DOI: 10.7860/JCDR/2022/51835.15965

Original Article

Obstetrics and Gynaecology Section

Association between Intrapartum Cardiotocography and Umbilical Cord Blood pH in Term Pregnancies: A Cross-sectional Study in a Tertiary Care Centre, Kolkata, India

ROSHNI SETHIA[1], ANIMESH NASKAR[2], SAIKAT TRIPATHY[3], RUPKAMAL DAS[4]

ABSTRACT

Introduction: Labour, a physiological process for majority of foetuses, often acts as a challenge to foetal reserves causing foetal hypoxia. Foetal monitoring with intrapartum cardiotocography is an important tool to enable timely intervention to reduce adverse neonatal outcomes like postnatal cerebral palsy.

Aim: To determine an association between cardiotocography tracing and umbilical artery cord blood pH in term pregnancies in labour where the influence of drugs and the presence of other co-morbid medical/obstetric adverse outcomes have been ruled out.

Materials and Methods: This cross-sectional, hospital-based, observational study involved singleton uncomplicated term pregnancies with a normal baseline cardiotocography and spontaneous labour onset and progression admitted to the Labour Ward of the Department of Obstetrics and Gynaecology, of R.G. Kar Medical College and Hospital, Kolkata, West Bengal, India. Intrapartum continuous cardiotocography traces were recorded and those showing abnormal traces were documented and delivery expedited within two hours. Total of 90 such consecutive women were included in the study and umbilical arterial cord blood sample was taken for all these pregnancies immediate postpartum. Cardiotocography traces were then statistically compared with cord blood parameters and the findings were computed using Statistical Package for the Social Sciences (SPSS) software version 22.0.

Results: Out of 90 participants, the mean age was 24.21±3.43 years, most (43, 47.8%) of them were in between 21 to 25 years. Of the abnormal traces, 51 (56.7%) were NICE Category II (suspicious) and 39 (43.3%) were NICE category III (pathological). Cord blood analysis revealed that 40% had a pH value <7.0, 44.4% had blood lactate levels above 6 mmol/L and another 47.7% had a base deficit ≥12 mmol/L. On cross-tabulation and Chi-square analysis, these were all found to be statistically significant (p-value <0.05). Abnormalities of Foetal Heart Rate (FHR) and baseline variability had higher Odds ratio of predicting umbilical artery acidemia with Odd's ratio for baseline variability abnormality as high as 2.768.

Conclusion: Although there has been a rising trend towards operative deliveries, the overall incidence of neonatal morbidity due to cerebral palsy is still on the rise. Cardiotocography can be a very important tool to identify neonatal acidosis in "at risk" foetuses and helps in timely intervention giving long term best outcomes.

Keywords: Cord blood analysis, Foetal acidosis, Foetal heart rate

INTRODUCTION

Labour is a stressful event for the foetus [1]. When a vigorous foetus enters labour and there is successive development of hypoxia, foetal monitoring with cardiotocography can be an important tool to enable timely intervention and delivery of a healthy child [1]. Blood gas and lactate analysis of the umbilical cord blood during the first minutes of life is a useful and inexpensive way of quantifying, objectively the occurrence of hypoxia or acidosis just prior to birth [2].

It is theorised that intrapartum cardiotocography can detect foetal hypoxia and/or acidosis allowing timely intervention to reduce adverse neonatal outcomes such as postnatal cerebral palsy [3]. To involve intrapartum hypoxia/acidosis as the reason of cerebral palsy in term infants, there is a requirement to document the existence of metabolic acidosis in umbilical artery cord blood [2].

Over the years, there has been a lot of work on the validity of electronic foetal monitoring and how it correlates with foetal outcome in high-risk pregnancies. However, it has been observed that the apparently "low-risk" cohort of pregnancies contributes more significantly to perinatal morbidity and mortality. Very few studies have been conducted that aim to quantify foetal hypoxia in these low-risk settings [3-5]. The present literature is sparse when it comes to providing sufficient statistical power to explore the relationship between intrapartum FHR patterns and neonatal acidemia with an adjustment for several confounders including important maternal co-morbidities and the effect of intrapartum drugs and analgesia [3].

The main purpose of the present study was to help identify these apparently low-risk foetuses at the brink of impending acidosis so as to deliver them at "the window of opportunity", before severe neurological damage sets in. The aim of the present study was to establish an association between cardiotocography and umbilical artery cord blood pH in term pregnancies in labour where the influence of drugs and presence of other co-morbid medical/obstetric adverse outcomes have been ruled out.

MATERIALS AND METHODS

This was a cross-sectional, hospital-based, observational study conducted over a period of 18 months from January 2019 to June 2020 in the Labour Ward of the Department of Obstetrics and Gynaecology, R.G. Kar Medical College and Hospital, Kolkata, West Bengal, India. Ethical clearance was obtained through proper channel from the Institutional Review and Ethics Committee vide memo no. RKC/295.

Inclusion criteria: Singleton pregnancy, maternal age 15 to 30 years, term gestation (gestational age: 37 to 41^{+6} weeks), cephalic

presentation, spontaneous onset and progress of labour, normal baseline cardiotocography and those who had given informed consent for the study, patients admitted during the study period for safe confinement were included in the study.

Exclusion criteria: Pregnant women with preterm premature rupture of the membranes, premature rupture of the membranes, oligo/polyhydramnios, pregnancies with induced or augmented labour (use of oxytocics), high-risk gestations (anaemia, hypertension, diabetes mellitus, epilepsy, asthma), multifoetal gestation and malpresentations were excluded from the study. Women undergoing elective Cesarean (C)-section, foetuses with congenital anomalies and diagnosed foetal growth restriction, documented abnormal umbilical doppler study and abnormal baseline cardiotocography, pregnant women with antepartum haemorrhage, placental abruption etc., were excluded from the study.

Sample size calculation: The study "Intrapartum cardiotocography and its association with umbilical cord blood pH in term pregnancies: a prospective study" by Ray C and Ray A conducted over the Indian population showed a [4]:

**52.5% incidence of foetal acidosis in those with pathological cardiotocography trace

**22.7% incidence of foetal acidosis in those with suspicious cardiotocography trace.

At a confidence interval of 95% and the power of the study set at 80%, cord blood pH <7.0 was chosen as the primary outcome measure and the sample size for the present study was calculated as:

$$n = \left\{ \frac{\left(Z_\alpha \sqrt{2\bar{p}(1-\bar{p})} + Z_\beta \sqrt{P_1(1-P_1) + P_2(1-P_2)} \right)^2}{(P_1 - P_2)^2} \right\}$$

n is the sample size

Zα is the confidence interval i.e., 1.96 for 95%

Zβ is the power of the study i.e., 0.84 for 80%

P_1 is prevalence of foetal acidosis in those with pathological cardiotocography i.e., 0.525

P_2 is prevalence of foetal acidosis in those with suspicious cardiotocography i.e., 0.227

$$\bar{p} = \frac{P_1 + P_2}{2}$$

It was thus calculated that a total of 82 women would be required for the study.

A further 10% was included to account for missing data/technical failures. Overall, it was estimated that 90 women should be recruited for the purpose of the study and considering the daily admission rate, it will be possible to achieve this number within the stipulated study period.

Study Procedure

Over the period of study, women with uncomplicated term gestation were enrolled as per the inclusion/exclusion criteria of the study. After enrolment, every pregnant mother was subjected to a routine physical and obstetrical assessment along with ultrasonographic examination of placenta, foetal well being and biometry. Labour was monitored through partography and continuous intrapartum cardiotocography. Details regarding patient profile, history, gestational age at onset of labour, phase of labour (active or latent), state of membranes on admission, characteristics of liquor after rupture of membranes, cardiotocographs, details of termination and delivery, baby records and cord blood analysis were recorded in study proforma sheets. Pregnancy was neither augmented nor induced and was allowed to progress spontaneously.

Intrapartum continuous cardiotocography was performed using departmental monitor machine BPL FM9852 EF. Traces were recorded at a speed of 1 cm/min.

Foetal heart rate patterns were interpreted using the NICE 2017 guidelines. All cardiotocography traces were studied by a single trained personnel so as to eliminate interobserver bias. The tocogram and cardiogram were both studied and details regarding FHR, variability and decelerations were all documented in a tabular form.

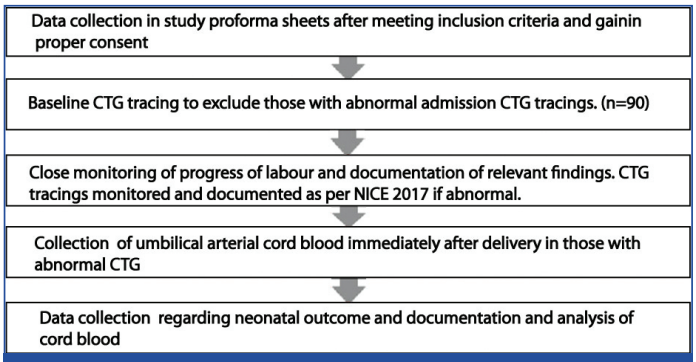
National Institute for Health and Care Excellence (NICE) 2017 categorisation [6]:

Category I-Normal: All features reassuring

Category II-Suspicious: 1 non reassuring feature and 2 reassuring feature

Category III-Pathological: 1 abnormal feature or 2 non reassuring features.

In subjects with abnormal traces recorded, umbilical cord blood was collected after birth. Umbilical blood gas concentrations change significantly with time after birth, so collection was done immediately postpartum [7]. Blood was collected by aspiration into two separate 2 mL preheparinised syringes carefully to avoid air acculmulation. Syringes were then capped and rolled adequately to ensure proper mixing of blood and heparin, and arterial blood gas analysis performed in the departmental calibrated machine within half an hour of collection. Metabolic acidosis was defined as the measurement in umbilical artery blood of pH value <7.0 and Base Deficit (BD) value in excess of 12 mmol/L [8]. The entire procedure has been documented in [Table/Fig-1].



[Table/Fig-1]: Study procedure.
CTG: Cardiotocography

STATISTICAL ANALYSIS

Data was entered into Microsoft Excel datasheet and all analysis was performed using SPSS software version 22.0. Data was represented in the form of frequencies and proportions and Chi-square test was used as a measure of significance. A p-value <0.05 was considered statistically significant.

RESULTS

The study population was normally distributed for various characteristics like age, period of gestation, admission to delivery interval, birth weight etc., as shown in [Table/Fig-2].

Baseline variability was the most common abnormal cardiotocography finding as shown in [Table/Fig-3], whereas decelerations were the most common non reassuring feature. Almost 16 (17.8%) cardiotocography traces had abnormal decelerations, while 24 (26.7%) had abnormal baseline variability. Of the abnormal traces, 51 (56.7%) were NICE category II and the 39 (43.3%) were NICE category III.

[Table/Fig-4] shows the results of cord blood analysis which revealed that 36 (40%) had a pH <7.0, 40 (44.4%) had blood lactate levels in excess of 6 mmol/L and another 43 (47.7%) had a base deficit ≥12 mmol/L. The mean pO_2 values were found to be 51.34±15.414 mm of Hg, which of pCO_2 was calculated as 53.73±11.722 and of HCO_3 as 19.133±2.9925 mmol/L.

[Table/Fig-5] shows that pH value <7.0, base deficit ≥12 mmol/L and lactate ≥6 mmol/L were all found to be statistically significant

Characteristics		Value
Mean maternal age (in years)		24.21±3.43
Age range (in years)	15 to 20	17 (18.9%)
	21 to 25	43 (47.8%)
	26 to 30	30 (33.3%)
Mean gestational age (in weeks)		38.57±1.01
Gravida	1	28 (31.1%)
	2	36 (40%)
	3	18 (20%)
	4	6 (6.7%)
	5 or more	2 (2.2%)
Period of gestation (in completed weeks)	Early term	42 (46.7%)
	Full term	29 (32.2%)
	Late term	19 (21.1%)
Membrane status	Intact	54 (40%)
	Ruptured	36 (60%)
Foetal movements	Adequate	70 (77.8%)
	Reduced	20 (22.2%)
Mean admission to delivery interval (in hours)		4.84±1.40
Average birth weight (in kilograms)		2.67±0.28
Neonatal outcome	Discharged	77 (85.6%)
	Death	13 (14.4%)

[Table/Fig-2]: Distribution as per various demographic variables.

Cardiotocography features		Category II (n=51, 56.7%)	Category III (n=39, 43.3%)	Frequency
Baseline foetal heart rate	Reassuring	40 (44.4%)	23 (25.6%)	63 (70%)
	Non reassuring	11 (12.4%)	8 (8.8%)	19 (21.2%)
	Abnormal	0	8 (8.8%)	8 (8.8%)
Baseline variability	Reassuring	37 (41.1%)	6 (6.7%)	43 (47.8%)
	Non reassuring	14 (15.5%)	9 (10%)	23(25.5%)
	Abnormal	0	24 (26.7%)	24 (26.7%)
Decelerations	Reassuring	26 (28.9%)	15 (16.7%)	41 (45.6%)
	Non reassuring	25 (27.8%)	8 (8.8%)	33 (36.6%)
	Abnormal	0	16 (17.8%)	16 (17.8%)

[Table/Fig-3]: Distribution as per cardiotocography features and category (NICE 2017) [6].

Cord blood parameter	Value	Frequency	Percent
pH	*<7.0	36	40%
	≥7.0	54	60%
Base deficit	<12.0 mmol/L	47	52.22%
	*≥12.0 mmol/L	43	47.78%
Lactate	<6.0 mmol/L	50	55.55%
	≥6.0 mmol/L	40	44.45%

[Table/Fig-4]: Distribution on the basis of cord blood analysis.
*Foetal umbilical artery acidemia defined as pH <7.0 or base deficit ≥12 mmol/L or both [8]

with p-value <0.05. Umbilical cord blood pCO_2 and HCO_3 both were found statistically not significant.

[Table/Fig-6] shows that abnormalities of FHR and baseline variability had higher odds of predicting umbilical artery acidemia. The odd's ratio for FHR abnormality was as high as 2.768 in predicting umbilical artery acidemia.

DISCUSSION

Conventionally, for many years, the diagnosis of intrapartum hypoxia has been based on the clinical signs of foetal distress (like meconium staining of liquor and FHR abnormalities on auscultation) and

Parameters		Category II (n=51)	Category III (n=39)	Chi-square, p-value
pH	<7.0	14 (15.5%)	22 (24.5%)	6.562971, 0.010*
	≥7	37 (41.1%)	17 (18.9%)	
Lactate (mmol/L)	≥6	16 (17.8%)	24 (26.7%)	6.9688916, 0.008*
	<6	35 (38.8%)	15 (16.7%)	
Base deficit (mmol/L)	≥12	16 (17.8%)	27 (30.0%)	11.222973, 0.001*
	<12	35 (38.8%)	12 (13.4%)	
pCO_2 (mm Hg)	Normal (35.7 to 64.1)	42 (46.6%)	25 (27.8%)	2.9693358, 0.084
	Abnormal	9 (10.0%)	14 (15.6%)	
HCO_3 (mmol/L)	Normal (20.3 to 25.9)	29 (32.2%)	14 (15.6%)	3.0983274, 0.078
	Abnormal	22 (24.4%)	25 (27.8%)	

[Table/Fig-5]: Association between cardiotocography category and cord blood parameters.
*p-value <0.05 was considered statistically significant

Cardiotocography features		Umbilical artery acidemia (pH <7.0 and/or BD ≥12 mmol/L) [8]		Odd's ratio, 95% confidence interval
		Present	Absent	
FHR	Reassuring	32 (35.6%)	31 (34.4%)	2.768, 1.02 to 7.46
	Abnormal/non reassuring	20 (22.2%)	7 (7.8%)	
Baseline variability	Reassuring	25 (27.8%)	17 (18.9%)	1.824, 1.44 to 10.94
	Abnormal/non reassuring	27 (30.0%)	21 (23.3%)	
Decelerations	Reassuring	23 (25.5%)	18 (20.0%)	1.135, 0.49 to 2.62
	Abnormal/non reassuring	29 (32.3%)	20 (22.2%)	

[Table/Fig-6]: Association between cardiotocography features and umbilical acidemia.

the assessment of Appearance Pulse Grimace response Activity Respiration (APGAR) scores at birth [9]. However, all conventional methods are plagued by poor specificity and predictive values which necessitate the need for better diagnostic tests.

The present study population was normally distributed for age, with 43 (47.8%) patients falling between 21 to 25 years of age. The mean age was calculated as 24.21±3.43 years. A 32.2% of the study population was at full term on admission with the mean gestational age in weeks on admission being 38.567±1.01 weeks. In the study by Aboulghar WM et al., the mean age of included women was 26.94±6.23 years (Range: 17 to 42 years) and the mean gestational age was 38.41±2.65 weeks (Range: 29 to 42.14 weeks) which corroborated well with the present study [10]. In the study population, 36 (40%) mothers were second gravida, while only 2 (2.2%) were 5th order or higher pregnancies. As per the study by Aboulghar WM et al., the median parity was 1 (Range: 0-5) [10].

Baseline variability was the most common abnormal cardiotocography finding, whereas decelerations were the most common non reassuring feature. A 70% of the cardiotocography traces had a normal FHR pattern. Almost 18% cardiotocography traces had abnormal decelerations, while 26.66% had abnormal baseline variability. A 56.7% of the traces were categorised as NICE category II traces, while the rest were all documented as category III traces. In the study by Aboulghar WM et al., 52% subjects had suspicious cardiotocography, while 48% had pathological cardiotocography [10]. Abnormal variability was the most common pattern. In the study by Ray C and Ray A, 50.2% of the subjects had category I (normal) cardiotocography tracing, 36.5% had category II (indeterminate) cardiotocography tracing and 13.3% had category III (abnormal) intrapartum cardiotocography tracing [4]. A 90.7% had normal baseline FHR, 8.0% had bradycardia and 1.3% had tachycardia, 45.8% had abnormal beat-to-beat variability. Jackson M et al., studied the intrapartum FHR characteristics in more than 48,000 patients with a singleton, non anomalous foetus in term labour

at 10 hospitals [11]. In their study, considering all of labour, FHR pattern was category I in 77.9 percent of the time, category II in 22.1% of the time and category III in 0.004% of the time. In the two hours before delivery, category I tracings were less commonly observed (60.9%) and both category II and category III tracings became more common (39.1% and 0.006%, respectively). They concluded that category I and II FHR patterns are more common in labour than category III.

Cord blood analysis revealed that 40% had a pH <7.0, 44.4% had blood lactate levels in excess of 6 mmol/L and another 47.7% had a base deficit ≥12 mmol/L. The mean pO_2 values were found to be 51.34±15.414 mm of Hg, which of pCO_2 was calculated as 53.73±11.722 and of HCO_3- as 19.133±2.9925 mmol/L. In the study by Aboulghar WM et al., the mean cord blood pH was 7.24±0.07 (range: 7.05-7.39) [10]. In the study by Ray C and Ray A mean cord blood pH was 7.253±0.07 [4].

An 18.3% of the neonates had acidosis which is comparable to the studies by Kaban A et al., (13.26%) and Modarressnejad V (20.25%) [12,13]. In the study by Aboulghar WM et al., incidence of acidosis was higher, with 34% of babies having abnormal cord blood pH [10]. This higher value of acidosis in the neonates could be explained by the fact that their study included only those women who had undergone C-section for pathological and suspicious cardiotocography, while in the other studies mentioned above and in the present study, consecutive term labouring women were included.

On Odd's ratio estimation for individual cardiotocography features with respect to umbilical artery acidemia (defined as pH<7.0 and/or BD ≥12 mmol/L as per guidelines), it was found that abnormalities of FHR and baseline variability had higher odds of predicting umbilical artery acidemia. The study by Aboulghar WM et al., performed a binary logistic regression analysis of different features of cardiotocography as predictor of abnormal cord blood pH (<7.2) was performed [10]. Baseline bradycardia significantly increased the risk of abnormal cord blood pH almost three-folds {RR 3.2, 95% CI (2.29 to 4.33)}. Reduced beat-to-beat variability significantly increased the risk of abnormal cord blood pH almost two-folds {RR 2.35, 95% CI (1.08 to 5.09)}. Late decelerations significantly increased the risk of abnormal cord blood pH almost seven-folds {RR 7.1, 95% CI (3.86 to 12.3)}.

The strength of the present study was its exclusion of various high-risk pregnancies and their confounding effect on foetal well-being. The idea was to isolate possibility of timely intervention to improve foetal outcomes even in apparently low risk pregnancies those that contribute the most to foetal morbidity in low-middle income countries. These pregnancies, perceived as low risk cases, fall victim to unexplained foetal deterioration in the absence of adequate foetal surveillance.

Limitation(s)

Cardiotocography, in spite of being a good screening tool, is prone to significant intra and interobserver variation. A considerable degree of bias is associated with cardiotocography interpretation. Sample size was small. Sampling of wrong vessels is a common difficulty encountered during blood sampling particularly when the needle crosses the artery to pierce the vein, often leading to mixed sampling. Despite its strengths, the present study has been conducted over a short period and the long term effect of drugs and analgesics on behavioural/neurological/cognitive development seen during the first five years of life, has not been taken into account, some of which may be a sequelae of intrapartum hypoxic stress. These need to be explored further so that existing knowledge may be updated.

CONCLUSION(S)

Foetal surveillance is slated to become the cornerstone of modern obstetrics. In low-resource settings where facilities for foetal scalp blood sampling is not readily available and where rates of perinatal mortality and neonatal morbidity are even higher, cardiotocography may find a suitable place in anticipating adverse outcomes. The findings of the present study may find a place in low and middle income countries where foetal hypoxia in the background of limited resources still remains a challenge to many.

REFERENCES

[1] Alfirevic Z, Devane D, Gyte GM. Continuous cardiotocography (cardiotocography) as a form of electronic foetal monitoring (EFM) for foetal assessment during labour. Cochrane Database Syst Rev. 2013;5:CD006066.
[2] Ayres-de-Campos, D. Arulkumaran, S. FIGO consensus guidelines on intrapartum foetal monitoring: Physiology of foetal oxygenation and the main goals of intrapartum foetal monitoring. International Journal of Gynaecology & Obstetrics. 2015;131(1):05-08.
[3] De Souza MTK, Dobre M, da Silva DMB, Brateanu A, Baltatu OC, Campos LA. Intrapartum foetal heart rate: A possible predictor of neonatal acidemia and Apgar score. Front Physiol. 2018;9:1489.
[4] Ray C, Ray A. Intrapartum cardiotocography and its correlation with umbilical cord blood pH in term pregnancies: A prospective study. International Journal of Reproduction, Contraception, Obstetrics and Gynaecology. 2017;6(7):2745-52.
[5] Behra S, Agarwal N, Sinha M, Goel J. To study the category ii cardiotocography and its correlation with umbilical cord pH. Int J of Adv Res. 2020;8:1086-91. (ISSN 2320-5407). www.journalijar.com.
[6] National Institute for Health and Care Excellence 2017. Intrapartum Care. Nice Guideline CG190 (February 2017). Available at: https://www.nice.org.uk/guidance/cg190/resources/interpretation-of-cardiotocograph-traces-pdf-248732173.
[7] Armstrong L, Stenson B. Effect of delayed sampling on umbilical cord arterial and venous lactate and blood gases in clamped and unclamped vessels. Arch Dis Child Foetal Neonatal Ed. 2006;91(5):F342-45.
[8] ACOG Committee on Obstetric Practice. ACOG Committee Opinion No. 348, November 2006: Umbilical cord blood gas and acid-base analysis. Obstet Gynaecol. 2006;108(5):1319-22.
[9] Upadhyay M, Duhan N, Chugh K. Umbilical cord blood lactate as an indicator of foetal hypoxia. J Gynecol. 2017;2(S3):S03-06.
[10] Aboulghar WM, Ibrahim MA, Allam IS, Hosny W, Otify M. Validity of cardiotocography in the diagnosis of acute foetal hypoxia in low resources settings. The Internet Journal of Gynaecology and Obstetrics. 2013;17(1):01-08.
[11] Jackson M, Holmgren CM, Esplin MS, Henry E, Varner MW. Frequency of foetal heart rate categories and short term neonatal outcome. Obstet Gynecol. 2011;118(4):803-08.
[12] Kaban A, Cengiz H, Kaban I, Özcan A, Karakaş S. The success of cardiotocography in predicting perinatal outcome. J Clini Experiment Investigations. 2012;3(2):168-71.
[13] Modarressnejad V. Umbilical cord blood pH and risk factors for acidemia in neonates. Eastern Mediterranean Health J. 2005;11(1/2):96-101.

PARTICULARS OF CONTRIBUTORS:
1. Junior Resident, Department of Obstetrics and Gynaecology, R.G. Kar Medical College and Hospital, Kolkata, West Bengal, India.
2. Associate Professor, Department of Obstetrics and Gynaecology, R.G. Kar Medical College and Hospital, Kolkata, West Bengal, India.
3. Senior Resident, Department of Obstetrics and Gynaecology, R.G. Kar Medical College and Hospital, Kolkata, West Bengal, India.
4. Professor, Department of Obstetrics and Gynaecology, R.G. Kar Medical College and Hospital, Kolkata, West Bengal, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Animesh Naskar,
Krishna Bihar, Flat-201, 2nd Floor, 10, Baje Shibpur, 2nd Bye Lane, Shibpur,
Howrah-711102, West Bengal, India.
E-mail: animesh282@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Aug 13, 2021
- Manual Googling: Dec 10, 2021
- iThenticate Software: Jan 06, 2022 (17%)

ETYMOLOGY: Author Origin

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Aug 09, 2021**
Date of Peer Review: **Nov 10, 2021**
Date of Acceptance: **Dec 11, 2021**
Date of Publishing: **Feb 01, 2022**