Cardiotocography and diabetic pregnancy

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Abstract

Foetal monitoring in antenatal period and during labour is done to detect foetal distress and to take necessary action timely in order to improve perinatal outcome. Maternal awareness of foetal movement is routinely recommended in all pregnancies after 28 weeks gestation. In high risk pregnancies like diabetes, foetal growth restriction, macrosomia, additional means of foetal surveillance should be used like antenatal cardiotocography, non stress test, biophysical profile or Doppler studies. Diabetic mothers are at increased risk for sudden intrauterine foetal demise, thereby mandating the need of cardiotocography and ultrasound biophysical profile testing weekly or twice weekly in such patients. Foetal surveillance in diabetic patients in low resource settings demands for frequent antenatal visits and non stress test if possible. During labour also, there should be continuous electronic foetal monitoring in diabetic mothers in both first and second stages of labour for early detection of foetal hypoxic stress and timely intervention.

Keywords: Cardiotocography, Diabetes, Foetal surveillance, Antenatal, Intrapartum.

Introduction

Assessment of foetal well being is very important during the antenatal period. It needs additional testing when pregnancy is complicated by medical disorders in the mother and conditions affecting foetal health. Maternal diabetes is one such condition which exposes the foetus to increased morbidity and mortality, thus advocating additional testing for foetal well being. Uncontrolled diabetes has profound effects on embryogenesis, organogenesis, and foetal growth. Preconception control of diabetes and monitoring throughout pregnancy are important in reducing the impact of diabetes on the foetus and newborn.[1]

Foetal well being assessment should be done to detect foetal hypoxic stress which may lead to foetal or neonatal death, and neurological damage. There are many ways to do foetal surveillance. These include daily foetal movement count, electronic foetal monitoring by non-stress test (NST), cardiotocography (CTG), contraction stress test (CST), biophysical profile (BPP) and; uterine and umbilical artery Doppler.

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Cardiotocograph (CTG)

It is a continuous electronic record of foetal heart rate and uterine activity obtained by ultrasound transducer probes placed on maternal abdomen (external or indirect CTG). It can be traced on a paper strip or displayed on the monitor of the machine. Cardio-tocography also records uterine contractions along with the foetal heart rate thereby allowing assessment of the relationship between the two. An alternative means of monitoring the baby's heart rate with the CTG machine is to attach an electrode directly to the baby's presenting part, usually its head. This form of continuous monitoring is known as 'internal CTG' and requires a ruptured amniotic sac (either spontaneously or artificially) and a scalp electrode (clip) attached to the baby's head.[2]

When foetal heart rate is monitored alone it is termed as non-stress test and when it is done with stimulation of uterine contractions to see the foetal heart response, it is termed as contraction stress test. Antenatal CTG is dependent on the maturation of foetal autonomic nervous system so it should be performed till after 28 weeks of gestation for foetal well being. Foetal hypoxia leads to certain adaptations which in turn cause changes in the foetal heart rate parameters.[3]

Accepted normal parameters for the term foetus are reported as follows (Gribbin 2006; RCOG 2001).[4,5]

1. Baseline foetal heart rate of 110 to 160 beats per minute.

2. Baseline variability should be greater than five beats per minute.

3. Presence of two or more accelerations of the foetal heart rate exceeding 15 beats per minute, sustained for at least 15 seconds in a 20-minute period - this pattern is termed reactive.

4. Absence of decelerations.

Diabetes in pregnancy leads to increased incidence of macrosomia, IUGR in cases of associated pre-eclampsia or vasculopathy, congenital foetal malformations, and sudden intrauterine death. This is due to maternal hyperglycaemia leading to foetal hyperglycaemia,

hyperinsulinaemia, hypertriglyceridaemia and macrosomia. There is sudden foetal death in diabetic patients due to oxidative stress, foetal hypoxia and acidosis, and free radical injury. Data suggests that there is as much as five times increased risk of stillbirth and perinatal mortality in patients with insulin dependent diabetes than in the general population. Therefore, it demands for extra and additional testing to assess the foetal status thereby allowing for timely detection of foetal compromise. This is achieved by non stress test (NST) and biophysical profile repeated twice a week or every 72 hours.[6] No single test alone is sufficient for foetal surveillance. There should be a combination of subjective maternal counting of foetal movement, NST and ultrasound biophysical profile. A normal NST is predictive of good perinatal outcome for one week (provided the maternal-foetal condition remains stable), except in women with insulin dependent diabetes or with a postdates pregnancy, in which case NSTs are recommended at least twice weekly. There is consensus that women who require insulin for treatment of GDM should undergo twice weekly heart rate testing after 32 weeks. While in patients with nephropathy, vascuolpathy and foetal growth restriction, it should begin as early as 28 weeks gestation. A normal BPP score along with a reactive NST is an indication of foetal well-being. The BPP provides 2 points each for foetal breathing, movement, and foetal tone in 30 minutes and 2 points for normal amniotic fluid

Table-1: Foetal monitoring in women with diabetic pregnancy.

1) DFMC	Daily	All patients
2) NST	twice weekly	Controlled IDDM- start at 32 -34 weeks
	Start at 28-32 weeks if	IUGR, hypertension, Nephropathy, insulin requirement >100U/day, previous still birth
3) Biophysical profile	Weekly/ twice weekly	
4) Doppler umblical artery	in early detection of IUGR, vasculopathy, IUGR, preeclampsia	

Table-2: Antepartum classification of CTG: non stress test.[9]

Parameter	Normal NST (Previously "Reactive")	Atypical NST (Previously "Non-Reactive")	Abnormal NST (Previously "Non-Reactive")
Baseline	110–160 bpm	• 100–110 bpm • > 160 bpm < 30 min. • Rising baseline	• Bradycardia < 100 bpm • Tachycardia > 160 for > 30 min. • Erratic baseline
Variability	• 6–25 bpm (moderate) • ≤ 5 (absent or minimal) for < 40 min.	< 5 (absent or minimal) for 40–80 min.	• < 5 for > 80 min. • ≥ 25 bpm > 10 min. • Sinusoidal
Decelerations	None or occasional variable < 30 sec.	Variable decelerations 30–60 sec. duration	• Variable decelerations > 60 sec. duration • Late deceleration(s)
Accelerations Term Fetus	≥ 2 accelerations with acme of ≥ 15 bpm, lasting 15 sec. < 40 min. of testing	≤ 2 accelerations with acme of ≥ 15 bpm, lasting 15 sec. in 40–80 min.	• ≤ 2 accelerations with acme of ≥ 15 bpm, lasing 15 sec. in > 80 min.
Preterm Fetus (< 32 weeks)	≥ 2 accelerations with acme of ≥ 10 bpm, lasting 10 sec. < 40 min. of testing	≤ 2 accelerations of ≥ 10 bpm, lasting 10 sec. in 40-80 min.	≤ 2 accelerations of ≥ 10 bpm, lasting 10 sec. in > 80 min.
ACTION	FURTHER ASSESSMENT OPTIONAL, based on total clinical picture	FURTHER ASSESSMENT REQUIRED	URGENT ACTION REQUIRED An overall assessment of the situation and further investigation with U/S or BPP is required. Some situations will require delivery.

Table-3: Classification of intrapartum Electronic foetal heart rate tracings (SOGC).[9]

	Normal Tracing Previously "Reassuring"	Atypical Tracing Previously "Non-reassuring"	Abnormal Tracing Previously "Non-reassuring"
Baseline	110–160 bpm	Bradycardia 100–110 bpm Tachycardia > 160 for > 30 min to < 80 min. Rising baseline	Bradycardia < 100 bpm Tachycardia > 160 for > 80 min. Erratic baseline
Variability	6–25 bpm ≤ 5 bpm for < 40 min.	≤ 5 bpm for 40–80 min.	≤ 5 bpm for > 80 min. ≥ 25 bpm for > 10 min. Sinusoidal
Decelerations	None or occasional uncomplicated variables or early decelerations	Repetitive (≥ 3) uncomplicated variable decelerations Occasional late decelerations Single prolonged deceleration > 2 min. but < 3 min.	Repetitive (≥ 3) complicated variables: deceleration to < 70 bpm for > 60 secs. loss of variability in trough or in baseline biphasic decelerations overshoots slow return to baseline baseline lower after deceleration baseline tachycardia or bradycardia Late decelerations > 50% of contractions Single prolonged deceleration > 3 min. but < 10 min.
Accelerations	Spontaneous accelerations present (FHR increases >15 bpm lasting > 15 seconds (< 32 weeks' gestation increase in the FHR > 10 bpm lasting >10 seconds) Accelerations present with fetal scalp stimulation	Absence of acceleration with fetal scalp stimulation	Usually absent*
ACTION	EFM may be interrupted for periods up to 30 min. if maternal-fetal condition stable and/or oxytocin infusion rate stable.	Further vigilant assessment required, especially when combined features present.	ACTION REQUIRED Review overall clinical situation, obtain scalp pH if appropriate/prepare for delivery.

*Usually absent, but if accelerations are present, this does not change the classification of tracing.

volume. A total biophysical score of <4 is abnormal and suggestive of foetal compromise and increased risk of adverse outcome. People have also studied the role of Doppler umbilical blood flow measurement in women with GDM for foetal assessment with the main role being in growth restricted foetuses in diabetic women.[2] Type and frequency of foetal surveillance should be individualised depending on the severity of maternal hyperglycaemia or presence of other adverse factors (Table-1).

SOGC (Society of Obstetricians and Gynecologists of Canada, 2007) suggests insulin-requiring GDM is one such condition where additional foetal surveillance both antenatally and intrapartum may be beneficial. SOGC has given classification of antepartum CTG or non-stress test as shown in Table-2.

ACOG (American College of Obstetricians and Gynecologists, 2014) recommends initiation of antenatal foetal testing at 32 to 36 weeks of gestation in diabetic pregnancy requiring insulin that are well controlled and are otherwise uncomplicated.

International Diabetes Practice Guideline 2003 recommends that foetal kick count monitoring should begin from 28 weeks, and NST from 34 weeks in women with GDM.[7]

The negative predictive value of NST alone for predicting stillbirth within 1 week of a normal test is 99.8%; for BPP, modified BPP, and CST, it is greater than 99.9%. The false negative rate of antenatal testing (i.e. NST and amniotic fluid index) is 0.8 per 1000 women tested. About 60% who delivered because of abnormal testing showed no evidence of short-term or long-term foetal compromise. Non reactive NST has a low sensitivity and positive predictive value of 40% and 28% respectively to identify population at risk so it cannot be used as stand-alone test. Continuous CTG can prevent one death in one thousand births (0.1%).[8]

Intrapartum CTG

Diabetes is a high risk medical condition complicating pregnancy and it adversely affects both antepartum and intrapartum period of the foetus thereby necessitating strict monitoring. We have explained the role of cardiotocography during antepartum period. Now, we will discuss foetal monitoring in diabetic women during labour.

When a diabetic women comes in labour, there is recommendation to do admission foetal heart test as compared to no indication in low risk pregnancy.[8] Foetal monitoring in labour can be electronic or manual intermittent auscultation. There is a consensus in the guidelines from professional bodies that the foetal heart should be auscultated at least every 15 minutes in the first stage of labour and at least every five minutes in the second stage of labour (ACOG 2014; Liston 2002; NCCWCH 2008; RANZCOG 2002) with each auscultation lasting at least 60 seconds.[2] Electronic foetal monitoring is recommended for pregnancies at risk of adverse perinatal outcomes.[7] In diabetes, continuous electronic foetal monitoring is recommended to detect foetal hypoxic distress and timely intervention. The absence of foetal heart rate reactivity and presence of decelerations is predictive of foetal distress in labour requiring caesarean section (Table-3). USG measurement of amniotic fluid does not have a significant role in predicting foetal distress during labour in diabetic patients.

CTG changes in pregnancies complicated by diabetes are: reduced short term foetal heart rate variability, reduced foetal movements, longer episodes of low variation and reduced reactivity.[9]

CTG in Diabetic Ketacidosis

Continuous foetal monitoring is mandatory to assess foetal wellbeing. A non-reactive foetal heart tracing, repetitive late decelerations, or a non-reassuring biophysical profile may be present indicating some degree of foetal compromise in the ketoacidotic patient but they are not necessarily indications for immediate delivery.[10]

Conclusion

Diabetic mothers whether gestational or pre-pregnancy, are at high risk for adverse foetal and neonatal outcome, thus requiring additional testing for foetal monitoring in antenatal and intrapartum period. In low resource settings, the antenatal visits of diabetic women should be more frequent in third trimester as weekly or sometimes twice weekly to assess the foetal heart and growth at each visit. Women should be counseled regarding strict foetal kick counting and reporting if abnormal. In such settings, health care personnel should see the record of subjective foetal movement monitoring by women weekly at antenatal visit. If CTG machines are not available, foetal heart should be auscultated for any accelerations during foetal movement perceived by the woman. During labour, intermittent auscultation every 10-15 minutes in first stage and every 4-5 minutes in second stage is recommended if electronic foetal monitoring is not possible in the peripheral set-up.

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