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PREDICTIVE ACCURACY OF ADMISSION CARDIOTOCOGRAPHY IN SCREENING FOR FETAL ACIDOSIS USING UMBILICAL CORD PH AMONGST PARTURIENTS IN ABUJA, NIGERIA.

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ABSTRACT

BACKGROUND: *Assessment of fetal wellbeing during labour may be achieved through cardiotocography (CTG) on admission. It is a screening test that can detect fetuses with existing compromise or predict fetal wellbeing in labour. It allows for timely intervention to reduce possible neurological damage and perinatal death. The linkages between this screening and perinatal outcome is being explored in this study.* ***OBJECTIVE:*** *To evaluate the accuracy of cardiotocography in predicting neonatal asphyxia and to analyze cardiotocographic findings of parturients on admission with neonatal outcome.* ***METHODS:*** *This was a cross-sectional study of parturients in the labour ward of National Hospital Abuja between October 2018 to March 2019. A 20 minutes admission cardiotocography was done in parturient who fulfilled the inclusion criteria and classified according to National Institute for Health and Care Excellence (NICE)-Clinical guideline 2017. Umbilical cord arterial blood pH status and Apgar score were documented. The data was analyzed with the aid of Statistical Package for Social Sciences (SPSS) version 22. Test of association for categorical variables were done using the chi-square test, P value <0.05 was regarded as statistically significant. Predictive accuracy of admission carditocography was determined using sensitivity, specificity and tests for predictive value.* ***RESULTS:*** *Out of 170 parturients, 147(86.5%) recorded a normal tracing, 20(11.8%) had suspicious tracing, while a pathological tracing was recorded in 3(1.8%). Using pH <7.2 as a criteria for diagnosing acidosis, admission cardiotocography as a screening test had a sensitivity of 73.3%, specificity of 97.3%, positive predictive value of 47.8%, negative predictive value of 92.3% and a predictive accuracy of 90.6%.* ***CONCLUSION:*** *Admission cardiotocography helps in identifying early fetal compromise, so that early intervention can be made thereby reducing fetal mortality and morbidity.*

KEYWORDS: *Admission CTG, mode of delivery, ph status, Apgar score, diagnostic accuracy.*

INTRODUCTION

Intrapartum fetal monitoring has witnessed great advancement in technology in recent years. This can be partly attributed to increasing number of litigations, majority of which are as a result of intrapartum events leading to perinatal morbidity and mortality.[1] Obstetricians are concerned with recognition of fetal hypoxia early during labour using safe, easy and quick assessment of fetal wellbeing thereby predicting fetal compromise early enough to allow intervention and avoid adverse neonatal outcome.[2] The aim of this study is to evaluate the role of the admission cardiotocography in intrapartum patients in predicting fetal hypoxia detected by cord blood arterial pH measurements.

MATERIALS AND METHODS

This was a cross-sectional study involving parturients attending the labour ward of the National Hospital, Abuja. Women who fulfilled the inclusion criteria (i.e., gestational age of 37 to 42 completed weeks, active phase of labour with cervical dilatation ≥4cm, cephalic presentation) and gave an informed consent were consecutively enrolled in the study. The Huntleigh Healthcare BD4000XS CTG machine was used for the admission cardiotocography. The parturient was asked to empty her bladder and the procedure, including what to expect during the procedure and what was expected of her was explained to her. The ultrasound transducer was applied to the maternal abdomen with a gel interface for the cardio transducer and tracing was taken at a speed of 1cm/min for 20 minutes with the parturient in left lateral position. The patient was asked to press the event marker every time she perceives fetal movement. Presence of spontaneous fetal heart rate accelerations with fetal movement is an indicator of fetal wellbeing.

The cardiotocograph tracing was classified as normal, suspicious or pathological as proposed by National

Institute for Health and Care Excellence (NICE)-Clinical guideline 2017.[3]

Based on the parameters recorded by the cardiotocography machine, the findings were either reassuring, non reassuring or abnormal:
In **reassuring** cardiotocography, the baseline fetal heart rate was between 110 to 160 beats per minute, baseline variability of 5 to 25 beats per minute, and absence or an early deceleration. In **non-reassuring** trace, the fetal heart rate ranged between 100 to 109 or 161 to 180 beat per minute. The baseline variability was less than 5 for 30 to 50 minutes or more than 25 for 15 to 25 minutes. Variable decelerations with no concerning characteristics for more than 90 minutes or more, or in up to 50% of contractions for 30 minutes or more, or late decelerations in over 50% of contractions for less than 30 minutes with no maternal or fetal clinical risk factors such as vaginal bleeding or significant meconium were non reassuring.

Abnormal findings included fetal heart rate below 100 or above 180 beat per minute, baseline variability less than 5 for more than 50 minutes or more than 25 for more than 25 minutes or sinusoidal pattern or the presence of variable deceleration in over 50% of contraction for 30 minutes or late deceleration for 30 minutes or acute bradycardia or a single prolonged deceleration lasting 3 minutes or more.

Management of women based on interpretation of cardiotocograph traces included: **normal** category where all features are reassuring, intermittent auscultation with handheld sonicaid every 30 minutes in first stage of labour and every 5 minutes in second stage of labour and the women were adequately counseled.

If cardiotocograph tracing was **suspicious**, the underlying causes such as hypotension or uterine hyperstimulation etc. if any were corrected. Cardiotocograph tracing was continued for 30 more minutes and thereafter re-categorized appropriately to either reassuring or abnormal, and appropriate management instituted.

For **pathological** tracings, patients were reviewed in collaboration with a senior obstetrician and delivery expedited depending on the clinical situation and cervical dilatation to prevent adverse outcome.

Cord blood collection
Immediately after delivery of the baby, the umbilical cord was clamped in four places to isolate a 10 cm segment, the cord was cut between the two sets of clamps such that an isolated segment independent of both the baby and placenta had a clamp insitu. The umbilical artery was immediately identified in the cord and if difficult the cord was dabbed with saline soaked gauze and 1-2mls of blood was aspirated with a pre-heparinized syringe. The blood sample was analyzed within 15 minutes of collection using a rapid point of care analyzer (Abbott i-STAT®□1 Analyzer MN: 300, East Windsor, NJ-08520- USA). The umbilical cord artery blood pH was used to assess for fetal acidosis. An umbilical artery pH of <7.20 defined fetal acidosis.[4]

RESULTS
Table I shows that the majority of respondents, 147(86.5%) recorded a normal tracing, 20(11.8%) had suspicious tracing, while pathological tracing was recorded in 3(1.8%).

Amongst the parturients with normal CTG tracings, a larger number, 134 (91.2%) had spontaneous vaginal delivery, while 13(8.8%) delivered abdominally. About a third, 8(40%) of Parturients with suspicious CTG tracings had abdominal delivery. Parturients with abnormal CTG tracing, 3(100%) all had abdominal delivery. There was a statistically significant difference in mode of delivery among the patients with the various cardiotocographic tracings on admission (p-value<0.001). There is tendency for Caesarean section with worsening admission cardiotocography tracing. This is shown in Table II.

Amongst the parturients with normal CTG tracings, a significant majority, 143 (97.3%) had cord blood pH levels >7.2, with a fraction 4(2.7%) recording levels suggestive of asphyxia (<7.2). About a third, 8(40%) of Parturients with suspicious CTG tracings had pH levels < 7.2. Parturients with abnormal CTG tracing, 3(100%) all had cord blood pH levels <7.2. There was a statistically significant relationship in cord blood pH levels among parturients with various admission cardiotocographic tracings (p-value<0.001) as shown in table III.

The **Apgar scores** at the 1st minute ranged from 2-9, with a mean of 7.38 ± 1.55 SD, the fifth minute Apgar scores ranged from 3-10, with a mean of 8.94 ± 1.69 SD. The babies with a depressed Apgar score (<7) in the first minute were resuscitated by the attending Mid-wife / neonatologist and subsequently taken to the neonatal intensive care unit (NICU) for further evaluation. Seventeen babies (10%) had a first minute APGAR core of < 7 and six (3.5%) babies had fifth minute Apgar scores of < 7.

Tables IV depicts the CTG categories with Apgar scores at the first minute. In the normal group, most of the parturients (97.2%) delivered babies with normal Apgar scores; only 4 (2.7%) neonates had depressed Apgar scores. Whereas in the pathological group 3 (100%) neonates had depressed Apgar scores. There was a statistically significant association between the results of the CTG and the Apgar score in the 1st minute. (X^2; 70.16, p-value <0.001)

Tables V shows the CTG categories with Apgar scores at the fifth minute. In the normal group, most of the parturients (99.3%) delivered babies with normal Apgar scores; only 1 (0.7%) neonate had depressed Apgar

scores. Whereas in the pathological group 3 (100%) neonates had depressed Apgar scores. There was a statistically significant association between the results of the CTG and the Apgar score in the 5th minute. (X^2; 60.13, p-value <0.001)

As shown in Tables VI and VII, the sensitivity of admission cardiotocography as a screening test for predicting perinatal asphyxia (cord blood pH<7.2) was found to be 73.3%%. Its positive predictive value was 47.8%, the specificity was 97.3%. The negative predictive value was 92.3%. The overall predictive accuracy of the test was 90.6%.

Table I. Admission Cardiotocography Trace Patterns.

CTG TRACING	FREQUENCY(n=170)	PERCENTAGE (%)
NORMAL	147	86.5
SUSPICIOUS	20	11.8
PATHOLOGICAL	3	1.8
TOTAL	170	100

Table Ii. Admission Cardiotocography And Mode Of Delivery.

CTG FINDINGS	MODE OF DELIVERY			TEST STATISTICS	
	VAGINAL DELIVERY	CAESAREAN SECTION	TOTAL	X^2	P-value
NORMAL	134 (91.2%)	13(8.8)	147(100%)		
SUSPICIOUS	12 (60%)	8(40%)	20(100%)		
PATHOLOGICAL	0	3(100%)	3 (100%)		
TOTAL	146	24	170	32.67	<0.001

Table Iii. Admission Cardiotocography And Cord Blood Ph.

CTG FINDINGS	CORD BLOOD PH			TEST STATISTICS	
	<7.2	≥7.2	TOTAL	X^2	P-value
NORMAL	4(2.7%)	143(97.3%)	147		
SUSPICIOUS	8(40%)	12(60%)	20		
PATHOLOGICAL	3(100%)	0	3		
TOTAL	15(8.8%)	155(91.2%)	170	61.96	<0.001

Table Iv. Admission Cardiotocography Findings And Apgar Score At One Minute.

CTG FINDINGS	APGAR SCORE (1 minute)			TEST STATISTICS	
	0-6	7-10	TOTAL	X^2	P-VALUE
NORMAL	4	143	147		
SUSPICIOUS	10	10	20		
PATHOLOGICAL	3	0	3		
TOTAL	17	153	170	70.16	<0.001

Table V. Admission Cardiotocography Findings And Apgar Score At Five Minutes.

CTG FINDINGS	APGAR SCORE (5 minutes)			TEST STATISTICS	
	0-6	7-10	TOTAL	X^2	P-VALUE
NORMAL	1	146	147		
SUSPICIOUS	2	18	20		
PATHOLOGICAL	3	0	3		
TOTAL	6	164	170	60.13	<0.001

Table Vi: Screening Test Results.

SCREENING TEST	PERINATAL ASPHYXIA	NO PERINATAL ASPHYXIA	TOTAL
Positive (Abnormal and non-reassuring CTG	True +ve (a) **11**	False +ve (b) **4**	(a+b) **15**

Pattern)			
Negative (Normal CTG pattern)	False -ve (c) **12**	True -ve (d) **143**	(c+d) **155**
Total	(a+c) **23**	(b+d)**147**	(a+b+c+d) **170**

Table Vii: Predictive Accuracy Of Admission Cardiotocography Test.

PARAMETER	FORMULA	VALUE (%)
Sensitivity	a/(a+c) X 100	73.3%
Specificity	d/(b+d) X 100	97.3%
Positive predictive value (PPV)	a/(a+b) X 100	47.8%
Negative predictive value (NPV)	d/(c+d) X 100	92.3%
Diagnostic Accuracy	(a+d)/(a+b+c+d) X 100	90.6%

DISCUSSION

In our study of 170 parturients more than half (51.2%) of the antenatal women were multigravida. Out of the 170 women, 147(86.5%) had normal cardiotocographic tracing, 20(11.8%) had suspicious and only 3(1.8%) had pathological tracing. This is similar to the findings by Kushtag et al. in India, which showed 86.6% of the tracings to be normal, 7.4% suspicious and 0.6% pathological.[5] This is also consistent with results reported by Rahman et al. which showed 76.9% and 14.4% in the normal and suspicious tracings respectively.[6] The pathological tracing from that study was 8.7%, which was higher than what was obtained from our study. However, their study was done only on high risk obstetric cases.

Rajalekshmi et al. conducted a study on admission test with 400 antenatal women in India and 66.7% of patients had normal tracing, 28.5% suspicious tracing and 4.75% had pathological tracing.[7] Their normal tracing was lower than what was found in our study and could be because their study was done only on low risk parturients and excluding all women that were high risk in labour. While in the study by Ray et al. 50.2% of the subjects had category I (normal) CTG tracing, 36.5% had category II (suspicious) CTG tracing and 13.3% had category III (abnormal) intrapartum CTG tracing.[1] This was not similar to what was obtained in our study. The group of patients involved in the study could have contributed.

On analyzing the admission test tracing in relation to mode of delivery, only 13(8.8%) of the normal group had Caesarean section, but 8(40%) of the suspicious group and 3(100%) of the pathological group had Caesarean section. This finding showed that abnormal tracings were associated with increased incidence of Caesarean section than normal trace. In a study by Rajalekshmi et al. 39.2% of the reactive trace had Caesarean section, but 51.4% of suspicious and 9.4% of the ominous had Caesarean section.[7] The inclusion of instrumental delivery could be responsible for the lowered Caesarean section rate in their report. Vanita et al. also found that most of the Caesarean delivery occurred in the abnormal cardiotocography group.[8] They found statistically significant relationship between non reactive test and increased Caesarean section rate, making it a salvage intervention in response to abnormal tracings that aimed at saving the life of babies.

In the present study, mean cord blood pH was 7.28 ± 0.73. The umbilical arterial cord blood pH of <7.2 at birth was taken as the cut off value to define acidosis in the neonate, as previously defined in the study by Ray et al.[1] Fifteen (8.8%) of the neonates in the current study had acidosis which is lower than the study by Aboulghar et al. who recorded 34% neonates with acidosis.[9] The higher prevalence of acidosis in the neonates in their study compared with the current study could be explained by the fact they included only those women who had undergone Caesarean section for pathological and suspicious CTG, while in our study, consecutive term labouring women were included.

From the current study, lower fifth minute Apgar scores were more in the non reassuring and abnormal groups as compared to the reassuring group. Similar results were obtained from other studies.[2], [7], [10] The Apgar score in the first minute correlated better with pH than the fifth minute Apgar score, although both were statistically significant. This is expected since the first minute Apgar score reflects the intrauterine state of the fetus, while the fifth minute Apgar score reflects the effects of resuscitative efforts.[11] Similar findings were reported in the study by Aboulghar et al.[9]

From the current study, the diagnostic ability of the CTG as a screening test gave a sensitivity of 73.3% and specificity of 97.3% in detecting acidosis, which meant that an abnormal CTG tracing could detect subjects with acidosis and it had a good ability to identify those who did not have acidosis because of its high specificity. It was also found that CTG as a screening test had a positive predictive value of 47.8% and negative predictive value of 92.3%, which meant that in absence of an abnormal CTG, the chance of having acidosis was very little. The overall diagnostic accuracy of admission CTG in diagnosing fetal acidosis was 90.6%. The specificity, negative predictive value, and diagnostic accuracy of cardiotocography as a screening test is

comparable to the study by Rajalekshmi et al. in India, that reported the values as 94.0%, 96.0% and 93.7% respectively.[7] This may be due to the fact that consecutive patients at term with cephalic presentation in active phase of labour were also used for the study.

In a study by Bhartiya et al. the sensitivity, specificity, and positive predictive value of admission cardiotocography in detecting intrapartum fetal distress was 25%, 75.3% and 39.6% respectively.[12] This was lower compared to what was obtained in our study perhaps due to the fact that Apgar scoring system instead of pH studies was used as a criteria for fetal distress and with its attendant subjectivity.

From the findings of the present study, the high sensitivity and specificity of the CTG, as well as its low cost and ease of carrying out the monitoring supported its use in intrapartum fetal monitoring and in alerting the obstetrician regarding an intra-uterine hypoxic event.

CONCLUSION

In conclusion, admission cardiotocography helps in identifying early fetal compromise, so that early intervention can be made thereby reducing fetal morbidity and mortality. It also shows that there is a good link between reactive tracings and good fetal outcome using umbilical cord arterial blood gases for detection of fetal acidosis and vice versa. Hence the admission test can be used as a useful tool to predict women in early labour who would need special attention in order to reduce perinatal morbidity and mortality.

CONFLICT OF INTEREST: Nil
SOURCE OF SUPPORT: Nil

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