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Original Research Article

Hematologic havoc: haemoglobins link to hypertensive pregnancy outcomes

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ABSTRACT

Background: Hypertensive disorders of pregnancy (HDP), such as preeclampsia and eclampsia, significantly threaten maternal and perinatal health. This study explores the impact of hemoglobin levels on pregnancy outcomes in women with HDP, aiming to identify potential predictors of adverse outcomes.
Methods: A retrospective analysis was conducted on 233 pregnant women diagnosed with HDP at Sapthagiri Hospital, Bengaluru, from June 2022 to June 2024. Data on patient demographics, hemoglobin levels, and maternal and perinatal outcomes were collected. Statistical analysis was performed using SPSS to examine associations between hemoglobin levels and clinical outcomes.
Results: The study found that low hemoglobin levels (<11 gm%) were associated with a significantly higher incidence of maternal complications (37.8%) compared to normal (15.1%) and high hemoglobin levels (>13 gm%) (35.5%). Eclampsia was more prevalent in women with both low and high hemoglobin levels (17.4% and 17.8%, respectively) compared to those with normal levels. Adverse perinatal outcomes, including increased NICU admissions, stillbirths, and intrauterine fetal demise (IUFD), were also more common in these groups.
Conclusions: The study underscores the importance of maintaining optimal hemoglobin levels during pregnancy to reduce the risk of severe maternal and perinatal complications in women with HDP. Both low and high hemoglobin levels are linked to adverse outcomes, highlighting the need for vigilant monitoring and management throughout pregnancy.

Keywords: Eclampsia, Hemoglobin, Hypertensive disorders, Maternal outcomes, Perinatal outcomes, Pregnancy

INTRODUCTION

Hypertensive disorders of pregnancy (HDP), affecting 5-10% of pregnancies, represent a complex spectrum of conditions, including chronic hypertension, gestational hypertension, preeclampsia/eclampsia, and chronic hypertension with superimposed preeclampsia.[1-2] These disorders not only pose significant risks to maternal health but also have profound implications for foetal outcomes.[2]

Traditionally, maternal anaemia has been linked to adverse pregnancy outcomes.[3] However, emerging research highlights a paradoxical concern: elevated haemoglobin concentrations may also cause perinatal complications.[3] This intriguing phenomenon may be partly explained by the pathophysiology of hypertensive disorders, which often induce endothelial dysfunction and vasoconstriction. Such conditions can precipitate fluid extravasation from the vasculature, thereby decreasing plasma volume and elevating haemoglobin concentration.[4] On the other hand, certain cases, particularly those involving HELLP syndrome (haemolysis, elevated liver enzymes, low

platelet count) or nutritional deficiencies (including deficits in antioxidants, calcium, and magnesium), show low haemoglobin levels due to haemolysis or other metabolic disturbances.[4]

Given that hypertensive disorders of pregnancy are a leading cause of maternal mortality, and their prevalence is on the rise, our study endeavours to explore the relationship between haemoglobin levels and maternal and perinatal outcomes in this patient population. By delving into these associations, we aim to uncover novel insights that could potentially inform clinical practice and improve prognosis for both mothers and their offspring.

METHODS

This retrospective study was conducted in the Department of Obstetrics and Gynaecology at Sapthagiri Hospital, Bengaluru, India, over a two-year period from June 2022 to June 2024.

Inclusion criteria

The study population included 233 patients admitted to either the in-patient department or the labour room, all diagnosed with hypertensive disorders of pregnancy.

Exclusion criteria

All antenatal cases of chronic hypertension identified within the same time frame were excluded.

Data collection

Data were meticulously extracted from hospital records, covering a range of variables, including patient demographic details (age, parity), diagnoses related to hypertensive disorders of pregnancy, haemoglobin levels post-20 weeks of gestation, and any maternofoetal complications.

Data analysis

The collected data underwent rigorous cleaning and verification before being entered into Microsoft Excel for preliminary organization. Subsequently, statistical analysis was performed using SPSS software version 20.0. Descriptive statistics, including frequencies, provided a foundational understanding of the data distribution, while Chi-Square tests were employed to examine the relationships between categorical variables, thereby uncovering potential associations between haemoglobin levels and clinical outcomes.

Ethical considerations

The study received ethical clearance from the ethical and scientific committee of the Sapthagiri Institute of Medical Sciences and Research Centre, ensuring adherence to ethical standards and safeguarding patient confidentiality.

Definitions

According to American College of Obstetricians and Gynaecologists (ACOG):

Chronic hypertension: Defined as systolic blood pressure (SBP) ≥140 mmHg and/or diastolic blood pressure (DBP) ≥90 mmHg before pregnancy or by 20 weeks of gestation, OR the use of antihypertensive medication prior to pregnancy OR persistence of hypertension beyond 12 weeks postpartum.

Gestational hypertension: Characterized by SBP ≥140 mm Hg and/or DBP ≥90 mmHg after 20 weeks of gestation in a previously normotensive woman.

Preeclampsia: Identified by the onset of SBP ≥140 mmHg and/or DBP ≥90 mmHg after 20 weeks of gestation in a normotensive woman, accompanied by proteinuria or signs of organ dysfunction such as thrombocytopenia, elevated transaminase levels, renal insufficiency, pulmonary edema, or new-onset headache.

RESULTS

The study included 233 participants, primarily within the 21-30 age range (72.5%), followed by those aged 31-40 (21%), with a smaller proportion under 20 years (5.2%) and over 40 years (1.3%). Parity distribution showed that 56.2% were primigravida, while 43.8% were multigravida. In terms of diagnosis, pre-eclampsia was the most prevalent condition, affecting 56.2% of the participants, followed by gestational hypertension (29.6%) and eclampsia (14.2%). Maternal complications were present in 30% of cases, while 70% had no complications. The gestational age at delivery revealed that 53.6% delivered between 28-37 weeks, 45.1% delivered after 37 weeks, and 1.3% delivered before 28 weeks. Regarding birth weight, 60.1% of newborns weighed between 2500-3500 grams, while 39.9% weighed less than 2500 grams. Perinatal complications were notable, with 32.3% of newborns requiring NICU admission, 3.4% resulting in stillbirths, and 6.4% in intrauterine foetal demise, while 57.9% had no complications. This data offers insights into the maternal and perinatal outcomes, highlighting areas of concern for managing conditions like pre-eclampsia and eclampsia (Table 1).

In the study of 233 participants, eclampsia was the most common complication, affecting 14.2% of cases, followed by abruptio placenta (9.9%), partial HELLP syndrome (6.4%), and oligohydramnios (6%). HELLP syndrome occurred in 5.2% of participants, while acute kidney injury was noted in 3%. Cardiomyopathy and DIC (Disseminated Intravascular Coagulation) were each present in around 2% of cases. Pulmonary Edema and subdural hematoma were rarer, at 1.7% and 0.9%, respectively, and maternal death occurred in 1.3% of the participants. These findings highlight the need for careful monitoring in high-risk pregnancies (Table 2).

In the study comparing gestational hypertension (GHTN), pre-eclampsia (PE), and eclampsia, the majority of participants were aged 21-30, with the highest proportion in the eclampsia group (78.8%). Eclampsia was more common among primigravida women (69.7%) and was associated with the highest rates of maternal complications (63.6%), low birth weight (63.6%), and NICU admissions (45.5%). While GHTN had the least severe outcomes, with 89.9% of women experiencing no complications, eclampsia showed the most adverse outcomes, including higher rates of intrauterine foetal demise (15.2%) and stillbirths (3%). This data underscores the increased risk associated with eclampsia compared to GHTN and PE (Table 3).

Table 1: General population characteristics and their frequencies with percentages.

Parameters		Frequency (n=233)	Percentage
Age	<20	12	5.2
	21-30	169	72.5
	31-40	49	21
	>40	3	1.3
Parity	Primigravida	131	56.2
	Multigravida	102	43.8
Diagnosis	GHTN	69	29.6
	Pre-eclampsia	131	56.2
	Eclampsia	33	14.2
Maternal complications	Present	70	30
	Absent	163	70
Gestational age	<28	3	1.3
	28-37	125	53.6
	>37	105	45.1
Birth weight	<2500 grams	93	39.9
	2500-3500 grams	140	60.1
Perinatal complications	Normal	135	57.9
	NICU	75	32.3
	Stillbirths	8	3.4
	IUFD	15	6.4

Table 2: Maternal complications with frequencies and percentages.

Maternal complication	Frequency (n=233)	Percentage
Partial HELLP	15	6.4
HELLP	12	5.2
Eclampsia	33	14.2
Cardiomyopathy	5	2.1
Acute kidney injury	7	3.0
Subdural hematoma	2	0.9
DIC	4	1.7
Oligohydramnios	14	6.0
Abruptio placenta	23	9.9
Pulmonary edema	4	1.7
Maternal death	3	1.3

The study categorizes patients into three groups based on Haemoglobin (Hb) levels: low Hb (<11 gm%), normal Hb (11-13 gm%), and high Hb (>13 gm%). A striking finding is that both low Hb levels (37.8%) and high Hb levels (35.5%) were significantly associated with a higher incidence of maternal complications compared to normal (15.1%). Moreover, eclampsia was more prevalent among women with low Hb (17.4%) and high Hb levels (17.8%) compared to those with normal Hb (6.8%) (p-value = 0.03 for high Hb) (Table 4).

Perinatal outcomes were also significantly affected by Hb levels. Low Hb was associated with higher rates of NICU admissions (41.9%) and Intrauterine Foetal Death (IUFD) (7.1%), with p-values of 0.0002. High Hb levels also correlated with adverse perinatal outcomes, including a higher incidence of stillbirths (6.5%) and IUFD (9.6%) with p-value of 0.0003.

Interestingly, the study reveals that high haemoglobin levels were linked to an elevated risk of eclampsia (17.8%)

and adverse perinatal outcomes, including higher rates of NICU admissions (38.7%), stillbirths (6.5%), and IUFD (9.6%). The significant p-values for maternal complications (0.022) and perinatal outcomes (0.0003) further underscore the importance of this finding.

Table 3: Comparative outcomes in GHTN, pre-eclampsia, and eclampsia with demographic parameters and maternofetal outcomes.

Parameters		GHTN (n=69)	Percentage	PE (n=131)	Percentage	Eclampsia (n=33)	Percentage
Age	<20	6	8.7	3	2.3	3	9.1
	21-30	46	66.7	97	74.0	26	78.8
	31-40	16	23.2	29	22.1	4	12.1
	>40	1	1.4	2	1.5	0	0.0
Parity	Primigravida	37	53.6	71	54.2	23	69.7
	Multigravida	32	46.4	60	45.8	10	30.3
Maternal complications	Present	7	10.1	42	32.1	21	63.6
	Absent	62	89.9	89	67.9	12	36.4
Gestational age	<28	1	1.4	2	1.5	0	0.0
	28-37	27	39.1	78	59.5	20	60.6
	>37	41	59.4	51	38.9	13	39.4
Birth weight	Low birth weight	22	31.9	50	38.2	21	63.6
	Normal	47	68.1	81	61.8	12	36.4
Perinatal complications	Normal	45	65.2	78	59.5	12	36.4
	NICU	23	33.3	40	30.5	15	45.5
	Stillbirths	1	1.4	6	4.6	1	3.0
	IUFD	3	4.3	7	5.3	5	15.2

Table 4: Hemoglobin levels correlation with demographic parameters and maternofetal outcomes.

Parameters		Low Hb (n=98)	Normal Hb (n=73)	High Hb (n=62)
Age	<=20	5 (5.1)	2 (2.7)	5 (8.1)
	21-30	68 (69.3)	56 (76.7)	45 (72.6)
	31-40	23 (23.5)	15 (20.6)	11 (17.7)
	>40	2 (2.1)	0 (0)	1 (1.6)
Parity	Primi	48 (48.9)	40 (54.8)	43 (69.3)
	Multi	50 (51.1)	33 (45.2)	19 (30.7)
P value		0.451		0.083
HDP	GHTN	24 (24.5)	21 (28.8)	24 (38.7)
	Pre-eclampsia	57 (58.1)	47 (64.4)	27 (43.5)
	Eclampsia	17 (17.4)	5 (6.8)	11 (17.8)
P value		0.126		*0.03
Maternal complications	Present	37 (37.8)	11 (15.1)	22 (35.5)
	Absent	61 (62.2)	62 (84.9)	40 (64.5)
P value		*0.004		*0.022
Gestational age	<28	1 (1)	1 (1.4)	1 (1.6)
	28-37	58 (59.2)	34 (46.6)	33 (53.2)
	>37	39 (39.7)	38 (52)	28 (45.2)
P value		0.262		0.726
Birth weight	2500-3500 grams	53 (54.1)	54 (74)	33 (53.2)
	<2500 grams	45 (45.9)	19 (26)	29 (46.8)
P value		*0.007		*0.012
Perinatal outcome	NICU	41 (41.9)	10 (13.8)	24 (38.7)
	Stillbirth	2 (2.1)	2 (2.7)	4 (6.5)
	IUFD	7 (7.1)	2 (2.7)	6 (9.6)
P value		*0.0002		*0.0003

*Statistically significant

DISCUSSION

In our study, most participants were in the 21-30 age group (72.5%), aligning with Gudeta et al (68.75%) and Thapa et al (61.5%), which highlights the typical childbearing years suggesting that even within this typically optimal age for childbearing, women are facing substantial risks.[5,6] This highlights a need for enhanced preventive measures and monitoring during this crucial period.

A majority (56.2%) were primigravida, consistent with Usman et al (56.6%), suggesting first-time pregnancies contribute to HDP indicating that primigravida women are more likely to encounter complications.[7] This suggests that special attention should be given to first-time pregnancies, as they carry a higher risk of adverse outcomes.

Pre-eclampsia was the most common diagnosis (56.2%), similar to Anh et al (71.4%), with high prevalence indicating severe maternal and neonatal risks.[8] This underscores the importance of developing and implementing effective management strategies to address the challenges associated with preeclampsia.

Preterm delivery (<37 weeks) was noted in 53.6% of cases, comparable to Nankali et al (59.1%), emphasizing the impact of HDP on neonatal outcomes.[9] Maternal complications included 11.6% with HELLP syndrome and 14.2% with eclampsia, similar to Yücesoy et al (11% each).[10] Abruptio placentae was found in 10% of cases, matching Murphy et al (15%).[11]

In eclampsia, 69% were primigravida, 63% had low birth weight, and 3% experienced stillbirths, aligning with Agida et al (61%, 43%, and 1.5%, respectively).[12] This indicates that primigravida status is a significant risk factor for eclampsia.

Regarding haemoglobin levels, the majority in low (69%) and high Hb (72%) groups were aged 21-30, similar to Sah et al.[13] Primigravida mothers had 50% low Hb and 69% high Hb, comparable to Wu et al (44.4% each).[14] Low Hb and high Hb groups had 46% and 47% of low-birth-weight babies, respectively, consistent with Sasmita et al.[15] Both low and high Hb levels were significantly linked to maternal complications (p-values 0.004 and 0.022). The higher incidence of maternal complications with abnormal haemoglobin levels may be due to the changes in blood volume and haemoglobin concentration during pregnancy, which impact maternal and foetal outcomes.

We observed a 2.1% rate of stillbirths among the low haemoglobin group, similar to the 1.6% reported by Dinçgez et al.[16] Preterm delivery rates were 59% for low Hb and 53% for high Hb cases in our study, compared to 26.6% and 23.5% in studies by Ali et al.[17] The higher rates in our study may be due to difference in sample sizes and demography.

Maternal complications were reported in 37.8% of the low Hb group and 35.5% of the high Hb group, with significant correlations between haemoglobin levels and maternal complications (p values of 0.004 and 0.02). This is linked to the pathophysiology of HDP, where lack of normal plasma expansion, hypovolemia, and poor perfusion can increase haemoglobin concentration.[18]

Preeclampsia exacerbates this through loss of serum proteins and increased capillary permeability, leading to reduced intravascular volume and increased tissue edema.[19] All organs are affected, including the liver, brain, and lungs. Decrease in blood volume increases haemoglobin concentration.[20]

Notably, a U-shaped relationship has been seen between haemoglobin concentration and pregnancy outcomes, showing that both low and high haemoglobin levels are associated with an increased risk of adverse birth outcomes.[21] This U-shaped relationship underscores the dual threat posed by both low and high haemoglobin levels, indicating that deviations in either direction can have severe implications for pregnancy outcomes. The study presents a critical examination of the impact of haemoglobin on hypertensive disorders of pregnancy (HDP) on a diverse cohort of women. The analysis of haemoglobin levels unveils a dramatic connection between extremes in haemoglobin and adverse outcomes. Low Haemoglobin levels were significantly associated with increased maternal complications, with a notable 37.8% incidence, while high haemoglobin levels correlate with severe conditions such as eclampsia and adverse perinatal outcomes.

The study's findings suggest that maintaining optimal haemoglobin levels is crucial for managing pregnancies complicated by hypertensive disorders. The dramatic impact of this study's findings reinforces the necessity of careful monitoring and management of haemoglobin levels throughout pregnancy to safeguard the health of both mother and baby.

CONCLUSION

In conclusion, this analysis underscores the critical importance of early detection and management of hypertensive disorders and haemoglobin imbalances during pregnancy. The data highlights a pressing need for targeted interventions to address the dual challenges posed by both low and high haemoglobin levels and to mitigate the associated risks for maternal and foetal health. Given that haemoglobin is routinely measured during antenatal visits, it may serve as a valuable indicator for identifying mothers at risk.

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