

Accuracy of Cardiotocography in Diagnosing Fetal Distress

MEHWISH ZAFAR¹, SAIRA JAMSHED², SARA YASEEN³, AYESHA KHALID⁴, MEHMOODA MEMON⁵

¹Senior Registrar, Department of Obstetrics and Gynaecology, Hamdard Hospital, Karachi, Pakistan

²Associate Professor, Department of Obstetrics and Gynecology, Hamdard Hospital, Karachi, Pakistan

³Postgraduate Trainee, Department of Obstetrics and Gynecology, Hamdard Hospital, Karachi, Pakistan

⁴Senior Registrar, Department of obstetrics and Gynaecology, Allied Hospital-1, Faisalabad, Pakistan

⁵Senior Registrar, Obstetrics and Gynecology, United Medical and Dental College, Karachi, Pakistan

Correspondence to: Mehwish Zafar, Email: wish_984@hotmail.com

ABSTRACT

Background: Surveillance of fetus is a simple method of identifying at risk fetuses for neonatal and delayed complications secondary to asphyxia and therefore preventing morbidity and mortality. Still the clinicians are not able to identify the perinatal asphyxia. Methods used to identify the fetal surveillance are clinical foetal heart auscultation, meconium staining of amniotic fluid, fetal scalp sampling and cardiotocography.

Worldwide the method for Electronic foetal monitoring i-e; EFM is during labour. This method determines different patterns of fetal heart. The screening test like umbilical cord blood pH monitoring, blood gases and excess measurements are used for validating it with CTG for screening of patients during labor. An easy method of investigating fetal oxygenation is umbilical artery sampling.

Objective: To determine the accuracy cardiotocography for diagnosing fetal distress and comparing with umbilical cord arterial blood pH.

Methodology: This cross-sectional study was conducted in the department of Gynaecology and Obstetrics, Abbasi Shaheed Hospital, Karachi after the approval from institution for duration of six months, from July 2021 to January 2022. The sample size of study was n=70, the inclusion criteria CTG traces were taken for fetal heart irregularities taken before 30min of delivery. APGAR was calculated at 1 and 5 minutes. Just after the birth a segment of umbilical cord of nearly 10-15cm was clamped and samples of blood of 3ml was collected from umbilical vein and artery by trained staff and blood gas analysis was done within 30min. The statistical analysis with kappa statistic used to measure between umbilical cord arterial pH and CTG with value >0.8 is taken as significant.

Results: Out of n=70 patients minimum age was 24 while the maximum age 37years. Mean age was 30.07±4.11 years, gestational age was 37.09±1.26 weeks, and parity was 2.7 ±1.81 respectively. Accuracy came out to be 70.0%. 21 (30%) and 49 (70%) had positive and negative fetal distress respectively.

Conclusion: The strength of agreement between umbilical cord arterial pH and CTG is weak in determining fetal distress. In institutions where umbilical cord availability is not present, CTG can be used to determine fetal distress as a screening tool especially in low resource areas.

Keywords: Fetal distress, accuracy, cardiotocography and umbilical cord arterial blood pH.

INTRODUCTION

Fetal distress is the non re-assuring condition of fetus in pregnancy or in labor leading to intrauterine hypoxia around 85% of four million births per year in US require fetal monitoring to check for fetal distress¹⁻³. Most common interpretation of fetal distress is the transient asphyxia which may impair blood gas exchange mechanism and will cause metabolic acidosis with mortality of 2.54%^{4,5}.

Neonatal mortality and morbidity due to asphyxia can have effects like seizures, hypoxic encephalopathy, cerebral palsy, haemorrhage, and delayed developmental effects. In transient asphyxia there may not be a pathological impact however numerous metabolic acids accumulate if there is a significant exposure and thus affects neonatal morbidity and mortality. Different characteristic patterns are present showing deceleration like late, variable deceleration or bradycardia.

Cardiotocography is the screening method used to identify the maternal contractions and fetal heart rate during labor in the last trimester of pregnancy and in labor. In order to identify the fetuses at risk of fetal hypoxia are screened by the CTG in order to take timely action and intervention⁴. A prospective study in 2022 showed abnormal CTG is a good predictor of meconium stained liquor but is not a good predictor in identifying fetal hypoxia or acidosis and therefore abnormal fetal heart rate judiciously used leads to increasing cesarean sections⁵. Therefore, CTG interpretation is of crucial importance and needs to have a more reliable, objective method.

Umbilical artery blood gas analysis is the now the gold standard method to identify fetal wellbeing with utero-placental functions and fetal acid base disturbances and excludes asphyxia

at birth in term infants⁶⁻⁸. The adequate oxygen in fetus and in the mother can be determined with fetal well being be assessed. Umbilical artery is therefore an easy accessible way of determining oxygenation of fetus during labor by fetal acidemia. Studies have shown that 74% patients presenting with acidosis at birth were in fetal distress and were delivered by cesarean sections and were found to have low APGAR scores⁷⁻⁹. Another study by Ghafoor et al¹⁰ has also shown that abnormal CTG have high predictive values with neonatal/ fetal distress.

Our study was aimed to determine CTG accuracy in diagnosing fetal distress due to paucity of local statistics in identifying the patients at risk of neonatal injury in order to prevent morbidity and mortality.

METHODOLOGY

The cross-sectional study was conducted in the department of Obstetrics and Gynecology of Abbasi Shaheed Hospital, Karachi. Ethical approval was taken and the study was conducted for the period of six months, from July 2021 to January 2022. The sample size of our study was n=70 with confidence interval of 95%. The study involve the non probability sampling. The inclusion criteria involved age 20-40yrs, women at term gestation >35weeks on ultrasound, singleton pregnancy, cephalic presentation while the patients excluded were who do-not give consent, h/o stroke, renal impairment, congestive heart failure, chronic liver diseases, chronic obstructive disease, mal presentation, membrane rupture, major congenital malformation. CTG traces was taken in active stage preferably 30 min before delivery for FHR irregularities. The outcome was monitored with fetal heart rate changes leading to cesarean section or forceps delivery, presence of meconium stained liquor, APGAR <7min, umbilical cord acidemia with pH <7.2. All the patients enrolled in inclusion criteria have CTG recordings done to monitor for fetal heart beat and uterine

Received on 25-04-2023

Accepted on 20-08-2023

contractions and classified according to NICE guidelines into reassuring i-e; normal, non reassuring as suspicious and abnormal as pathological. The samples were taken from umbilical cord pH and analyzed in a pre-heparinized syringe. True positive fetal distress was labelled as having fetal distress on CTG as well as on umbilical cord arterial blood pH. While the true negatives are the ones with fetal distress negative on CTG as well as on umbilical cord arterial blood pH.

The data was analyzed in SPSS version 16. The mean and standard deviation was calculated for quantitative variables for age, gestational age and parity. Percentages and frequencies were calculated for qualitative variable for age, gestational age and parity. True positive and true negative and accuracy of CTG by comparing with blood pH taken from umbilical cord was calculated. Kappa statistics was calculated to determine the strength between umbilical cord blood pH and CTG. Stratification was done with regards to age, parity and gestational age to determine the outcome variable.

Post stratification kappa statistics was applied and k-value of ≥ 0.8 was considered significant.

RESULT

Out of total $n=70$ patients visiting the Department of Gynecology and Obstetrics, Abbasi Shaheed hospital, Karachi the age range was 24-37 years with mean and standard deviation of 30.07 ± 4.11 years. Mean gestational age and parity was 37.09 ± 1.26 weeks and 2.77 ± 1.81 respectively. Accuracy came out to be 70% (Table 1). Out of 70 patients, 21 (30%) and 49 (70%) had positive and negative fetal distress respectively (figure 1). Maternal age frequency was 40 (56.3%) and 30 (42.3%) were in age group 21-30 years and 31-40 years respectively. Gestational age frequency showed that out of 70 patients, 37 (52.9%) and 33 (47.1%) were in gestational age group 35-37 weeks and 38-40 weeks respectively. (table 1). the parity of patients out of $n=70$ was $n=48$ (68.6%) and 22 (31.4%) patients with parity of <3 and >3 respectively (table 1).

Kappa statistics to assess the strength of association was done which showed that out of 70 patients who underwent cardiotocography 21 (27.4%) and 17 (22.6%) had positive and negative results respectively. Whereas out of 70 patients who underwent umbilical cord arterial blood pH 21 (41.5%) and 04 (5.8%) had positive and negative results respectively. So, the

kappa statistic on the above values was 0.4 which shows fair agreement between two values.

Age stratification shows age under 21-30 with respect to fetal distress showed that 11 (27.5%) and 29 (72.5%) had positive and negative fetal distress respectively. The accuracy was found to be 67.5% and the K-value was 0.38. As presented in table 2.

While the age under 31-40 with respect to fetal distress showed that 10 (33.33%) and 20 (67.67%) had positive and negative fetal distress respectively. The accuracy was found to be 73.33% and the K-value was 0.48. As presented in Table 2.

For the gestational age under 35-37 with respect to fetal distress showed that 12 (32.43%) and 25 (67.57%) had positive and negative fetal distress respectively. The accuracy was found to be 70.27% and the k value was 0.43. As presented in table 2

While for gestational age under 38-40 with respect to fetal distress showed that 09 (27.27%) and 24 (72.72%) had positive and negative fetal distress respectively. The accuracy was found to be 69.69% and the k value was 0.40. As presented in table 2.

The parity <3 with respect to fetal distress showed that 14 (29.17%) and 34 (70.83%) had the positive and negative fetal distress respectively. The accuracy was found to be 75% and k-value was recorded as 0.5 (Table 2.) While the parity >3 with respect to fetal distress showed that 07 (31.81%) and 15 (68.19%) had the positive and negative fetal distress respectively. The accuracy was found to be 59.09% and k- value was recorded as 0.22. (Table 2.)

RESULTS

Table 1: Demographic variables and Frequency

Demographic variables	Frequency(Percentages)
Age \pm SD	30.07 \pm 4.11 years.
Gestational age	
Parity	
<3	48(68.6%)
>3	22(31.4%)
Maternal age	
21-30	40 (57.14%)
31-40	30(42.86%)
Gestational age distribution	
35-37	37(52.86%)
38-40	33(47.14%)
Parity	
<3	48(68.57%)
>3	22(31.43%)

Table 2: Fetal distress and comparison of factors with cardiotocography

		Cardiotocography		Accuracy	K value
		Yes	no		
Age	Umbilical cord arterial blood pH				
21-30yrs		11(50%)	2 (11.12%)	67.50%	0.38
31-50yrs		10(62.5%)	2 (14.28%)	73.3%	0.48
Gestational age	Umbilical cord arterial blood pH				
35-37weeks		12(57.14%)	2(12.5%)	70.27%	0.43
38-40weeks		9(52.94%)	2(12.5%)	69.69%	0.4
Parity	Umbilical cord arterial blood pH				
<3		14(58.34%)	2(8.34%)	75%	0.5
>3		7(50%)	2(25%)	59.09%	0.22

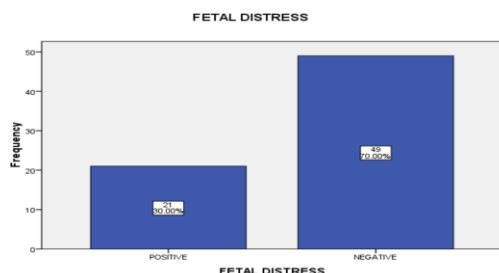


Figure 1

DISCUSSION

Worldwide, Fetal asphyxia in the intrapartum period is one of the leading cause of neonatal morbidity and mortality with neurological complications accounting for 23%¹². Birth asphyxia causes oxygen lack and hypercapnia which affects cardiac functioning. Studies have shown that there is an association of acidemia and complications in newborn affecting multi-organs involvement¹³

In our study out of 70 patients enrolled the age range from 24 to 37yrs with mean age of 30.07 ± 4.11 years, gestational age and parity of 37.09 ± 1.26 weeks and 2.77 ± 1.81 respectively. Accuracy came out to be 70%. 21 (30%) and 49 (70%) had positive and negative fetal distress respectively. The study by Nadeem et al has found mean age 26.35 ± 6.79 yrs with more primi

gravida mothers ¹². Another case control study has found increased perinatal asphyxia in primi gravida mother 52.1% ¹³.

Studies have shown that in low income, developing countries perinatal asphyxia can be controlled by reducing biological, social and psychosocial factors. The induction of labor reduces by 97% perinatal asphyxia, and monitoring of fetal heart rate reduces by 99%.

In Pakistan, numerous studies have identified different risk factors for risk identification and therefore to control birth asphyxia and fetal distress which increases neonatal morbidity and mortality. Our study also identifies fetal monitoring benefits for early identification of birth asphyxia.

CONCLUSIONS

The strength of agreement between CTG and umbilical cord arterial blood pH in detecting fetal distress is weak. In the absence of umbilical cord arterial blood pH availability, CTG may be a reasonable fetal distress screening method, especially in low resource settings.

REFERENCES

1. CDC. Births and Natality. (2021). Available online at: <https://www.cdc.gov/nchs/fastats/births.htm> (accessed September 27, 2021).
2. Shahzadi Saima Hussain, Syeda Sitwat Fatima, Tanveer Shafqat, Qudsia Qazi. Fetal outcome after caesarean section performed for fetal distress based on abnormal cardiotocography. *J Med Sci Jan - Mar 2021*;29(01):13-6
3. Mahnaz Raees, Laila Zeb. Perinatal outcome of patients undergoing cesarean section for fetal distress. *Gomal J Med Sci Jan - Mar 2023*;21(1):21-5
4. Akmal H, Hardalaç F, Ayturan K. A Fetal Well-Being Diagnostic Method Based on Cardiotocographic Morphological Pattern Utilizing Autoencoder and Recursive Feature Elimination. *Diagnostics (Basel)*. 2023 Jun 1;13(11):1931. doi: 10.3390/diagnostics13111931.
5. Gupta K, Haritwal A, Makhija B, Bhandari R. Is fetal CTG a reliable indicator of fetal distress? A prospective study on relationship between CTG suspected fetal distress and immediate postpartum umbilical cord blood pH. *J CLIN MED KAZ*. 2022;19(1):57-64. <https://doi.org/10.23950/jcmk/11683>
6. Olofsson P. Umbilical cord pH, blood gases, and lactate at birth: normal values, interpretation, and clinical utility. *Am J Obstet Gynecol*. 2023 May;228(5S):S1222-S1240. doi: 10.1016/j.ajog.2022.07.001. Epub 2023 Mar 19.
7. Brandstetter M, Neuner M, Dinges C, Hofstätter E, Wohlmuth C, Fazelnia C, Fischer T, Bogner G. Fetal Doppler monitoring during maternal open-heart surgery: Case report and key aspects of a multidisciplinary challenge. *Eur J Obstet Gynecol Reprod Biol*. 2023 Aug;287:63-66. doi: 10.1016/j.ejogrb.2023.05.034. Epub 2023 May 29.
8. Daydulo, Y.D., Thamineni, B.L., Dasari, H.K. et al. Deep learning based fetal distress detection from time frequency representation of cardiotocogram signal using Morse wavelet: research study. *BMC Med Inform Decis Mak* 22, 329 (2022). <https://doi.org/10.1186/s12911-022-02068-1>
9. Wajeeha Syed, Nazia Liaqat, Qudsia Qazi, Sumaira Yasmin. Relationship between immediate postpartum umbilical cord pH, fetal distress and neonatal outcome. *Pak J Med Sci Dec 2020*;36(7):1529-32
10. Saadia Ghafoor, Muhammad Al Fareed Zafar. Comparison of pathological versus suspicious cardiotocography in predicting fetal distress in terms of apgar score and umbilical cord ph at one minute on caesarean section. *Pak Postgrad Med J Jul - Sep 2023*;34(3):121-4.
11. Syeda Tahira Sherazi, Shazia Batool, Amna Noor, Sana Javed, Ayesha Hussain Sial, Muhammad Kashif Munir. Determination of Meconium Stained Liquor among Fetal Distress Lead Cesarean Mothers. *Pak J Med Health Sci Jun 2023*;17(6):86-8
12. Msisiri LS, Kibusi SM, Kimaro FD. Risk Factors for Birth Asphyxia in Hospital-Delivered Newborns in Dodoma, Tanzania: A Case-Control Study. *SAGE Open Nurs*. 2024 Apr 24;10:23779608241246874. doi: 10.1177/23779608241246874.
13. Masanja PP, Kibusi SM, Mkhoe ML. Predictors of Early Onset Neonatal Sepsis among Neonates in Dodoma, Tanzania: A Case Control Study. *J Trop Pediatr*. 2020 Jun 1;66(3):257-266. doi: 10.1093/tropej/fmz062.
14. Tolu LB, Birara M, Teshome T, Feyissa GT. Perinatal outcome of meconium stained amniotic fluid among labouring mothers at teaching referral hospital in urban Ethiopia. *PLoS One*. 2020 Nov 13;15(11):e0242025. doi: 10.1371/journal.pone.0242025.
15. Torres-Muñoz J, Fonseca-Perez JE, Laurent K. Biological and psycho-social Factors, risk behaviors, and perinatal asphyxia in a university hospital: matched case-control study, Cali, Colombia (2012-2014). *Front Public Health*. 2021 Jun 21;9:535737. doi: 10.3389/fpubh.2021.535737.

This article may be cited as: Zafar M, Jamshed S, Yaseen S, Khalid A, Memon M: Accuracy of Cardiotocography in Diagnosing Fetal Distress. *Pak J Med Health Sci*. 2023;17(9): 119-121.