardiomyopathy
- Signs of acute renal failure
- Fetal assessment by electrocardio-tocography

The laboratory investigations are mandatory and includes the following:

Examination of umbilical, middle cerebral and uterine arteries with fetal Doppler Ultrasound, plus examination of placenta and fetal well being assessment by Manning score concludes the perinatal investigations.

2.6. EMBRYOLOGY IN PIH:-

Placental implantation and invasion by trophoblasts would result in transport of nutrients and and oxygen that are needed for organ development in the fetus. During placental remodeling, the intra-decidual portion of spiral arteries are invaded by the trophoblastic cells between eight and 12 weeks constituting the first stage. In the next stage, the trophoblastic invades deeper into the myometrial segments from 14 weeks. This converts the utero-placental circulation into low resistance and high capacitance one. The remodeling ends by around 18 weeks following which hypoxic injury and oxidative stress sets in the cases of preeclampsia.

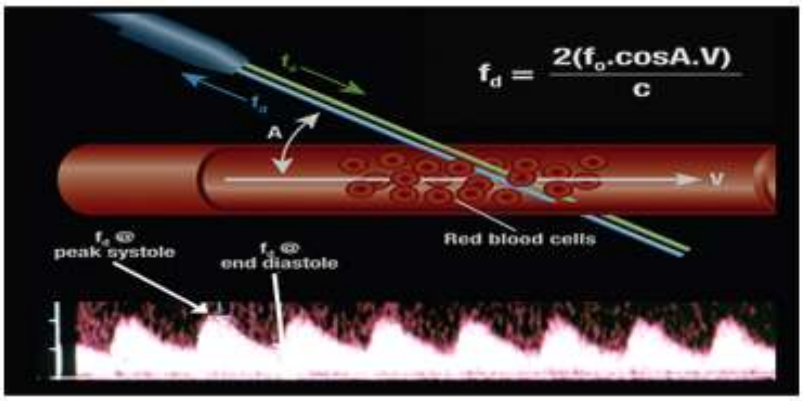


International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018

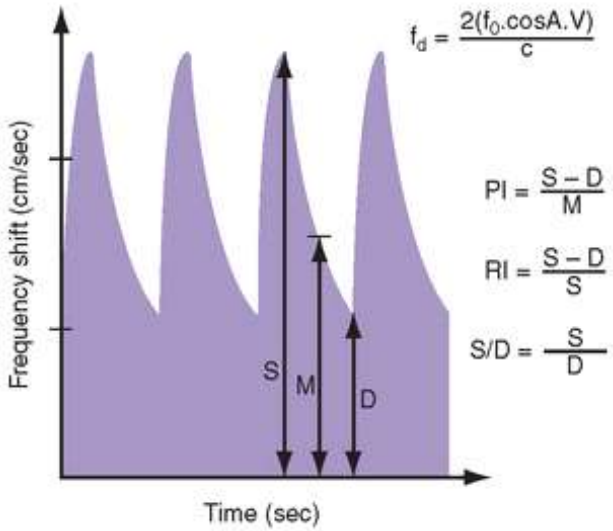
2.7. DOPPLER ULTRASOUND:-

2.7.1. Basic Principles:

When a blood vessel gets insonated by an ultrasound beam of certain frequency, the reflected or shift in frequency is considered to be directly proportional to the blood flow velocity and is displayed in a graphical form producing a time-dependent plot. The x-axis denotes temporal change relating to events of cardiac cycle and y-axis denotes shift in frequency. Hence during systole, the frequency shift would be high and low during diastole. Further, the impedance produced by the downstream vascular bed would also be inversely proportional to the flow velocity and frequency shift.(30)



The angle at which the sound beam intersects the target blood vessel alters the frequency shift and that, when the angle of incidence is 0 degrees (cosine Θ), the velocity measured would be equivalent to the true velocity. Therefore, its ideal to measure the velocity with minimum angle as possible. In order to quantify these waveforms, the Doppler indices that rely on certain frequency shift ratios were developed that are independent of consequences of the insonating angle.



The Doppler indices for arterial flow are shown below:

International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018

$$\text{S/D Ratio} = \frac{\text{Systolic peak velocity}}{\textit{End diastolic velocity}}$$

$$\text{Pulsatility Index} = \frac{\text{Systolic peak velocity} - \text{end diastolic velocity}}{\textit{Mean frequency shift}}$$

$$\text{Resistance Index} = \frac{\text{Systolic} - \text{end Diastolic velocity}}{\text{systolic peak velocity}}$$

The Doppler indices for venous flow are shown below:

$$\text{Preload Index} = \frac{\text{Peak velocity during atrial contraction}}{\text{Systolic peak velocity}}$$

$$\text{Pulsatility Index Veins (PIV)} = \frac{\text{Systolic} - \text{Diastolic peak velocity}}{\text{Time averaged maximum velocity}}$$

$$\text{Percentage reverse flow} = \frac{\text{Systolic time averaged velocity x 100}}{\textit{Diastolic time averaged velocity}}$$

The transabdominal technique for performing uterine artery ultrasound is demonstrated below:

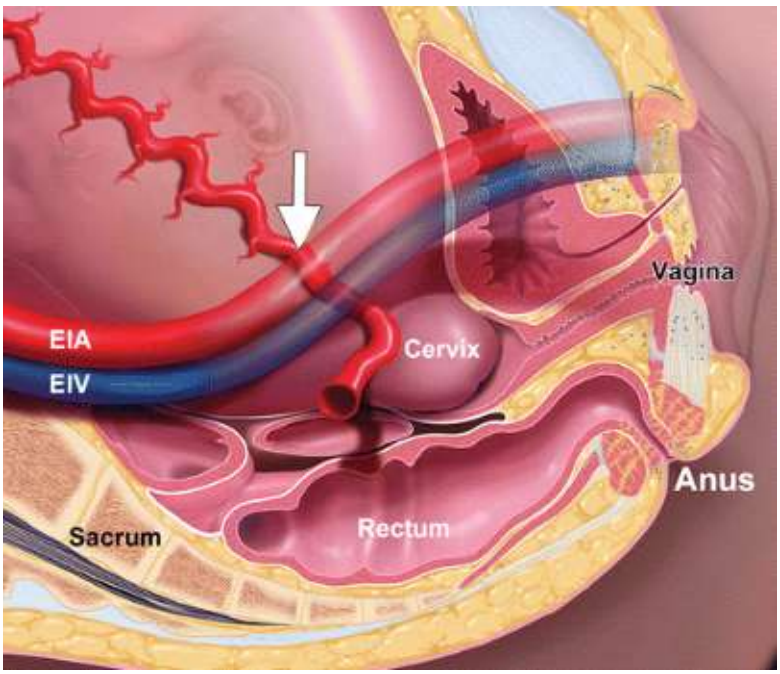
- A 5 or 3.5-MHz curvilinear transabdominal transducer is used.
- A midsagittal section of the uterus and cervical canal is obtained and the transducer is moved laterally until the paracervical vessels are visualized.
- Color flow Doppler is applied. The uterine arteries are seen as aliasing vessels along the side of the cervix.
- Using pulsed wave Doppler, flow velocity waveforms from the ascending branch of the uterine artery at the point closest to the internal os are obtained, with the Doppler sampling gate set at 2 mm.
- Care is taken to use the smallest angle of insonation (<30°) in order to achieve the highest systolic and end-diastolic velocities.
- When three similar consecutive waveforms are obtained, the PI can be measured. The mean PI is calculated as the average reading from each side combined.

International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018

Another site for Doppler insonation of the uterine artery is at the level of its apparent crossover with the external iliac artery.

- Using this method, the probe is positioned approximately 2-3 cm inside the iliac crests and then directed toward the pelvis and the lateral side of the uterus.
- Color flow Doppler is used to identify each uterine artery. Pulsed wave Doppler is applied approximately 1 cm above the point at which the uterine artery crosses over the external iliac artery. This ensures that Doppler velocities are obtained from the main uterine artery trunk

During mid-trimester, it is preferred to take PI values from ascending branch at internal os level in the uterine artery Doppler as it would be harder to locate the cross-over point of external iliac artery (Fig)



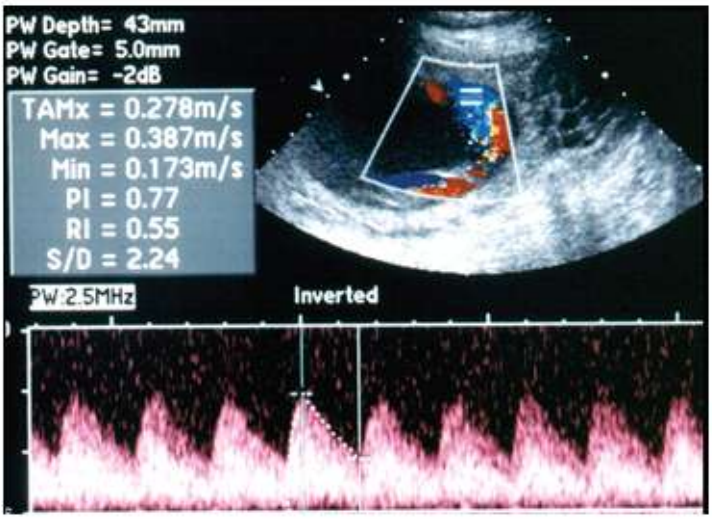
According to Plasencia et al., the mean uterine artery PI was showing lower values when measured by transabdominal ultrasound than by transvaginal and recommended appropriate charts while measuring these waveforms. The transvaginal technique has been described below:

International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018

- A 4.6–8 MHz transvaginal transducer is placed in the anterior vaginal fornix and a sagittal section of the cervix is obtained.
- The vaginal probe is then moved laterally until the paracervical vascular plexus is seen.
- Color flow Doppler is applied and the uterine artery is identified at the level of the cervicocorporeal junction.
- Measurements are taken at this point before the uterine artery branches into the arcuate arteries.

2.7.2. Umbilical artery Doppler:

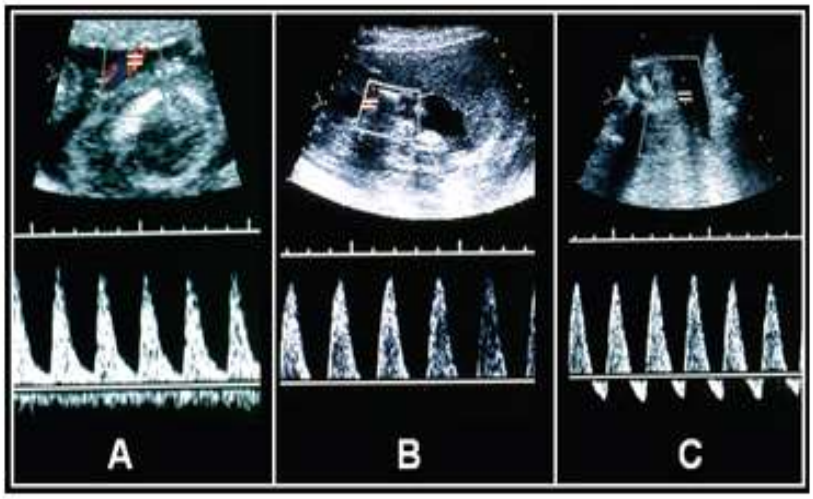
This arterial system has low impedance and the end-diastolic flow increases with advancing gestational age. Usually the tertiary stem-villi amplifies in number as the placenta matures and hence the Doppler waveforms may show increased end-diastolic flow pattern.



In the below figure Doppler waveforms of the umbilical artery in a normal fetus (third trimester of pregnancy) shows the increased end-diastolic velocity, consistent with a low impedance circulation.

In case of pre-eclampsia, when the disease obliterates the small muscular arteries of tertiary villi the end-diastolic flow gets decreased, that later disappears (absent) and reverses as the disease progresses.(Fig) The reversal of flow indicates nearly 70% placental compromise, the effect of which would be reduced liquor index (oligohydramnios) and fetal growth restriction (IUGR).

International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018

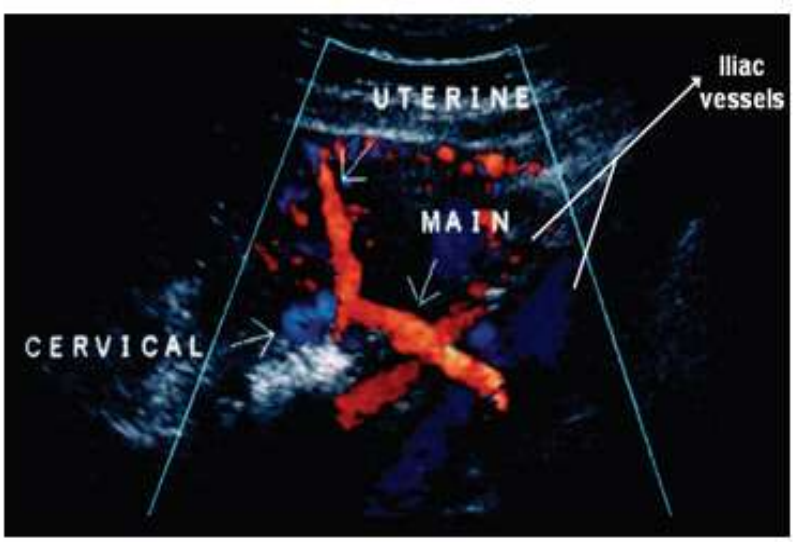


Although the Doppler waveforms of umbilical arteries when measured from placental end and abdominal end cord vary, only minor difference was noted and considered not significant.

2.7.3. Uterine artery Doppler:

As the trophoblastic invasion happens in maternal spiral arterioles, they remain dilated maximally due to their sluggish response to sympathetic and para-sympathetic stimuli thereby ensuring sustained increase in blood flow to uterus.

The uterine artery could be identified by color Doppler when it crosses hypogastric vessels before reaching utero-cervical junction. An abnormal uterine circulation is indicated by notching and increased impedance index after 20-22 weeks of gestation.

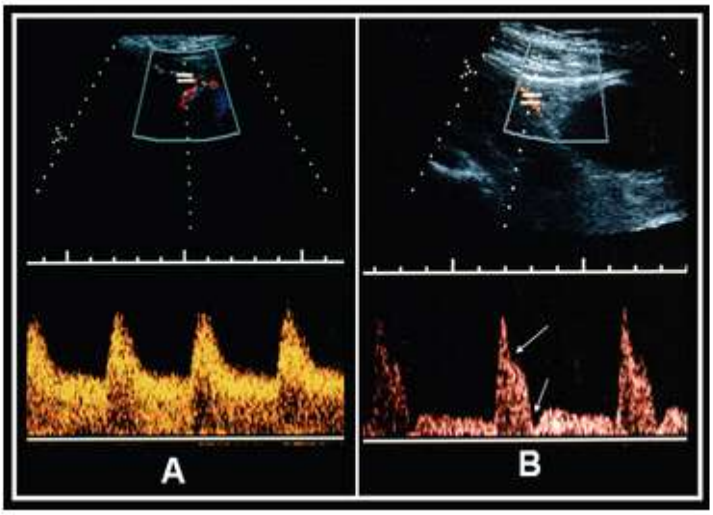


The above figure shows color Doppler imaging of lower uterine segment (lower part) where the main uterine artery crosses the hypogastric or iliac vessels before giving uterine and cervical branches.

Due to the trophoblastic invasion and fall in uterine vessel's impedance, the pulsatility index and resistance index tend to decline with increasing gestational age and Gomez et al., in their study have proven the fall of average uterine artery PI in later half of pregnancy till 34 weeks.

The figure below demonstrates Doppler waveforms (uterine artery) obtained in the late second trimester of pregnancy showing a normal uterine circulation (A), with increased end-diastolic velocity implying a low impedance circulation and an abnormal uterine artery circulation (B), with a

waveform notch and low end-diastolic velocity (high impedance).



Diastolic notching which is marked by fall of 50cm/s the maximum diastolic velocity has been noticed after 20 weeks which then declines till 25 weeks and remain stable later on. If the notching happens early, indicates reduced elasticity resulting in lowered diastolic velocities. Furthermore, persistence of notching in early diastole reflects vascular tone abnormality rather than raised impedance in uterine artery, supported by studies that show 97% negative predictive value and lower positive predictive values. This has led to exclusion of uterine artery notching and preference towards PI.

2.8. RELEVANT ARTICLES:

Trudinger BJ et al., (1985) have studied the role of diastolic flow velocity of uterine artery from 20 weeks of gestation till delivery. The diastolic flow velocity was constantly representing the downstream vascular bed perfusion or resistance which declined with increasing gestational age. He observed that 25 out of 91 (27.5%) complicated pregnancies have resulted in fetal morbidities where the infants were found to be small for gestational age (SGA). They also added that, those who had normal waveforms of uterine artery and given birth to 10 SGA babies could have inherent fetal cause associated with these patients.(31)

A prospective study was performed by **Mor S et al., (2015)** where patients with pregnant mothers were followed up for a one year period and perinatal outcomes like prematurity, neonatal deaths and NICU admissions were analysed.(32) They reported primigravida mothers, younger maternal age (21-25 years), low socio-economic status, illiteracy and inadequate antenatal care to be the high risk factors associated with the development of preeclampsia and eclampsia. They observed maternal complications in 38% cases, SGA in 14% cases and preterm babies in 48% cases and the recovery rate of NICU admissions to be 71.4%.

Lopez-Mendez MA et. al., (2013) have evaluated the hemodynamic changes in 65 pre-eclampsia patients and compared the uterine artery, umbilical artery and middle cerebral artery waveforms with that of 37 normotensive women between 24 to 37 weeks period of gestation. Toshiba Ultrasound Power Vision 6000 SSA-370A, with a 3.5 MHz convex transducer was trans-abdominally used here. Abnormal DUS findings were significantly more in the PE group and they have thrice the odds of showing such values [OR=2.93,95% CI=1.2 - 7.3,p-value = 0.02] in addition to having increased specificity (89.2%) and positive predictive value (88.6%). They have identified significant differences in Doppler indices like notching, RI and PI of umbilical artery and in only PI of middle cerebral artery between the two groups.(33)

Khong SL et. al., (2015) have revealed the importance of DUS in first trimester in ascertaining future preeclampsia or IUGR. The first trimester DUS were better in predicting early or late onset of preeclampsia. In low risk pregnant women it had a moderate sensitivity (40-70%) in prediction of PE or IUGR. They concluded that,

addition of biochemical markers, plus maternal risk factors to this first trimester DUS might increase the validity of early screening among antenatal mothers. (12)

In a meta-analysis by **Cnossen JS et. al., (2008)** the predictive accuracy of first and second trimester DUS in diagnosing future PE or IUGR was investigated. They postulated that second trimester uterine artery DUS have given more accurate prediction than that done in the first trimester. Further the pulsatility index and notching were the best in predicting PE with positive likelihood ratio (LR+) of 21 and 7.5 among high and low risk patients respectively. Similarly, their prediction of overall (LR+ = 9.1) and severe IUGR (LR+ = 14.6) was highly appreciated.(13)

In a study performed by **Myatt L et al., (2013)** a cohort of 2188 nulliparous women less than 21 weeks of gestation were enrolled and studied for the role of Doppler indices in predicting preeclampsia or fetal growth restriction. The incidence of preeclampsia was 7.5% and they noted that notching(N), RI, PI, PI or RI multiples of median (MoM) were strongly associated with development of preeclampsia. Their overall sensitivity and specificity was 43% and 67% respectively in predicting preeclampsia. They have also added that presence of N,RI,PI MoM had increased odds (OR=6.9) of predicting early onset preeclampsia than late onset or no preeclampsia and the presence of N or RI MoM had increased odds (OR=2.2) of predicting severe preeclampsia than mild or no preeclampsia.(34)

A prospective study was conducted by **Aharwal S et. al., (2016)** to describe the role of DUS in perinatal outcome that included 41 antenatal mothers. In this study 73.1% were between 20-29 years age group, 63.5% had abnormal Doppler indices of uterine artery, 60.9% had abnormal middle cerebral artery findings and 34.1% had abnormal umbilical artery indices. Reversal of waveforms were identified in 14.6% of cases and the perinatal mortality was 12.2%. They suggested the inclusion of uterine and umbilical artery waveforms in screening for gestational hypertension in order to restrict the perinatal morbidities and mortalities. (35)

In a multicenter study conducted by **Habli M et al., (2007)** (36)about 4293nulliparous mothers were recruited who were followed up and compared for neonatal outcomes between those with preeclampsia and others who were normotensive. The outcomes included were neonatal intensive care (NICU) admissions, duration of hospitalization and complications in neonates. They observed significantly higher rates of SGA babies born to hypertensive mothers than normotensive mothers who delivered at 35 (17.9% vs 1.7%) and 36 weeks (33.3% vs 10.7%). The hypertensive mothers who delivered at 37 weeks of gestation had more NICU admission rates (25.6%) than that of normotensive mothers (8.7%). The duration of stay was also prolonged for the babies born to preeclampsia mothers (3.9 days) than their counterparts (2.0 days).

McKenzie KA et al., (2018) have performed a retrospective study in West Indies and compared the babies born to preeclampsia mothers (GA= 35.3±3.7 weeks) and mothers with normal BP (GA= 38.6±1.4 weeks). The neonates of hypertensive mothers had increased odds of falling into low birth weight category (OR=2.8,95%CI=2-3), being SGA babies (OR=2.3,95%CI=1.9-2.9), delivered prematurely (OR=2.5,95%CI=2-3). The five minute APGAR score was significantly lower among these neonates born to hypertensive mothers than to normal mothers. The NICU admissions were also high (59%) in these babies born to preeclampsia mothers than their opponents (13%). 18 out of 114 neonates (15.8%) born to diseased mothers died during the course of admission. (37)

The association between PIH and adverse perinatal outcomes were determined by **Berhe AK et al, (2019)** (38) by enrolling 782 pregnant women in Ethiopia. All of them belonged to 28 to 35 weeks of gestation. The incidence of adverse perinatal outcome were higher in mothers with PIH (66.4%) than normotensive mothers (22.2%). The PIH mothers also delivered significantly higher number of LBW babies (RR=5.1,95%CI=3.4-7.8), SGA babies (RR=3.3,95%CI=2.3-4.6), preterm deliveries (RR=5.2,95%CI=3.4-7.9), NICU admissions (RR=5.1,95%CI=3.1-8.4), birth asphyxia (RR=2.6,95%CI=1.9-3.8) and perinatal deaths (RR=3.6,95%CI=1.8-7.4) when compared to their counterparts.

Saadat M et al., (2007) compared the maternal and fetal outcomes of preeclampsia mothers with the control group.(39) The mothers who were normotensive had higher parity (3.6± 0.7) than preeclampsia mothers (2.3± 0.6). In hypertensive mothers, the Cesarean section rates were high and in those who were delivered vaginally, 31% were inducted that were significantly high when compared to controls. The preeclampsia mothers delivered more LBW babies and constituted 5.6% of neonatal deaths

In a cross-sectional study by **Bonsaffoh KA et al., (2017)** the feto-maternal characteristics and outcome of hypertensive mothers were described. The average gestational age was 37.4 ± 3.3 weeks at delivery and 21.7% babies were preterm. The NICU admission rates was 24.7%, neonates with respiratory distress were 15.2% and about 4% required mechanical ventilation. LBW and IUGR was noted in 24.7% and 6.1% babies respectively. Stillbirths and early neonatal deaths occurred in 6.8% and 3.8% of the subjects respectively. The perinatal mortality rate was found to be 106/1000 live births. Low APGAR score (<7) at first and fifth minute was rated in 34% and 14.7% neonates respectively. They also added that, these complications were higher in preeclampsia mothers than those who had other forms of hypertensive diseases.(40)

In a hospital based study, secondary data was collected by **Aseffa NA et al., (2019)** that identified 2.3% cases as having HDP among the total 7347 deliveries that occurred between time span of two years. The perinatal mortality rate was 111.1/1000 live births and the factors predisposing were maternal complications, fetal LBW, reduced ANC utilization, raised DBP in mothers, preeclampsia/eclampsia and those who were referred from other centres.(41)

The ratio of PI of umbilical artery to middle cerebral artery was computed in fetuses that had absent end-diastolic blood flow at less than 34 weeks and was compared with the perinatal outcome by **Vergani P et al., (2005**). The PI ratio as well as estimated fetal weight evolved to be significant predictors of adverse neonatal outcomes and that the ratio of 1.9 or above was found to have a 75% sensitivity and 13% false positivity rate in predicting adverse outcomes.(42)

In a retrospective study by **Yildirim J et al., (2008)** the IUGR babies with positive deflection in end diastolic flow was compared with those with absent or reversed waveforms. The former group were associated with higher incidence of perinatal mortality (OR=1.09,95%CI=1.0-3.5) and morbidity (OR=2.0,95%CI=1.2-3.2) than the latter. Further, the NICU admissions were also higher in the first group though there were no difference in duration of NICU stay between the groups.(43)

Based on the umbilical artery Doppler, one group with absent or reversed end diastolic velocity was compared with normal end diastolic velocity in a study by **Jang DG et al., (2008)** for IUGR. The gestational age, fetal birth weight and platelet count were significantly lower in the former group while the fetal heart rate irregularity, serum SGOT levels were higher in them than the other group. They observed increased perinatal deaths and majority of mothers with preeclampsia in the former group than the latter and this difference was statistically significant.(44)

Mirza F et al., (2012) have studied the linear relationship between abnormal umbilical artery Doppler, IUGR and incidence of preeclampsia by enrolling 268 ANC cases. A total of 57 (21.3%) cases were having abnormal Doppler indices, out of which 14% developed preeclampsia during follow up and this proportion was significantly higher when compared against 4.3% of those with normal Doppler having developed this disease condition. They highlighted that abnormal Doppler mothers with abnormal Doppler had 2.9 times increased chances of developing preeclampsia than their counterpart and this was their age and parity was adjusted. (45)

AIMS AND OBJECTIVES

AIM-

To study the effect of doppler studies in known case of gestational hypertension and preeclampsia and its perinatal outcome.

Primary objective-

1. To study the variation in the uterine and umbilical artery blood flow pattern in Gestational Hypertension and preeclampsia.
2. To correlate the Doppler study with fetal outcome and critical analysis of the association of abnormal Doppler velocimetry in perinatal outcome.

Secondary objective

1. To evaluate the efficacy of Doppler velocimetry in early diagnosis of fetal hypoxia and to decide about the mode of termination in gestational hypertension and preeclampsia.

III. MATERIAL AND METHODS:-

The present study entitled "Role of Doppler studies in Gestational hypertension and its perinatal outcome " was undertaken to determine the usefulness of umbilical and uterine artery Doppler in predicting the outcome especially during the perinatal period.

My 3.1. STUDY DESIGN:

"Hospital based prospective observational study"

International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018

3.2. STUDY SETTINGS:

The study was conducted in Department of Obstetrics and Gynaecology, Narayana Hrudayalaya, Mazumdar Shaw Medical Centre, Bangalore.

Bangalore is the capital city of Karnataka, India and is located at 12.97°E, 77.60°N & 949 metres above the sea level. It is a cultural meeting point of Kannada, Telugu and Tamil speaking people of Southern India. Bengaluru has pleasant summers (about 34 °C) and mild winters (about 16 °C). The city receives its water from the River Kaveri, which is about 70 km to the south.

3.3. STUDY PERIOD:

The study period was 1year. Three months of the study period was expended for review of literature, development of interview schedule and pilot testing, six months for data collection and remaining three months for data compilation, analysis and thesis writing.

3.4. STUDY UNIVERSE:

The study universe consists of "mothers diagnosed with pregnancy induced hypertension" and National High Blood Pressure Education Program (NHBPEP) working group report on High BP in pregnancy has classified BP during pregnancy as follows:

Normal	
Mild hypertension	SBP 140-159 or DBP 90-109 (in mmHg)
Severe hypertension	SBP $\geq$ 160 or DBP $\geq$ 110 (in mmHg)

3.5. STUDY POPULATION:

Mothers diagnosed with preeclampsia who seek outpatient care in the Department of Obstetrics and Gynaecology, Narayana Hrudayalaya, Mazumdar Shaw Medical Centre, Bangalore during the study period of 12 months. Patients were selected according to inclusion and exclusion criteria.

3.6. INCLUSION CRITERIA:

- Gestational hypertensives (ie) onset of BP > 140/90
- Gestational age is from 32 weeks to till delivery .
- Mild and severe preeclampsia with or without proteinuria.

3.7. EXCLUSION CRITERIA:

- Women with twin pregnancy or chromosomal abnormalities, idiopathic IUGR/ Gestational diabetes, and presence of reverse waveform were excluded from the study.
- Chronic hypertension complicating pregnancy,chronic renal disease complicating pregnancy, SLE complicating pregnancy were excluded.
- Those patients in whom regular follow up to term and delivery was not possible were excluded from the study.

3.8. SAMPLE SIZE CALCULATION:

Sample size was calculated the following formula:-

$$n = z^2 \frac{p \times (1-p)}{d^2}$$

where,

n = sample size

p = prevalence of abnormal umbilical artery waveforms **79.0%** (46)

q = (100-p)% = (100-79.0)% = 21.0%

d = allowable margin of error = 11.85%

z = value of 95% confidence interval = 1.96

On applying these values to above formula,

n= 45.4

Assuming 10% of non-participation,

n= 45.4 + 10%(45.4) = 50

We would take a total of **50** antenatal mothers diagnosed with preeclampsia in this study.

3.9. STUDY VARIABLES:

- Information on socio-demographic details will be obtained.
- Risk factors & co-morbid conditions contributory to fall will be identified,
- Detailed history and examination will be recorded in the Performa.
- Routine blood investigations will be performed.
- Ultrasound Doppler of uterine and umbilical artery will be performed.
- Fetal outcomes like APGAR score, birth weight, NICU admissions, duration of hospital stay will be measured

International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018

3.10. TOOLS FOR DATA COLLECTION:

- Semi-structured questionnaire
- Ultrasound machine : Phillips Affiniti 70
- Baby weighing scale

3.11. ETHICAL CONSIDERATION:

Owing to ethical consideration, permission was obtained from the Institutional Ethical Committee. All pregnancies with hypertension will be subjected to Doppler studies from 32 weeks for better perinatal outcome. We will be inviting participants to take part in study. The participation is voluntary and we will also provide written informed consent. During this process, patients are provided with an informed consent form and are encouraged to present any question related to study. Confidentiality of participants will be maintained.

3.12. DATA COLLECTION PROCEDURE:

Among the pregnant mothers attending antenatal OPD, high risk patients were screened for gestational hypertension and preeclampsia. 50 pregnant patients with Gestational hypertension and preeclampsia were selected and admitted for management at Mazumdar Shaw Medical Centre, Narayana Health City. They were selected for the Doppler study. All the patients recruited for the study had systolic blood pressure of > 140 mmHg and diastolic blood pressure of > 90 mmHg. The gestational age during the study was 32weeks to til delivery.

3.13. DATA PROCESSING AND ANALYSIS:

Statistical analysis was performed using the Statistical Package for Social Sciences, version 22.0 (SPSS, Chicago, USA). Normality of the continuous data was checked using the K.S test. The continuous variables were described as mean ± standard deviation. The categorical variables were presented in terms of their frequencies and proportions. For comparison of means between the groups, independent t-test was used. In order to test the association between attributes, Pearson's chi-square test/Fisher's exact test were used. A p-value of less than 0.05 has been considered as significant. Microsoft Excel 2007 and Epi info 7 were also used for making graphs and charts.

IV. OBSERVATION AND RESULTS:-

This prospective observational study was conducted by enrolling and following up of 50 antenatal mothers who were diagnosed with preeclampsia in the Department of Obstetrics and Gynaecology , Narayana Hrudayalaya, Mazumdar Shaw Medical Centre, Bangalore, who have been further evaluated and managed appropriately.

(i) Socio-Demographic Characteristics & Obstetric Score:-

The table 1 shows the age distribution of the participants which ranged from 23 to 41 years. They averaged 31.2 ± 4.3 years and nearly half fell in the age range of 28 to 34 years.

Table 1. Age distribution of the study population (n=50)

Minimum	Maximum	Mean	SD	Median	IQR
23	41	31.2	4.3	30.0	28, 34

Table 2 (and fig) shows the distribution of subjects in each age category. More than half (52.0%) of the mothers developed the disease before reaching 30 years of age. This was followed by 30-35 years age group (32.0%) and least was the contribution by those aged above 35 years (16%).

Table 2. Age categorization of the cases (n=50)

Age categories (Years)	Frequency (No)	Percentage(%)
≤ 25	2	4.0
25 to 30	24	48.0
30 to 35	16	32.0
> 35	8	16.0

International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018

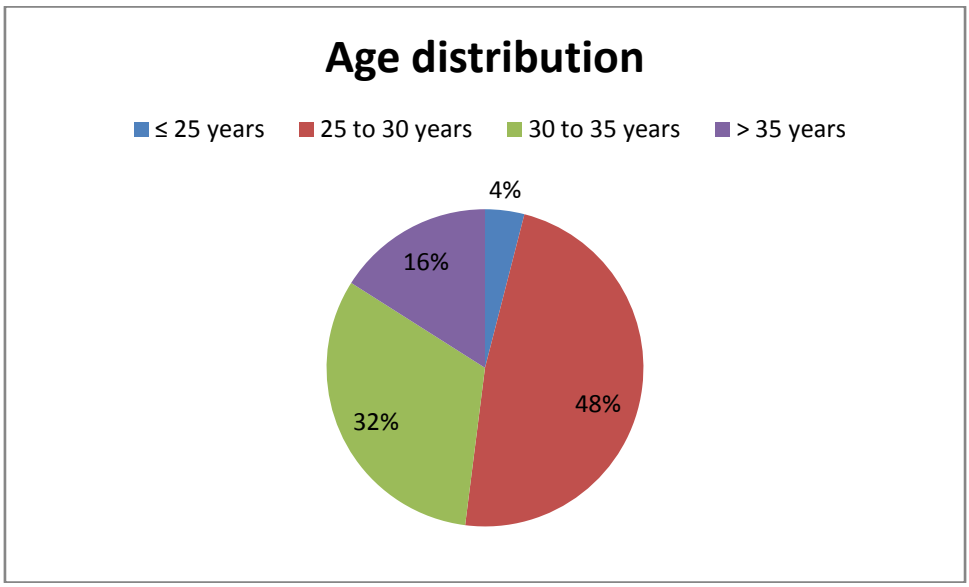


Table 3. Place of residence

	Frequency	Percentage
Urban	27	54.0
Rural	23	46.0

Table 4(and fig) portrays the gestational age distribution of the participants which ranged from 32 to 39 weeks. They averaged 36.7 ± 2.1 weeks and nearly 50% of them were between 35.9 and 37.9 weeks of gestation.

Table 4. Gestational age distribution

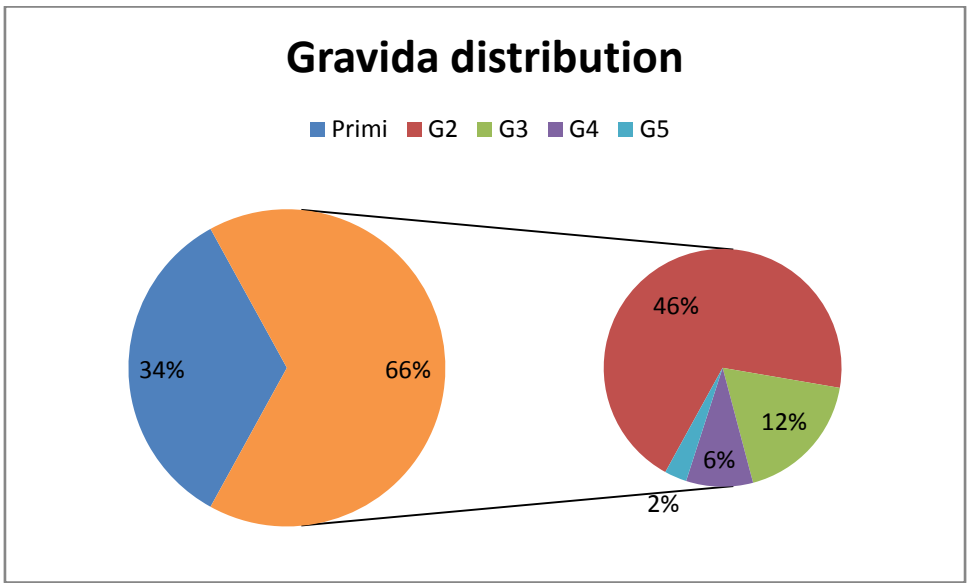
Minimum	Maximum	Mean	SD	Median	IQR
32	39	36.7	2.1	37.1	35.9, 37.9

Table 4(and fig) shows the distribution of the subjects according to their place of residence. It was evident that preeclampsia affects almost equally the mothers of urban and rural areas with a slightly higher participation from urban mothers (54%) than their counterparts (46%).

In table 5(and fig), the gravida score of the enrolled mothers has been shown. Nearly one-third of the cases were primi mothers (34.0%) and the rest were multi-gravid mothers. Of the multigravida mothers, maximum (46%) belonged to the second gravida and higher gravida (G>3) were only 8%.

Table 5.Distribution based on Gravida (n=50)

	Frequency	Percentage
Primi	17	34.0
Multi	37	66.0
G2	23	46.0
G3	6	12.0
G4	3	6.0
G5	1	2.0



The parity distribution (n=26) is shown in table 6(and fig). Primipara were the majority (92.4%) and mothers with P2 or P3 were only less than 10%.

Table6. Distribution of Parity (n=26)

	Frequency	Percentage
P1	24	92.4
P2	1	3.8
P3	1	3.8

The distribution showing live births to mothers (n=24) were depicted in table 7(and fig). Mothers with one live child birth (95.8%) were the majority and those having higher child births were only less than five percent.

Table 7. Distribution of Previous - Live births (n=24)

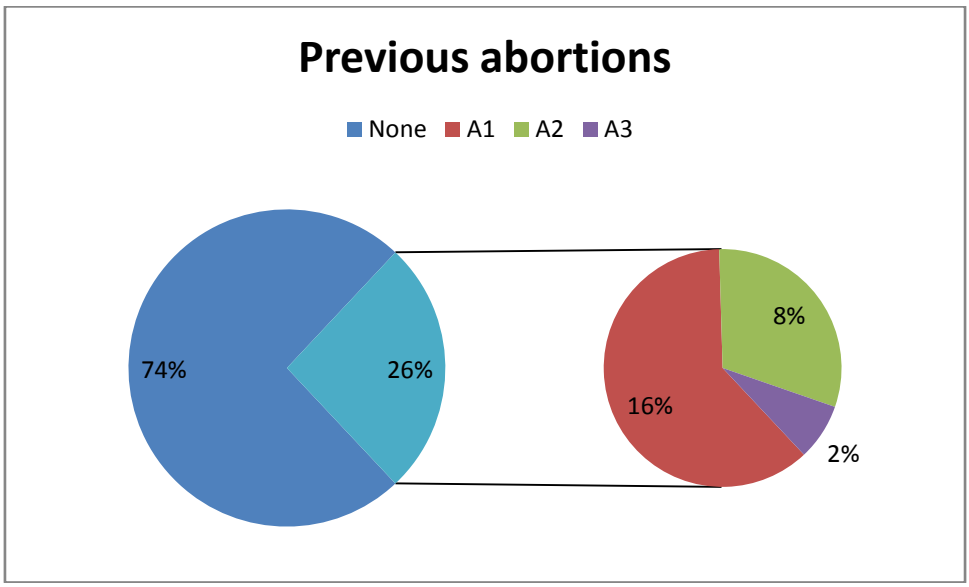
Live births	Frequency	Percentage
L1	23	95.8
L2	1	4.2

Table 8(and fig) shows the history of abortion for the subjects. It was obvious that those without previous history of abortions were more predominant (74.0%) when compared to their counterparts (26.0%).

International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018

Table8. Distribution of Previous - Abortions (n= 50)

Abortions	Frequency	Percentage
None	37	74.0
Present	13	26.0
A1	8	16.0
A2	4	8.0
A3	1	2.0



(ii) CO-MORBIDITIES, RISK FACTORS & CLINICAL FEATURES:-

Table 9 (and fig) demonstrates the distribution of co-morbidities and risk factors present in the mothers. The previous history of IUGR was seen the highest (34%) followed by history of hypothyroidism (22%) and previous LSCS (18%).

Table 9. Distribution of co-morbidities and other risks (n=50)

Co-morbidities/ Risk	Frequency	Percentage
IUGR	17	34.0
Hypothyroidism	11	22.0
Previous LSCS	9	18.0
Oligohydramnios	5	10.0
Rh negativity	3	6.0
PPROM	2	4.0
IUI	2	4.0
RHD	1	2.0
Breech	1	2.0
BOH	1	2.0
HELLP	1	2.0
COVID	1	2.0

International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018

Table 10. Proteinuria

	Frequency	Percentage
Absent	14	28.0
Trace	16	32.0
1+	16	32.0
2+	4	8.0

The presence of proteinuria is shown in table 10 (and fig). It was absent in 28% cases, trace in 32% cases, 1+ in 32% cases and 2+ in 8% cases.

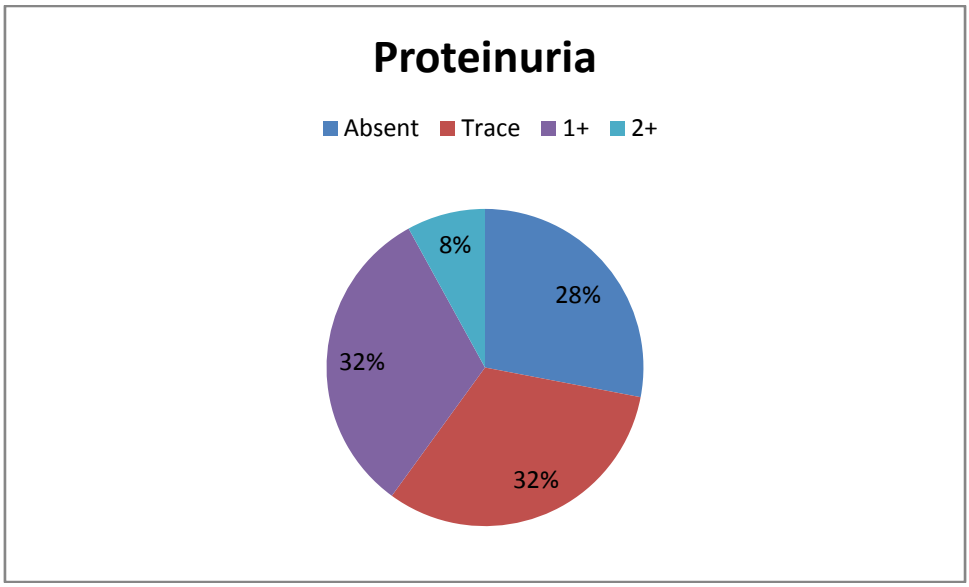


Table 11. Severity of PIH

	Frequency	Percentage
Mild	26	52.0
Severe	24	48.0

The distribution of severity of PIH was shown in table 11 (and fig). Mild and severe preeclampsia were present in 52% and 48% of the cases respectively.

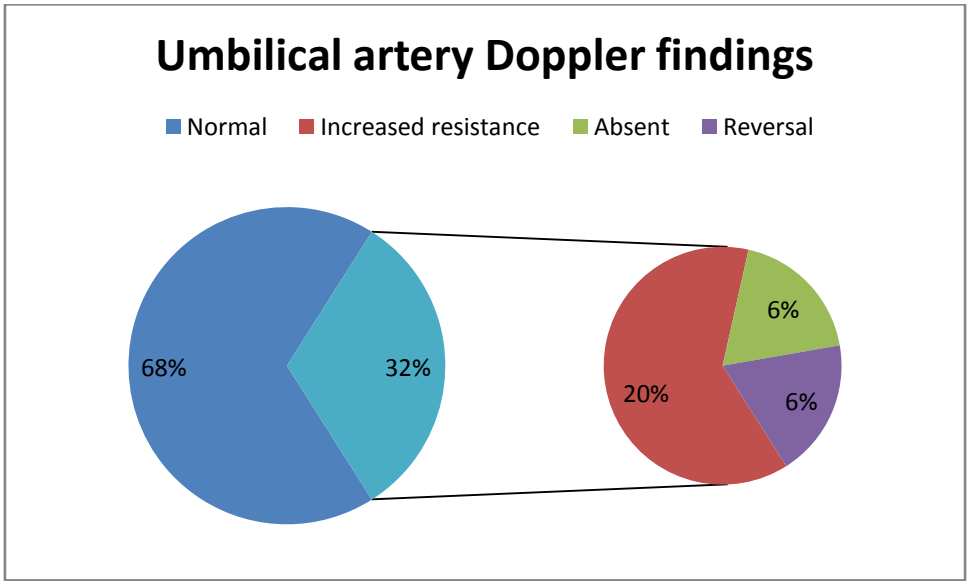
(iii) DOPPLER FINDINGS & OUTCOME:-

The Doppler findings of umbilical artery and uterine artery were described in the upcoming sections. The Doppler velocimetry findings were either normal or abnormal showing increased resistance, absent and reversal of flow. The umbilical artery Doppler showed (table 12 and fig) normality in 68% of cases and of the abnormal ones, increased resistance, absent flow and reversal of flow was seen in 20%, 6% and 6% of cases respectively.

International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018

Table 12. Doppler velocimetry findings of umbilical artery

	Frequency	Percentage
Normal	34	68.0
Abnormal	16	32.0
Increased resistance	10	20.0
Absent	3	6.0
Reversal	3	6.0



The uterine artery Doppler showed (table 13 and fig) normality in 60% of cases and of the abnormal ones, increased resistance and reversal of flow was seen in 38% and 2% of cases respectively and none (0%) had absent flow.

Table 13. Doppler velocimetry findings of uterine artery

	Frequency	Percentage
Normal	30	60.0
Abnormal	20	40.0
Increased resistance	19	38.0
Absent	0	0.0
Reversal	1	2.0

International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018

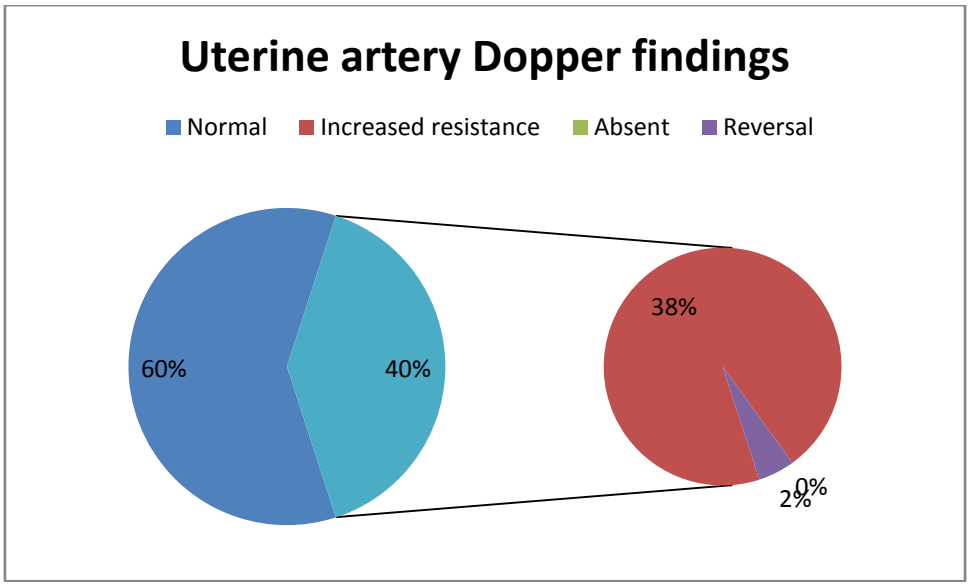


Table 14 (and fig) demonstrates the mode of delivery in the study population. Majority of the deliveries were Cesarean section (72%) and vaginal deliveries were only 38%

Table 14. Mode of delivery

	Frequency	Percentage
Vaginal	14	28.0
LSCS	36	72.0

Table 15. Preterm births

	Frequency	Percentage
Yes	25	50.0
No	25	50.0

The distribution of preterm births were shown in table 15 (and fig). The preterm and term births were equally distributed (50% each) among the study subjects.

Table 16. Low birth weight (<2.5 kg)

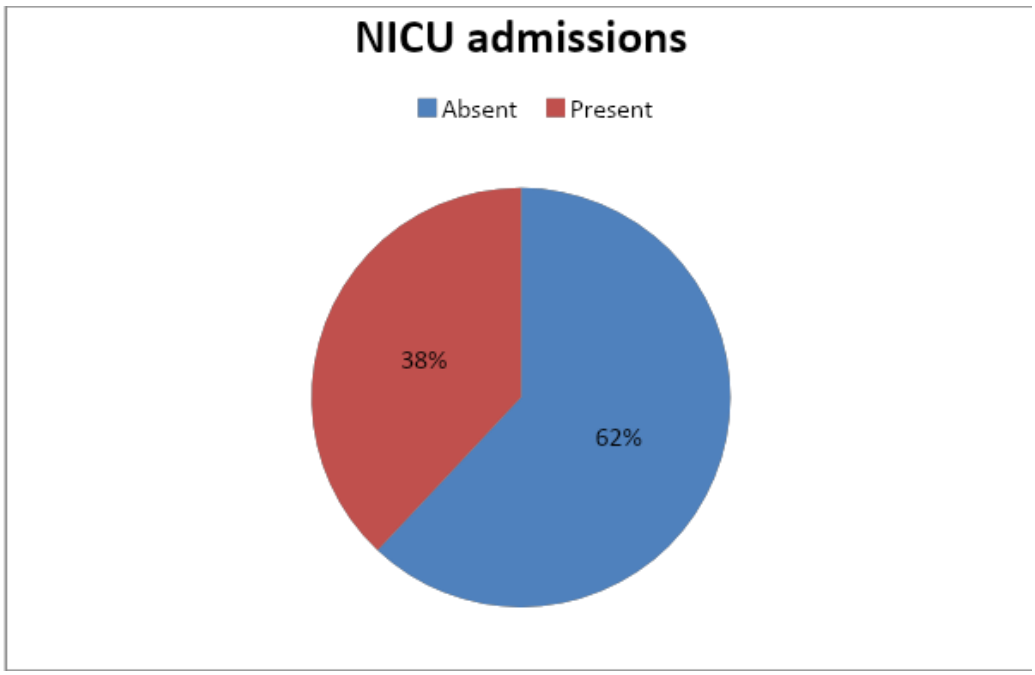
	Frequency	Percentage
Yes	25	50.0
No	25	50.0

International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018

The distribution of low birth weight babies (Birth weight <2.5 kg) were shown in table 16 (and fig). The babies weighing less than and above 2.5 kg were equally distributed (50% each) among the mothers.

Table 17. Fetal outcome

NICU admissions	Frequency	Percentage
Absent	31	62.0
Present	19	38.0



The adverse fetal outcome was described by their admissions in Neonatal Intensive Care Unit (NICU) and in this study nearly 38% of the babies required NICU admissions while the rest (62%) were discharged following normal post-natal care (table 17 and fig).

The table 18 shows the duration (in days) of hospitalization of neonates following delivery. It ranged from 2 to 36 days. It averaged 8.7 ± 8 days and about half of them stayed for a period of four to ten days.

Table 18. Days of hospitalization (n=19)

Minimum	Maximum	Mean	SD	Median	IQR
2.0	36.0	8.7	8.0	6.0	4, 10

The table 19 describes the neonatal mortality rate observed in this study group. One neonate died on 6th day of life and this translates to 2% whereas the recovery rate following NICU admissions were 97.4% (n=38).

International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018

Table 19. Mortality in neonates (n=50)

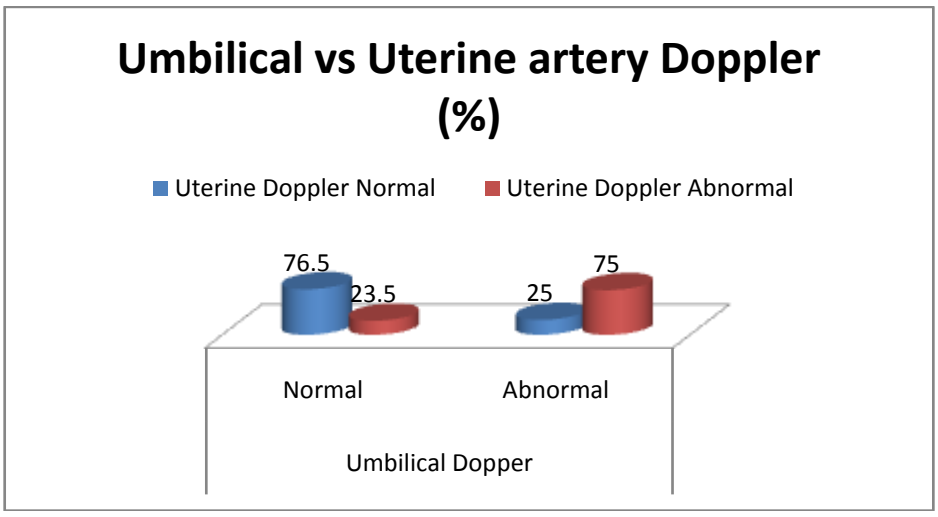
	Frequency	Percentage
Dead	1	2.0
Alive	49	98.0

(iii) VARIATION OF UTERINE & UMBILICAL ARTERY BLOOD FLOW PATTERN:-

Table 20 (and fig) shows the inter-relationship between uterine and umbilical artery Doppler findings. It was observed that those with normal and abnormal Doppler indices in both the vessels correlated in 76.5% and 75% of cases respectively. However, the about one-fourth of the observations diagnosed abnormal by umbilical Doppler fell in the normal range as observed with uterine Doppler. This difference was found to be statistically significant by Pearson's chi-square ($P<0.05$).

Table 20. Comparison of umbilical and uterine artery Doppler

Uterine Doppler	**Umbilical Doppler**				**χ^2**	**p-value**
	Normal (n=34)		**Abnormal (n=16)**			
	No	**%**	**No**	**%**		
Normal (n=30)	26	76.5	4	25.0	12.0	**0.001**
Abnormal (n=20)	8	23.5	12	75.0		
Pearson's chi-square test used; p-value <0.05 is significant;						



International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018

Table 21. Sub-group analysis of comparison between umbilical and uterine artery Doppler

Uterine Doppler	Umbilical Doppler				χ2	p-value
	Normal (n=34) N (%)	Increased Resistance (n=10), N (%)	Absent (n=3) N (%)	Reversal (n=3) N (%)		
Normal	26 (76.5)	4 (40.0)	0 (0.0)	0 (0.0)	19.6	**<0.001**
Increased Resistance	8 (23.5)	6 (60.0)	3 (100.0)	2 (66.7)		
Reversal	0 (0.0)	0 (0.0)	0 (0.0)	1 (33.3)		
Fisher's exact test used; p-value <0.05 is significant;						

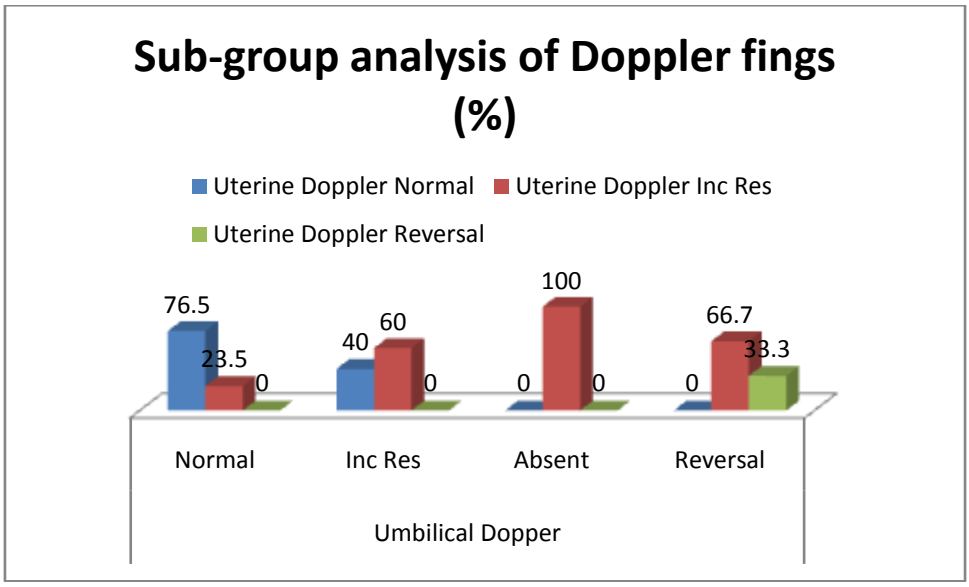


Table 21 (and fig) describes the sub-group analysis of the above findings. The mismatch was found in diagnosing increased resistance that popped up in umbilical Doppler among four cases that were showing normal waveforms in uterine Doppler. Similarly, when the umbilical artery showed normal waveforms, in eight cases increased resistance was spotted in uterine artery Doppler. This difference was found to be statistically significant by Fisher's exact chi-square (P<0.05).

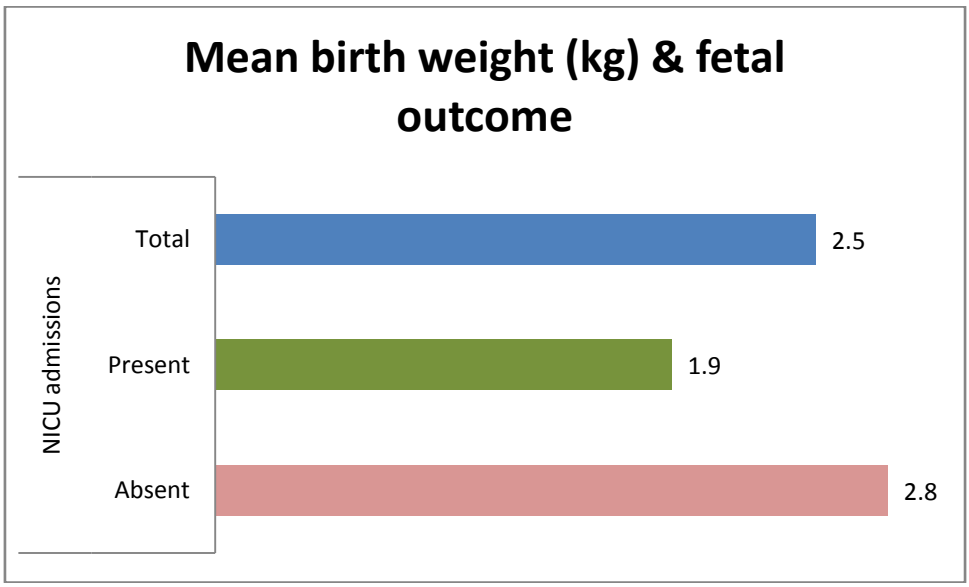
(iv) FETAL OUTCOME & ASSOCIATED FACTORS:

The difference in birth weight between the neonates admitted to NICU and those who were discharged normally was calculated.(Table 22 and fig) The average birth weight was lower (1.9 ± 0.6 kg) for the babies in the former group than the latter (2.8 ± 0.3 kg) and this difference was found to be statistically significant as shown by Independent t-test (P<0.05).

Table 22. Birth weight (kg) and fetal outcome

NICU admissions	Minimum	Maximum	Mean (SD)	Median (IQR)
No	2.0	3.5	2.8 (0.3)	2.8 (2.7, 3.0)
Yes	0.9	3.0	1.9 (0.6)	1.9 (1.5, 2.4)
Total	0.9	3.5	2.5 (0.6)	2.6 (2.2, 2.9)
Independent t-test used; p-value **<0.001** p-value <0.05 is significant;				

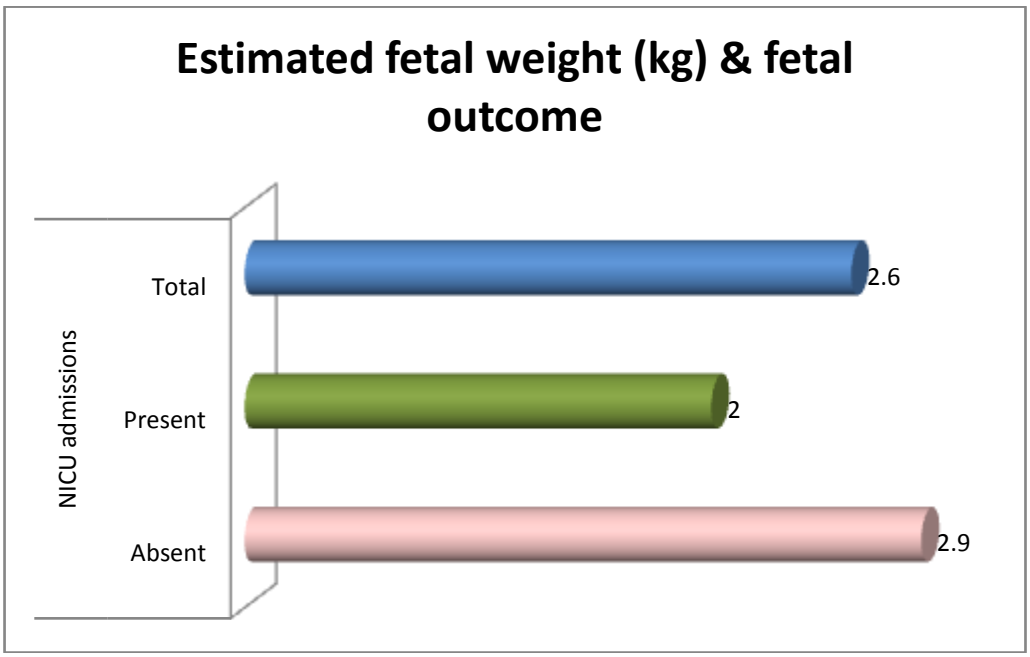
International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018



The estimated fetal weight was computed and compared between the neonates admitted to NICU and those who were not (table 23 and fig) The estimated fetal weight was higher (2.9 ± 0.4 kg) for the babies in the latter group than the former one (2.0 ± 0.6 kg) and this difference was found to be statistically significant as shown by Independent t-test (P<0.05).

Table 23. Estimated fetal weight and fetal outcome

NICU admissions	Minimum	Maximum	Mean (SD)	Median (IQR)
No	1.9	3.5	2.9 (0.4)	2.8 (2.7, 3.1)
Yes	1.1	3.3	2.0 (0.6)	2.0 (1.6, 2.5)
Total	1.1	3.5	2.6 (0.6)	2.8 (2.1, 3.0)
Independent t-test used; p-value **<0.001** p-value <0.05 is significant;				

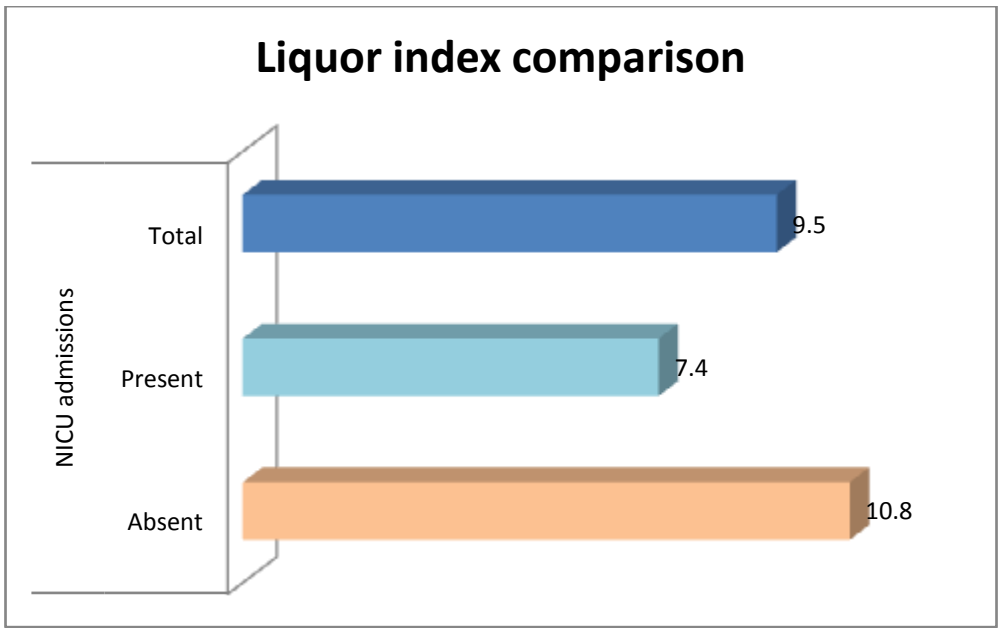


International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018

The liquor index was calculated and compared between the neonates that were normally discharged and those requiring NICU admissions (table 24 and fig). The mother with higher liquor index (10.8 ± 3.3) delivered normal babies while those with reduced liquor (7.4 ± 2.4) delivered babies that are admitted in NICU and this difference was found to be statistically significant as shown by Independent t-test (P<0.05).

Table 24. Liquor index comparison and fetal outcome

NICU admissions	Minimum	Maximum	Mean (SD)	Median (IQR)
No	6	24	10.8 (3.3)	10.0 (9.2, 12.5)
Yes	1.5	11.2	7.4 (2.4)	8.0 (5.6, 8.9)
Total	1.5	24	9.5 (3.4)	9.4 (7.9, 10.3)
Independent t-test used; p-value **<0.001** p-value <0.05 is significant;				

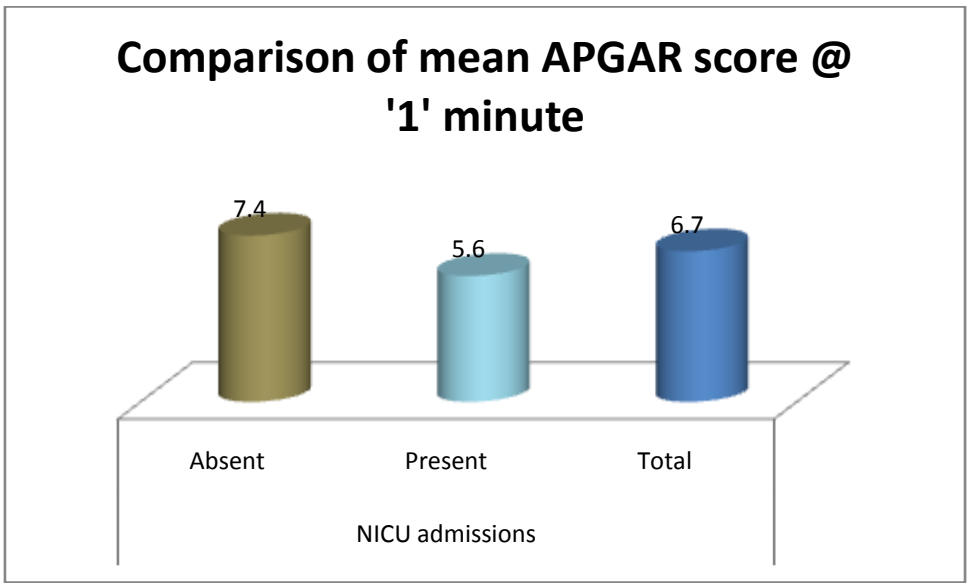


The comparison of APGAR score at one minute between the neonates admitted and normal babies were shown in table 25 (and fig) The score was lower (5.6 ± 1.3) for the admitted babies than the normal ones (7.4 ± 0.9) and this difference was found to be statistically significant as revealed by Independent t-test (P<0.05).

Table 25. APGAR "1 min" and fetal outcome

NICU admissions	Minimum	Maximum	Mean (SD)	Median (IQR)
No	6	8	7.4 (0.9)	8 (6, 8)
Yes	4	8	5.6 (1.3)	6 (4, 6)
Total	4	8	6.7 (1.4)	6.5 (6, 8)
Independent t-test used; p-value **<0.001** p-value <0.05 is significant;				

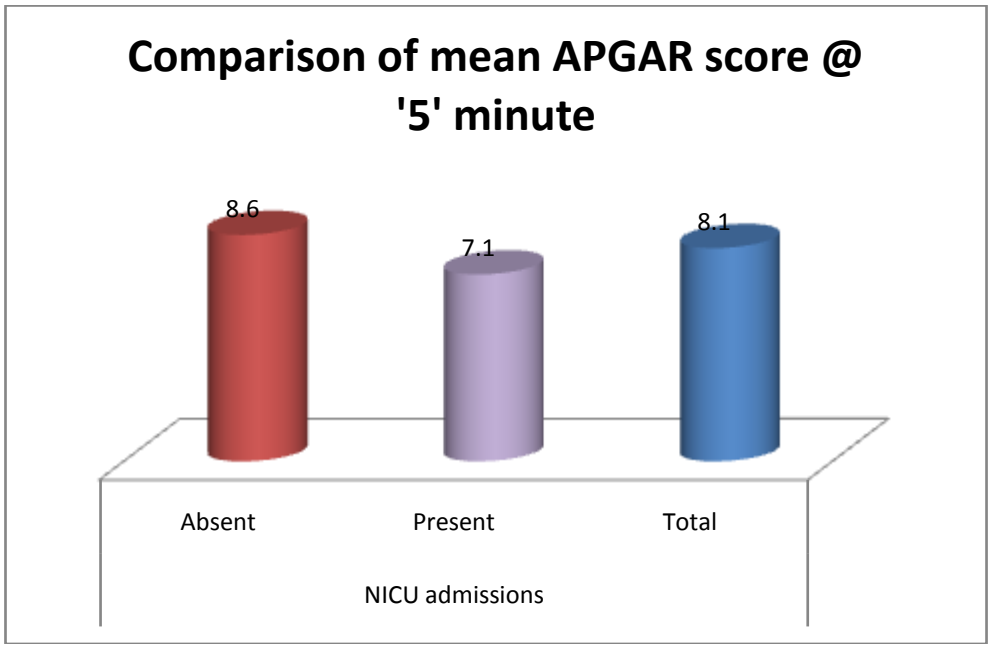
International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018



The comparison of APGAR score at fifth minute between the neonates admitted and normal babies were shown in table 26 (and fig) The score was lower (7.1 ± 1.3) for the admitted babies than the normal ones (8.6 ± 0.6) and this difference was found to be statistically significant as divulged by Independent t-test (P<0.05).

Table 26. APGAR "5 min" and fetal outcome

NICU admissions	Minimum	Maximum	Mean (SD)	Median (IQR)
No	8	10	8.6 (0.6)	9 (8, 9)
Yes	4	9	7.1 (1.3)	8 (4, 9)
Total	4	10	8.1 (1.2)	8 (8, 9)
Independent t-test used; p-value **<0.001** p-value <0.05 is significant;				

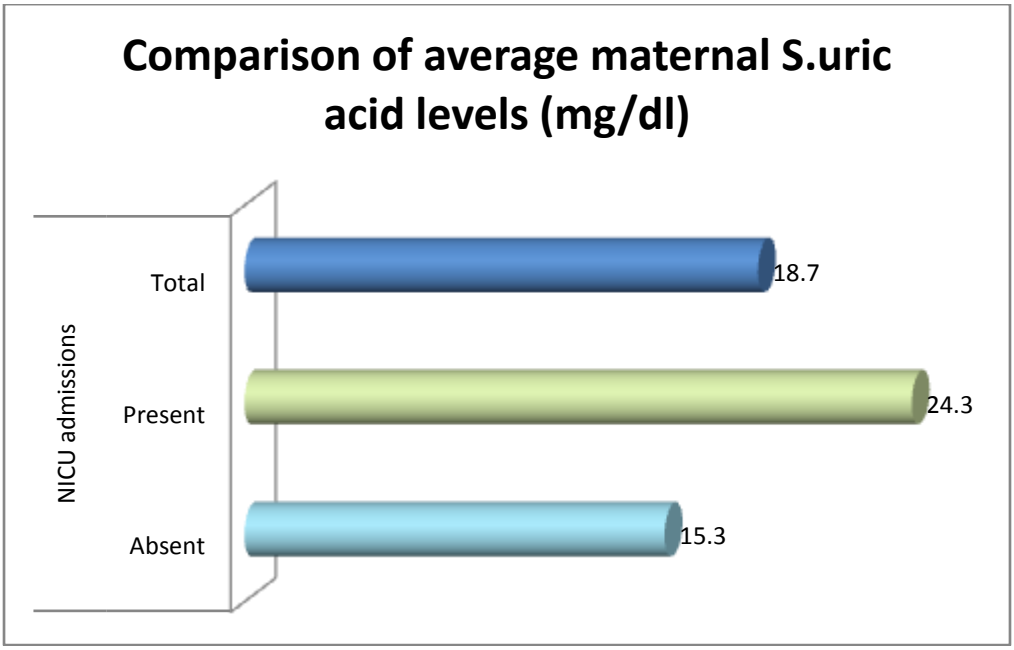


International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018

The uric acid levels of mothers measured before delivery and its association with neonatal outcome has been described in table 27 (and fig) The mothers with lower levels of uric acid (15.3 ± 4.4) delivered normal babies while those with high values (24.3 ± 10.2) delivered babies requiring NICU admissions and this difference was found to be statistically significant as demonstrated by Independent t-test (P<0.05).

Table 27. Maternal Uric acid levels and fetal outcome

NICU admissions	Minimum	Maximum	Mean (SD)	Median (IQR)
No	8	22	15.3 (4.4)	14.0 (12, 18)
Yes	8	55	24.3 (10.2)	24.0 (20, 30)
Total	8	55	18.7 (8.3)	18.0 (13, 22)
Independent t-test used; p-value **<0.001** p-value <0.05 is significant;				

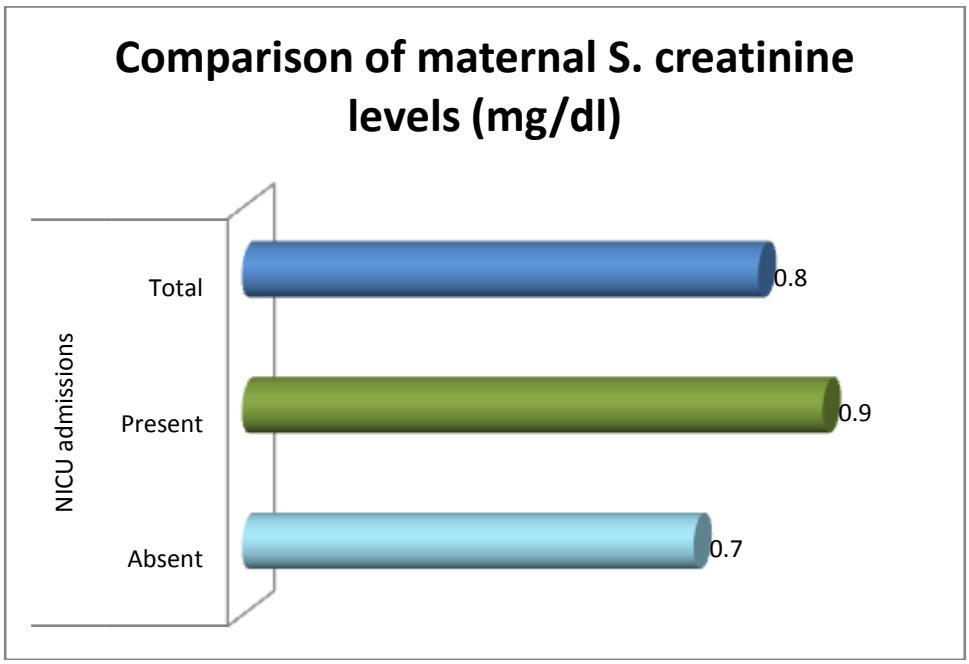


The maternal creatinine levels that were measured before delivery were associated with neonatal outcome and shown in table 28 (and fig) The mothers with lower levels of creatinine (0.7 ± 0.1) delivered normal babies while those with higher values (0.9 ± 0.2) delivered babies requiring NICU admissions and this difference was found to be statistically significant as given by Independent t-test (P<0.05).

Table 28. Maternal creatinine levels and fetal outcome

NICU admissions	Minimum	Maximum	Mean (SD)	Median (IQR)
No	0.4	1.0	0.7 (0.1)	0.7 (0.6, 0.8)
Yes	0.5	1.6	0.9 (0.2)	0.9 (0.7, 1.1)
Total	0.4	1.6	0.8 (0.2)	0.7 (0.6, 0.9)
Independent t-test used; p-value = **0.002** p-value <0.05 is significant;				

International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018



(v) CRITICAL ANALYSIS OF DOPPLER STUDY:

Table 29 (and fig) shows the relationship between Doppler velocimetry of umbilical artery and severity of PIH. It was observed that those who had mild PIH were having significantly higher percentage of normal waveforms (92.3%) when compared against the severe cases (41.7%) whereas those with severe PIH had significantly higher proportion of abnormal waveforms (58.3%) than their opponents (7.7%). Pearson's chi-square test was applied and this difference was found to be statistically significant (P<0.05).

Table 29. Doppler velocimetry (Umbilical artery) and PIH severity

Doppler findings	**PIH severity**				**$\chi 2$**	**p-value**
	Mild (n=26)		**Severe (n=24)**			
	No	**%**	**No**	**%**		
Normal (n=34)	24	92.3	10	41.7	14.7	**<0.001**
Abnormal (n=16)	2	7.7	14	58.3		
Pearson's chi-square test used; p-value <0.05 is significant;						

International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018

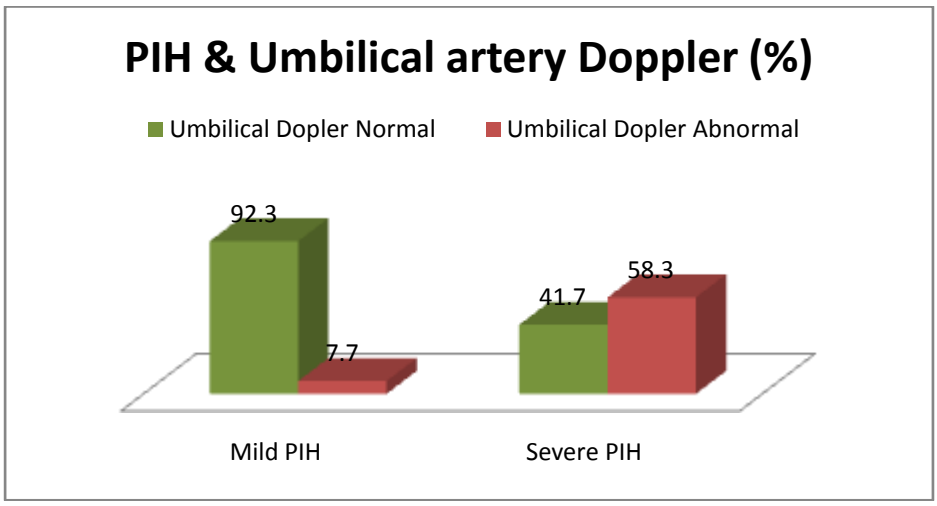
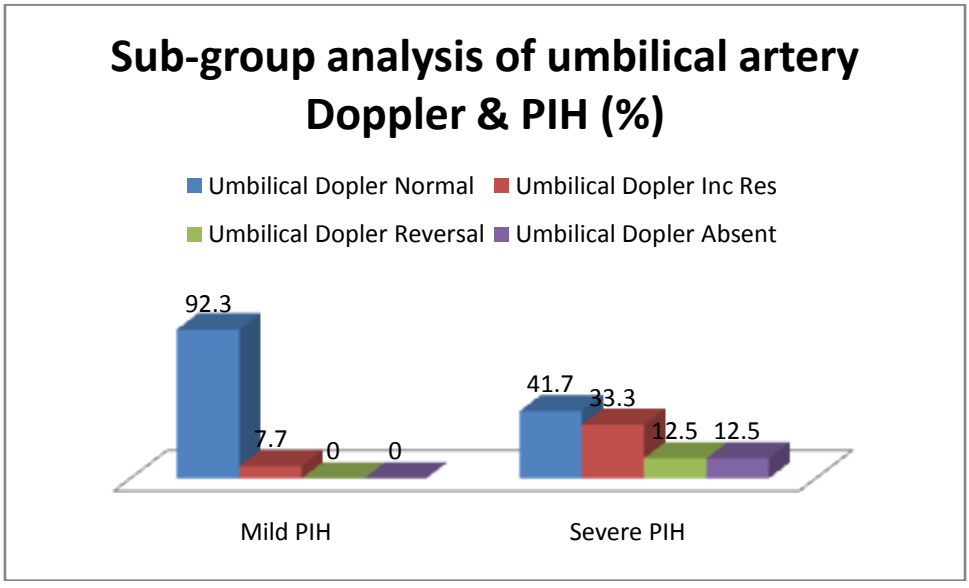


Table 30. Sub-group analysis of Doppler velocimetry (Umbilical artery) and PIH severity

Doppler findings	PIH severity				χ^2	p-value
	Mild (n=26)		Severe (n=24)			
	No	%	No	%		
Normal (n=34)	24	92.3	10	41.7	14.4	**0.001**
Increased resistance (n=10)	2	7.7	8	33.3		
Reversal (n=3)	0	0.0	3	12.5		
Absent (n=3)	0	0.0	3	12.5		
Fisher's exact test used; p-value <0.05 is significant;						



International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018

Table 30 (and fig) shows the sub-group analysis of relationship between Doppler velocimetry of umbilical artery and PIH severity. It was observed that those who had mild PIH were having significantly lower percentage of waveforms showing increased resistance (7.7%) than the severe cases (33.3%) whereas those with severe PIH had significantly higher proportion of reversal and absent waveforms (12.5% each) that was totally absent (0%) in their opponents. Fisher's exact chi-square test was applied and this difference was found to be statistically significant (P<0.05).

Table 31. Doppler velocimetry (Uterine artery) and PIH severity

Doppler findings	PIH severity				χ^2	p-value
	Mild (n=26)		Severe (n=24)			
	No	%	No	%		
Normal (n=34)	22	84.6	8	33.3	13.7	**<0.001**
Abnormal (n=16)	4	15.4	16	66.7		
Pearson's chi-square test used; p-value <0.05 is significant;						

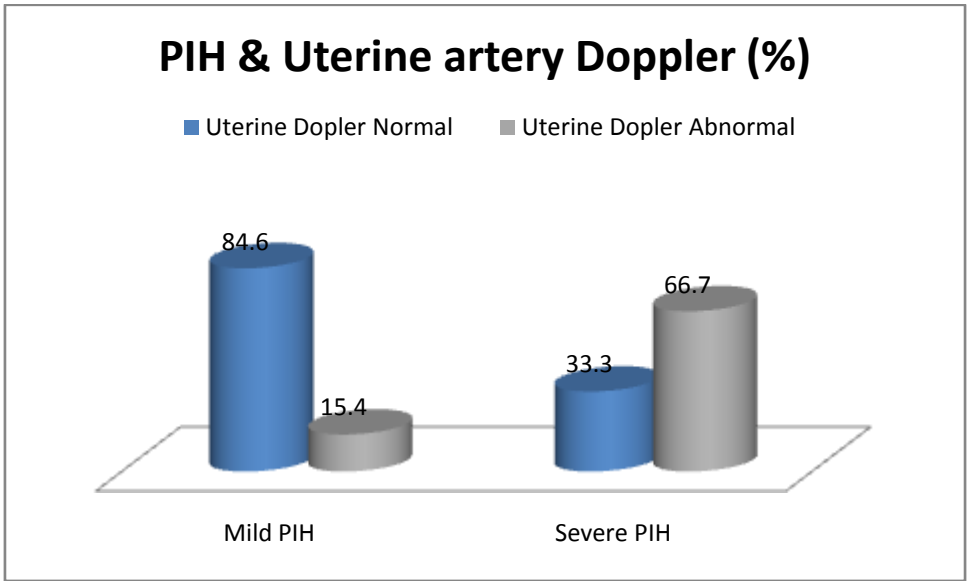


Table 31 (and fig) shows the association between Doppler velocimetry of uterine artery and severity of PIH. It was observed that those who had mild PIH were having significantly higher percentage of normal waveforms (84.6%) when compared against the severe cases (33.3%) whereas those with severe PIH had significantly higher proportion of abnormal waveforms (66.7%) than their opponents (15.4%). Pearson's chi-square test was applied and this difference was found to be statistically significant (P<0.05).

International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018

Table 32. Sub-group analysis of Doppler velocimetry (Uterine artery) and PIH severity

Doppler findings	PIH severity				χ2	p-value
	Mild (n=26)		Severe (n=24)			
	No	%	No	%		
Normal (n=34)	22	84.6	8	33.3	13.8	**<0.001**
Increased resistance (n=10)	4	15.4	15	62.5		
Reversal (n=3)	0	0.0	1	4.2		
Fisher's exact test used; p-value <0.05 is significant;						

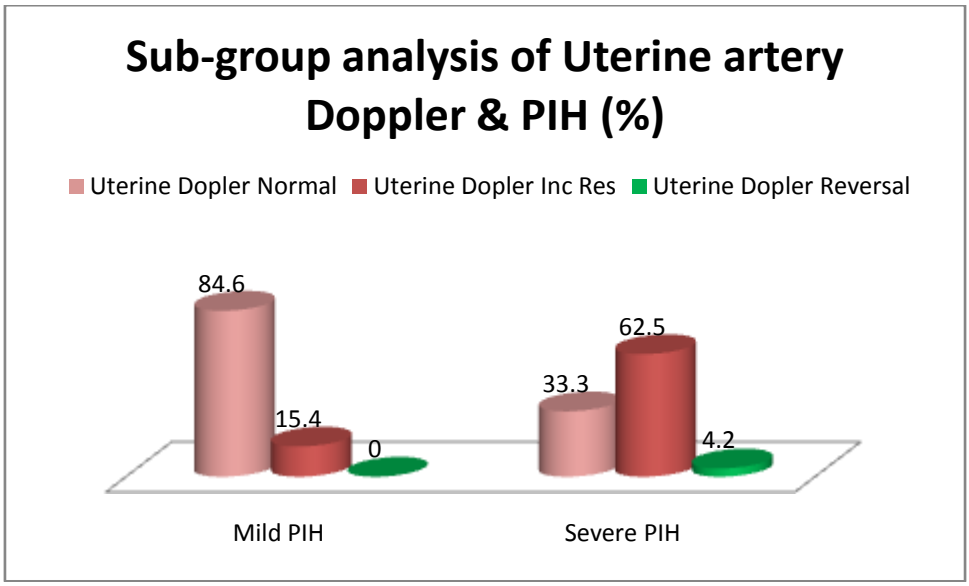


Table 32 (and fig) shows the sub-group analysis of association between Doppler velocimetry of uterine artery and PIH severity. It was observed that those who had mild PIH were having significantly lower percentage of waveforms showing increased resistance (15.4%) than the severe cases (62.5%) whereas those with severe PIH had significantly higher proportion of wave reversal (4.2%) that was totally absent (0%) in mild PIH. Fisher's exact chi-square test was applied and this difference was found to be statistically significant (P<0.05).

Table 33. Doppler velocimetry (Umbilical artery) and fetal outcome

NICU admissions	Doppler findings				χ2	p-value
	Normal (n=34)		Abnormal (n=16)			
	No	%	No	%		
No (n=31)	29	85.3	2	12.5	24.5	**<0.001**
Yes (n=19)	5	14.7	14	87.5		
Pearson's chi-square test used; p-value <0.05 is significant;						

International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018

Table 33 (and fig) shows the link between Doppler velocimetry of umbilical artery and neonatal morbidity. It was observed that mothers who had normal waveforms (85.3%) had delivered normal neonates when compared against those with abnormal waveforms (12.5%) whereas those mothers with abnormal waveforms had delivered neonates with increased morbidities (87.5%) that mandated NICU admissions as compared to their counterparts (14.7%). Pearson's chi-square test was applied and this difference was found to be statistically significant (P<0.05).

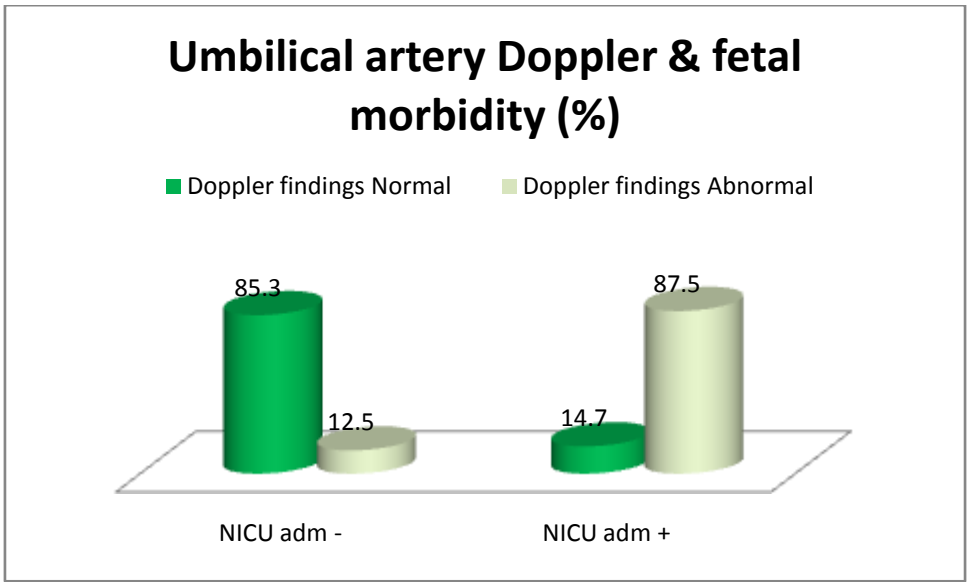


Table 34. Sub-group analysis of Doppler velocimetry (Umbilical artery) and fetal outcome

NICU admissions	Umbilical Doppler				$\chi 2$	p-value
	Normal (n=34) N (%)	Increased Resistance (n=10), N (%)	Absent (n=3) N (%)	Reversal (n=3) N (%)		
No (n=31)	29 (85.3)	2 (20.0)	0 (0.0)	0 (0.0)	19.6	**<0.001**
Yes (n=19)	5 (14.7)	8 (80.0)	3 (100.0)	3 (100.0)		
Fisher's exact test used; p-value <0.05 is significant;						

Table 34 (and fig) shows the sub-group analysis of association between Doppler velocimetry of umbilical artery and neonatal morbidity. It was observed that mothers who had normal waveforms delivered only smaller proportion of babies requiring NICU admission (14.7%) than those who had waveforms like increased resistance (80.0%), absent waves (100.0%) and wave reversal (100.0%). Fisher's exact chi-square test was applied and this difference was found to be statistically significant (P<0.05).

International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018

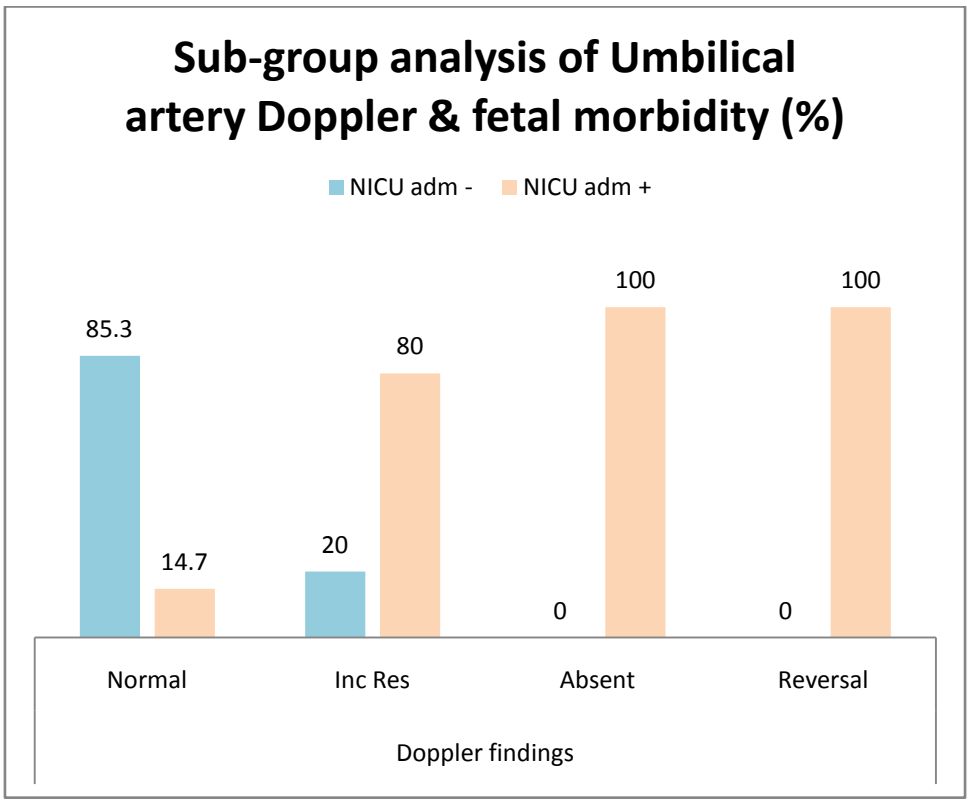


Table 35. Doppler velocimetry (Uterine artery) and fetal outcome

NICU admissions	Doppler findings				χ^2	p-value
	Normal (n=30)		Abnormal (n=20)			
	No	%	No	%		
No (n=31)	26	86.7	5	25.0	19.4	**<0.001**
Yes (n=19)	4	13.3	15	75.0		
Pearson's chi-square test used; p-value <0.05 is significant;						

Table 35 (and fig) shows the relationship between Doppler velocimetry of uterine artery and adverse neonatal outcome. It was observed that mothers who had normal waveforms (86.7%) had delivered normal neonates when compared against those with abnormal waveforms (25.0%) whereas those mothers with abnormal waveforms had delivered neonates with increased morbidities (75%) that mandated NICU admissions as compared to their counterparts (13.3%). Pearson's chi-square test was applied and this difference was found to be statistically significant (P<0.05).

International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018

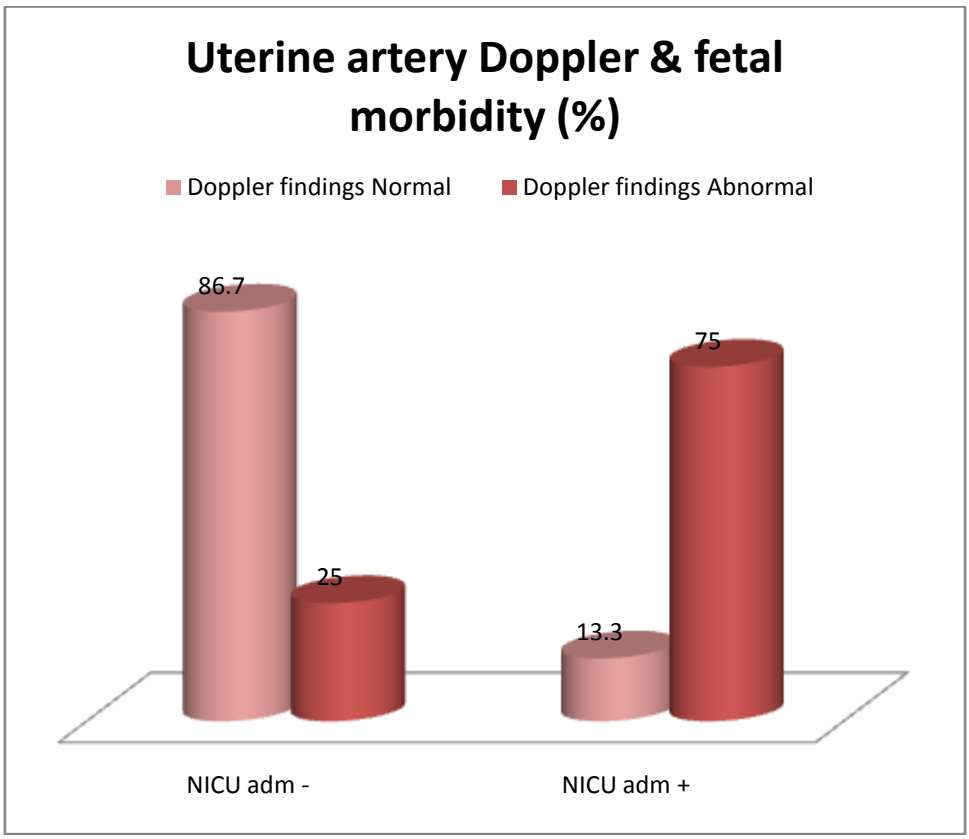


Table 36 (and fig) shows the sub-group analysis of relationship between Doppler velocimetry of uterine artery and adverse neonatal outcome.

Table 36. Sub-group analysis of Doppler velocimetry (Uterine artery) and fetal outcome

NICU admissions	Doppler findings			$\chi 2$	p-value
	Normal (n=30) N (%)	Increased Resistance (n=19), N(%)	Reversal (n=1) N (%)		
No (n=31)	26 (86.7)	5 (26.3)	0 (0.0)	19.7	**<0.001**
Yes (n=19)	4 (13.3)	14 (73.7)	1 (100.0)		
Fisher's exact test used; p-value <0.05 is significant;					

It was observed that mothers who had normal waveforms delivered only smaller proportion of babies requiring NICU admission (13.3%) than those who had waveforms like increased resistance (73.7%) and wave reversal (100.0%). Fisher's exact chi-square test was applied and this difference was found to be statistically significant (P<0.05).

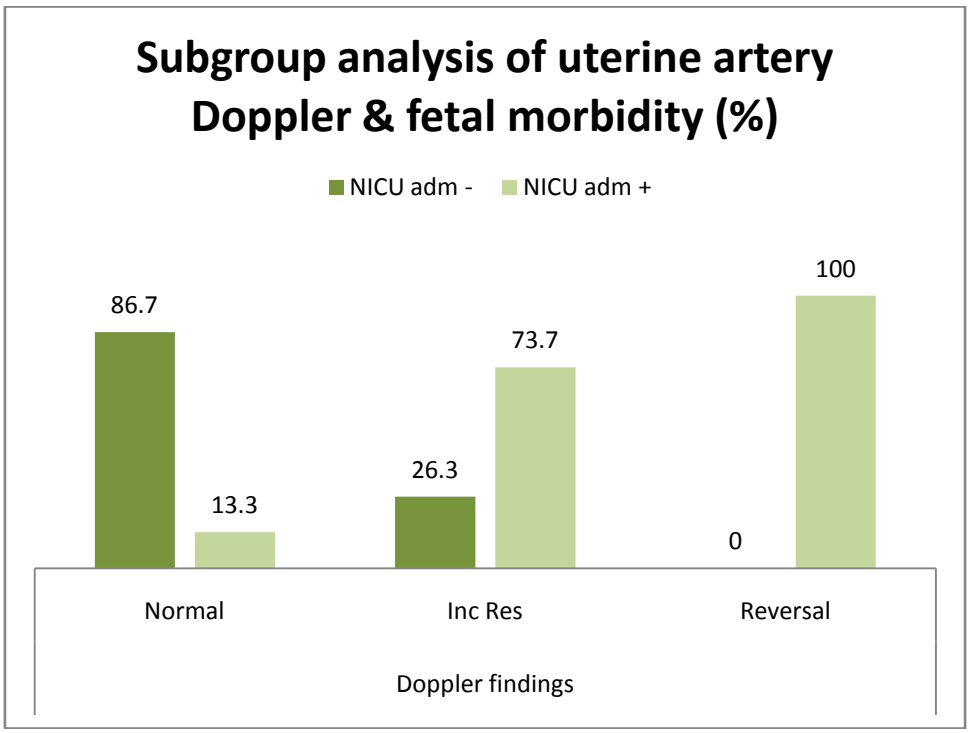
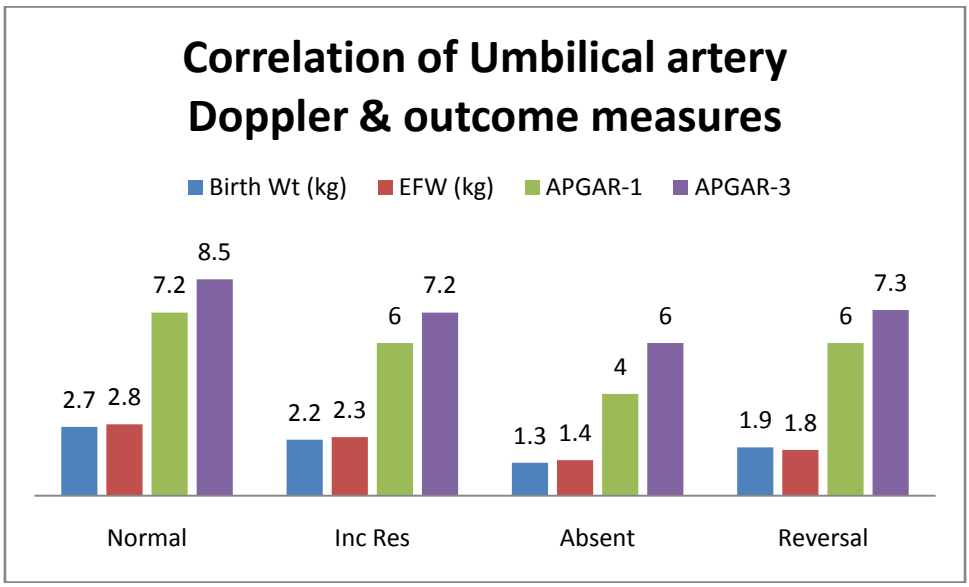


Table 37. Correlation of Doppler velocimetry (Umbilical artery) and other variables

	Normal (n=34)		**Increased resistance (n=10)**		**Reversal (n=3)**		**Absent (n=3)**		**F-value**	**p-value**
	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
Birth Wt (kg)	2.7	0.4	2.2	0.5	1.3	0.6	1.9	0.6	12.8	**<0.001**
EFW (kg)	2.8	0.5	2.3	0.5	1.4	0.5	1.8	0.5	12.3	**<0.001**
APGAR 1 min	7.2	1.0	6.0	1.6	4.0	0.0	6.0	0.0	10.8	**<0.001**
APGAR 5 min	8.5	0.7	7.2	1.5	6.0	0.0	7.3	1.2	11.6	**<0.001**
One way ANOVA used; p-value <0.05 is significant;										

International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018



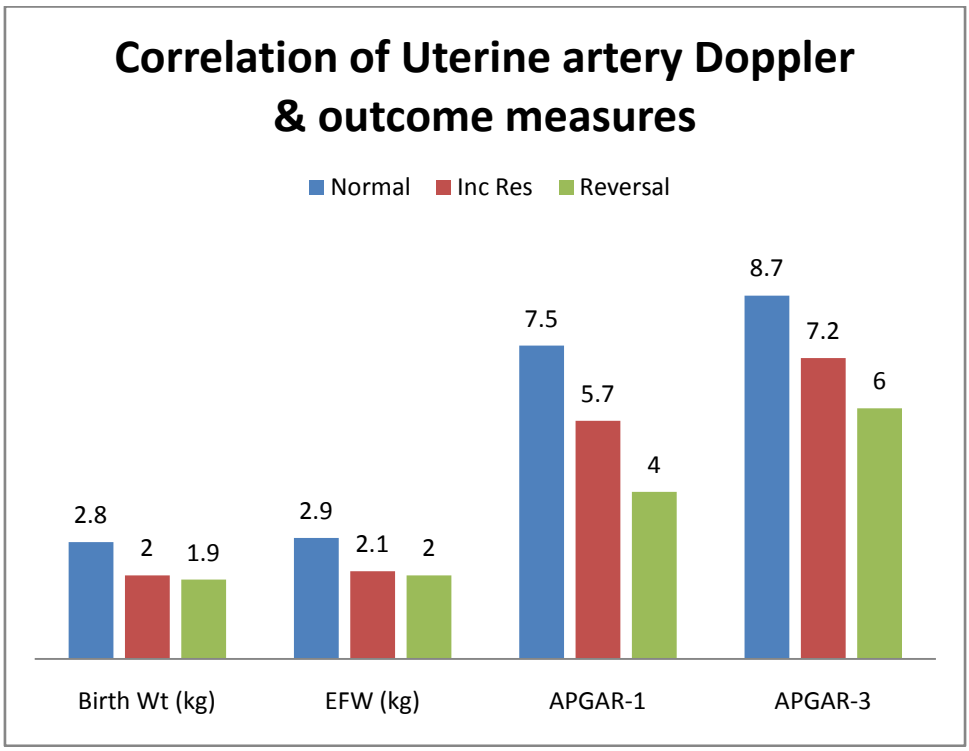
The umbilical Doppler findings and its association with quantitative variables like birth weight, estimated fetal weight (EFW), APGAR score at one minute and APGAR score at 5 minute were elaborated in table 37 (and fig). One way ANOVA test with post-hoc analysis using LSD was performed here. All the parameters varied significantly between the normal and abnormal waveforms thereby supporting the predictability of neonatal outcomes by performing third trimester umbilical Doppler.

The uterine Doppler findings and its association with quantitative variables like birth weight, estimated fetal weight (EFW), APGAR score at one minute and APGAR score at 5 minute were elaborated in table 38 (and fig). One way ANOVA test with post-hoc analysis using LSD was performed here. All the parameters varied significantly between the normal and abnormal waveforms thereby supporting the predictability of neonatal outcomes by performing third trimester uterine artery Doppler.

Table 38. Correlation of Doppler velocimetry (Uterine artery) and other variables

	Normal (n=30)		**Increased resistance (n=19)**		**Reversal (n=1)**		**F- value**	**p-value**
	Mean	SD	Mean	SD	Mean	SD		
Birth Wt (kg)	2.8	0.4	2.0	0.6	1.9	-	12.6	**<0.001**
EFW (kg)	2.9	0.4	2.1	0.6	2.0	-	13.4	**<0.001**
APGAR 1 min	7.5	1.0	5.7	1.0	4.0	-	21.9	**<0.001**
APGAR 5 min	8.7	0.5	7.2	1.3	6.0	-	19.4	**<0.001**
One way ANOVA used; p-value <0.05 is significant;								

International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018

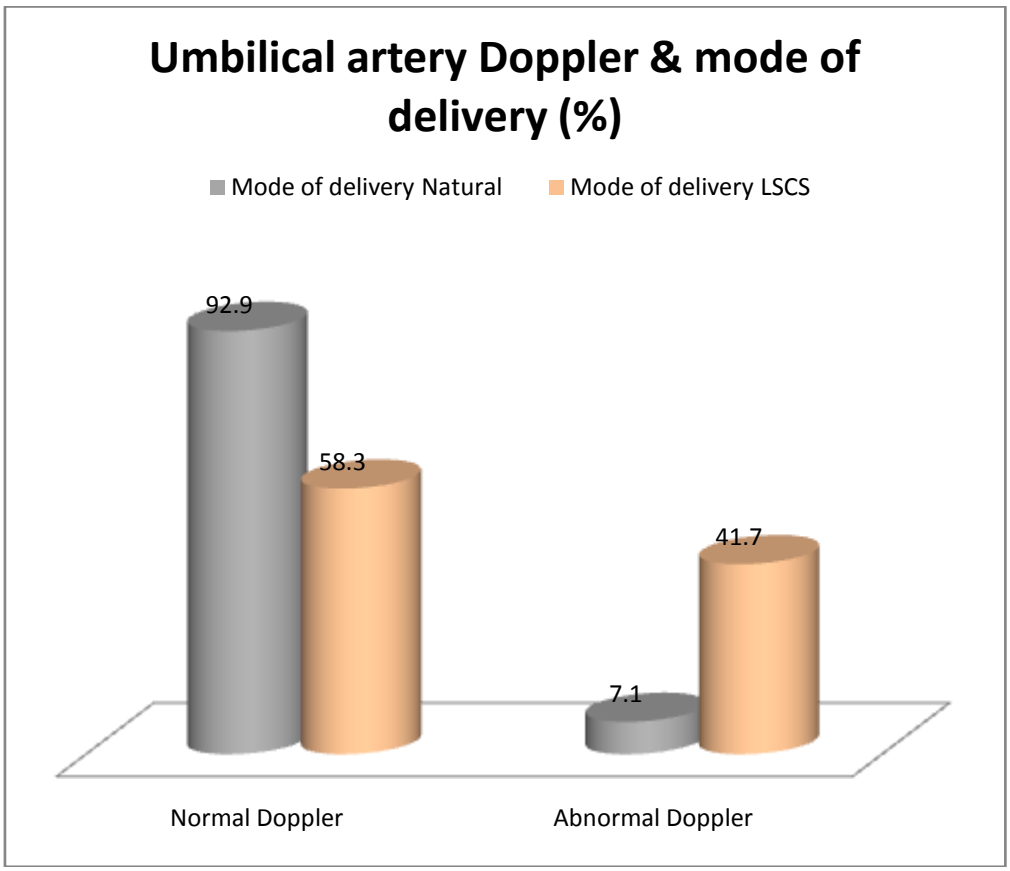


An association was made between Doppler velocimetry of umbilical artery and the mode of delivery (table 39 and fig). It was evident that majority of the vaginal deliveries were performed for mothers who had normal waveforms (92.9%) and majority of the abnormal waveforms have been delivered by LSCS (93.8%) and this difference became significant when Pearson's chi-square test was applied.(P<0.05)

Table 39. Doppler velocimetry (Umbilical artery) and mode of delivery

Doppler findings	**Mode of delivery**				**χ2**	**p-value**
	Vaginal (n=14)		**LSCS (n=36)**			
	No	**%**	**No**	**%**		
Normal (n=34)	13	92.9	21	58.3	5.5	**0.02**
Abnormal (n=16)	1	7.1	15	41.7		
Pearson's chi-square test used; p-value <0.05 is significant;						

International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018



An association was made between Doppler velocimetry of uterine artery and the mode of delivery (table 40 and fig). It was evident that majority of the vaginal deliveries were performed for mothers who had normal waveforms (85.7%) and majority of the abnormal waveforms have been delivered by LSCS (90.0%) and this difference became significant when Pearson's chi-square test was applied.(P<0.05)

Table 40. Doppler velocimetry (Uterine artery) and mode of delivery

Doppler findings	**Mode of delivery**				**χ^2**	**p-value**
	Natural (n=14)		**LSCS (n=36)**			
	No	**%**	**No**	**%**		
Normal (n=30)	12	85.7	18	50.0	5.4	**0.02**
Abnormal (n=20)	2	14.3	18	50.0		
Pearson's chi-square test used; p-value <0.05 is significant;						

International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018

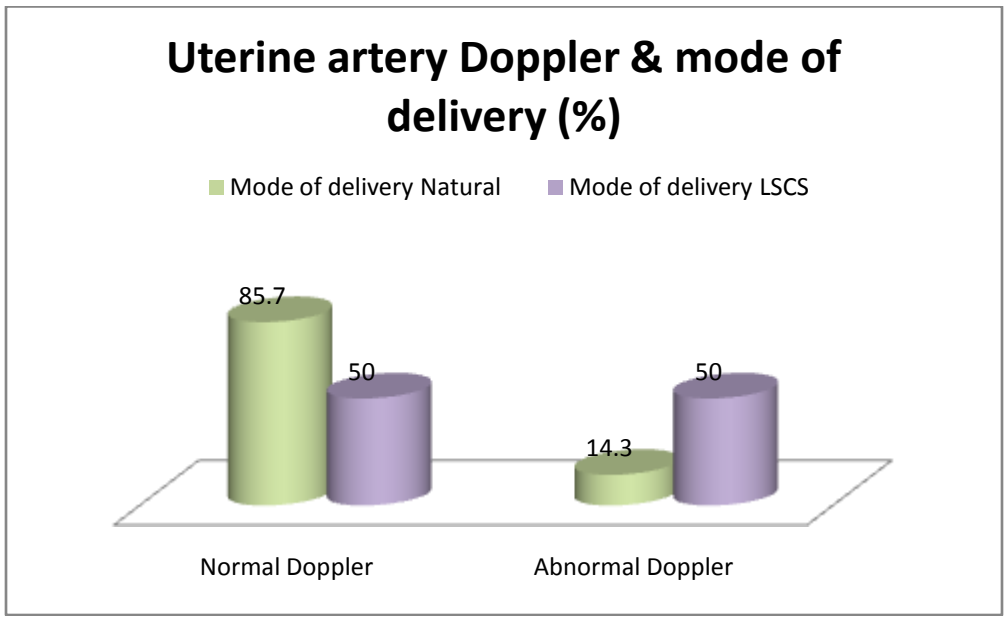
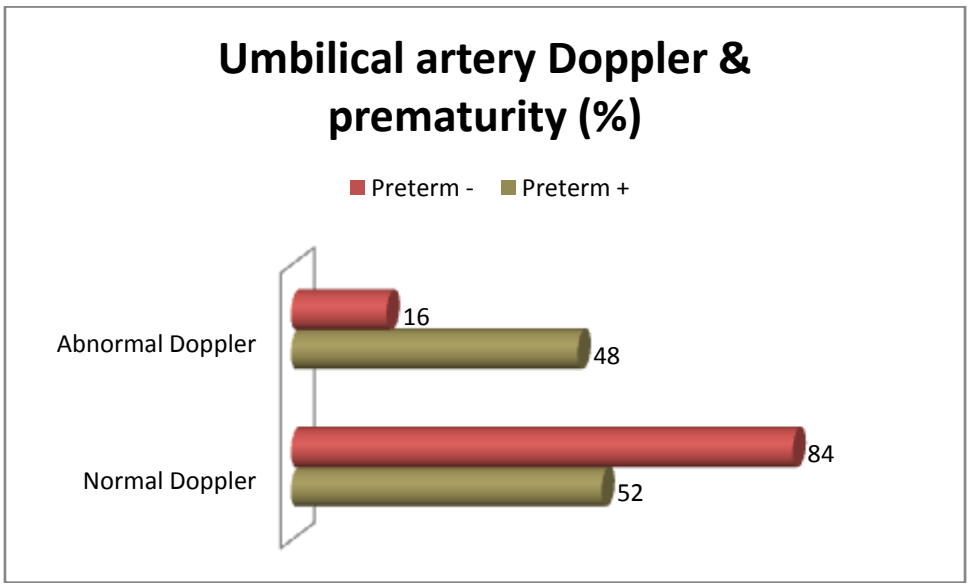


Table 41. Doppler velocimetry (Umbilical artery) and prematurity

Doppler findings	Preterm				χ^2	p-value
	Yes (n=25)		No (n=25)			
	No	%	No	%		
Normal (n=34)	13	52.0	21	84.0	5.9	**0.02**
Abnormal (n=16)	12	48.0	4	16.0		
Pearson's chi-square test used; p-value <0.05 is significant;						

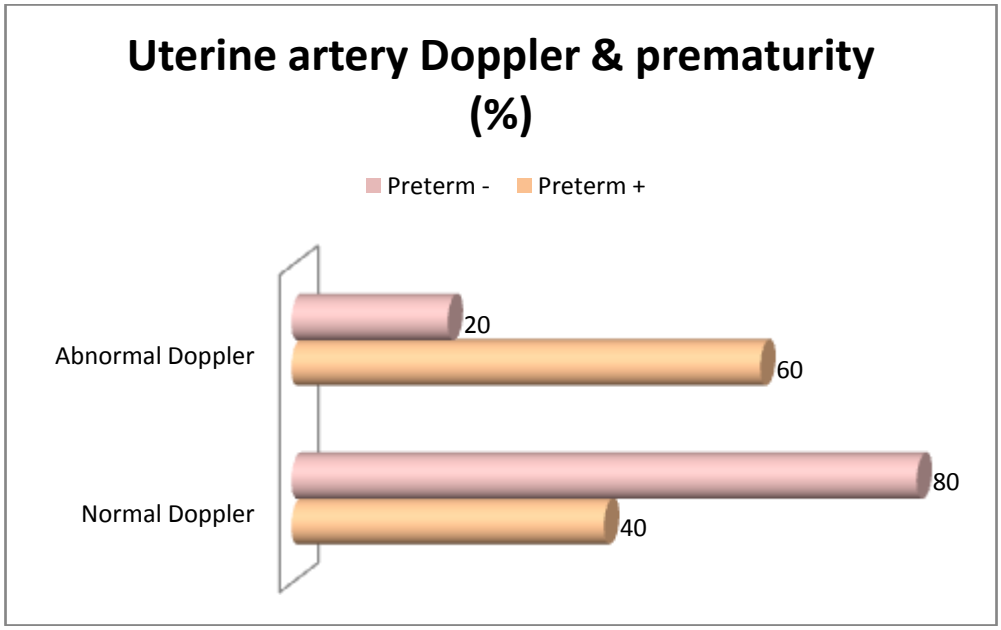


International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018

An association was made between Doppler velocimetry of umbilical artery and preterm births (table 41 and fig). It was evident that majority of the abnormal waveforms (n=16) resulted in premature babies (75.0%) and majority of the normal waveforms (n=34) have delivered normal babies (61.8%) and this difference became significant when Pearson's chi-square test was applied.(P<0.05)

Table 42. Doppler velocimetry (Uterine artery) and prematurity

Doppler findings	Preterm				χ^2	p-value
	Yes (n=25)		No (n=25)			
	No	%	No	%		
Normal (n=34)	10	40.0	20	80.0	8.3	**0.004**
Abnormal (n=16)	15	60.0	5	20.0		
Pearson's chi-square test used; p-value <0.05 is significant;						

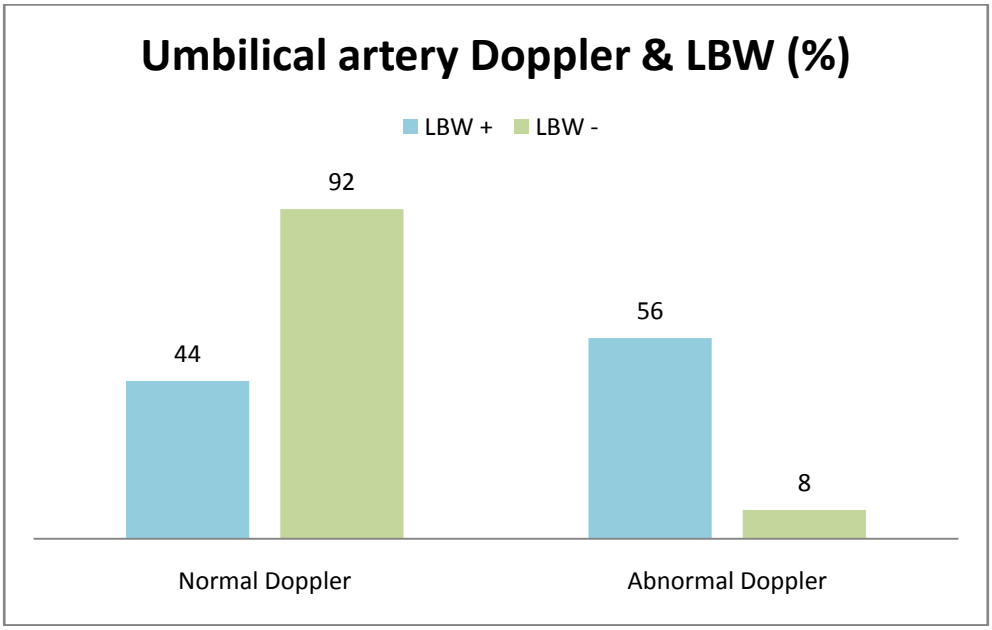


An association was made between Doppler velocimetry of uterine artery and the mode of delivery (table 42 and fig). It was evident that majority of the abnormal waveforms (n=16) resulted in premature babies (60.0%) and majority of the normal waveforms (n=34) have delivered normal babies (66.7%) and this difference became significant when Pearson's chi-square test was applied.(P<0.05)

International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018

Table 43. Doppler velocimetry (Umbilical artery) and low birth weight

Doppler findings	Low Birth Weight				χ^2	p-value
	Yes (n=25)		No (n=25)			
	No	%	No	%		
Normal (n=34)	11	44.0	23	92.0	5.9	**0.02**
Abnormal (n=16)	14	56.0	2	8.0		
Pearson's chi-square test used; p-value <0.05 is significant;						

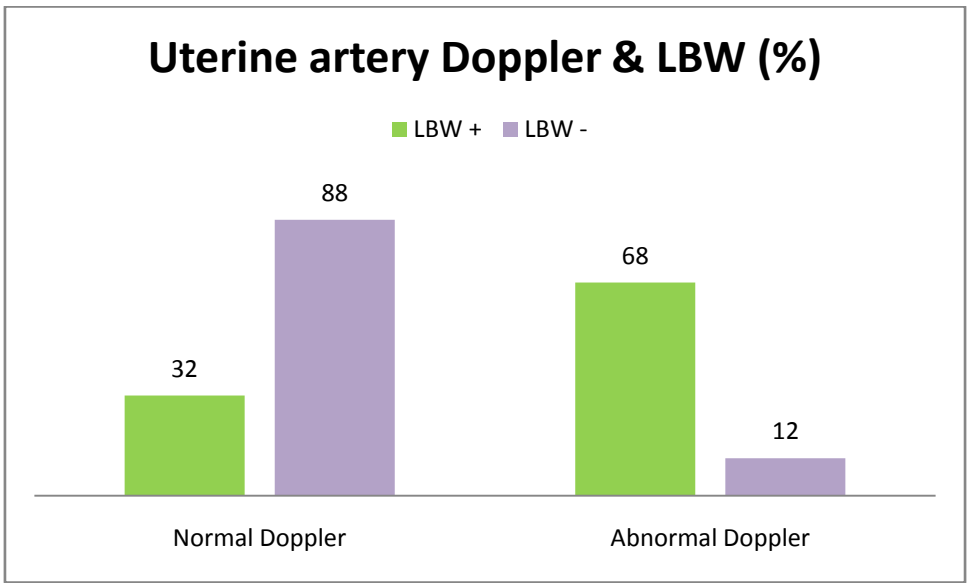


An association was made between Doppler velocimetry of umbilical artery and low birth weight (table 43 and fig). There were higher proportion of LBW babies were born to mother who shown abnormal waveforms (56.0%) and higher proportion of normal weight babies were born to mother who showed normal waveforms (92.0%) and this difference became significant when Pearson's chi-square test was applied. (P<0.05)

Table 44. Doppler velocimetry (Uterine artery) and low birth weight

Doppler findings	Low Birth Weight				χ^2	p-value
	Yes (n=25)		No (n=25)			
	No	%	No	%		
Normal (n=34)	8	32.0	22	88.0	16.3	**<0.001**
Abnormal (n=16)	17	68.0	3	12.0		
Pearson's chi-square test used; p-value <0.05 is significant;						

International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 22-71 www.ijdmsrjournal.com ISSN: 2582-6018



association was made between Doppler velocimetry of uterine artery and the mode of delivery (table 44 and fig). There were higher proportion of LBW babies were born to mother who shown abnormal waveforms (68.0%) and higher proportion of normal weight babies were born to mother who showed normal waveforms (88.0%) and this difference became significant when Pearson's chi-square test was applied.(P<0.05)

V. 5. DISCUSSION:-

In this study the role of DUS in the third trimester , mothers with preeclampsia has been analysed. The mode of termination and the role of DUS in predicting the fetal outcome have been derived and discussed.

The mothers are aged between 23 and 41 years with mean age of 31.2 ± 4.3 years. Almost half fell in the age range of 28 to 34 years. More than half (52.0%) of the mothers developed the disease before reaching 30 years of age and this was not dissimilar to study by Kaur et al, which had 50% of cases in this age group. In contradiction to this, 90% of mothers belonged to less than 30 years in study by Mor S et al.(32)

The gestational age distribution of the participants ranged from 32 to 39 weeks. Their average was 36.7 ± 2.1 weeks and nearly 50% of them were between 35.9 and 37.9 weeks of gestation. This was also observed in study done by Bonsaffoh KA et al., they had mothers with average gestational age 37.4 ± 3.3 weeks at delivery.(40)

In this study, nearly one-third were primi mothers (34.0%) and this was in contrast with Mor S et al., which had 74% primi mothers and Ndaboine et al had 61% primis. Primipara were the majority (92.4%) and mothers with P2 or P3 were only less than 10% and the average parity was 0.3 ± 0.7 for women enrolled in Mor S et al.(32) Mothers with one live child birth (95.8%) were the majority and those having higher child births were only less than five percent in our study. It is worth emphasizing that mothers with no previous history of abortions were predominantly (74.0%) diagnosed with preeclampsia in this study. We observed preeclampsia to affect mothers of urban and rural areas more or less equally with a slightly higher involvement in urban mothers (54%) than rural ones.

The proteinuria was absent in 28% cases, trace in 32% cases, 1+ in 32% cases and 2+ in 8% cases. The mothers with lower levels of uric acid (15.3 ± 4.4) delivered normal babies while those with high values (24.3 ± 10.2) delivered babies requiring NICU admissions and this difference was found to be statistically significant as demonstrated by Independent t-test (P<0.05). The mothers with lower levels of creatinine (0.7 ± 0.1) delivered normal babies while those with higher values (0.9 ± 0.2) delivered babies requiring NICU admissions.

Mild and severe preeclampsia were present in 52% and 48% of the cases respectively. About three fourths of the deliveries (72%) were Cesarean section and vaginal deliveries were only 38%. The Cesarean rates were reported to be lower in studies by Mor S et al (52%), Arshad T et al (37.5%) and Khanum et al (25%). However similar rates were found in Ndaboine et al (66.3%).(32)

The umbilical artery Doppler was normal in 68% of cases and of the abnormal ones,

increased resistance, absent flow and reversal of flow was seen in 20%, 6% and 6% of cases respectively. The uterine artery Doppler was normal in 60% of cases ,increased resistance in 38% and reversal of flow in 2% of cases respectively and none (0%) had absent flow.

The preterm and term births were equally distributed ,50% each among the study subjects. The babies weighing less than and above 2.5 kg were also equal ,50% each in distribution.

The adverse fetal outcome was described by their admissions in Neonatal Intensive Care Unit (NICU) and in this study nearly 38% of the babies required NICU admissions while the rest (62%) were discharged following normal post-natal care. The duration ,in days of hospitalization of neonates following delivery ranged from 2 to 36 days. It averaged 8.7 ± 8 days and about half of them stayed for a period of four to ten days.

One neonate died on 6th day of life and this translates to perinatal mortality rate of 2% and this was superior than Aseffa NA et al study and Bonsaffoh KA et al study that observed perinatal mortality of 111.1/1000 live births and 106/1000 live births respectively.(47)(40) Nonetheless, the recovery rate following NICU admissions were 97.4% (n=38).

It was observed that those with normal and abnormal Doppler indices in both the vessels correlated in 76.5% and 75% of cases respectively. This is the new aspect which is shown in our study. Nevertheless, about one-fourth of the observations diagnosed abnormal by umbilical Doppler fell in the normal range as observed with uterine Doppler and further studies needs to be done to address this area.

The average birth weight of babies was significantly lower (1.9 ± 0.6 kg) for the mothers with abnormal DUS than the normal ones (2.8 ± 0.3 kg) and this was in concordance with Trudinger BJ et al., and Knosses JS et. al., which agreed with this result.(31)(13) The estimated fetal weight was significantly higher (2.9 ± 0.4 kg) for the mothers who showed normal waveforms than the others (2.0 ± 0.6 kg) and similar findings were reported by Habli M et al in their study.(36)

The present study observed that mother with higher liquor index (10.8 ± 3.3) delivered normal babies while those with reduced liquor (7.4 ± 2.4) delivered babies that are admitted in NICU. The APGAR score at one minute was significantly lower (5.6 ± 1.3) for the admitted babies than the normal ones (7.4 ± 0.9) The APGAR score at fifth minute was also significantly lower (7.1 ± 1.3) for the admitted babies than the normal ones (8.6 ± 0.6) and this was supported by findings from Mckenzie and Berhe et al in their research.(37)(38)

Our study has shown that mothers with mild PIH, having significantly higher percentage of normal umbilical artery waveforms (92.3%) when compared with severe cases (41.7%) and in severe PIH patients significantly higher proportion of abnormal waveforms (58.3%) were observed than their opponents (7.7%).Mild PIH had increased resistance finding in 7.7% of patients. On the contrary, severe PIH patients had increased resistance in 33%. In addition, reversal and absent flow in 12.5% each. In uterine artery Doppler,mild PIH patients were having significantly higher percentage of normal waveforms observed in (84.6%) when compared to severe cases (33.3%). Those with severe PIH had significantly higher proportion of abnormal waveforms (66.7%) than mild cases of PIH(15.4%). Our study results is in congruence with the observations from Aharwal S et. al., in identifying the variation in nature of waveforms in accordance to the disease severity.(8)

The current study also demonstrated that mothers who had normal waveforms delivered healthier babies,which did not require NICU admission (14.7%) than those who had waveforms like increased resistance (80.0%), absent waves (100.0%) and wave reversal (100.0%). In addition the normal waveform mothers (86.7%) had delivered normal neonates when compared to those with abnormal waveforms (25.0%). In contradiction, those mothers with abnormal waveforms had delivered neonates with increased morbidities (75%) that mandated NICU admissions as compared to their counterparts (13.3%) and this was supported by findings from Mckenzie and Berhe et al in their researches.(37)(38)

This study has also added an important evidence that majority of the vaginal deliveries happened mothers who had normal waveforms in umbilical artery (92.9%) as well as uterine artery (85.7%) while majority of the abnormal waveforms in umbilical artery (93.8%) and uterine artery (90.0%) underwent Caesarean section .

The strong relationship between DUS waveforms and prematurity has been well proved in our study as majority of the abnormal umbilical and uterine artery DUS resulted in 75.0% and 60.0% premature babies respectively. Moreover, the benefits of DUS in diagnosing LBW babies has been highlighted in our study as abnormal waveforms of umbilical and uterine artery have resulted in 56.0% and 68.0% of LBW respectively. Hence, the inclusion of uterine and umbilical artery waveforms to the conventional methods of screening for gestational hypertension would

effectively uplift the maternal and neonatal well-being by averting perinatal morbidities and mortalities which is the need of the hour in developing countries like India.

VI. CONCLUSION & RECOMMENDATIONS:-

- Almost about 54% of the participants were from urban area and 46% were from rural area. More than half of them (52%) were aged below 30 years and averaged 31.2 ± 4.3 years.
- Almost two-thirds were multi-gravida mothers and three-fourths had previous history of abortions. Their mean gestational age was 36.7 ± 2.1 weeks.
- Mild and severe preeclampsia patients have contributed to 52% and 48% of the cases respectively. Majority of them (72%) were delivered by Cesarean section.
- The umbilical and uterine artery Doppler were normal in 68% and 60% of cases respectively. In umbilical Doppler, 20%, 6% and 6% of cases increased resistance, absent and reversal of flow was respectively noted whereas in uterine Doppler the above observations were seen in 38%, 0% and 2% of cases respectively.
- Proteinuria was seen in 62% of cases and majority of them showed abnormal Doppler finidngs. The mothers with raised uric acid and creatinine levels have mostly delivered babies that required NICU admissions
- The abnormalities in uterine and umbilical artery waveforms were exclusively associated with increased rates of Cesarean sections, preterm births, LBW babies and NICU admissions.
- The present study suggests implementation of Doppler imaging as a screening tool in prediction of preeclampsia as well as adverse-fetal-outcomes.
- Therefore we recommend various studies exploring its effectiveness and validity either alone or when combined with other diagnostic modalities to develop protocols that can be utilized even in peripheral health centres in order to enhance our maternal and child health indicators.

REFERENCES:-

[1]. JE L, H B, S O, D Y, AC L, P W, et al. Every Newborn: progress, priorities, and potential beyond survival. Lancet (London, England). 2014;384(9938):189–205. Available from: https://pubmed.ncbi.nlm.nih.gov/24853593/

[2]. Hodgins S. Pre-eclampsia as Underlying Cause for Perinatal Deaths: Time for Action. Glob Heal Sci Pract. 2015;3(4):525. Available from: /pmc/articles/PMC4682577/

[3]. Sustainable Development Goals | United Nations Development Programme. Available from: https://www.undp.org/sustainable-development-goals?utm_source=EN&utm_medium=GSR&utm_content=US_UNDP_PaidSearch_Brand_English&utm_campaign=CENTRAL&c_src=CENTRAL&c_src2=GSR&gclid=Cj0KCQjwg7KJBhDyARIsAHrAXaEJfYurNuJJDfVvZYlW-8laAZlFzZ239eOypvGsDjWc_rEacQqsbIQaAl8aEALw_wcB#good-health

[4]. NT N, M M, H A-A, G C, M P, N Z, et al. Causes of stillbirths and early neonatal deaths: data from 7993 pregnancies in six developing countries. Bull World Health Organ. 2006;84(9):699–705. Available from: https://pubmed.ncbi.nlm.nih.gov/17128339/

[5]. Abalos E, Cuesta C, Carroli G, Qureshi Z, Widmer M, Vogel J, et al. Pre-eclampsia, eclampsia and adverse maternal and perinatal outcomes: a secondary analysis of the World Health Organization Multicountry Survey on Maternal and Newborn Health. BJOG An Int J Obstet Gynaecol. 2014;121:14–24. Available from: https://obgyn.onlinelibrary.wiley.com/doi/full/10.1111/1471-0528.12629

[6]. Mehta B, Kumar V, Chawla S, Sachdeva S, Mahopatra D. Hypertension in Pregnancy: A Community-Based Study. Indian J Community Med. 2015;40(4):273. Available from: /pmc/articles/PMC4581149/

[7]. Sadanandan K, Kurian S, Valliot B, Sasidharan A, Sherin N, Madhu R, et al. PREVALENCE OF GESTATIONAL HYPERTENSION AND FACTORS INFLUENCING SELECTION OF ANTI-HYPERTENSIVE DRUGS IN PREGNANCY. J Hypertens. 2019;37:e239–40. Available from: https://journals.lww.com/jhypertension/Fulltext/2019/07001/PREVALENCE_OF_GESTATIONAL_HYPERTENSION_AND_FACTORS.703.aspx

[8]. Agrawal S, Walia GK. Prevalence and risk

factors for Pre-eclampsia in Indian women: a national cross sectional study.2011; Available from: www.measuredhs.com

[9]. JS C, KC V, N de V, G ter R, BW M, A F, et al. Accuracy of mean arterial pressure and blood pressure measurements in predicting pre-eclampsia: systematic review and meta-analysis. BMJ. 2008;336(7653):1117–20. Available from: https://pubmed.ncbi.nlm.nih.gov/18480117/

[10]. Kumar G, Choudhary TS, Srivastava A, Upadhyay RP, Taneja S, Bahl R, et al. Utilisation, equity and determinants of full antenatal care in India: analysis from the National Family Health Survey 4. BMC Pregnancy Childbirth. 2019;19(1):1–9. Available from: https://bmcpregnancychildbirth.biomedcentral.com/articles/10.1186/s12884-019-2473-6

[11]. C R. Pre-eclampsia: A complex and variable disease. Pregnancy Hypertens. 2014;4(3):241–2. Available from: https://pubmed.ncbi.nlm.nih.gov/26104638/

[12]. SL K, SC K, SP B, F da SC. First-trimester uterine artery Doppler analysis in the prediction of later pregnancy complications. Dis Markers. 2015; Available from: https://pubmed.ncbi.nlm.nih.gov/25972623/

[13]. Cnossen JS, Morris RK, Riet G ter, Mol BWJ, Post JAM van der, Coomarasamy A, et al. Use of uterine artery Doppler ultrasonography to predict pre-eclampsia and intrauterine growth restriction: a systematic review and bivariable meta-analysis. C Can Med Assoc J. 2008;178(6):701. Available from: /pmc/articles/PMC2263112/

[14]. NATIONAL FAMILY HEALTH SURVEY (NFHS-4) 2015-16 INDIA. 2017. Available from: http://www.rchiips.org/nfhs

[15]. PERINATAL MORTALITY RATE.

[16]. Population-based rates, timing, and causes of maternal deaths, stillbirths, and neonatal deaths in south Asia and sub-Saharan Africa: a multi-country prospective cohort study. Lancet Glob Heal. 2018;6(12):e1297–308. Available from: https://pubmed.ncbi.nlm.nih.gov/30361107/

[17]. JE L, H B, S O, D Y, AC L, P W, et al. Every Newborn: progress, priorities, and potential beyond survival. Lancet (London, England). 2014;384(9938):189–205. Available from: https://pubmed.ncbi.nlm.nih.gov/24853593/

[18]. Sankar MJ, Neogi SB, Sharma J, Chauhan M, Srivastava R, Prabhakar PK, et al. State of newborn health in India. J Perinatol. 2016;36(Suppl 3):S3. Available from: /pmc/articles/PMC5144119/

[19]. Williams PJ, Pipkin FB. The genetics of pre-eclampsia and other hypertensive disorders of pregnancy. Best Pract Res Clin Obstet Gynaecol. 2011;25(4–4):405. Available from: /pmc/articles/PMC3145161/

[20]. Podymow T, August P. Update on the Use of Antihypertensive Drugs in Pregnancy. Hypertension. 2008;51(4 PART 2 SUPPL.):960–9. Available from: https://www.ahajournals.org/doi/abs/10.1161/hypertensionaha.106.075895

[21]. Spradley FT. Metabolic abnormalities and obesity's impact on the risk for developing preeclampsia [Internet]. Vol. 312, American Journal of Physiology - Regulatory Integrative and Comparative Physiology. American Physiological Society; 2017 [cited 2020 Dec 15]. p. R5–12. Available from: https://pubmed.ncbi.nlm.nih.gov/27903516/

[22]. Diagnosing Preeclampsia - Key Definitions and ACOG Guidelines - The ObG Project. Available from: https://www.obgproject.com/2017/01/08/diagnosing-preeclampsia-key-definitions/

[23]. GA D. Risk factors for preeclampsia. Clin Obstet Gynecol. 1999;42(3):422–35. Available from: https://pubmed.ncbi.nlm.nih.gov/10451762/

[24]. K D, D H. Risk factors for pre-eclampsia at antenatal booking: systematic review of controlled studies. BMJ. 2005;330(7491):565–7. Available from: https://pubmed.ncbi.nlm.nih.gov/15743856/

[25]. R S, LJ V, AJ W, T R, LM I, RT L. Recurrence of pre-eclampsia across generations: exploring fetal and maternal genetic components in a population based cohort. BMJ. 2005;331(7521):877–9.

Available from: https://pubmed.ncbi.nlm.nih.gov/16169871/
[26]. Risk factors for severe preeclampsia - PubMed. Available from: https://pubmed.ncbi.nlm.nih.gov/8127525/
[27]. Mendilcioglu I, Trak B, Uner M, Umit S, Kucukosmanoglu M. Recurrent preeclampsia and perinatal outcome: A study of women with recurrent preeclampsia compared with women with preeclampsia who remained normotensive during their prior pregnancies. Acta Obstet Gynecol Scand. 2004 Nov;83(11):1044–8.
[28]. BM S, T G, E T, SN C, M K, D M, et al. Risk factors for preeclampsia in healthy nulliparous women: a prospective multicenter study. The National Institute of Child Health and Human Development Network of Maternal-Fetal Medicine Units. Am J Obstet Gynecol.1995;172(2 Pt 1):642–8. Available from: https://pubmed.ncbi.nlm.nih.gov/7856699/
[29]. Milne F, Redman C, Walker J, Baker P, Bradley J, Cooper C, et al. The pre-eclampsia community guideline (PRECOG): how to screen for and detect onset of pre-eclampsia in the community. BMJ Br Med J. 2005;330(7491):576. Available from: /pmc/articles/PMC554032/
[30]. THE ROLE OF DOPPLER ULTRASOUND IN OBSTETRICS | Radiology Key. Available from: https://radiologykey.com/the-role-of-doppler-ultrasound-in-obstetrics/
[31]. BJ T, WB G, CM C. Uteroplacental blood flow velocity-time waveforms in normal and complicated pregnancy. Br J Obstet Gynaecol.. 1985;92(1):39–45. Available from: https://pubmed.ncbi.nlm.nih.gov/3966989/
[32]. Mor S, Sirohiwal D, Hooda R. Eclampsia: maternal and perinatal outcomes in a tertiary care centre. Int J Reprod Contraception, Obstet Gynecol. 2017;4(3):653–7. Available from: https://www.ijrcog.org/index.php/ijrcog/article/view/1972
[33]. Lopez-Mendez MA, Martinez-Gaytan V, Cortes-Flores R, Ramos-Gonzalez RM, Ochoa-Torres MA, Garza-Veloz I, et al. Doppler ultrasound evaluation in preeclampsia. BMC Res Notes. 2013;6(1):477. Available from: /pmc/articles/PMC3843591/
[34]. Myatt L, Clifton RG, Roberts JM, Spong CY, Hauth JC, Varner MW, et al. The Utility of Uterine Artery Doppler Velocimetry in Prediction of Preeclampsia in a Low-Risk Population. Obstet Gynecol. 2012;120(4):815. Available from: /pmc/articles/PMC3449210/
[35]. View of A study of role of Doppler ultrasound in Pregnancy induced hypertension (PIH) and perinatal outcome | International Journal of Medical Research and Review. Available from: https://ijmrr.medresearch.in/index.php/ijmrr/article/view/537/1042
[36]. M H, RJ L, C Q, B S. Neonatal outcomes in pregnancies with preeclampsia or gestational hypertension and in normotensive pregnancies that delivered at 35, 36, or 37 weeks of gestation. Am J Obstet Gynecol. 2007;197(4):406.e1-406.e7. Available from: https://pubmed.ncbi.nlm.nih.gov/17904980/
[37]. McKenzie K-A, Trotman H. A Retrospective Study of Neonatal Outcome in Preeclampsia at the University Hospital of the West Indies: A Resource-limited Setting. J Trop Pediatr. 2019;65(1):78–83. Available from: https://academic.oup.com/tropej/article/65/1/78/4953526
[38]. Berhe AK, Ilesanmi AO, Aimakhu CO, Mulugeta A. Effect of pregnancy induced hypertension on adverse perinatal outcomes in Tigray regional state, Ethiopia: a prospective cohort study. BMC Pregnancy Childbirth. 2019;20(1):1–11. Available from: https://bmcpregnancychildbirth.biomedcentral.com/articles/10.1186/s12884-019-2708-6
[39]. Saadat M, Nejad SM, Habibi G, Sheikhvatan M. Maternal and Neonatal Outcomes in Women with Preeclampsia. Taiwan J Obstet Gynecol. 2007;46(3):255–9.
[40]. K A-B, MY N, SA O, JD S. Perinatal outcomes of hypertensive disorders in pregnancy at a tertiary hospital in Ghana. BMC Pregnancy Childbirth.2017;17(1). Available from: https://pubmed.ncbi.nlm.nih.gov/29157196/
[41]. NA A, BW D. Perinatal outcomes of hypertensive disorders in pregnancy at a referral hospital, Southern Ethiopia. PLoS

One. 2019;14(2). Available from: https://pubmed.ncbi.nlm.nih.gov/30817780/

[42]. P V, N R, A L, C A, I C, JC P, et al. Antenatal predictors of neonatal outcome in fetal growth restriction with absent end-diastolic flow in the umbilical artery. Am J Obstet Gynecol.. 2005;193(3 Pt 2):1213–8. Available from: https://pubmed.ncbi.nlm.nih.gov/16157140/

[43]. Perinatal and neonatal outcomes of growth restricted fetuses with positive end diastolic and absent or reversed umbilical artery doppler waveforms - PubMed Available from: https://pubmed.ncbi.nlm.nih.gov/18327368/

[44]. DG J, YS J, SJ L, N K, GS L. Perinatal outcomes and maternal clinical characteristics in IUGR with absent or reversed end-diastolic flow velocity in the umbilical artery. Arch Gynecol Obstet. 2011;284(1):73–8. Available from: https://pubmed.ncbi.nlm.nih.gov/20658142/

[45]. FG M, WC S, J R, C G-B. Intrauterine growth restriction with abnormal umbilical artery Dopplers: a harbinger for preeclampsia? J Matern Fetal Neonatal Med.2012;25(12):2658–61. Available from: https://pubmed.ncbi.nlm.nih.gov/22725654/

[46]. K N, H M, R Y, H K, S H, K I. Prevalence of umbilical artery Doppler waveform abnormality during the early second trimester and the subsequent variation of waveforms in monochorionic diamniotic twin pregnancies: A prospective cohort study. J Obstet Gynaecol Res. 2011;47(7):2338–46. Available from: https://pubmed.ncbi.nlm.nih.gov/33899318/

[47]. Herrador Z, Sordo L, Gadisa E, Moreno J, Nieto J, Custodio E, et al. Cross-Sectional Study of Malnutrition and Associated Factors among School Aged Children in Rural and Urban Settings of Fogera and Libo Kemkem Districts , Ethiopia. 2014;9(9):1–11.

PROFORMA

TOPIC: DOPPLER STUDY IN GESTATIONAL HYPERTENSION & IT'S PERINATAL OUTCOME

AGE:
EDUCATION:
OCCUPATION:
SOCIOECONOMIC STATUS:
HISTORY OF PRESENTING ILLNESS:
HISTORY OF PRSENT PREGNANCY:
I TRIMESTER:
II TRIMESTER:
III TRIMESTER:
MENSTRUAL HISTORY:
PAST MENSTRUAL HISTORY:

OBSTETRIC HISTORY:

- GRAVIDA: PARA: LIVE BIRTH: ABORTION: STILLBIRTH:
- LAST MENSTRUAL HISTORY:
- EXPECTED DATE OF DELIVERY:
- PERIOD OF GESTATION:

VERSION 1.0
4/8/21
1

MARRIED LIFE:
PREVIOUS PREGNANCY:

- SL.NO. :
- HISTORY OF DELIVERY:
- PUERPERIUM:
- OUTCOME OF PREGNANCY:

PAST HISTORY: H/O TB,HTN,DM,other systemic disease
FAMILY HISTORY:H/O TB,HTN,DM,other systemic disease
PERSONAL HISTORY:

EXAMINATION:

HEIGHT:
WEIGHT:
BMI:
BUILT:
PALLOR:
OEDEMA:
CYNOSIS:
CLUBBING:
LYMPHADENOPATHY
PULSE:
BLOOD PRESSURE:
RESPIRATORY RATE:
TEMPERATURE:

SYSTEMIC EXAMINATION:

Cardiovascular system:
Respiratory System:
Central nervous System:
Per Abdomen:

DIAGNOSIS:BLOOD INVESTIGATIONS:
CBC, Blood grouping and typing
FBS, PPBS
HIV-I,II,HBsAg, VDRL;
FT4;S.TSH
LFT, RFT
Urine:Albumin,Sugar,Microscopy

ULTRASONOGRAPHY:
- GA
- FHS
- Placenta
- AFI

COLOUR DOPPLER:
UMBILICAL ARTERY:
UTERINE ARTERY:
NST-Reactive/Non reactive

MODE OF DELIVERY:
Labour: Spotaneous/induced
Normal delivery or lower segment caeserian section
Normal Delivery: Instrumental/non instrumental
LSCS(Emergency/Elective)

NEONATAL OUTCOME

LIVE BORN:	BORN ALIVE & DEAD	STILL BORN
APGAR-1' 5'		
Sex of baby	M/F	
Birth wt in kg		
Congenital malformation	Yes	No
Neonatal morbidity	Yes	No
Preterm Baby		
Small for GA		
Admission to NICU:	Yes	No
Reason:		
Duration of admission:		
Condition at discharge:		

PATIENT INFORMATION SHEET

We are inviting you to participate in a research study "ROLE OF DOPPLER STUDIES IN GESTATIONAL HYPERTENSION AND ITS PERINATAL OUTCOME".My name is Dr NEHA P S and I am doing this study as part of my training at Mazumdar shaw Medical centre, Narayana Hrudayalaya Limited.We would like to enroll you into this study since you have (give the diagnosis / expected risk factor/ or expected procedure being done as part of standard of care)

1. What is the background and purpose of the study?

We will study the role of uterine artery and umbilical artery in known case of hypertension in pregnancy and it's perinatal outcome and mode of delivery .This study may help us to prevent increased chances of intrauterine deaths and perinatal deaths.

Do I have to take part?

It is up to you to decide whether to take part. If you decide to take part, you are still free to withdraw at any time and without giving a reason. This will not affect the standard of care you receive.

2. What will happen to me if I take part?

If you take part in the study, we will be collecting data by examining you and from your blood tests, ultrasound, urine test. These tests will be done as a part of work up before delivery or term. These tests will be done as a part of your standard care. You will be observed and followed up till delivery.

3. What do I have to do?

You will be asked to give consent if you are willing to participate in the study for collecting data from your antenatal examination,blood tests, ultrasound, urine examination and antenatal records.

4. What are the possible side effects, risks and complications of taking part?

There will be no much risk due to this study as we are only recording data and not carrying out any procedure unless needed for your care.

5. What are the possible benefits of taking part?

Early detection and early management of

intrauterine fetal hypoxia in a case of hypertension in pregnancy would improve fetal outcome. We could also detect the risk factor associated with it.

6. What if new information becomes available?

If any new information becomes available about the procedure being studied, the doctor will tell you about it and discuss with you whether you want to continue in the study. If you decide to withdraw your research doctor will make arrangements for your care to continue. If you decide to continue in the study, you will be asked to sign an updated consent form.

7. What are the costs of taking part?

There are no additional costs of taking part in the study.

8. How will my personal data be used?

Personal data will be used to determine maternal and fetal risk factors but privacy and confidentiality of your data will be maintained

9. Will there be provision for free treatment research related injury? There is no evidence of any major injuries associated with the procedure under the study.

10. Will compensation be paid to the subject if disability or death results from such injury? There are no injuries or risks associated with this study as this an observational prospective study. There will be no more than minimal risk due to this study as we are only recording data.

11. Whom should I contact if I need more information or help?

Contact the principal investigator: Dr. Neha P S, contact number: 9164479488