IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 17, Issue 11 Ver. 4 (November. 2018), PP 84-88
www.iosrjournals.org

Efficacy of Fetal Doppler Velocimetry Waveforms in Predicting Fetal Distress and Its Correlation with Umbilical Cord Blood Ph Analysis

Pooli Radhika[1]. Bharathi Sudha[1]

Abstract
Background: *The primary goal of all antenatal fetal surveillance tests is to identify fetuses at risk for asphyxia and death. The aim of this study is to demonstrate the effectiveness of ante partum Doppler velocimetry in detecting fetal distress and correlating it with umbilical artery blood gas analysis at birth and studying the neonatal outcome.*
Materials and methods: *This was a prospective study carried out in the Dept of Obstetrics and Gynecology in collaboration with Dept of Radiology at Gandhi Medical College/Hospital, Secunderabad, Telangana, India. 50 cases were studied between the years Sep 2015 and Oct 2016. The study was carried out on women with singleton pregnancies ≥ 34 weeks gestational age who underwent caesarean section within 5 days of undergoing fetal Doppler studies. Umbilical artery cord blood sample was collected in these subjects by standard collecting method for studying the pH value and the results were correlated with the ante partum Doppler studies.*
Results: *The efficacy of ante partum fetal arterial Doppler velocimetry in identifying fetal acidosis was determined. In the present study there was a statistical significance in the association between low pH and Middle cerebral artery and uterine artery abnormality on Doppler with an adverse neonatal outcome.*
Conclusion: *In this study there was a significant correlation between ante partum fetal arterial Doppler velocimetry and umbilical artery pH which is a sensitive indicator of fetal distress.*
Keywords: *Fetal Doppler velocimetry, Umbilical cord blood pH.*

Date of Submission: 02-11-2018 Date of acceptance: 16-11-2018

I. Introduction:

Attempts to access the intrauterine life have long been a challenge to obstetricians. Though ultrasound has been a part of prenatal care for as long as 40 years, it is the recent technological advances which have made it possible for early diagnosis and interpretation of intrauterine fetal condition.

World Health Organization (WHO) estimates that globally, between four and nine million newborns suffer from birth asphyxia each year leading to an estimated 1.2 million deaths[1,2]. The current perinatal mortality in India is 49 per 1000 births[3] of which fetal distress or birth asphyxia is the third leading cause[4]. Epidemiological data shows that by the time labor begins most of the cerebral damage has already taken place.

Fetal hypoxia or fetal distress initially will lead to decreased fetal movements to conserve energy, hemodynamic redistribution to favor the oxygenation of critical organs such as brain and heart. Further decompensation will lead to metabolic and respiratory acidosis, renal insufficiency with decreased amniotic fluid volume, myocardial compromise which finally leads to death. Fetal Doppler ultrasound provides a non-invasive method for the study of fetal hemodynamics. Investigation of the uterine and umbilical arteries gives information on the perfusion of the uteroplacental and fetoplacental circulations respectively, while Doppler studies of selected fetal organs are valuable in detecting the hemodynamic rearrangements that occur in response to fetal hypoxemia.

Significant associations between umbilical artery Doppler waveforms and blood gas levels at delivery have been demonstrated in many studies. In 1958, James et al. recognized that umbilical cord blood gas analysis can give an indication of preceding fetal hypoxic stress[5]. It has since become widely accepted that umbilical cord blood gas analysis can provide important information about the past, present and possibly the future condition of the infant. Umbilical cord blood gas analysis is now recommended in all high-risk deliveries by both the British and American Colleges of Obstetrics and Gynaecology[6,7].

NEED FOR STUDY:

The primary goal of all the antenatal fetal surveillance tests is to identify fetuses at risk for intrauterine injury and death. Ante partum tests should be successful in identifying the compromised fetus well in advance for any proper intervention to be taken.

Various Cochrane studies have shown Doppler studies to be superior to other ante partum fetal surveillance tests in predicting fetal distress. Estimating the efficacy of fetal Doppler will prevent adverse neonatal outcomes[8]

One of the methods to demonstrate effectiveness of ante partum Doppler in detecting fetal distress is to assess the correlation of Doppler abnormalities with neonatal asphyxia as determined by umbilical artery blood gas analysis. This forms the main purpose of this study.

AIM & OBJECTIVES:

To determine the efficacy of antenatal fetal Doppler in predicting fetal distress by correlating it with neonatal umbilical cord blood gas analysis and detecting fetal acidemia.

II. Material And Methods:

This was a prospective study conducted in the Department of Obstetrics & Gynaecology at Gandhi hospital Secunderabad in the period September 2015 to October 2016 with a sample of 50. Subjects included were women with singleton pregnancies with a gestational age≥ 34weeks who underwent cesarean section within 5 days of undergoing fetal Doppler. None of the patients were in labour.

III. Methodology:

50 patients who have met the inclusion criteria were enrolled into this study. Informed consent was taken. For each case a detailed history was taken followed by general, systemic and obstetric examination. The patients besides routine investigations underwent serial Fetal Doppler every 6 days until delivery by caesarean section. Pulsatality index which is measurement of (peak systolic velocity - end diastolic velocity) / time averaged velocity = (PSV - EDV) / TAV was measured from the uterine arteries, umbilical artery and the middle cerebral artery. Pulsatality Index was considered abnormal when the values were more than 95th percentile for that gestational age in uterine & umbilical artery & less the 5th centile for MCA.

Umbilical cord blood analysis was performed for all the study cases by collecting umbilical artery blood samples, the sample was analyzed within 30 minutes as recommended by the clinical and Laboratory Standards Institute(CLSI)[8]. PH was taken as abnormal when it was less than 7.2.

IV. Observations And Results:

A total of 50 patients who met the inclusion criteria were included into this study. The study was conducted between September 2015 and October 2016 in Gandhi Medical College / Hospital, Secunderabad.
All the cases in the study population underwent fetal Doppler studies

TABLE 1: **DISTRIBUTION OF NORMAL AND ABNORMAL DOPPLER STUDIES**

DOPPLER	NO.OF CASES(PERCENTAGE)
NORMAL	16(32%)
ABNORMAL	34(78%)

In this study out of 50 cases, 34 cases had abnormal Doppler and 16 cases had normal Doppler.
The following table shows the various abnormalities of fetal Doppler in the study population:

TABLE 2: VARIOUS DOPPLER ABNORMALITIES IN THE STUDY:

ABNORMAL DOPPLER	NUMBER OF CASES	PERCENTAGE
RIGHT UTERINE ARTERY	18	52.94%
LEFT UTERINE ARTERY	15	44.12%
UA-DECREASED DIASTOLIC FLOW	24	70.59%
UA-ABSENT EDF	4	11.76%^
UA-REVERSAL OF FLOW	2	5.88%
MCA CENTRALIZATION	14	41.17%
COMBINED UTERINE,UMBILICAL,MCA ABNORMALITIES	11	22%

In this study majority of the cases had reduced diastolic flow in the umbilical artery (70.59%) followed by abnormality in the uterine arteries. 11 cases (22%) had combined abnormalities of uterine, umbilical and middle cerebral arteries.

UMBILICAL ARTERY BLOOD GAS ANALYSIS:

Umbilical artery blood gas analysis was done in all the newborns in the study population and was analyzed as below:

TABLE 3 : DISTRIBUTION OF CASES ACCORDING TO PH VALUE

PH	NUMBER OF NEONATES
PH<7.2	20
PH≥7.2	30

PIE DIAGRAM 1: DISTRIBUTION OF CASES ACCORDING TO pH

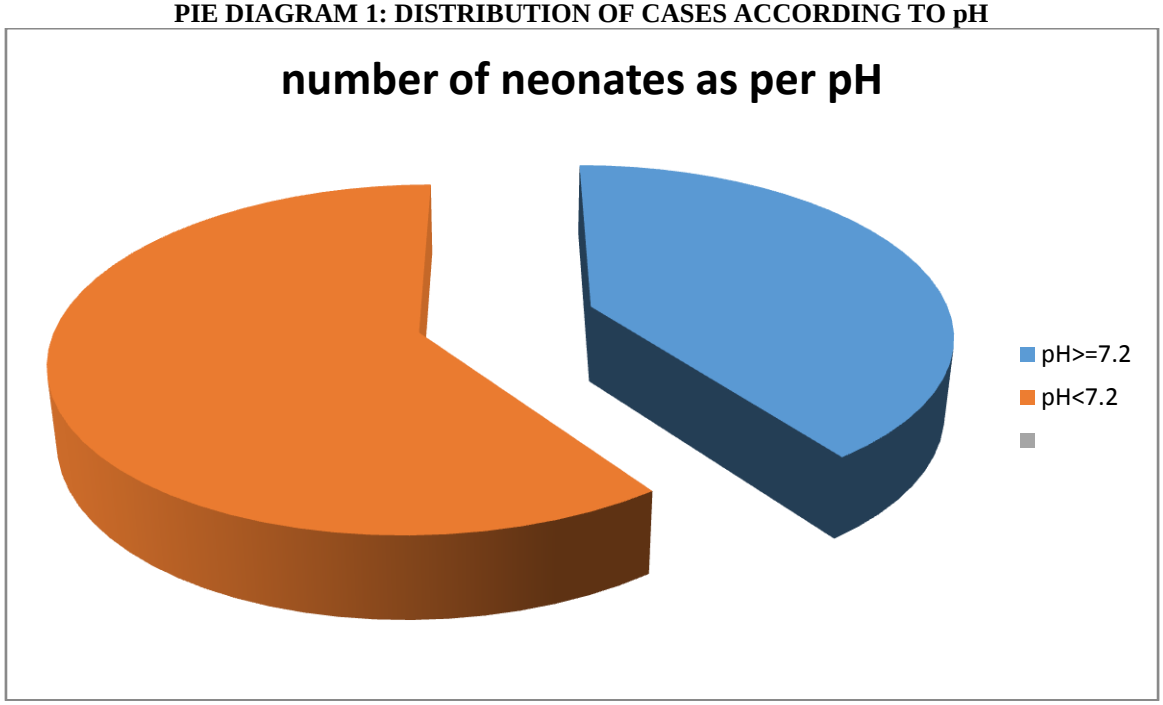


TABLE 4 CORRELATION OF DOPPLER STUDIES WITH UMBILICAL CORD BLOOD pH:

The relation between the fetal Doppler and the umbilical artery blood gas analysis was done in all the 50 cases included in the study. The following table depicts the cases pH value and their Doppler findings.

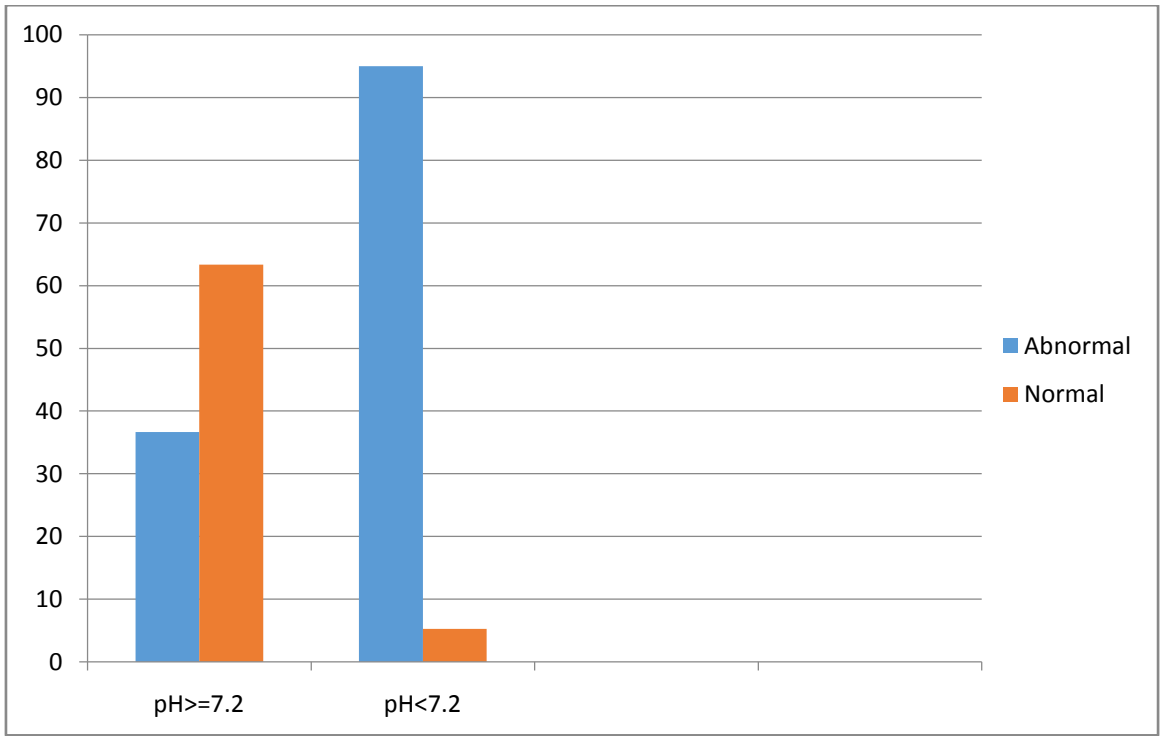
	NUMBER OF CASES	NORMAL DOPPLER (PERCENTAGE)	ABNORMAL DOPPLER(PERCENTAGE)
PH≥7.2	30	19(63.33%)	11(36.67%)
PH< 7.2	20	1(5.26%)	19(95%)

Chi-Square test	14.670
P value	0.0001

In this study majority of the cases with PH<7.2 had abnormal Doppler findings (95%) whereas only 11% of the cases with PH>7.2 had abnormal Doppler findings.

Using Fischer-exact test the calculated p value is 0.0001 which is statistically significant.

BAR DIAGRAM 1: DISTRIBUTION OF CASES IN RELATION TO DOPPLER FINDINGS AND Ph VALUES:



.In this study cases with abnormal Doppler were followed up and umbilical artery blood gas analysis was studied. The mean pH of cases with different abnormalities of Doppler was studied. The pH lowered with sequential increase in fetal Doppler abnormalities

TABLE 5 : CORRELATION OF DOPPLER WITH UMBILICAL CORD ABG:

	Present study
Mean PH in cases with abnormal umbilical artery Doppler	6.85
Mean PH in cases with abnormal Doppler of MCA	6.95

The mean pH in the middle cerebral artery Doppler group was higher than mean pH in the umbilical artery abnormal group with a statistical significance.

.

A similar study done by Zahra Fardiazar et al.[9] in 2010 who studied 100 fetuses and compared Fetal Doppler results with newborn arterial blood gas analysis.

TABLE 6

	Zahra Fardiazar et al.	**Present study**
Mean maternal age	28+_7years	25.8+_4.29 years
Mean GA	31.79+_2.59wks	37.02+_1.89wks
Decreased diastolic flow in umbilical artery	54%	70.59%
Absent diastolic flow in UA	22%	11.76%6
Reversal of flow in UA	3%	5.88%
Brain sparing effect	51%	41.17%
Association between low PH & abnormal UA Doppler	No statistical significance	Significant in cases with absent or reversal of flow
Association between low PH & MCA Doppler	No statistical significance	Statistical significance present
PH<7.0	5	8

V. **Discussion:**

Fetal distress or birth asphyxia still remains a major problem in the developing countries and underdeveloped countries despite advances in fetal surveillance methods and resuscitative measures. The main disadvantage of the surveillance methods is that they detect fetal compromise much late in the disease cascade. The neonatal mortality rate in India is one of the highest in the world and fetal distress or birth asphyxia is considered the third most common cause behind poor outcome of the neonate.

Fetal Doppler has long been regarded as a useful indicator of fetal compromise. One of the first trials correlating the degree of compromise with the changes in Fetal Doppler was done by Kurt Hecher et al in 1995 in 105 women .the compromised group consisted of 37 fetuses delivered by caesarean section. The mean values

for Doppler parameters of the compromised groups differed significantly from the noncompromised groups. This is comparable to the present study in which only 5.2% of the cases with normal Doppler had fetal distress whereas 95% of the cases with abnormal Doppler had fetal compromise and had a statistical significance. A study done by Dhand Hemalatha et al[10] in 2011 on 121 women with single term pregnancies. In that study low PI in MCA was found in 13 cases(18.3%) and PI > 95 percentile was found in 29 cases (40.85%).In the present study, abnormal MCA and umbilical artery Doppler was found in 41.17% and 70.59% respectively. In their study 28 cases (96.55%) with abnormal uterine artery PI had NICU admissions in contrast to the present study in which only 29.16% of the cases with abnormal UA PI were admitted to NICU.

Umbilical blood gas analysis gives an insight into the past, present and future distress in the newborn. Umbilical blood gas analysis is now recommended in all high risk deliveries by both British and American college of Obstetrics and Gynaecology. James et al[5] in 1958 recognized that umbilical cord blood gas analysis can give an indication of preceding hypoxic fetal stress which can be predicted by fetal Doppler velocimetry studies. Information from umbilical cord blood sampling can be useful immediately after birth from medical and medico legal perspectives since it provides insight into intrapartum fetal physiology.

Tyrell S et al.[11] (1989) studied the relationship between preoperative umbilical artery Doppler waveforms and umbilical vein pO2 and pH at elective cesarean section and observed that the absence of end-diastolic velocity in umbilical artery had a strong statistical association with hypoxia and acidosis and was a sensitive indicator of perinatal morbidity and mortality.

Yoon B H et al[12] (1992) studied 105 singleton pregnancies in which caesarean section was performed, Doppler studies showed a significant correlation with the umbilical artery pH and was found to be a sensitive indicator of fetal acidosis. The mean pH was lower in the present study compared to the study done by Zahra Fardiazar et al.33 But the mean pH in the abnormal MCA Doppler group was higher than mean pH in umbilical artery abnormality group in both the studies. This substantiates the fact that abnormalities in umbilical artery and MCA have a good role in prediction of fetal distress. But in the above quoted study the association between pH<7 and Doppler abnormalities of Umbilical artery and Middle Cerebral Artery were not statistically significant in contrast to the present study. Worsening Umbilical artery acidosis was directly and adversely related to increased neonatal morbidity in this study.

VI. Conclusion & Summary:

1) Confirmation of suspected fetal distress through newborn umbilical cord acid base study is recommended to prevent an overestimation of fetal distress or a misinterpretation of fetal heart rate patterns and abnormal Doppler findings.

2) Increasing umbilical artery PI values have a strong negative linear correlation with decreasing pH values.

3) The sensitivity and specificity of antenatal fetal Doppler in predicting fetal compromise is 95% and 63.3% respectively.

4)) The positive and negative predictive values of antenatal fetal Doppler in predicting fetal compromise is 63.3% and 95% respectively

References

[1]. Inappropriate useof the terms fetal distress and birth asphyxia. ACOG committee opinion no.197.Washington DC ; American College of Obstetricians and Gynaecologists, 1998. Obstee Gynaecol. 2005; 106(6); 1469-70.

[2]. Hamilton BE,Martin JA, Ventura SJ. Births; Preliminary Data for 2012. National vital statistics report. 2012 Sep 6; 62(3): 1-20.

[3]. Cousens S, Blencowe H ,Stanton C, Chou D Ahmed S, Steinhardt L et al. Natinal, regional, and worldwide estimates of stillbirth rates in 2009 with trends since 1995 : A systematic analysis. The Lancet 2011 APR 16;377(9774): 1319-30.

[4]. Lozano R Wang H, Foreman KJ, Rajaratnam JK, Naghavi M, Marcus JR, et al. Progress towards millennium development goals 4 and 5 on maternal and child mortality; an updated systematic analysis . The Lancet 2011;378(9797):1139-65.

[5]. James LS, Weisbrot IM , Prince CE, Holaday DA, Apgar V . The acid base status of human infants in relation to birth asphyxia and the onset of respiration. J Pediatr 1958 Apr;52(4):379-94.

[6]. RCOG Clinical Effectiveness Support Unit. The use of electronic fetal monitoring: the use and interpretation of CTG in intrapartum fetal surveillance. London: RCOG, 2001, search via http://www.rcog.org.uk (accessed 10 April 2007).

[7]. ACOG Committee Opinion No. 348, November 2006: Umbilical cord blood gas and acid base analysis. Obstet Gynaecol 2006 Nov; 108(5): 1

[8]. Blonshine et al. Procedures for collectionof arterial blood specimens. Clinical and laboratory standards institute 2004 Sep;24(28) :9-18.

[9]. Fardiazar Z et al. Comparision of fetal middle cerebral arteries, umbilical and uterine artery. Color Doppler ultrasound with blood gas analysis in pregnancy complicated by IUGR. J Reprod Med 2013; 11(1): 47- 51.

[10]. Dhand H et al . Middle cerebral artery Doppler indices beeter predictor for fetal outcome in IUGR.J Obstet Gynecol India 2011;61:166-7111.

[11]. Tyrell S et al. Umbilical Artery Doppler velocimetry as a predictor of fetal hypoxia and acidosis at birth. Obstet Gynecol. 1989 Sep;74 (3):332-37.

[12]. Yoon BH et al. The efficacy of Doppler umbilical artery artery velocimetry in identifying fetal acidosis- A comparision with fetal biophysical profile. J Ultrasound Med.1992 Jan;11(1):1-6.