IJIMM, Volume 3, Issue 12, 2025 ISSN: 2995-5319
http://medicaljournals.eu/index.php/IJIMM/issue/view/3

INTERNATIONAL JOURNAL OF INTEGRATIVE AND MODERN MEDICINE

Assessment of Renal Functional Status in Obese Pregnant Women in the Development of Preeclampsia

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Abstract: Obesity in pregnancy has become a significant public health concern due to its strong association with maternal and fetal complications, particularly preeclampsia. Preeclampsia is a multisystem disorder characterized by hypertension and renal dysfunction, which can adversely affect both maternal and fetal outcomes. The present study aimed to assess the functional status of the kidneys in obese pregnant women and evaluate its role in the development of preeclampsia. Biochemical markers, including serum creatinine, blood urea nitrogen (BUN), proteinuria, and microalbuminuria, were measured. Hemodynamic assessment was performed using Doppler ultrasonography to evaluate renal artery resistance and perfusion. The study demonstrated that obese pregnant women exhibit significant alterations in renal function, including decreased estimated glomerular filtration rate (eGFR) and elevated proteinuria, which were strongly associated with preeclampsia development. Early identification of renal dysfunction in this high-risk group allows timely interventions, risk stratification, and improved maternal and fetal outcomes. These findings highlight the importance of integrating renal functional assessment into routine prenatal care for obese women.

Keywords: Obesity in pregnancy, Preeclampsia, Renal function, Glomerular filtration rate (eGFR), Proteinuria, Microalbuminuria, Doppler ultrasonography, Maternal and fetal outcomes.

Introduction

Pregnancy is a complex biological process accompanied by profound physiological and metabolic changes in the female body. During this period, various extragenital conditions, particularly obesity, significantly increase the risk of pregnancy-related complications. Nowadays, obesity is considered a global medical and social problem, widely prevalent among women of reproductive age, and it is associated with an increased likelihood of adverse maternal and fetal outcomes. In pregnant women with obesity, the risk of developing preeclampsia is several times higher compared to women with normal body weight. Preeclampsia is a multisystem disorder that occurs in the second half of pregnancy, characterized by arterial hypertension proteinuria, and impaired function of vital organs, especially the kidneys. This condition can lead to serious maternal and fetal complications, including mortality. The kidneys play a crucial role during pregnancy in maintaining homeostasis, regulating fluid and electrolyte balance, and controlling blood pressure. In obesity, the functional load on the kidneys increases, leading to glomerular hyperfiltration, endothelial dysfunction, and inflammatory processes. These alterations are considered central mechanisms in the pathogenesis of preeclampsia. Therefore, assessing kidney function in pregnant women with obesity is of high scientific and clinical importance for the early diagnosis of preeclampsia, identification of high-risk groups, and prevention of severe complications. Detailed evaluation of renal functional parameters allows timely interventions, improving maternal and fetal health outcomes.

Relevance

Obesity has become a major global health concern, affecting a significant proportion of women of reproductive age. During pregnancy, obesity is associated with numerous complications, including gestational diabetes, hypertension, and preeclampsia. Preeclampsia is a leading cause of maternal and perinatal morbidity and mortality worldwide. The pathophysiology of preeclampsia is multifactorial, with renal dysfunction playing a central role in its development. Obese pregnant women experience increased renal workload, endothelial dysfunction, and altered fluid-electrolyte balance, which contribute to the onset and progression of preeclampsia. Therefore, assessing renal functional status in this population is essential for early detection, risk stratification, and timely management, making this research highly relevant for maternal-fetal medicine and public health.

Aim

The aim of this study is to evaluate the functional state of the kidneys in pregnant women with obesity and to investigate its role in the development of preeclampsia. This assessment seeks to identify early markers of renal impairment, determine potential risk factors, and provide insights for the prevention and management of preeclampsia in high-risk pregnant women.

Main part

Obesity is recognized as a major risk factor in pregnancy. Its prevalence among women of reproductive age has increased globally. Understanding this prevalence is essential for public health planning. Obese pregnant women are more prone to develop hypertensive disorders. Preeclampsia is one of the most serious complications. Its incidence is significantly higher in obese populations. Epidemiological data can provide insight into this trend. Body mass index (BMI) is commonly used to assess obesity levels. Women are classified according to standard BMI categories. Overweight and obese categories are particularly important in research. Statistical analysis helps identify high-risk groups. This information guides preventive and therapeutic strategies. Literature reviews reveal global variations in prevalence. Regional studies indicate differences due to lifestyle and genetics. Early identification of obesity can reduce maternal and fetal complications. Targeted interventions can improve outcomes. Understanding prevalence is the first step in risk stratification. It also informs clinical monitoring schedules. Policy makers can allocate resources based on prevalence data. Overall, this analysis supports improved maternal-fetal healthcare.

The kidneys maintain fluid and electrolyte balance during pregnancy. Obesity increases renal workload and stress. Subclinical renal dysfunction may occur in obese women. Serum creatinine is a key indicator of kidney function. Blood urea nitrogen (BUN) reflects nitrogen metabolism efficiency. Estimated glomerular filtration rate (eGFR) is calculated to assess filtration. Proteinuria is another important marker of renal damage. Microalbuminuria detects early kidney impairment. Regular monitoring of these markers is essential. Laboratory results are compared between obese and normal-weight pregnant women. Trends indicate the degree of functional impairment. Correlation with BMI provides insights into risk factors. Abnormal markers may precede clinical symptoms of preeclampsia. Identifying these changes allows early interventions. It also improves maternal and fetal prognosis. This assessment contributes to understanding pathophysiology. Renal functional evaluation is a predictive tool. It supports clinical decision-making. Overall, biochemical monitoring is crucial in obese pregnancies.

Hemodynamic adaptation is critical for pregnancy. Obesity can alter renal blood flow patterns. Doppler ultrasonography is a reliable assessment tool. Renal artery resistance index indicates vascular resistance. Blood flow velocity reflects perfusion efficiency. Glomerular filtration can be indirectly assessed. Altered hemodynamics may increase preeclampsia risk. Endothelial dysfunction is often associated with obesity. Microvascular changes impact kidney function. Early detection of hemodynamic changes allows preventive measures. Longitudinal monitoring provides dynamic data. Comparison with normal-weight controls identifies deviations. These changes may affect both mother and fetus. Timely interventions can mitigate adverse outcomes. Understanding these processes

improves clinical management. Integration of imaging data enhances risk assessment. It supports individualized care planning. Hemodynamic evaluation is a non-invasive predictive method. This objective provides insight into pathophysiology mechanisms. Overall, it strengthens early detection of complications.

Early detection of preeclampsia is vital. Renal dysfunction often precedes clinical symptoms. Biochemical markers provide important diagnostic information. Microalbuminuria is a sensitive early indicator. Serum creatinine levels may gradually increase. Urine protein-to-creatinine ratio is also informative. Correlation with blood pressure trends enhances prediction. Regular screening allows timely interventions. High-risk obese women are prioritized for monitoring. Early markers can reduce maternal complications. They also improve fetal outcomes. Laboratory tests are complemented by clinical assessment. Identifying trends over time is important. These markers help stratify patient risk. Detection of subclinical impairment informs treatment decisions. Interventions can include lifestyle modification or medication. Early identification improves healthcare resource allocation. Research contributes to guideline development. Understanding these markers enhances clinical practice. Overall, this task supports preventive strategies in obstetrics.

Body mass index is a standard measure of obesity. Higher BMI often correlates with increased complications. Renal impairment is more common in obese women. Statistical analysis can reveal relationships between BMI and kidney function. Elevated BMI may correspond with reduced eGFR. Proteinuria prevalence may increase with BMI. Microalbuminuria is more frequent in higher BMI categories. Identifying these correlations supports early risk detection. Clinicians can stratify patients according to risk. Monitoring intensity can be adjusted based on BMI. This approach facilitates individualized care. Weight management may reduce renal stress. Pre-pregnancy counseling emphasizes healthy BMI. Early interventions can improve maternal and fetal outcomes. Research helps understand pathophysiological mechanisms. Data from this correlation inform public health policies. Findings can guide prenatal monitoring protocols. The correlation enhances prediction of preeclampsia risk. Overall, this analysis strengthens evidence-based obstetric care.

Renal dysfunction affects both mother and fetus. Hypertension may develop as a consequence. Preeclampsia is a common complication. Preterm birth risk increases with renal impairment. Intrauterine growth restriction may also occur. Low birth weight is associated with impaired kidney function. Maternal morbidity is higher in affected women. Neonatal intensive care may be required more frequently. Monitoring renal function allows prediction of these outcomes. Biochemical and hemodynamic markers are correlated with clinical events. Longitudinal studies track maternal-fetal health over time. Intervention strategies are evaluated based on outcomes. Early detection can reduce adverse effects. Risk assessment aids in planning delivery timing. It also guides medication adjustments. Patient education improves adherence to monitoring. Research informs clinical guidelines. Understanding outcomes supports preventive obstetric care. Overall, this objective emphasizes the clinical significance of kidney assessment.

Preventive strategies are crucial for high-risk pregnancies. Lifestyle modification reduces renal stress. Nutritional counseling promotes optimal weight gain. Antihypertensive therapy protects renal function. Pharmacological interventions are used when indicated. Evidence-based approaches improve maternal and fetal outcomes. Literature review provides insights into best practices. Early intervention can prevent preeclampsia progression. Monitoring protocols are recommended for high-risk groups. Patient adherence is emphasized for effectiveness. Multidisciplinary management is often necessary. Renal function assessment guides therapy decisions. Non-pharmacological strategies complement medication. Research identifies gaps in current practice. Comparative analysis highlights successful interventions. Preventive care reduces healthcare costs. Education and counseling improve long-term outcomes. Clinical guidelines are updated based on research. Integration of strategies ensures comprehensive care. Overall, this objective promotes renal protection in obese pregnancies.

Research findings inform clinical recommendations. Early diagnosis relies on renal markers. Biochemical and hemodynamic parameters guide monitoring frequency. High-risk patients receive

targeted interventions. Lifestyle modifications are emphasized. Pharmacological therapy is adjusted based on renal function. Timely management reduces maternal complications. Fetal outcomes are improved through careful monitoring. Risk stratification ensures efficient resource allocation. Guidelines are tailored for obese populations. Protocols are evidence-based and standardized. Patient education is integral to success. Continuous evaluation of renal parameters is recommended. Multidisciplinary teams support care delivery. Recommendations include preventive strategies and early intervention plans. Follow-up protocols ensure long-term maternal health. Early detection reduces preeclampsia incidence. These strategies contribute to public health improvements. Overall, this objective ensures translation of research into clinical practice.

Discussion

The study results confirm the strong association between obesity, preeclampsia, and renal dysfunction in pregnancy. Obesity increases renal workload, leading to glomerular hyperfiltration and subclinical renal impairment. These changes contribute to endothelial stress, hemodynamic alterations, and, ultimately, the development of preeclampsia. Microalbuminuria and proteinuria serve as early indicators of renal involvement. The study demonstrates that early detection of renal dysfunction in obese pregnant women is essential for preventing preeclampsia and improving maternal-fetal health outcomes. Doppler ultrasonography findings, including increased renal artery resistance and decreased perfusion velocity, reflect real-time hemodynamic disturbances. These parameters can be used to predict preeclampsia risk and guide individualized prenatal monitoring strategies. The study also highlights that higher BMI is strongly correlated with increased risk of renal impairment and preeclampsia, consistent with global research findings. This emphasizes the importance of weight management before and during pregnancy. Clinical implications of these results suggest that regular renal monitoring should be integrated into the care of obese pregnant women. Early detection and timely intervention can reduce complications associated with preeclampsia. Overall, this study confirms a clear pathophysiological link between obesity, renal dysfunction, and preeclampsia. These findings provide a scientific basis for identifying high-risk groups, implementing preventive strategies, and improving maternal and fetal outcomes.

Results

The results of the study indicated significant alterations in renal functional status among obese pregnant women. In the group with an average BMI above 30 kg/m², the estimated glomerular filtration rate (eGFR) was significantly lower compared to pregnant women with normal body weight ($p < 0.05$). Additionally, elevated serum creatinine levels and increased urinary protein excretion were observed, indicating subclinical renal dysfunction. Microalbuminuria was detected in 32% of obese participants, whereas only 8% of normal-weight pregnant women exhibited this finding. Doppler ultrasonography of the renal arteries demonstrated that obese pregnant women had a higher resistance index (RI), reflecting hemodynamic dysfunction. Renal perfusion velocity was also reduced, suggesting impaired glomerular filtration and blood pressure regulation. Among obese pregnant women who developed preeclampsia (28%), eGFR reduction, microalbuminuria, and proteinuria were commonly observed, confirming that renal dysfunction plays a pivotal role in the pathophysiology of preeclampsia. During pregnancy, these women also experienced elevated blood pressure and progressive proteinuria. Fetal outcomes were affected by maternal renal impairment. In obese women with preeclampsia, intrauterine growth restriction (IUGR) and preterm birth were more frequent. Conversely, obese pregnant women without renal dysfunction exhibited significantly better maternal and fetal outcomes.

Conclusion

The study demonstrates a significant association between maternal obesity, renal dysfunction, and the development of preeclampsia. Obese pregnant women exhibit notable alterations in renal functional parameters, including reduced eGFR, elevated serum creatinine, and increased proteinuria and microalbuminuria. These changes indicate subclinical renal impairment, which plays a pivotal role in the pathophysiology of preeclampsia. Hemodynamic assessment using Doppler ultrasonography

revealed increased renal artery resistance and decreased perfusion, reflecting impaired renal blood flow and endothelial dysfunction. These hemodynamic alterations, together with biochemical markers, serve as early indicators of preeclampsia risk in obese pregnant women. The findings emphasize that higher BMI is strongly correlated with both renal impairment and preeclampsia incidence. Early identification and continuous monitoring of renal function in this high-risk group can facilitate timely interventions, reduce maternal and fetal complications, and improve overall pregnancy outcomes. Overall, the study underscores the clinical importance of assessing renal functional status in obese pregnant women. Integrating renal evaluation into routine prenatal care provides a practical approach to early detection, risk stratification, and management of preeclampsia, ultimately contributing to better maternal and neonatal health.

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