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Preeclampsia And Eclampsia: A Focus On Pathogenesis And Treatment

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Abstract:
Background *: Epidemiological studies indicate that the incidence of preeclampsia and eclampsia in pregnant women varies between 5% and 7% globally. Preeclampsia (PE) and eclampsia (EP) are hypertensive conditions of pregnancy that can lead to serious complications for both the mother and the fetus.Therefore, the objective of this study aims to evaluate the scientific literature on preeclampsia and eclampsia in pregnant women and describe the pathogenesis, emphasizing risk factors, signs and symptoms, consequences of preeclampsia and eclampsia, and treatment, with the goal of providing robust scientific evidence for the prevention and management of this pathology.*
Materials and Methods*: PubMed, Scopus, Web of Science, and Cochrane Library databases will be consulted for studies published in the last 20 years (2004-2024). The search strategy will include MeSH terms and keywords such as "consequences," "eclampsia," "risk factors," "pregnancy," "pre-eclampsia" and "signs and symptoms."*
Results and Discussion*: The pathophysiology of PE involves multiple placental dysfunctions, including endothelial injury, systemic arterial vasospasm, inadequate trophoblastic invasion of the maternal spiral arteries, and impaired placental development and perfusion.*
Conclusion: *Therefore, it is concluded that preeclampsia and eclampsia are severe hypertensive conditions of pregnancy, causing serious harm to both mother and fetus, including death. Maternal complications of EP include HELLP syndrome, placental abruption, and acute renal failure, which can lead to maternal death without proper intervention. Therefore, the proper diagnosis and management of PE and EP are essential due to the high risks for both mother and baby.*
Key Word*: Embryology; Fetal Medicine; Placenta.*

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I. Introduction

Epidemiological studies indicate that the incidence of preeclampsia and eclampsia in pregnant women ranges from 5% to 7% globally [9,2]. Preeclampsia (PE) and eclampsia (EP) are hypertensive conditions of pregnancy that can lead to severe complications for both the mother and the fetus.

Preeclampsia is defined by the presence of hypertension, characterized by systolic blood pressure equal

to or greater than 140 mmHg and diastolic blood pressure equal to or greater than 90 mmHg, accompanied by unexplained proteinuria (greater than or equal to 300 mg in a 24-hour urine sample or a protein/creatinine ratio greater than or equal to 0.3) [9,2]. This condition not only increases the risks during pregnancy but can also result in serious complications such as intrauterine growth restriction and preterm birth.

Eclampsia, a severe complication of preeclampsia, is characterized by generalized tonic-clonic seizures in pregnant women diagnosed with preeclampsia. This condition requires obstetric interventions Immediate interventions and strict monitoring are crucial to prevent maternal and fetal morbidity and mortality [10]. The occurrence of seizures in pregnant women can result in neurological damage and other adverse effects for both the mother and the fetus.

Therefore, the aim of this study is to evaluate the scientific literature on pre-eclampsia and eclampsia in pregnant women and to describe the pathogenesis, emphasizing the risk factors, signs and symptoms, consequences of pre-eclampsia and eclampsia, and treatment, with the objective of providing robust scientific evidence for the prevention and management of this condition.

II. Material And Methods

This study will be a systematic review of the literature, aiming to evaluate the scientific literature on pre-eclampsia and eclampsia in pregnant women, identifying risk factors, signs and symptoms, and the consequences of these conditions. Databases such as PubMed, Scopus, Web of Science, and Cochrane Library will be consulted for studies published in the last 20 years (2004-2024). The search strategy will include MeSH terms and keywords such as "consequences," "eclampsia," "risk factors," "pregnancy," "pre-eclampsia," and "signs and symptoms".

Observational studies, clinical trials, systematic reviews, and meta-analyses published in English, Portuguese, and Spanish will be included, excluding those focused on non-human populations and publications of low methodological quality.

This systematic and rigorous approach will allow for a comprehensive understanding of the pathogenic aspects, risk factors, signs and symptoms, and consequences of pre-eclampsia and eclampsia and treatment, contributing to the improvement of clinical practices and health policies.

III. Results And Discussion

PE and EP are severe gestational hypertensive syndromes that can cause high maternal-fetal morbidity and mortality. The pathophysiology of PE involves multiple placental dysfunctions, including endothelial injuries, systemic arterial vasospasm, inadequate trophoblastic invasion of maternal spiral arteries, and impaired placental development and perfusion [2].

Although the mechanism of the pathology of EP is not completely elucidated, studies demonstrate that genetic and environmental factors, such as mitochondrial dysfunction caused by substances secreted by the placenta itself, culminate in endothelial dysfunction and EP [3]. Biomolecular studies indicate that variants in the FNBP1L, NMUR1, and PP14571 genes influence M2 macrophages, affecting the development of PE. The FNBP1L gene is crucial for cellular structural and functional integrity, NMUR1 regulates the neuroendocrine system, and PP14571 modulates immune function, all contributing to the pathogenesis of PE [3].

Adequate diagnosis and management of PE and EP are essential due to the high risks for the mother and baby. Fetal complications include intrauterine growth restriction and prematurity [9]. The main risk factors for PE and EP include nulliparity, advanced maternal age, multiple pregnancies, a history of pre-eclampsia, gestational diabetes mellitus, chronic hypertension, and obesity. Typical symptoms include severe headache, visual disturbances, epigastric pain, nausea, vomiting, and dyspnea [10].

The management of EP aims at symptomatic remission through antihypertensive, antispasmodic, and sedative therapy. The definitive resolution of EP is the termination of pregnancy, with the removal of the placenta, preventing hemorrhage and maternal death [2]. The placenta is crucial for providing oxygen and nutrients to the fetus and for the production of hormones such as hCG, hPL, estriol, progesterone, and relaxin. Elevated levels of hCG are associated with PE.

Elevated levels of free β-hCG are associated with PE and EP, suggesting this hormone as an early biomarker. β-hCG influences angiogenesis and endothelial function, impacting the pathophysiology of PE, and is related to inflammatory processes and oxidative stress [4].

The etiology of PE and EP remains obscure. However, the pharmacological management of magnesium sulfate ($MgSO_4$) in the prevention and treatment of seizures generated by the condition is still not completely elucidated. Although not traditionally classified as an anticonvulsant, magnesium sulfate has been the gold standard in treatment, demonstrating superiority in controlling eclamptic seizures compared to the use of other conventional anticonvulsants. This anticonvulsant activity may be mediated by its antagonism of N-methyl-D-aspartate (NMDA) receptors [6]. Glutamatergic hyperstimulation of NMDA receptors can trigger seizures in neural networks, promoting increased excitability in the central nervous system (CNS). $MgSO_4$ prevents and controls eclamptic seizures by inhibiting these receptors. Additionally, $MgSO_4$ acts by inhibiting NMDA

receptors, attenuating neuronal injury due to ischemia. An alternative hypothesis suggests that $MgSO_4$ induces cerebral vasodilation, promoting vasodilation and inhibiting cerebral ischemia.

$MgSO_4$ also acts as an antagonist of voltage-dependent calcium (Ca^{2+}) channels, which inhibit the contractility of smooth muscle, modulating the cerebral vascular endothelium that constitutes the blood-brain barrier (BBB). The reduction of intracellular calcium limits the influx and flow of ions and proteins, reducing factors that lead to the progression of cerebral edema and seizure activity [6].

IV. Conclusion

It is concluded that PE and eclampsia (EP) are severe hypertensive disorders during pregnancy, causing serious harm to both the mother and the fetus, including the possibility of death. Maternal complications associated with PE may include HELLP syndrome and premature placental abruption, which can result in maternal death in the absence of appropriate intervention. These conditions demand immediate obstetric interventions and strict monitoring to prevent maternal and fetal morbidity and mortality.

The correct diagnosis and management of PE and EP are essential due to the high risks for both mother and baby. This study identified the need for further research to validate CircPAPPA2 and β-hCG as reliable biomarkers, aiming to clarify their mechanisms of action in these hypertensive disorders. Early detection and the initiation of appropriate treatment are crucial for improving pregnancy outcomes.

Early identification of PE and EP is fundamental to reducing complications and improving maternal and fetal outcomes. PE and EP remain significant causes of global perinatal morbidity and mortality, highlighting the importance of diagnostic and therapeutic advances. Effective screening strategies and continuous monitoring during pregnancy can enable timely interventions, minimizing the risks associated with these conditions.

Furthermore, this study suggests that understanding the molecular mechanisms underlying PE and EP can pave the way for new personalized therapeutic approaches for each pregnant woman. The investigation of the potential of CircPAPPA2 and β-hCG as biomarkers is a promising step in this direction, as it can contribute to risk stratification and the personalization of prenatal care.

Therefore, it is imperative to continue investing in research and the development of new technologies and treatment methods for PE and EP, aiming to reduce the impact of these conditions on the healthcare system and improve the quality of life for affected pregnant women.

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