Urgent Cesarean Delivery Following Nonstress Test in a Patient with COVID-19 and Pregestational Diabetes

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ELECTRONIC FETAL MONITORING CASE REVIEW SERIES

Electronic fetal monitoring (EFM) is a popular technology used to establish fetal well-being. Despite its widespread use, the terminology used to describe patterns seen on the monitor has not been consistent until recently. In 1997, the National Institute of Child Health and Human Development (NICHD) Research Planning Workshop published guidelines for interpretation of fetal tracings. This publication was the culmination of 2 years of work by a panel of experts in the field of fetal monitoring and was endorsed in 2005 by both the American College of Obstetricians and Gynecologists (ACOG) and the Association of Women's Health, Obstetric and Neonatal Nurses (AWHONN). In 2008, ACOG, NICHD, and the Society for Maternal-Fetal Medicine reviewed and updated the definitions for fetal heart rate (FHR) patterns, interpretation, and research recommendations. Following is a summary of the terminology definitions and assumptions found in the 2008 NICHD workshop report. Normal arterial umbilical cord gas values and indications of acidosis are defined in the Table.

ASSUMPTIONS FROM THE NICHD WORKSHOP

- Definitions are developed for visual interpretation, assuming that both the FHR and uterine activity recordings are of adequate quality
- Definitions apply to tracings generated by internal or external monitoring devices
- Periodic patterns are differentiated based on waveform, abrupt or gradual (eg, late decelerations have a gradual onset and variable decelerations have an abrupt onset)
- Long- and short-term variability are evaluated visually as a unit
- Gestational age of the fetus is considered when evaluating patterns
- Components of FHR do not occur alone and generally evolve over time

DEFINITIONS

Baseline FHR

- Approximate mean FHR rounded to increments of 5 beats/min in a 10-minute segment of tracing, excluding accelerations and decelerations, periods of marked variability, and segments of baseline that differ by >25 beats/min

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TABLE. Arterial Umbilical Cord Gas Values

	pH	Pco$_2$ (mm Hg)	Po$_2$ (mm Hg)	BASE EXCESS
Normal*	≥7.20 (7.15 to 7.38)	<60 (35 to 70)	≥20	≤–10 (−2.0 to −9.0)
Respiratory acidosis	<7.20	>60	Variable	≤–10
Metabolic acidosis	<7.20	<60	Variable	≥–10
Mixed acidosis	<7.20	>60	Variable	≥–10

Normal ranges from Obstet Gynecol Clin North Am. 1999;26:695.

- In the 10-minute segment, the minimum baseline duration must be at least 2 minutes (not necessarily contiguous) or the baseline for that segment is indeterminate
- Bradycardia is a baseline of <110 beats/min; tachycardia is a baseline of >160 beats/min
- Sinusoidal baseline has a smooth sine wave-like undulating pattern, with waves having regular frequency and amplitude

Baseline Variability
- Fluctuations in the baseline FHR of ≥2 cycles per minute, fluctuations are irregular in amplitude and frequency, fluctuations are visually quantitated as the amplitude of the peak to trough in beats per minute
- Classification of variability:

  o Absent: Amplitude range is undetectable
  o Minimal: Amplitude range is greater than undetectable to 5 beats/min
  o Moderate: Amplitude range is 6–25 beats/min
  o Marked: Amplitude range is >25 beats/min

Accelerations
- Abrupt increase in FHR above the most recently determined baseline
- Onset to peak of acceleration is <30 seconds, acme is ≥15 beats/min above the most recently determined baseline and lasts ≥15 seconds but <2 minutes
- Before 32 weeks' gestation, accelerations are defined by an acme ≥10 beats/min above the most recently determined baseline for ≥10 seconds
- Prolonged acceleration lasts ≥2 minutes but <10 minutes

Late Decelerations
- Gradual decrease in FHR (onset to nadir ≥30 seconds) below the most recently determined baseline, with nadir occurring after the peak of uterine contractions
- Considered a periodic pattern because it occurs with uterine contractions

Early Decelerations
- Gradual decrease in FHR (onset to nadir ≥30 seconds) below the most recently determined baseline, with nadir occurring coincident with uterine contraction
- Also considered a periodic pattern

Variable Decelerations
- Abrupt decrease in FHR (onset to nadir <30 seconds)
- Decrease is ≥15 beats/min below the most recently determined baseline lasting ≥15 seconds but <2 minutes
- May be episodic (occurs without a contraction) or periodic

Prolonged Decelerations
- Decrease in the FHR ≥15 beats/min below the most recently determined baseline lasting ≥2 minutes but <10 minutes from onset to return to baseline
- Decelerations are tentatively called recurrent if they occur with ≥50% of uterine contractions in a 20-minute period
- Decelerations occurring with <50% of uterine contractions in a 20-minute segment are intermittent

Sinusoidal FHR Pattern
- Visually apparent, smooth sine wave-like undulating pattern in the baseline with a cycle frequency of 3 to 5 per minute that persists for ≥20 minutes

Uterine Contractions
- Quantified as the number of contractions in a 10-minute window, averaged over 30 minutes

  o Normal: ≤5 contractions in 10 minutes
  o Tachysystole: >5 contractions in 10 minutes

INTERPRETATION

A 3-tier FHR interpretation system has been recommended as follows:

- Category I FHR tracings: Normal, strongly predictive of normal fetal acid-base status and require routine care. These tracings include all of the following:

  - Baseline rate: 110 to 160 beats/min
  - Baseline FHR variability: Moderate
  - Late or variable decelerations: Absent
  - Early decelerations: Present or absent
  - Accelerations: Present or absent

- Category II FHR tracings: Indeterminate, require evaluation and continued surveillance and reevaluation. Examples of these tracings include any of the following:

  - Bradycardia not accompanied by absent variability
  - Tachycardia
  - Minimal or marked baseline variability
  - Absent variability without recurrent decelerations
  - Absence of induced accelerations after fetal stimulation
  - Recurrent variable decelerations with minimal or moderate variability
  - Prolonged decelerations
  - Recurrent late decelerations with moderate variability
  - Variable decelerations with other characteristics, such as slow return to baseline

- Category III FHR tracings: Abnormal, predictive of abnormal fetal acid-base status and require prompt intervention. These tracings include:

  - Absent variability with any of the following:

    ▪ Recurrent late decelerations
    ▪ Recurrent variable decelerations
    ▪ Bradycardia

  - Sinusoidal pattern

Data from Macones GA, Hankins GDV, Spong CY, Hauth J, Moore T. The 2008 National Institute of Child Health and Human Development workshop report on electronic fetal monitoring. *Obstet Gynecocol.* 2008;112:661-666 and American College of Obstetricians and Gynecologists. Intrapartum fetal heart rate monitoring: nomenclature, interpretation, and general management principles. *ACOG Practice Bulletin No. 106.* Washington, DC: American College of Obstetricians and Gynecologists; 2009.

We encourage readers to examine each strip in the case presentation and make a personal interpretation of the findings before advancing to the expert interpretation provided.

CASE PRESENTATION

A 28-year-old gravida 4, para 2-0-1-2 at 34 weeks' gestation was found to be COVID-19 positive after reporting symptoms of rhinorrhea, anosmia, and mild cough during a telehealth visit. She had poorly controlled type 1 diabetes mellitus and chronic hypertension controlled without medication. Her prior pregnancy was notable for a shoulder dystocia with permanent brachial plexus injury and a subsequent cesarean delivery for arrest of dilation. Her diabetes was complicated by proliferative retinopathy, proteinuria, and suboptimal compliance with her insulin regimen. She had no obstetrical complaints, fetal movement was good, and fetal surveillance had been reassuring in the several weeks before her COVID-19 diagnosis. Therefore, consideration was given to forgoing her scheduled antenatal testing the day after her COVID-19 diagnosis to decrease exposure to both staff and other patients. Ultimately the decision was made to proceed with routine antenatal testing with a nonstress test (NST) and amniotic fluid index (AFI) measurement using appropriate precautions and personal protective equipment (PPE) for staff. She was scheduled as the last patient of the day with the plan for a terminal clean of both the NST and ultrasonography rooms after her visit.

On the day of her fetal surveillance, she reported a mild cough but was not in acute distress, and her vital signs were normal. She reported good fetal movement and denied any contractions, vaginal bleeding, or leakage of fluid. Her NST demonstrated multiple variable decelerations (Fig 1).

Findings from the electronic fetal monitoring (EFM) strip 1 are as follows:

- Baseline rate: 140 beats/min
- Variability: Moderate
- Episodic pattern: Variable decelerations
- Periodic pattern: None
- Uterine contractions: Irregular
- Interpretation: Category II
- Differential diagnosis: Uteroplacental insufficiency, umbilical cord compression
- Action: Transfer to the labor and delivery (L&D) department for evaluation

She was immediately transferred to L&D where the category II tracing persisted, with a prolonged deceleration (Fig 1). The decision was made to proceed with an urgent repeat cesarean delivery.

Figure 2: Labor and Delivery Fetal Heart Tracing. Findings from EFM strip I are as follows: • Baseline rate: 120 bpm, • Variability: Minimal to moderate, • Episodic pattern: Prolonged deceleration, • Periodic pattern: None, • Uterine contractions: Irregular, • Interpretation: Category II, • Differential diagnosis: Uteroplacental insufficiency, umbilical cord compression, abruption, • Action: Emergent delivery via cesarean

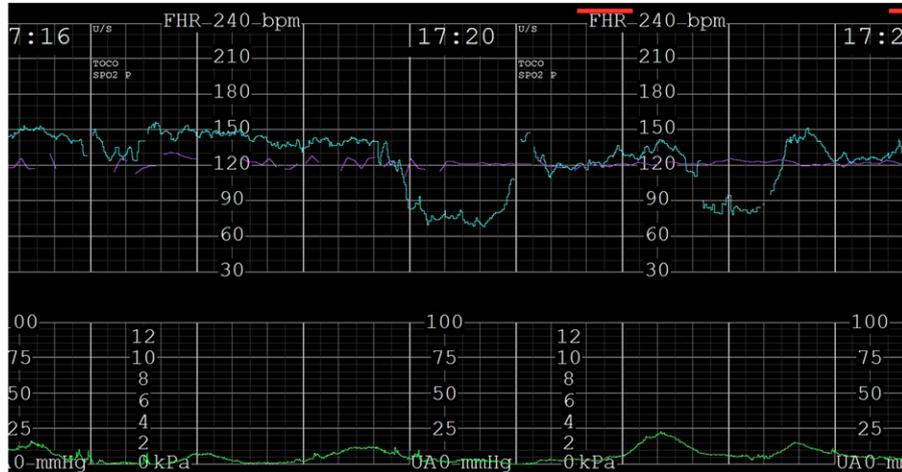Findings from EFM strip 2 are as follows:

Figure 1. Nonstress Test.

- Baseline rate: 120 beats/min
- Variability: Minimal to moderate
- Episodic pattern: Prolonged deceleration
- Periodic pattern: None
- Uterine contractions: Irregular
- Interpretation: Category II
- Differential diagnosis: Uteroplacental insufficiency, umbilical cord compression, abruption
- Action: Emergent delivery via cesarean

OUTCOME

The patient described had an uncomplicated low transverse repeat cesarean delivery of a female infant. Cord arterial pH was 7.15, base deficit 12.8 mmol/L, and Apgar scores were 4, 7, and 8 at 1, 5, and 10 minutes, respectively. After the cesarean delivery, the patient developed a fever (102.3°F [39.0°C]). She was empirically started on antibiotics for possible endometritis and transferred to a COVID-19 patient floor for further monitoring. She received multidisciplinary care from our institution's COVID-19 team, which included infectious disease, maternal-fetal medicine, and endocrinology. Her blood cultures were negative. She underwent chest radiography on postoperative day (POD) 1 which demonstrated patchy bilateral airspace opacities consistent with her known COVID-19 diagnosis. In the subsequent PODs, she did not require oxygen supplementation, nor did she develop acute respiratory distress. She was discharged on POD4 in good condition. She was given prophylactic enoxaparin during the hospitalization and discharged with a 2-week prescription, given concerns for hypercoagulability associated with COVID-19 and her
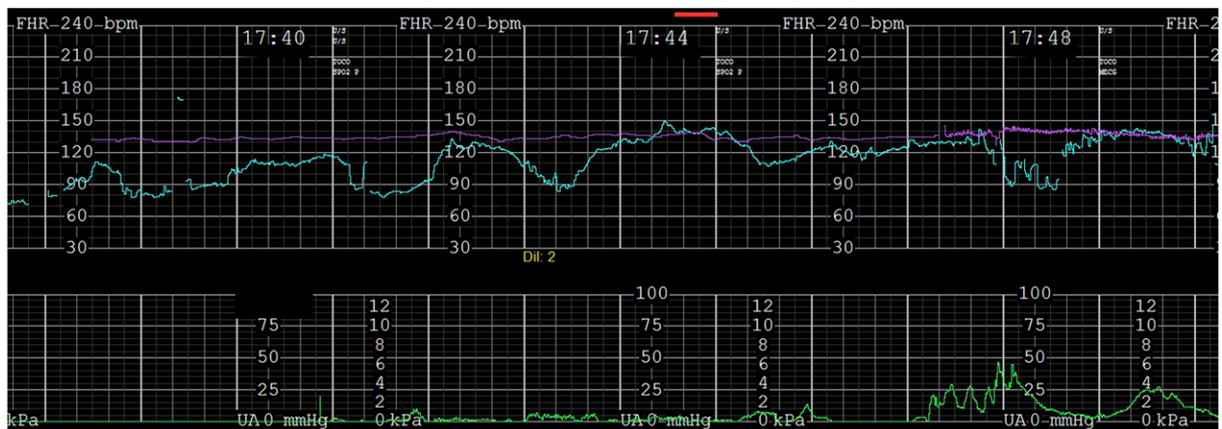

Figure 2. Labor and Delivery Fetal Heart Tracing.

multiple risk factors for venous thromboembolism. Since discharge, she has had multiple telehealth visits with maternal-fetal medicine and endocrinology. She did not require readmission within 30 days of discharge.

The female neonate weighed 2,480 g at birth. Immediately after delivery, the neonate demonstrated respiratory distress. After a trial of continuous positive airway pressure with increasing fraction of inspired oxygen up to 80%, the decision was made to intubate. She was admitted to the infant special care unit. Chest radiography demonstrated granular lung fields consistent with respiratory distress syndrome. Result of COVID-19 testing for the neonate was negative. The neonate was discharged from the hospital 2 weeks after birth.

DISCUSSION

The emergence of the novel, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has led to a global pandemic. (1) The United States federal government issued a stay-at-home order that many states have since extended in an effort to limit the spread of COVID-19. Nationally, the health care system has been placed under immense stress because of COVID-19, which has led to many changes in patient care guidelines.(2)(3) Institutions are modifying outpatient clinic schedules to minimize patient and provider exposure. In obstetrics, recently published guidelines recommend modifications to outpatient prenatal visits, obstetrical ultrasonography, and antenatal testing during the COVID-19 pandemic.(4)

The practice of antenatal testing is based primarily on expert opinion and observational studies. (5) The American College of Obstetricians and Gynecologists (ACOG) suggests antepartum testing for "pregnancies in which the risk of antepartum fetal demise is increased." (6) Pregestational diabetes mellitus is associated with an increased risk of stillbirth and is further increased with poor glycemic control and concomitant chronic hypertension. (7)(8)(9) Although the optimal timing and frequency of fetal surveillance for women with pregestational diabetes is left to clinician discretion, ACOG recommends initiation for most women at 32 weeks' gestation and describe the wide practice of twice-weekly testing. (10)

In the setting of the global COVID-19 pandemic, modifications to antenatal testing have been proposed that limit the frequency of evaluations, including reducing antenatal testing from twice weekly to weekly for pregnancies complicated by pregestational diabetes at 36 weeks' gestation. (4) Although the fetal heart rate decelerations were attributed to uteroplacental insufficiency associated with her poorly controlled diabetes and concomitant hypertension, little is known regarding potential adverse effects of maternal COVID-19 infection on placental function and perinatal demise. A small case series demonstrates potential for fetal vascular malperfusion associated with COVID-19 infection. (11) Unfortunately, the placenta in our case was inadvertently discarded, as it was intended for pathologic analysis. A systematic review of coronavirus spectrum infections reported an 11% increased rate of perinatal death in a population in which 90% of patients were diagnosed with pneumonia. (12) In contrast, a study of 43 pregnant women with COVID-19 infection had clinical outcomes similar to those seen in the general population, with 86% having mild disease. (13) The perinatal death rate among those with COVID-19 remains unknown, as is the question of whether the severity of illness has an impact on this risk.

This case highlights the challenges of modifying antepartum testing strategies during the COVID-19 pandemic. In women without COVID-19, the rationale for decreasing fetal surveillance is based on reducing patient risk through lessening health care exposures. (4) The incentive of delaying or cancelling antenatal testing in COVID-19–positive women primarily lies in reducing exposure to health care workers, staff, and other patients. However, as our case demonstrates, bypassing indicated fetal surveillance could potentially lead to adverse outcomes. We support the ACOG recommendation that antenatal testing should continue as medically indicated when possible and that any modification made to care should be relayed to patients with a discussion of the altered risks and benefits in the setting of a global pandemic. (14) It is currently unknown whether fetal surveillance is indicated for the diagnosis of COVID-19 infection alone. As the COVID-19 pandemic continues, more robust data may become available to further characterize antenatal risk. We advocate for the use of appropriate safety precautions and PPE during the pandemic while performing the antenatal testing indicated rather than postponing or forgoing testing altogether. This strategy aims to optimize maternal and neonatal safety during the global pandemic.

American Board of Pediatrics Neonatal-Perinatal Content Specification

- Know the effects on the fetus and/or newborn infant of other maternal infections (eg, malaria) and their management

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