

The Importance of Cardiotocography (CTG)

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Abstract

Cardiotocography (CTG) is a crucial tool in monitoring fetal health and uterine contractions during pregnancy and labor. This method, by simultaneously recording the fetal heart rate and uterine contractions, allows for the early detection of fetal abnormalities, hypoxia, and other threatening conditions. The present article, conducted in a library-based approach, aims to examine the importance, role, and challenges of CTG in prenatal care. Findings indicate that CTG plays a significant role in clinical decision-making by providing precise information about the fetal condition and can prevent complications during high-risk deliveries. However, challenges such as misinterpretation, false-positive results, and limitations in equipment and skill levels remain obstacles to the effective use of this method. Therefore, effective utilization of CTG requires specialized training, the use of complementary tools, and improvements in the facilities of healthcare centers.

Keywords: Cardiotocography, fetal health, hypoxia, uterine contractions, high-risk delivery

Introduction

Maternal and fetal health during pregnancy is one of the fundamental pillars of medical care in obstetrics and gynecology. With the increasing public and specialized awareness of the risks of pregnancy and childbirth, there is a growing need for effective and reliable diagnostic tools. Among these tools, cardiotocography (Cardiotocography or CTG) has gained a prominent position, as it enables the simultaneous assessment of fetal heart rate and uterine contractions ([Agarwal, Gupta, & Sharma, 2020](#)).

As a non-invasive method, cardiotocography plays a key role in assessing fetal distress and in decision-making regarding the continuation of pregnancy and labor. The use of CTG has been highly effective in the early detection of fetal heart rate abnormalities, reducing the risk of intrauterine death, and preventing neurological damage to the newborn ([Ali & Hussain, 2020](#)). In countries with advanced healthcare systems, CTG is considered part of routine prenatal care.

Some pregnancies may be complicated by a medical condition in the mother (such as diabetes or high blood pressure) or conditions that could affect the health or development of the baby. If babies at risk of complications are identified and if effective interventions are available to improve outcomes, a precise test that can be used during pregnancy becomes valuable. Cardiotocography (CTG) is a continuous electronic recording of the baby's heart rate, performed using an ultrasound transducer placed on the mother's abdomen. It is sometimes referred to as "electronic fetal monitoring" ([Grivell RM, et.al, 2015](#)).

According to studies, the accurate interpretation of CTG charts requires proper training and specialized knowledge. Therefore, emphasis on the proper education of healthcare personnel in using this tool is crucial for its effective utilization ([Bashir, Khan, & Qureshi, 2018](#)). Additionally, by providing immediate and analyzable data, CTG allows for quick decision-making in critical conditions, which is highly effective in improving maternal and neonatal health indicators.

This study, using a library-based method and up-to-date scientific resources, aims to analyze the role, importance, benefits, and challenges related to cardiotocography in the form of a systematic scientific review.

By examining research in various aspects of maternal and neonatal health, it is hoped that this research will provide valuable information for broader and more effective use of this tool by physicians and researchers (Ghulam, Khan, & Ali, 2021).

Problem Statement

Maternal and fetal health during pregnancy is considered one of the most fundamental indicators of public health in society. In this regard, the timely diagnosis of potential fetal issues, especially in the later stages of pregnancy and during labor, can play a decisive role in preventing severe complications or the death of the newborn and mother. One of the essential tools used in this context is cardiotocography (Cardiotocography - CTG). This tool, by simultaneously monitoring fetal heart rate and uterine contractions, provides precise information about the fetal health status for the healthcare team.

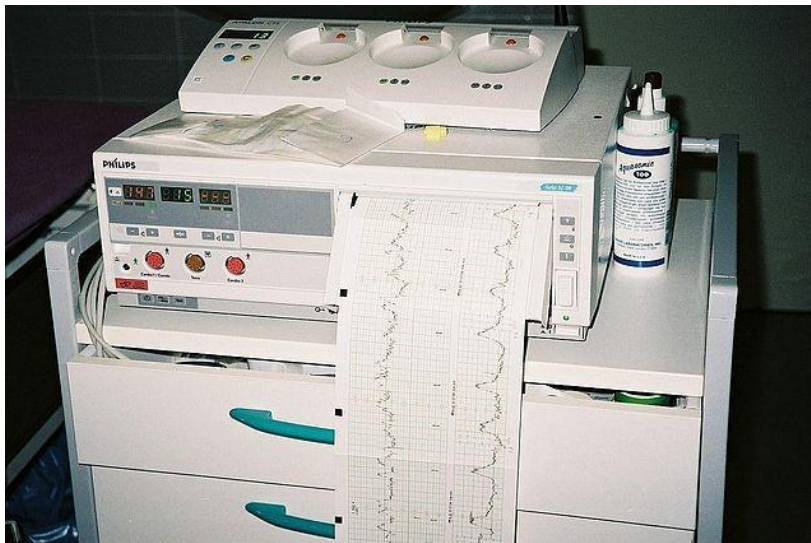
Despite scientific advancements in prenatal care, the effective use of CTG in many healthcare centers, especially in developing countries, still faces challenges. The lack of sufficient knowledge in the accurate interpretation of results, the shortage of training for healthcare personnel, and inadequate access to standardized devices are some of the problems that hinder the full utilization of this diagnostic method.

On the other hand, some studies have highlighted discrepancies regarding the accuracy and sensitivity of cardiotocography in diagnosing fetal distress. This issue underscores the necessity of further investigation into the role of CTG in prenatal care and the evaluation of existing scientific evidence in this field.

Therefore, this research aims to clarify the role and importance of cardiotocography in monitoring fetal health through a review of scientific literature and reliable studies, and to address existing questions regarding the efficiency, accuracy, and challenges in using this method.

The Role of Cardiotocography (CTG) in Fetal Health

Cardiotocography (CTG), as one of the essential tools for monitoring fetal health, plays a significant role in reducing fetal mortality and preventing complications during labor. This device, by recording fetal heart rate and uterine contractions, reveals the oxygenation status and fetal responses to intrauterine stresses (Ayres-de-Campos et al., 2015).



The clinical application of CTG is particularly important in the later stages of pregnancy and during labor, as it allows physicians to intervene quickly when abnormal heart rate patterns are detected, such as inducing labor or performing a cesarean section. In fact, CTG is recognized as a tool for diagnosing fetal distress, which can help prevent adverse outcomes such as brain injury, asphyxia, or even intrauterine death (Grivell, Alfirevic, & Gyte, 2012).

Furthermore, studies have shown that the proper and evidence-based use of CTG can reduce labor-related complications and improve neonatal outcomes, provided that the interpretation of results is conducted by trained and knowledgeable personnel (Devane et al., 2017). However, ongoing training of healthcare professionals in accurately reading charts and preventing misinterpretations is essential for the successful use of this technology.

As a result, CTG is not only a tool for monitoring fetal health, but also plays a pivotal role as a clinical decision-making instrument in the management of labor and the care of both mother and baby.

Intervention Description

Cardiotocography (CTG) is a continuous electronic recording of the fetal heart rate obtained using an ultrasound transducer placed on the mother's abdomen (external or indirect CTG). Another transducer is placed on the fundus of the uterus to simultaneously record uterine activity. Both the fetal heart rate and uterine contractions are recorded on a paper strip simultaneously.

Evaluable components in CTG include the baseline heart rate, variability of the heart rate, accelerations, and decelerations of the heart rate. Additionally, the relationship between fetal heart rate and the timing of uterine contractions is assessed. CTG is widely used in obstetric care, both during pregnancy and labor. Although the theoretical principles and monitoring indicators are similar, this review focuses on the use of CTG

during pregnancy and before the onset of labor. A separate Cochrane review specifically examines the effectiveness of continuous CTG during labor (Alfirevic, 2013).

The term "electronic fetal monitoring" is sometimes used interchangeably with CTG, but it is not a more precise term because:

- CTG also includes monitoring uterine contractions;
- Other forms of fetal monitoring, such as fetal ECG or pulse oximetry, may also be considered "electronic."

Pregnancy-related CTG is used as a common tool for evaluating fetal health, with fetal heart rate considered as an indicator of fetal well-being (Boyle, 2004). This test may be performed without stimulation, referred to as a "non-stress test," or it may be performed with uterine contraction stimulation to evaluate the fetal heart rate response, known as a "contraction stress test" (Owen, 2001).

Pregnancy-related CTG is often performed in the third trimester (after 28 weeks). The gestational age at which CTG is initiated can vary and is partially dependent on the minimum gestational age for neonatal survival in the neonatal intensive care unit; therefore, in some centers, it may even be used before 26 weeks (Smith, 1987).

Pregnancy CTG may also be used in combination with other fetal assessment methods, such as Doppler ultrasound or amniotic fluid volume measurement (Turan, 2008), and is part of the formal biophysical profile (which assesses fetal movements, tone, breathing, and fluid volume, with or without evaluating the fetal heart rate) (Lalor, 2008). The frequency of the test depends on the reason for performing the CTG and the gestational age, ranging from once a week to three times a day.

Advantages of Cardiotocography (CTG)

Cardiotocography (CTG), as one of the essential methods for monitoring fetal health, offers several advantages during pregnancy and labor, including the following:

The most prominent advantage of CTG is the continuous monitoring of the fetal heart rate. By electronically recording the fetal heart rate and synchronizing it with uterine contractions, physicians can instantaneously assess the oxygenation status and overall well-being of the fetus. This feature is especially crucial in high-risk pregnancies, in fetuses at risk of intrauterine growth restriction, or in mothers with chronic illnesses (Ayres-de-Campos et al., 2015).

Another benefit of CTG is the early detection of fetal distress. Prompt identification of a decrease in fetal heart rate or an inadequate fetal response to contractions can prevent complications such as asphyxia, brain damage, or fetal death. This advantage enables quicker therapeutic decisions, such as performing a cesarean section or accelerating labor (Grivell et al., 2012).

Additionally, CTG contributes to increased peace of mind for the mother and family. Knowing that the fetal health is being accurately monitored helps reduce maternal anxiety and fosters a more positive interaction between the mother and the healthcare team (Devane et al., 2017).

Lastly, CTG is widely used in clinics and hospitals due to its non-invasive nature, high accuracy, and ease of use. It does not require any special preparation and can be performed at any time during pregnancy after the 28th week (Alfirevic et al., 2017).

Challenges of Cardiotocography (CTG)

Despite the numerous benefits of cardiotocography (CTG) in evaluating fetal health, this technique also comes with challenges and limitations that can negatively impact diagnosis and treatment. These challenges can be categorized into two main groups: issues related to accuracy and problems arising from improper use.

One of the primary challenges in using CTG is its limited accuracy in identifying actual fetal problems. Sometimes, CTG can generate false positive or false negative results. This means that some changes in the fetal heart rate that may occur due to non-pathological factors can be mistakenly interpreted as fetal problems. These errors can lead to unnecessary interventions such as cesarean sections, which themselves carry specific risks and complications (Alfirevic et al., 2017). Moreover, misinterpretation of data in cases where CTG results are complex is another major issue (Ayres-de-Campos et al., 2015).

Another challenge is the need for experience and skill in interpreting the data. Since CTG requires accurate interpretation by a physician, any errors in data interpretation can result in incorrect diagnosis of the fetal condition and failure to take appropriate immediate action (Grivell et al., 2012). This is particularly concerning in hospitals or healthcare centers with a shortage of specialists, as it can increase the risk for both the mother and the fetus.

In addition, technical and equipment-related problems are also common challenges in using CTG. Issues such as signal disruption, fetal movement, or maternal movement can make the recorded signals unreliable and insufficient. These problems are especially observed in active labor or in patients who are overweight (Devane et al., 2017).

Finally, the high costs and limited access to CTG devices in some countries and regions are significant challenges. In many areas, particularly in developing countries, access to this technology may be limited, and its use requires appropriate healthcare and financial infrastructure (Alfirevic et al., 2017).

Conclusion

Cardiotocography (CTG) is recognized as one of the most important tools for assessing fetal condition during labor. By providing precise information about the fetal heart rate and uterine activity, this technique helps doctors continuously monitor the health of the fetus. Numerous studies have shown that proper use of CTG can significantly reduce maternal and fetal mortality during childbirth (Alfirevic et al., 2017). However, challenges in interpreting CTG data and optimizing its use still exist, requiring further attention.

One of the strengths of CTG is its ability to identify irregular changes in the fetal heart rate, which may indicate potential issues such as hypoxia (lack of oxygen) or circulatory disturbances in the fetus. Research has shown that these changes can provide vital guidance for making decisions regarding immediate actions such as cesarean section or preterm delivery (Ayres-de-Campos et al., 2015). For this reason, the importance of CTG as a preventive and management tool in emergency labor situations becomes more evident.

Nevertheless, misinterpretation of signals or errors in data analysis can lead to incorrect diagnoses and inappropriate medical interventions. Occasionally, fetal movements or technical errors in the equipment may cause false results that could mislead doctors and lead to unnecessary procedures such as cesarean sections (Devane et al., 2017). This issue is especially prominent in hospitals with less advanced technical infrastructure or limited numbers of specialists.

Additionally, some studies have shown a lack of correlation between CTG results and the actual condition of the fetus. In other words, despite alarming CTG reports, the fetus may remain in a healthy condition. Therefore, one of the main challenges in using CTG is over-reliance on the system and not considering other clinical parameters, which can lead to incorrect decision-making (Grivell et al., 2012).

Overall, studies indicate that enhancing training and skills of doctors in using CTG and interpreting its data can help reduce diagnostic errors and optimize the use of this technology. Furthermore, more advanced and accurate devices can help reduce the technical limitations of this technique. The development of clinical policies and guidelines offering more precise instructions for using CTG in various labor conditions is another necessity that can contribute to improving clinical outcomes.

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