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HEMATOLOGICAL AND BIOCHEMICAL PROFILE IN HYPERTENSIVE DISORDER OF PREGNANCY: A CASE-CONTROL STUDY

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Abstract

Background: *Hypertensive disorders of pregnancy (HDP) remain a significant cause of maternal and fetal morbidity and mortality. The early identification of hematological and biochemical alterations in HDP can aid in risk stratification and management.* ***Objectives:*** *This study aims to analyze hematological and biochemical profiles in pregnant women with HDP, categorizing them into severe and non-severe cases and correlating these parameters with fetal outcomes.* ***Methods:*** *A case-control analytical study was conducted over 1.5 years, including 70 pregnant women diagnosed with HDP and 70 normotensive pregnant controls. Hematological parameters such as hemoglobin (Hb), hematocrit (Hct), total leukocyte count (TLC), platelet count, and biochemical markers, including liver and kidney function tests and lactate dehydrogenase (LDH), were analyzed. Statistical significance was determined using appropriate tests, with $p < 0.05$ considered significant.* ***Results:*** *Significant alterations were observed in hematological and biochemical markers among HDP cases compared to controls. Lower platelet counts and higher LDH levels were associated with severe HDP. Liver and renal function markers showed significant deviations, correlating with disease severity. Adverse fetal outcomes, including intrauterine fetal demise and fetal distress, were more prevalent in severe HDP cases.* ***Conclusion:*** *Haematological and biochemical parameters provide valuable insights into the severity of HDP and its impact on fetal outcomes. These markers may serve as useful adjuncts in clinical decision-making and early intervention strategies to reduce maternal and perinatal complications.*

INTRODUCTION

During pregnancy, a woman's body undergoes significant anatomical, physiological, and metabolic changes, primarily affecting the uterus, cardiovascular system, and other vital organs. While these adaptations are usually well-coordinated, complications may arise, endangering both the mother and the baby.

One of the most concerning complications is hypertension during pregnancy, commonly known as Hypertensive Disorders of Pregnancy (HDP). This condition, including severe forms like preeclampsia, can place both maternal and fetal health in jeopardy.

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Background on Hypertensive Disorder of Pregnancy

HDP is a complex, puzzling, and potentially modifiable pregnancy-related disorder that is exclusive to humans. Although its exact cause remains unknown, prevailing theories suggest that widespread dysfunction of the maternal vascular endothelium, triggered by abnormal placental development, is a key factor in its pathogenesis.

Preeclampsia is a hypertensive disorder of pregnancy characterized by new-onset hypertension and proteinuria after 20 weeks of gestation. It is a leading cause of maternal and fetal morbidity and mortality worldwide. The American College of Obstetricians and Gynecologists (ACOG) emphasizes the importance of early detection and management to mitigate risks associated with preeclampsia. ACOG recommends low-dose aspirin (81 mg/day) prophylaxis for women at high risk of preeclampsia, initiated between 12 and 28 weeks of gestation and continued daily until delivery. This approach has been shown to reduce the incidence of preeclampsia and related complications.(1)

Chronic hypertension in pregnancy, defined as elevated blood pressure present before pregnancy or diagnosed before 20 weeks of gestation, is associated with increased risks of adverse maternal and fetal outcomes, including superimposed preeclampsia, placental abruption, and fetal growth restriction. Eclampsia, a severe complication of preeclampsia, is characterized by new-onset generalized tonic-clonic seizures and can occur in the absence of overt proteinuria or severe hypertension. The pathogenesis involves endothelial dysfunction, abnormal placentation, and cerebral vasogenic edema. Effective management requires early identification and blood pressure control to mitigate risks for both mother and fetus (2)

Hypertensive disorders of pregnancy: Prevalence and Frequency

Preeclampsia is a pregnancy-specific hypertensive disorder that can sometimes develop into a multi-organ condition with diverse clinical manifestations. It affects approximately 5-8% of pregnant women worldwide and ranks among the top five causes of maternal mortality. Despite nearly 150 years of extensive research, preeclampsia continues to pose a major obstetric challenge and remains a significant public health concern, contributing to substantial maternal and perinatal morbidity and mortality in both developed and developing countries.

Globally, hypertension-related complications during pregnancy are the third leading cause of maternal deaths, following embolism and hemorrhage. Preeclampsia is particularly prevalent among first-time mothers, complicating around 10-15% of first pregnancies. The disorder exhibits a bimodal distribution, being more common among young first-time mothers (nulliparous women) and older multiparous women. (3) In 2002 alone, around 152,000 cases of preeclampsia resulted in 63,000 deaths globally. (4)

In developed nations, preeclampsia remains one of the leading causes of maternal mortality. However, due to better healthcare infrastructure, the burden of this disorder primarily affects newborns, as premature deliveries are often performed to safeguard maternal health. (5)

Prevalence and Frequency in Developing Countries

Hypertensive disorders of pregnancy (HDP) remain a major contributor to maternal and perinatal morbidity in developing countries. The pooled prevalence of HDP in Sub-Saharan Africa is approximately 8%, with preeclampsia and gestational hypertension each accounting for about 4.1%.(6)

In Ethiopia, a systematic review found an overall prevalence of 6.82%, with preeclampsia alone at 4.74%, influenced by factors such as advanced maternal age, obesity, and prior history of hypertension (7), In Malaysia, the prevalence has risen to 6.5% in recent years, with advanced maternal age and

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ethnicity being significant risk factors. [8] These data highlight the urgent need for targeted screening and preventive strategies in low- and middle-income countries.

Hypertensive Disorder of Pregnancy in India

In India, HDP affects approximately 30% of all deliveries, with around 50,000 women experiencing this severe complication each year. According to the Registrar General of India, for every 100,000 live births, 407 maternal deaths occur due to pregnancy-related causes. This translates to nearly 100,000 maternal deaths annually in India due to complications arising from pregnancy and childbirth.

Maternal mortality in India remains a significant public health concern, despite notable progress in recent years. The leading causes of maternal deaths include obstetric hemorrhage, hypertensive disorders of pregnancy, and sepsis. A study conducted at a tertiary care center in Central India from May 2023 to April 2024 reported that obstetric hemorrhage and hypertensive disorders each accounted for 25.6% of maternal deaths. Anemia was prevalent in 60.5% of the cases, highlighting the impact of indirect causes. The majority of these deaths occurred among unbooked cases, underscoring the importance of early antenatal care and timely referrals. The study emphasizes that many maternal deaths are preventable with timely intervention and proper management.[9]

Recent studies indicate that the prevalence of HDPs in India is approximately 11%, one of the highest rates globally. This includes conditions such as gestational hypertension, preeclampsia, and eclampsia. A systematic review and meta-analysis encompassing 18 studies with over 92,000 participants estimated the pooled prevalence of HDPs in India to be 11% (95% CI: 5%–17%). The study also highlighted regional variations, with the highest prevalence in the northern zone and the lowest in the eastern zone of India. [10].

Further research has identified socioecological factors influencing the risk of developing HDPs in India. A rapid review utilizing Bronfenbrenner's Ecological Model found that women in rural and low socioeconomic status areas are at higher risk due to factors such as limited health education, inadequate prenatal screening, and insufficient antenatal care visits[11]

Additionally, a community-based cross-sectional study conducted among 384 pregnant women reported a hypertension in pregnancy prevalence of 9.1%. The study identified multigravidity, multiparity, gestational age beyond 20 weeks, and a history of hypertension in previous pregnancies as significant risk factors. [12].

India has achieved a significant milestone in maternal health by reducing the **Maternal Mortality Ratio (MMR) from 130 per 100,000 live births in 2014–16 to 97 in 2018–20**, meeting the National Health Policy (NHP) 2017 target ahead of schedule. This progress is attributed to comprehensive initiatives under the National Health Mission (NHM), including programs like Janani Suraksha Yojana, LaQshya (Quality Improvement Initiatives), and the Maternal Death Surveillance and Response (MDSR) system. These efforts have collectively enhanced maternal healthcare services, contributing to the decline in MMR[13]

MATERIAL AND METHODS

Study Design: Case Control Analytical Study

Period: One and half year (May 2023 - November 2024)

Sample Size Study:

70 Cases and 70 Controls who were normotensive pregnant females with ≥ 20 weeks of gestation d=5% (precision) included in the study.

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Inclusion Criteria:

a) Pregnant females visiting OPD / Labour room in the Department of Obstetrics and Gynaecology of SMS&R and diagnosed with hypertensive disorder of pregnancy based on the recommendations of The American College of Obstetricians and Gynecologists.

b) Singleton pregnancy.

Exclusion criteria:

a) History of systemic illnesses like diabetes mellitus, renal disease, liver diseases

b) Women with history of recent blood transfusion.

c) Pregnancy associated with Germ cell tumors

Methodology:

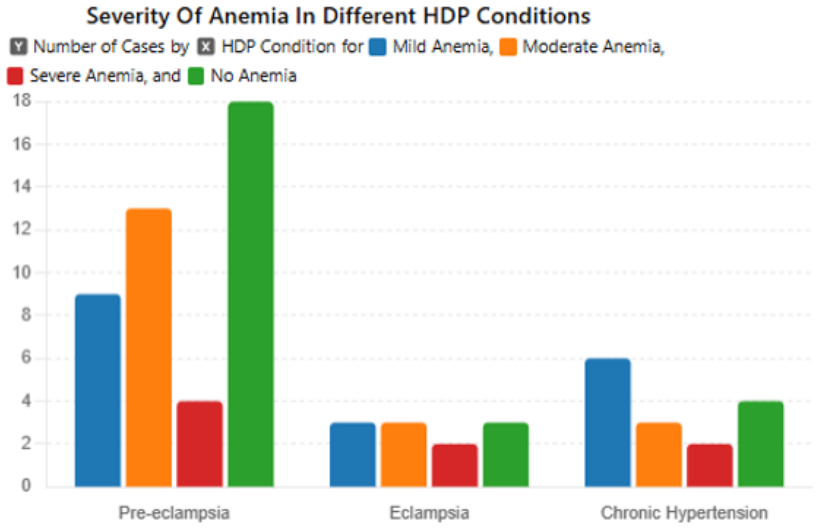
The pregnant females with ≥ 20 weeks of gestation, visiting OPD / Labour room in the Department of Obstetrics and Gynaecology were included in the study.

Gestational age was recorded from ultrasonography report or case sheet. Blood pressure readings with an appropriate-size cuff will be recorded.

RESULTS

Haematological findings in hypertensive disorders of pregnancy (HDP) indicate lower haemoglobin (Hb) and platelet counts compared to controls, with HDP cases showing an average Hb of 10.10 g/dL and platelets at 221.44 ×10³/µL, whereas controls had 10.76 g/dL and 402.85 ×10³/µL, respectively (p-value of Hb is 0.01 and Platelet is <0.001). Additionally, total leukocyte count (TLC) was significantly elevated in HDP cases (11,007/mm³ vs. 7,980/mm³, $p < 0.001$), alongside higher white blood cell (WBC) counts and haematocrit levels.

Biochemical alterations suggest liver dysfunction, evidenced by elevated SGOT (55.21 vs. 31.63 U/L, $p < 0.001$) and SGPT (48.40 vs. 38.87 U/L, $p = 0.0255$), as well as renal dysfunction marked by significantly increased uric acid levels (27.06 vs. 15.88 mg/dL, $p < 0.001$).. In terms of fetal outcomes, severe HDP cases had a 32.8% mortality rate, with a higher incidence of intrauterine fetal demise and fetal distress, whereas mild and moderate HDP cases showed no mortality.



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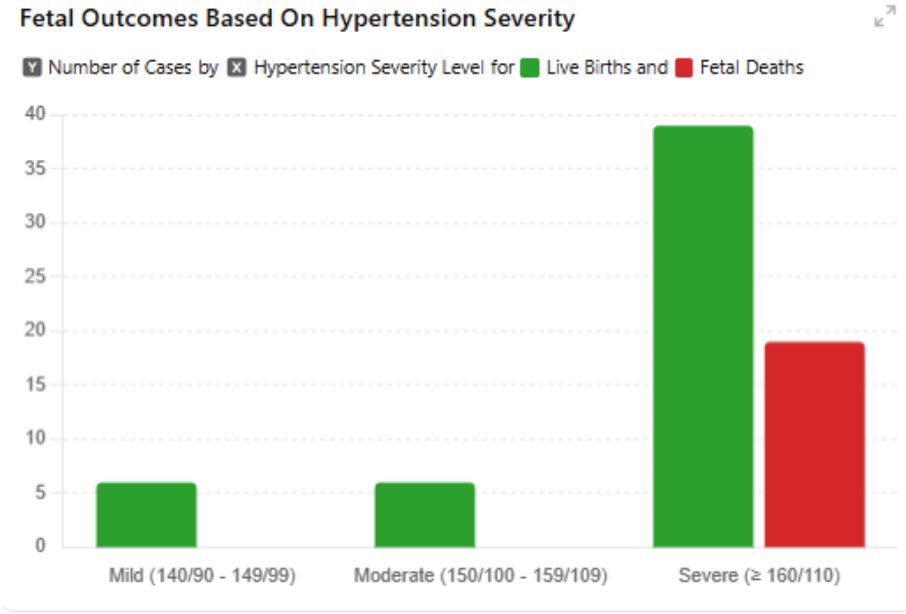

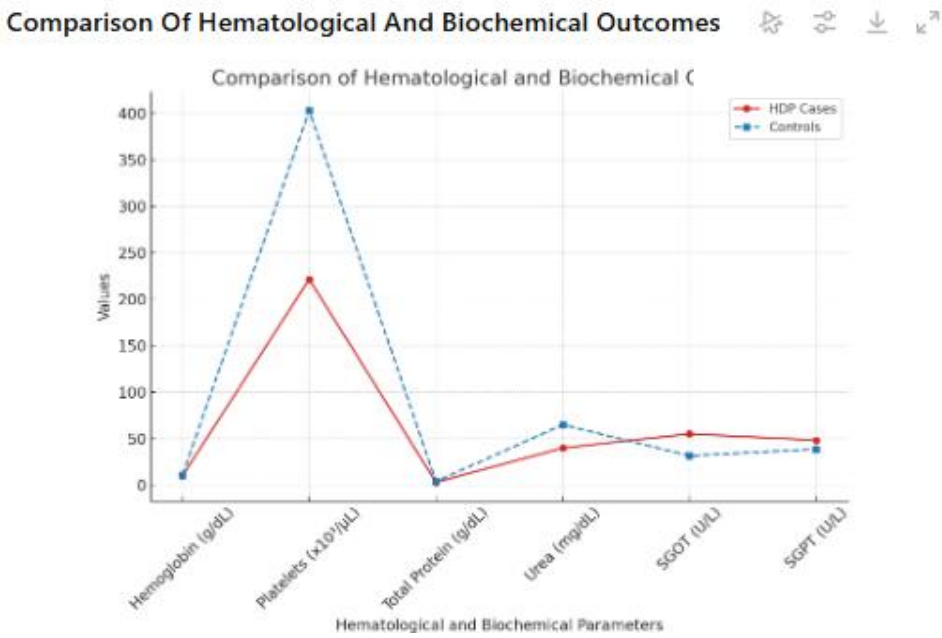

DISCUSSION

Hypertensive disorders of pregnancy (HDP) remain a major cause of maternal and fetal complications, necessitating early detection and monitoring. This study highlights significant haematological and biochemical changes in HDP cases compared to normotensive controls, emphasizing their role in disease progression and risk assessment.

Haematological Alterations:

- Lower haemoglobin and platelet counts in HDP cases indicate anaemia and possible coagulopathy, with thrombocytopenia being particularly prominent in severe cases.
- Elevated total leukocyte count suggests an inflammatory response, potentially worsening endothelial dysfunction.

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Biochemical Changes:

- Liver dysfunction markers (SGOT, SGPT) were significantly elevated, suggesting hepatic involvement, possibly linked to HELLP syndrome in severe cases.
- Increased uric acid and urea levels indicate renal impairment, a common complication in HDP, further correlating with disease severity.

Fetal Outcomes:

- A strong association was observed between severe HDP and adverse fetal outcomes, including intrauterine fetal demise and distress, with a mortality rate of **32.8%** in severe cases.
- No mortality was observed in mild and moderate HDP cases, emphasizing the need for timely diagnosis and intervention in severe cases.

CONCLUSION

Routine haematological and biochemical monitoring can serve as a predictive tool for identifying high-risk pregnancies. Early intervention strategies, including close maternal-fetal surveillance and timely management of complications, are crucial in reducing perinatal morbidity and mortality. The findings reinforce the importance of integrating laboratory diagnostics into standard hypertension management protocols in pregnancy.

This study underscores the need for further research on biomarkers that could enhance early detection and treatment strategies, ultimately improving maternal and neonatal outcomes.

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