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EVALUATION OF THE RISK OF PERINATAL COMPLICATIONS USING REMOTE FETAL MONITORING

Ahmedova A.T [1]
Rasulova F [2]
Sayfiyeva N [3]
Abduvaliyeva M [4]

Abstract: Cardiotocography (CTG) is a key method for evaluating fetal condition, providing vital information on fetal heart rate and activity. It is widely applied in clinical settings for monitoring the fetus during pregnancy and labor. Different types of CTG are employed depending on risk factors. Understanding CTG principles and accurate result interpretation helps improve birth outcomes and determine optimal labor management strategies. CTG records made during labor serve as medical documentation, aiding in comprehensive birth assessments and providing legal protection for healthcare providers in complex cases.

Keywords: cardiotocography, perinatal outcomes, childbirth, complications, prevention, remote monitoring.

CTG evaluation typically starts with an analysis of the baseline fetal heart rate, which is one of the main characteristics of heart function and a very important parameter for assessing fetal heart activity as a criterion of intrauterine status. It was proven in the early 1970s that fetal heart rate decreases as pregnancy progresses. At 15 weeks, the normal heart rate averages 160 bpm, while at term, it averages 140 bpm. This phenomenon is linked to the gradual activation of the parasympathetic division of the autonomic nervous system (ANS) and indicates that heart rate depends on the maturity of this system [6; 7].

In early pregnancy, the sympathetic component of the ANS dominates, which is why the fetal heart rate is generally higher than in later pregnancy. Once the parasympathetic division reaches a certain level of maturity, a balance is established between the two components of the ANS, leading to a reduction in the average (baseline) fetal heart rate.

Thus, heart rate is influenced by the constant interaction between the parasympathetic and sympathetic nervous systems. Initially, heart rate is set by the atrial pacemaker and is approximately 60 bpm. Impulses from higher centers of the ANS are transmitted to the heart via the vagus nerve (parasympathetic component) and sympathetic fibers. At term and in normal fetal conditions, heart rate ranges between 110-160 bpm (averaging 140-145 bpm), reflecting the interaction between the parasympathetic and sympathetic nervous systems.

Fetal tachycardia can result from several factors, including:

- **Fetal anemia**. Tachycardia helps increase cardiac output and tissue perfusion.

[1] Samarkand State Medical University, Samarkand, Uzbekistan
[2] Samarkand State Medical University, Samarkand, Uzbekistan
[3] Samarkand State Medical University, Samarkand, Uzbekistan
[4] Samarkand State Medical University, Samarkand, Uzbekistan

- **Congenital heart defects** and fetal heart dysfunction, compensated by an increased heart rate and cardiac output. May be accompanied by arrhythmia (tachyarrhythmia, paroxysmal ventricular tachycardia, ventricular extrasystole).
- **Maternal fever**. This leads to an activation of fetal myocardial metabolism and increased sympathetic activity.
- **Maternal hyperthyroidism**. Thyroid hormones pass through the placental barrier and stimulate fetal heart activity.
- **Amnionitis**. Tachycardia can be the first sign of intrauterine infection development.
- **Medications**. Parasympatholytics (atropine, phenothiazines, etc.) block the parasympathetic division of the ANS. β-adrenergic agonists (Partusisten, Gynipral) have a cardiostimulatory effect.

Fetal bradycardia, defined as a heart rate of less than 110 bpm for more than 10 minutes, is caused by parasympathetic activation.
The causes of bradycardia include:

- Severe fetal hypoxia with hyperkalemia and acidosis, leading to myocardial dysfunction.
- Congenital heart defects accompanied by conduction abnormalities.
- Use of β-adrenergic blockers (propranolol, etc.). Parasympathetic activation is caused by these medications blocking epinephrine receptors in the myocardium.
- Maternal hypotension due to compression of the inferior vena cava while lying on her back, indirectly leading to reduced fetal heart rate.
- Severe maternal hypoglycemia, promoting hypoxemia.
- Prolonged umbilical cord compression, activating parasympathetic influences.

The baseline heart rate is further assessed by examining its variability. In a healthy pregnancy, as a result of the interaction between the parasympathetic and sympathetic divisions of the ANS and their regulatory influence on heart rate, the fetal heart does not beat rhythmically. The difference in the duration of consecutive cardiac intervals is, on average, 20-30 ms (or 2-3 bpm). As a result, fetal heart rate deviates from the baseline heart rate at any given moment. Variations in fetal heart rate from the average value, occurring from beat to beat, with specific direction and amplitude, are manifested on the CTG as oscillations of the heart rhythm.
This phenomenon, which reflects the regulatory influence of the fetal ANS on heart rhythm, is referred to as **baseline heart rate variability**. Baseline variability is the most important characteristic of fetal condition and cardiovascular system reactivity. Its normal parameters indicate sufficient compensatory capabilities of the fetus. If consecutive cardiac intervals are the same and the heart rhythm resembles that of a metronome, fetal nervous system damage due to damaging factors should be suspected [2; 4; 7].

Advantages of Remote CTG
Studies show that remote CTG offers several key advantages:

- **Accessibility**: Pregnant women, especially those in remote areas, can receive quality medical supervision without visiting medical facilities.
- **Comfort**: Patients can undergo monitoring at home, reducing stress and increasing satisfaction.
- **Early Detection of Complications**: Remote CTG allows for timely detection of abnormalities in fetal condition, enabling immediate intervention.

The strength of this study is the clinical benefit of remote FHR self-monitoring in preventing or mitigating adverse fetal outcomes in outpatient settings in a major urban tertiary medical center, which has not previously been published. Similar to the traditional FHR monitoring mode in the clinic, we found that remote FHR self-monitoring was comparable and did not increase the risk of adverse neonatal outcomes, regardless of whether pregnant women were at high or low risk

[9; 12]. Notably, there is no established strategy for preventing fetal distress. To date, we have not proven that remote FHR self-monitoring helps prevent fetal distress. Further larger multicenter randomized trials are needed to determine whether remote FHR monitoring can improve neonatal outcomes and reduce healthcare costs for newborns. In addition, according to Smith S. et al., our results showed that cesarean section rates do not increase in pregnancies with remote FHR self-monitoring, which is encouraging since it can complement traditional prenatal care.

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