

Original article:

Importance of umbilical artery Doppler in unselected pregnancies for prediction of adverse perinatal outcome in western Maharashtra population

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ABSTRACT

Objectives - To evaluate the distribution of Doppler pulsatility index (PI) measurements of the umbilical artery values to assess the effects of routine umbilical Doppler ultrasound in unselected and low-risk pregnancies in western Maharashtra population coming to tertiary care centre, Fetal Medicine unit, SKNMC, Pune.

Aim: To evaluate the distribution of these Doppler values with neonatal outcome and perinatal morbidity.

Materials and methods - A prospective analytical study was performed at Fetal Medicine Unit, SKNMC, Pune, from September 2014 to August 2017. Total 4579 women were screened at routine antenatal visit during this period, out of which 400 were selected.

Results - UA PI values < 5th centile and > 95th centile increases perinatal morbidity & mortality.

Conclusion - umbilical artery doppler is a clinical tool which used in adjuvant with other dopplers will help us to guide further management and prediction of perinatal outcome. Fetal circulation as such has multiple variables and fetal outcome mainly related to hypoxia is measured by indirect means. In low resource setting and in rural India, we can use this method as it is easy to perform and operator expertise and errors are minimal.

INTRODUCTION

One of the main challenges of antenatal management is distinguishing between normal small fetuses and growth retarded fetuses, which are at increased risk of intrauterine death or asphyxia at birth. In hypoxic fetuses the blood velocity in the aorta is decreased. (1) Doppler measurement of blood velocity is non-invasive but requires expensive pulsed Doppler equipment and an experienced operator. The presence or absence of end diastolic frequencies in the umbilical artery can be ascertained with continuous wave Doppler equipment, which is much cheaper and requires less training of the operator. Many babies that are growth retarded because of uteroplacental insufficiency have birth weights that are within the normal range for gestational age. (2) If waveforms of flow velocity in the umbilical artery prove to be as useful a marker of prenatal asphyxia in well grown fetuses as they are in small fetuses they may replace measurement of fetal size for the antenatal prediction of fetal asphyxia. Missed diagnoses of fetal hypoxia might account for some "unexplained" stillbirths. (3)

Flow of the umbilical and fetal arteries is most often quantified either by pulsatility index or resistant index. These indices reflect the down stream vascular resistance by quantifying the differences between the peak systolic and the enddiastolic velocity within blood vessels of interest in each cardiac cycle. A high ratio in umbilical artery indicates a high vascular impedance and possible fetoplacental compromise. In extreme circumstance the blood flow at the end of diastole may be absent or even reversed.

Subjecting a large group of low-risk patients to a screening test with a relatively high false positive rate is likely to cause anxiety and lead to inappropriate intervention and subsequent risk of iatrogenic morbidity and mortality. (4)

The objective of our study is to assess the effects of routine umbilical Doppler ultrasound in unselected and low-risk pregnancies on obstetric practice and pregnancy. A low-risk population is defined as a population where those considered at risk have been excluded. In the context of this review 'unselected' pregnant population refers to a mixture of pregnant women with no identified risk factors and those who may have some risk factors but not reported separately.

MATERIALS AND METHODS

A prospective analytical study was performed at Fetal Medicine Unit, SKNMC, Pune, from September 2014 to August 2017. Total 4579 women were screened at routine antenatal visit during this period, out of which 400 were selected.

Inclusion criteria -

1. Pregnant women more than or equal to 28 weeks of gestation.
2. Women who are willing to perform the doppler study (written informed consent taken).

Exclusion criteria -

1. Pregnant women who are less than 28 weeks of gestation.
2. Multifetal pregnancies.
3. Diagnosed case of IUGR either clinically or ultrasonographically.

This visit included recording of maternal characteristics and medical history, and estimation of fetal size from transabdominal ultrasound measurement of biparietal diameter fetal head circumference, abdominal circumference and femur length. Determination of gestational age was done from menstrual history or measurement of the fetal crown-rump length at 11 weeks - 13 weeks 6 days gestation or the fetal head circumference at 19-24 weeks (5). UA was visualised by transabdominal colour doppler. Pulsed-wave Doppler was then used to assess impedance to flow; when three similar waveforms were obtained consecutively the PI was measured (6)

Doppler studies were performed using Seimens Acuson X300 Ultrasound machine by single Fetal medicine specialist using 5-MHz sector transducers with spatial peak temporal average intensities below 50 mW/cm² and the high-pass filter at 50-100 Hz. The said fetal medicine specialist had accreditation to FMF. Umbilical artery pulsatility index is measured at its midportion (7)

Angle of insonation kept as close to 0° as possible. Waveforms of good quality were collected and analyzed in the absence of fetal breathing movements. Waveform analysis was performed by measuring in the frozen display the maximum and minimum values of the velocity waveforms with the electronic calipers of the instrument (8). All images taken during this study were stored at PACS (Picture

archiving and communication system) electronic database in fetal medicine department at SKNMC, Pune.

When at least five consecutive uniform flow velocity waveforms with a high signal-to-noise ratio were obtained during periods of fetal rest and apnea the image was frozen and the waveforms were quantified using the PI.

Umbilical artery (UA) pulsatility index (PI) was calculated with the help of Barcelona fetal medicine calculator and reported in percentile form. Their relationship with GA was explored using regression analysis. An abnormal UA PI was defined as a UA below the 5th percentile for gestational age on the basis of the nomogram by Baschat and Gembruch. (7)

Maternal parameters studied were weeks of gestation, mode of delivery (vaginal or Cesarean section), complications during pregnancy (oligohydramnios, pregnancy induced hypertension).

Neonatal parameters studied were birth weight, NICU admissions, neonatal death.

Preterm delivery was defined as delivery before 37 completed weeks. Neonatal morbidity was assessed by the length of stay in the neonatal intensive care unit.

We have taken help of Barcelona fetal medicine calculator and perinatology calculators as derivation of MoM and percentile value is required for better prediction than mere numbers. Because of cost concern and affordability of patient, all babies were not subjected to ABG (arterial blood gas) at birth, but all babies in NICU were subjected to ABG examination as per protocol.

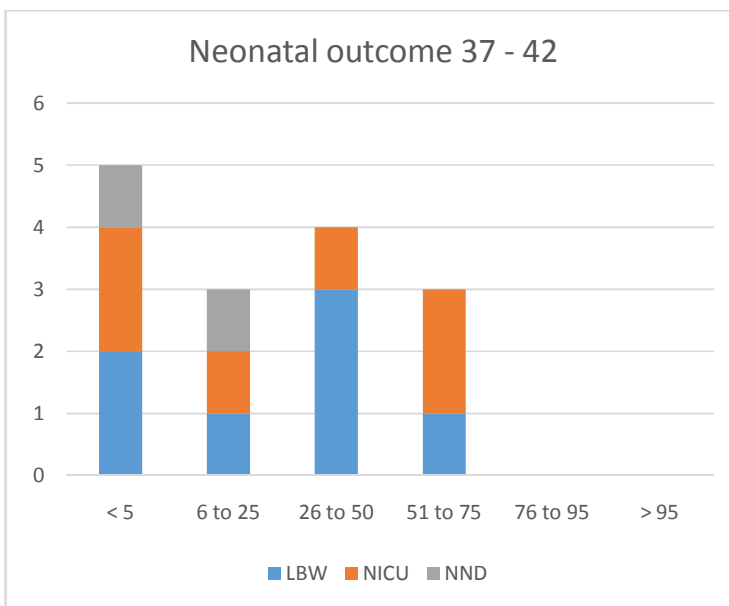
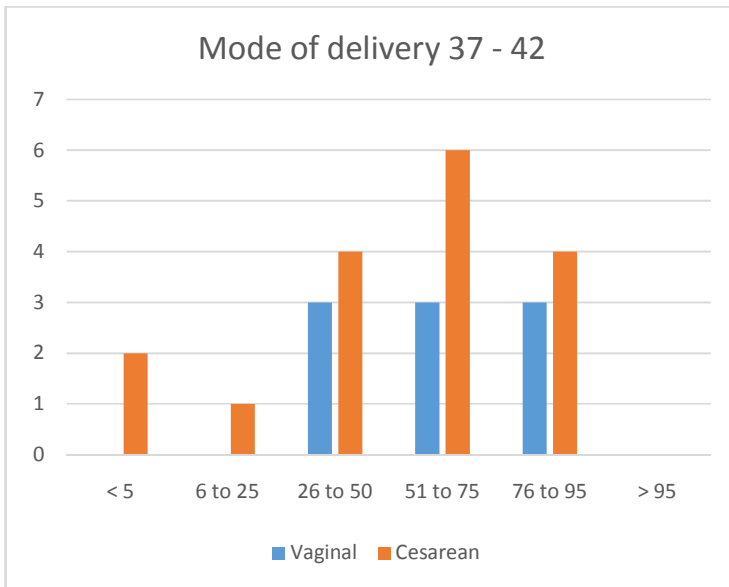
RESULT

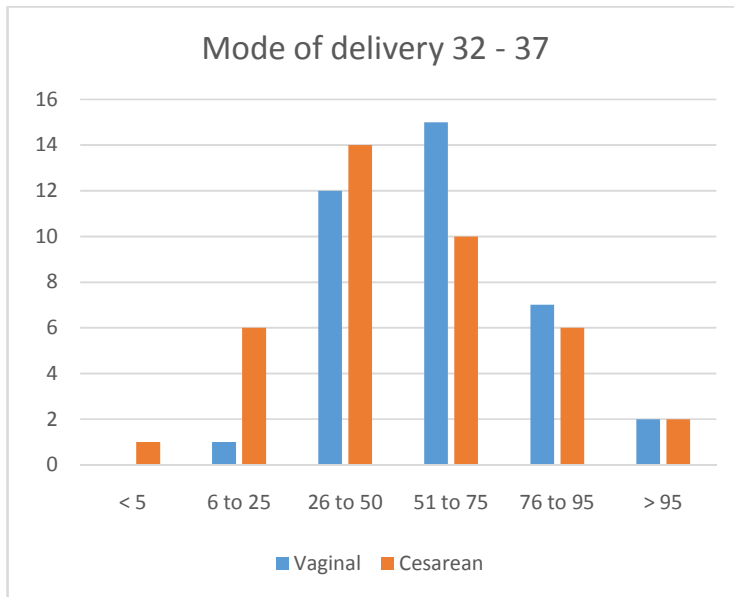
Generally umbilical artery more than 95 centile can predict poor outcome. Maternal and perinatal characteristics were evaluated and sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were calculated.

Overall cesarean rate is increased for delivering babies between 28 - 32 weeks gestation irrespective of UA values possibly due to policy of cesarean section in preterm deliveries. (Figure no.1)

Whereas abnormal UA values ($< 5^{\text{th}}$ and $> 95^{\text{th}}$ centile) at 28 - 32 weeks, 32 - 37 weeks & 37 - 42 weeks (Figure no. 2 - 8) has shown clear cut increased in cesarean section rate, NICU admission and duration of stay in NICU, Intrauterine deaths, low birth weight. We have categorically identified that UA PI values $< 5^{\text{th}}$ centile and $> 95^{\text{th}}$ centile increases perinatal morbidity & mortality.

Intrauterine deaths were observed more at $< 5^{\text{th}}$ and $> 95^{\text{th}}$ centile, but some deaths present at normal levels of UA which indicates other etiology.





DISCUSSION

In a clinical scenario, Doppler plays a very important role in predicting neonatal as well as perinatal outcome. Since 2002, there is progressive utilisation of doppler in western population. Because of time & patient's constraints, Dopplers were not used widely in Indian scenario.

We conducted a trail in our institute by doing extensive doppler study in all low as well as high risk patients coming to our department. We have found that uterine artery doppler has good predictive value in early trimester, so as to start aspirin. It also clearly demarcates between early & late IUGR which helps in early detection & prompt management.

According to Gardosi et al & his growth assessment protocol from 2018, he clearly demarcated that stillbirth can be prevented by minimising failure to diagnose IUGR.(9). In our study, we have seen that there is progressive increase in uterine artery pulsatility index & umbilical artery pulsatility index indicating increase demand of oxygen & nourishment to fetus.

Brain has initial high resistance blood flow. In response to rising umbilical & uterine artery PI, there is vasodilatation. Progressive increase in ambilical artery PI with decrease in MCA PI leads to slow deterioration of condition of baby. For planning of termination of pregnancy, we have to consider growth, placenta, liquor. Roughly umbilical artery doppler predicts fetal well being and prediction for 15 days.

DISCUSSION

This review includes data from 400 women. No differences in perinatalmortality were demonstrated, although there was considerable heterogeneity and the numberof participants remains too small to detect small but potentially significant changes inperinatal outcome.

The data from our studies using umbilical artery Doppler showed a significantreduction in potentially preventable perinatal mortality. In the Perth study conducted by Newnham in 1993(10), there was an unexpected finding of a greater risk ofintrauterine growth restriction in the serial umbilical ultrasound and Doppler examination group (i.e.the intensive monitoring group).

Cochrane database suggests that use of routine umbilical doppler for low risk or unselected population neigher benefit mother or baby(11). Trials should focus on potentially preventabledeaths and

inclusion criteria should reflect that. It would be also important to include assessment of neurodevelopment assessment of maternal outcomes and psychological effects on mother.

However, in this study we found that there is a greater risk of IUGR in serial ultrasound of patient who is having umbilical doppler at > 95th centile.

It also shows few cases were not consistent for associated with increase in umbilical pi with increase in perinatal morbidity and mortality in linear way. This finding may suggest that there will be additional factors that need to be investigated in further trials.

CONCLUSION

With abnormal umbilical doppler, there is significant increase in perinatal mortality and NICU admission between 32 - 37 weeks which may help us to decrease stillbirth.

This clearly indicates that umbilical artery doppler is a clinical tool which used in adjuvant with other dopplers will help us to guide further management and prediction of perinatal outcome. Fetal circulation as such has multiple variables and fetal outcome mainly related to hypoxia is measured by indirect means. In low resource setting and in rural India, we can use this method as it is easy to perform and operator expertise and errors are minimal. We clearly advocate to use umbilical doppler for all patients as no additional time and cost required. This will guide us towards evolving pathologies which will help us to reduce IUD and adverse perinatal outcomes.

LIMITATIONS –

1. Biases of selective assessment of a population referred for scan assessment a term so there will be a slightly higher than the expected proportion of at risk fetuses.
2. The results of the ultrasound and Doppler assessment were not blinded, giving rise to the possibility of subsequent clinical intervention and a 'treatment effect' in view of fetal safety.
3. The threshold for the diagnosis of fetal compromise is also likely to have been influenced by changing personnel and attitudes toward intrapartum management.

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