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Fetal cardiomegaly in a preeclamptic pregnancy: A case report

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Abstract

Background: Preeclampsia is a pregnancy-specific condition characterized by hypertension and proteinuria after 20 weeks of gestation. This disorder is associated with endothelial dysfunction, abnormal placentation, and reduced uteroplacental perfusion. Preeclampsia increases the risk of complications for both mother and fetus, including intrauterine growth restriction, preterm birth, and perinatal mortality. In the fetus, placental insufficiency caused by preeclampsia may result in hypoxia and increased cardiac workload, which can subsequently lead to cardiomegaly. Early detection and proper management are essential to reduce morbidity and improve pregnancy outcomes.
Purpose: To evaluate the association between preeclampsia and the occurrence of fetal cardiomegaly as detected through prenatal ultrasound.
Method: This descriptive analytic study applied a case study approach involving a 20-year-old pregnant woman with preeclampsia who delivered preterm at the Obstetrics and Gynecology Department. Data collection included interviews, physical examinations, medical records, and diagnostic imaging, particularly fetal ultrasound. Ethical principles were followed, and informed consent was obtained from the patient. Data analysis was performed descriptively, comparing clinical findings with theoretical evidence to support discussion and management strategies.
Results: Ultrasound examination revealed fetal cardiomegaly accompanied by reversed end-diastolic flow in the umbilical artery, indicating severe compromise of fetal well-being. The patient was closely monitored, and timely delivery was performed. The neonate required immediate neonatal intensive care management due to prematurity and cardiovascular complications.
Conclusion: This case highlights the relationship between preeclampsia and fetal cardiomegaly, emphasizing the importance of comprehensive monitoring and timely intervention in high-risk pregnancies. Early recognition and appropriate management can improve maternal and neonatal outcomes in cases complicated by preeclampsia.

Keywords: Cardiomegaly; Fetal Cardiology; Preeclampsia; Prenatal Diagnosis.

INTRODUCTION

Over the past two decades, there have been significant developments in the assessment of the fetal heart and circulatory system, largely driven by innovations in imaging technology. These advancements have not only improved image clarity but also introduced the use of Doppler imaging and 3D/4D echocardiography, allowing for more accurate evaluations of both the structure and function of the fetal heart (Mongiovi, Fesslova, Fazio, Barbaro, & Pipitone, 2010). As a result, clinicians are now able to identify subtle cardiac abnormalities that may have previously gone undetected, enabling earlier diagnoses and more informed management of high-risk pregnancies (Pfitzer, Helm, Ferentzi, Rosenthal, Bauer, Berger, & Schmitt, 2017).

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In this context, preeclampsia emerges as a critical pregnancy complication with profound cardiovascular implications. The condition is characterized by maternal vascular maladaptation and placental dysfunction, which together contribute to impaired uteroplacental blood flow and increased fetal cardiac workload (Ortega, Fraile-Martínez, García-Montero, Sáez, Álvarez-Mon, Torres-Carranza, Álvarez-Mon, Buján, García-Honduvilla, Bravo, Guijarro, & De León-Luis, 2022). Advanced echocardiographic techniques, such as speckle-tracking, have demonstrated that pregnancies complicated by preeclampsia often show diastolic dysfunction and atrial strain abnormalities, underscoring its role in both diagnostic evaluation and prognostic assessment (Li, Sun, Piao, He, Li, Xu, Song, & Cong, 2021). From the maternal perspective, the hemodynamic stress imposed by preeclampsia reflects underlying limitations in cardiovascular reserve and has been linked to increased risk of long-term cardiovascular disease after pregnancy (Melchiorre, Sharma, & Thilaganathan, 2014). Recent findings further suggest a shared maternal–fetal cardiac pathway, strengthening the hypothesis that preeclampsia may originate, at least in part, from underlying cardiac maladaptation (Reilly, Watson, Ruddock, Watt, Kurth, Fitzgerald, Breathnach, & Mone, 2024).

Historically, pediatric cardiologists focused primarily on basic anatomical analysis of fetal heart conditions, with limited options for prenatal intervention. Today, fetal cardiology has evolved into a comprehensive, multidisciplinary field that enables precise structural diagnosis through ultrasound, recognizing the fetus as a distinct patient (Marler, Fishman, Upton, Burrows, Paltiel, Jennings, & Mulliken, 2002). This perspective has transformed fetal healthcare, shifting the focus from purely anatomical assessments to include detailed hemodynamic and functional evaluations when making clinical decisions (Davey, Szwast, & Rychik, 2012).

The growth of this specialty has also stimulated research into fetal cardiovascular physiology, enhancing the ability to anticipate postnatal outcomes based on in-utero development. This is supported by the unique nature of fetal circulation, which relies on specialized shunts such as the ductus venosus, foramen ovale, and ductus arteriosus. Some cardiac defects may be well tolerated before birth but pose serious risks after delivery (Mongiovi et al., 2010). This underlines the need for customized diagnostic strategies and specialized clinical expertise.

Collaboration between pediatric cardiologists and maternal-fetal medicine specialists is essential in managing conditions such as congenital heart disease, arrhythmias, and fetal cardiovascular compromise. A multidisciplinary team including radiologists, neonatologists, and genetic counselors contributes to the development of comprehensive care plans, improving both prenatal counseling and perinatal outcomes (Pfitzer et al., 2017). This integrated approach has also led to joint research efforts aimed at refining diagnostic tools and therapeutic protocols.

This article explores key components of fetal cardiac care, including methods for diagnosis, functional analysis, therapeutic options, and prenatal interventions. It also discusses delivery planning and outcome assessment, advocating for a modernized standard of care in this dynamic field. Furthermore, rapid technological progress has led to the development of educational initiatives and simulation-based training for medical professionals, particularly in underserved regions where late diagnosis and limited access to care remain challenges (Davey et al., 2012).

In addition to technological progress and increased interdisciplinary collaboration, the field of fetal cardiology is now encountering a range of new challenges and opportunities. Ethical issues have come to the forefront as the ability to detect serious cardiac conditions before birth introduces complex decisions about when and how to intervene (Revencu, Boon, Mulliken, Enjolras, Cordisco, Burrows, Clapuyt, Hammer, Dubois, Baselga, Brancati, Carder, Ceballos Quintal, Dallapiccola, Fischer, Frieden, Garzon, Harper, Johnson-Patel, Labrèze, Martorell, Paltiel, Pohl, Prendiville, Quere, Siegel, Valente, Van Hagen, Van Hest, Vaux, Vicente, Weibel, Chitayat, & Vikkula, 2008). Providing counseling to families facing these diagnoses requires a compassionate, transparent approach with careful explanation of possible outcomes and uncertainties.

To address such complexities, many institutions have established multidisciplinary fetal care boards to evaluate challenging cases and collaboratively navigate ethical concerns. These teams often include ethicists and social workers, ensuring holistic family

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support (Dipak, Nanawati, Desai, & Ananthan, 2017). In conclusion, contemporary fetal cardiology is defined by the intersection of cutting-edge technology, collaborative care models, and a growing emphasis on education and ethical responsibility. As the field continues to evolve, it expands the possibilities for prenatal diagnosis and intervention, ultimately aiming to improve both short- and long-term outcomes (Osuga, Hori, Kitayoshi, Khankan, Okada, Sugiura, Murakami, Hosokawa, & Nakamura, 2002).

RESEARCH METHOD

This study employed a qualitative descriptive method based on a comprehensive literature review of recent advances in fetal cardiology. Data were gathered from peer-reviewed journals, clinical guidelines, and case reports published within the last two decades, focusing on innovations in imaging technologies such as Doppler ultrasound and 3D/4D echocardiography (Mongiovi et al., 2010). The analysis emphasizes the evolution of diagnostic and management strategies in fetal cardiology, highlighting the role of multidisciplinary collaboration among pediatric cardiologists, maternal-fetal medicine specialists, and other healthcare professionals (Pfitzer et al., 2017). Special attention was given to the physiological characteristics of fetal circulation and their clinical implications for prenatal diagnosis and intervention planning (Davey et al., 2012). Additional evidence also highlights the contribution of structured echocardiographic protocols and cardiovascular scoring systems in strengthening prenatal cardiac evaluation (Yagel, Cohen, & Achiron, 2001; Rychik, Tian, Bebbington, Xu, McCann, Mann, Wilson, & Johnson, 2007).

RESEARCH RESULTS

A 20-year-old primigravida (G1P0A0) presented at Arifin Achmad Hospital, Pekanbaru, at 31 weeks of gestation with frequent uterine contractions accompanied by bloody mucus discharge. On admission, her blood pressure was 182/104 mmHg, which decreased to 166/98 mmHg following antihypertensive treatment. Physical examination revealed pitting edema in both lower limbs, and pelvic assessment showed cervical dilation of 5 cm with the fetal head at station Hodge 2 and strong, regular contractions.

Ultrasound confirmed a cephalic presentation with an estimated fetal weight of 1360 grams and a heart rate of 132 beats per minute. The cardiothoracic ratio exceeded 50%, raising concern for cardiomegaly. Doppler evaluation of the umbilical artery was performed, and fetal echocardiography excluded septal defects. The patient had previously received corticosteroid therapy to enhance fetal lung maturation. Given that she was in active labor, vaginal delivery was pursued.

A female infant weighing 1300 grams and measuring 44 cm in length was delivered. The Apgar scores were 3 at one minute and 5 at five minutes. Due to asphyxia, the neonate was admitted to the NICU and supported with CPAP. Echocardiography revealed an ejection fraction of 55% and a cardiothoracic ratio of 0.55. The mother recovered well and was discharged after five days with a final blood pressure of 165/97 mmHg.

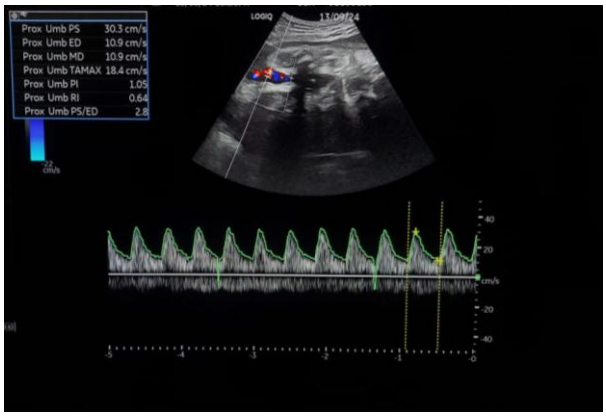


Figure 1. Doppler assessment of the umbilical artery revealed normal findings.

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Figure 2. Fetal heart ultrasound reveals a cardiothoracic ratio greater than 50%.



Figure 3. Doppler assessment of the middle cerebral artery showed normal results.

DISCUSSION

Fetal cardiomegaly in pregnancies complicated by preeclampsia is an important factor to consider, as it is closely linked to placental insufficiency (Mongiovi et al., 2010). This relationship highlights the connection between maternal vascular health and the increased cardiac workload on the fetus, with maternal hypertension reducing placental blood flow and impairing oxygen delivery (Davey et al., 2012). Research has shown that the severity of placental dysfunction correlates with the degree of fetal cardiac remodeling, which may serve as a predictor of adverse neonatal outcomes (Pfitzer et al., 2017). Epidemiologically, preeclampsia occurs in 5–10% of pregnancies and is a significant cause of intrauterine growth restriction (IUGR) and fetal distress (Revencu et al., 2008).

When placental dysfunction becomes severe, the fetus is exposed to chronic hypoxia and nutritional deficiency, leading to cardiomegaly. In this state, the fetal myocardium increases its contractility and wall thickness as a compensatory mechanism; however, prolonged exposure may progress into pathological hypertrophy and eventual heart failure (Mongiovi et al., 2010). In addition, redistribution of fetal circulation through the "brain-sparing effect" helps maintain oxygenation to the brain and heart but reduces perfusion to other developing organs, potentially causing multisystem compromise **(**Marler et al., 2002). These hemodynamic changes increase the likelihood of cardiomegaly, which is often accompanied by reversed end-diastolic flow (REDF) in the umbilical artery. The presence of REDF indicates further placental dysfunction and higher vascular resistance, which is strongly associated with adverse outcomes including intrauterine hypoxia and fetal demise (Osuga et al., 2002).

The detection of both cardiomegaly and REDF should be considered a critical prognostic sign, as it significantly elevates the risk of acidemia, neurodevelopmental impairment, and intrauterine death (Dipak et al., 2017). Current guidelines stress that timely intervention is essential once these markers are identified, as rapid deterioration may occur (Davey et al., 2012). Serial ultrasound and non-

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stress testing are therefore recommended to optimize delivery timing, as early recognition has been shown to improve neonatal outcomes by enabling appropriate and timely intervention (Pfitzer et al., 2017).

Several echocardiographic studies reinforce these observations. Research has demonstrated that fetal cardiac impairment can be detected before the clinical onset of preeclampsia, particularly at 35–37 weeks, indicating that cardiac dysfunction may precede maternal symptoms (Semmler, Garcia-Gonzalez, Sanchez Sierra, Gallardo Arozena, Nicolaides, & Charakida, 2021). Similarly, abnormal diastolic function has been consistently associated with placental insufficiency and IUGR, suggesting that cardiac changes are integral to the pathophysiology of early-onset disease (Crispi, Comas, Hernández-Andrade, Eixarch, Gómez, Figueras, & Gratacós, 2009). Early-onset preeclampsia shows stronger links with pathological cardiac remodeling compared with late-onset cases, emphasizing the importance of individualized risk assessment (Mongiovi et al., 2010).

The present case illustrates the clinical implications of these mechanisms. The cardiothoracic ratio exceeding 50% confirmed the presence of cardiomegaly, reflecting the impact of chronic hemodynamic strain. Comparable findings have been reported in earlier studies, where cardiomegaly was associated with intrauterine compromise and increased need for neonatal intensive care (Chaoui, Bollmann, Göldner, Heling, & Tennstedt, 1994). Moreover, broader cohort studies on fetal cardiomyopathies have shown that prenatally diagnosed cases present with a wide clinical spectrum, ranging from mild to severe forms, and their outcomes vary considerably depending on the underlying etiology and perinatal management strategies (Walter, Calite, Geipel, Strizek, Recker, Herberg, Berg, & Gembruch, 2023).

Beyond the perinatal period, preeclampsia has also been linked to long-term cardiovascular risk in both mother and child. Women with hypertensive disorders of pregnancy are predisposed to persistent vascular dysfunction, while offspring exhibit altered cardiovascular physiology later in life (Garcia-Gonzalez, Nunez, Zhang, Nicolaides, & Charakida, 2023). This underscores the importance of postnatal follow-up and preventive strategies to reduce intergenerational transmission of cardiovascular risk.

Effective management of preeclamptic pregnancies complicated by cardiomegaly requires a multidisciplinary approach. Emergency obstetric guidelines recommend continuous maternal hemodynamic monitoring and timely delivery when compromise is detected (Boyle, 2024). Integration of echocardiography, Doppler studies, and clinical markers helps refine clinical decisions. Moreover, cases complicated by maternal mirror syndrome or progressive hypertension may require early delivery or intrauterine intervention, which has been shown to improve maternal stability and fetal prognosis in selected situations (Chimenea, García-Díaz, Calderón, Heras, & Antiñolo, 2018).

In summary, fetal cardiomegaly in preeclamptic pregnancies reflects the intersection of maternal vascular pathology, placental insufficiency, and fetal cardiac. The condition signifies increased intrauterine stress and should prompt close monitoring and individualized care strategies. Early diagnosis through advanced imaging techniques, combined with coordinated maternal and neonatal management, is vital to improving both immediate and long-term outcomes (Melchiorre et al., 2014; Garcia-Gonzalez, Nunez, Zhang, Nicolaides, & Charakida, 2023). Continued research on predictive biomarkers and interventional strategies will be crucial for further reducing morbidity and mortality in this high-risk population.

CONCLUSION

Fetal cardiology has advanced significantly, enabling the early detection and management of cardiovascular issues. In cases of preeclampsia with cardiomegaly and reversed end-diastolic flow, early identification and timely intervention are crucial for improving outcomes for both mothers and fetuses, particularly in high-risk pregnancies complicated by placental insufficiency.

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