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A study to determine the association between elevated maternal serum β-hCG levels and HDP

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Abstract
Aim: The objective of the present study was to determine the association between elevated maternal serum β-hCG levels and HDP, the correlation between serum β-hCG level and severity of preeclampsia and to determine the value of serum β-hCG level as a diagnostic marker for early diagnosis of HDP.
Methods: A hospital's Obstetrics and Gynecology Department did this research. A 12-month observational study. Ethics committee permission was obtained. This research included 150 pregnant women: 100 with hypertension problems and 50 as controls. Both groups had their serum β-hCG levels tested and compared.
Results: Twenty (20%) of 100 hypertensive women had prenatal hypertension, 22 (22%) had non-severe preeclampsia, 40 (40%) had severe, and 18 (18%) had antepartum. Control group normotensive moms averaged 25.85 years, whereas research group hypertensive mothers averaged 24.48 years. Mothers with HDP exhibited a significantly higher mean SBP (150.70±18.72 mmHg) compared to normotensive mothers (110.40±10.15 mmHg) ($p<$ Significantly, hypertensive women had a mean DBP of 105.66±12.48 mmHg, whereas normal mothers had 75.5±5.50 mmHg ($p<0.001$). Significant difference ($p<0.001$) in proteinuria levels was observed between the two groups.
Conclusion: Early detection and treatment may reduce maternal and fetal mortality and morbidity from HDP. Compared to normotensive women, pregnancy-related hypertension was linked to higher blood β-hCG levels. In severe preeclampsia and primigravid hypertensive mothers, the levels are higher than in multigravida.

Keywords: Eclampsia, hypertensive disorders of pregnancy, preeclampsia, serum β-hCG

Introduction

The ultimate objective of safe motherhood is attained when a woman in good health delivers a healthy baby, with ideal timing and comprehensive preservation of the well-being of both the fetus and the mother during the whole duration of pregnancy, labor, and the postnatal period [1]. Nevertheless, a multitude of difficulties may occur during and during childbirth, greatly affecting the positive result of pregnancy. Hypertensive disorders of pregnancy are a complex and difficult collection of illnesses that contribute significantly to the overall burden of sickness in both developed and developing nations. Surprisingly, almost 830 women lose their lives each day, on average, due to pregnancy-related reasons that may have been avoided [2].

Hypertensive diseases of pregnancy, such as gestational hypertension, preeclampsia, eclampsia, and chronic hypertension, continue to be unresolved challenges in the field of obstetrics, presenting a significant global public health concern. These conditions contribute to a considerable number of deaths and illnesses among pregnant women and their unborn babies, and are a major reason for hospitalizations during pregnancy. According to the World Health Organization, even with a lot of study, hypertensive disorders of pregnancy still make up over 16% of maternal mortality [3]. These diseases occur in around 5-10% of pregnancies worldwide, with variations depending on the locale. Hypertensive illnesses were responsible for 9% of maternal mortality in Africa and Asia, but in Latin America and the Caribbean, the percentage topped 25%. In India, the prevalence of this condition varies from 5-15%, with rates of 16-20% for women experiencing their first pregnancy (Primigravida) and 7-10% for women who have had many pregnancies (Multigravida). Hypertensive diseases during pregnancy provide distinct difficulties, remaining as feared risks despite advancements in treatment for both the mother and newborn [4].

An ongoing effort of obstetricians is to discover and anticipate the hazards linked to pregnancy, enabling prompt prevention. Several variables lead to the development of pre-eclampsia, such as

advanced maternal age, having no prior pregnancies, a history of pre-eclampsia in past pregnancies, carrying numerous babies, using assisted reproductive procedures, and certain pre-existing medical disorders and dietary factors. The range of hypertensive diseases during pregnancy varies from slightly raised blood pressures with little clinical importance to severe hypertension and malfunction of many organs [5]. The American College of Obstetricians and Gynecologists (ACOG) has categorized hypertensive diseases of pregnancy into four groups: prenatal hypertension, preeclampsia/eclampsia, preeclampsia superimposed on chronic hypertension, and chronic hypertension. This classification system helps in diagnosing and managing these conditions. Each group is defined by particular diagnostic criteria that are determined by blood pressure levels, proteinuria, organ involvement, and other clinical indications [6]. The aim of this research was to investigate the relationship between high levels of maternal blood β-hCG and hypertensive disorders of pregnancy (HDP), as well as the link between serum β-hCG levels and the severity of preeclampsia. Additionally, the study aimed to assess the usefulness of serum β-hCG levels as a diagnostic marker for early detection of HDP.

Materials and Methods

This research was done at the Department of Obstetrics and Gynecology at a hospital. It was an observational study that lasted for 12 months and was approved by the ethics committee. This research had a sample of 150 pregnant women, divided into two groups: 100 pregnant women with hypertensive disorders of pregnancy and 50 normotensive women as the control group. The levels of serum β-hCG were measured and compared in both groups.

Inclusion criteria

Study group: This included 100 pregnant women with gestational age more than 20 weeks, fulfilling the criteria as any of the following three subgroups;

- **Gestational hypertension:** Pregnant women with gestational age more than 20 weeks with blood pressure, systolic ≥140 mmHg and diastolic ≥90 mmHg with no proteinuria.
- **Preeclampsia (Non-severe and severe):** Pregnant women with gestational hypertension with proteinuria and imminent symptoms like headache, epigastric pain, thrombocytopenia, altered renal function test, elevated liver enzymes, pulmonary edema.
- **Eclampsia:** Preeclamptic women with convulsions.
- **Control group:** This included 50 pregnant women with gestational age more than 20 weeks, who were normotensive with blood pressure, systolic <140 mmHg and diastolic <90 mmHg.

Exclusion criteria

Pregnant women more than 20 weeks of gestation with

- Multiple pregnancies
- Gestational diabetes mellitus
- Medical disease like chronic hypertension, chronic renal disease, chronic liver disease, cardiac disease, SLE or hematological disorders.

A comprehensive assessment was conducted, which included a meticulous analysis of the patient's medical background, as well as a thorough check of their overall health and specific bodily systems. This was done to verify the criteria for inclusion and exclusion that were previously discussed. A signed informed consent was obtained after providing a detailed explanation of the protocol for measuring blood pressure, collecting urine samples for proteinuria testing, and obtaining a blood sample for serum β-hCG analysis.

Blood sample collection

Approximately 3 ml of venous blood samples were taken using aseptic precautions and stored in a test tube. The sample was centrifuged at a speed of 3000 revolutions per minute for a duration of 5 minutes, after a collecting period of 2 hours. The serum was isolated and collected in a polythene tube with a cork stopper. The sera that showed no evidence of hemolysis were used for the determination of β-hCG. Analysis of biological substances at a molecular level, the concentration of serum β-hCG was determined using a solid-phase, two site chemiluminescence immunoassay (CLIA). The authors used the Immulite 1000 analyzer, which is a fully automated enzyme amplified chemiluminescent immunoassay system.

Statistical analysis

The data was compiled and subjected to analysis using statistical package for social sciences (SPSS) and interpreted according to the type of variables. 5% level of significance (p<0.05) was considered for the study.

Results

Table 1: Patient details

Study group	N%
Gestational hypertension	20 (20)
Non- severe preeclampsia	22 (22)
Severe preeclampsia	40 (40)
Antepartum eclampsia	18 (18)

The 100 hypertensive women in the research had 20 (20%) prenatal hypertension, 22 (22%) non-severe preeclampsia, 40 (40%) severe, and 18 (18%) antepartum. Normal mothers in the control group averaged 25.85 years old, whereas hypertensive mothers were 24.48 years old.

Table 2: Comparison between study group (Hypertensive) and control (Normotensive) mothers group in respect to parity and Systolic and diastolic blood pressure and proteinuria

Gravida	Normotensives (n=50)	Hypertensives (n=100)	Total (n=150)		P value
	N %	N %	N %		
Primi	22 (44)	56 (56)	78 (52)		p=0.01
Multi	28 (56)	44 (44)	72 (48)		
Total	50	100	150		
Blood pressure	Mean	SD	Mean	SD	
SBP (mm Hg)	110.40	10.15	150.70	18.72	$p<0.001$
DBP (mm Hg)	75.5	5.50	105.66	12.48	$p<0.001$
Proteinuria	No. %	No. %	No. %		
Absent	39 (78)	20 (20)	59 (39.34)		$p<0.001$
Present	11 (22)	80 (80)	91 (60.66)		
Total	50	100	150		

The research found a significant difference in maternal parity ($p<0.05$), with more primigravida in the hypertension group compared to the control group. The mean SBP moms with HDP was 150.70±18.72 mmHg, whereas normotensive mothers had 110.40±10.15 mmHg, which was statistically significant ($p<0.001$). Hypertensive moms had a mean DBP of 105.66±12.48 mmHg, whereas normal mothers had 75.5±5.50 mmHg, which was statistically significant ($p<0.001$). There was a significant difference ($p<0.001$) in proteinuria between the two groups.

Table 3: Distribution of cases according to gestational age

Gestational age	Normotensives (n=50)	Hypertensives (n=100)
20W OD-27W 6D	1 (2)	3 (3)
28W-31W 6 0D	2 (4)	6 (6)
32W-36W 6 OD	10 (20)	44 (44)
37W-40W 6 OD	35 (70)	46 (46)
41W OD & ABOVE	2 (4)	1 (1)
Mean±SD	37.3±2.7	36.4±3.6

Results showed a significant difference in gestational age across groups ($p<0.05$). The normotensive group had a mean gestational age of 37.3±2.7 weeks, whereas the hypertension group had 36.4±3.6

Table 4: Comparison of serum β-hCG between non-severe preeclamptic and severe preeclamptic mothers

β-hCG (IU/L)	Non-severe preeclampsia (n=22)	Severe preeclampsia (n=40)	Significance
Mean	34422.32	60050.34	$p<0.001$
SD	24987.74	2754.31	
Median	33456.5	67076	

The mean serum β-hCG level of severe preeclamptic mothers was higher than non-severe preeclamptic mothers.

Table 5: Comparison of serum levels of β-hCG in primigravida and multigravida women

Serum β- hCG (IU/L)	Primigravida (n=78)		Multigravida (n=72)	
	Normotensives (n=23)	Hypertensives (n=55)	Normotensives (n=28)	Hypertensives (n=44)
Mean	18065.15	52820.15	17030.08	49050.1
SD	16740.90	29550.77	16590.06	30440
Median	13999.5	55350.6	10444	45026

In primigravida, β-hCG levels differed significantly between control (Normotensives) and study (Hypertensives) women ($p<0.001$). In multigravida, hypertensive moms had significantly higher levels of β-hCG ($p<0.001$). No significant difference in β-hCG levels was seen between primi and multigravid control group (Normotensives) ($p>0.05$). A substantial difference ($p<0.05$) was seen in β-hCG levels between primi and multigravid hypertensives, with greater levels in primigravida individuals.

Table 6: Comparison of serum β-hCG levels between different categories of hypertensive disorders of pregnancy

Serum β-hCG (IU/L)	Gestational hypertension (n=20)	Non-severe preeclampsia (n=22)	Severe preeclampsia (n=40)	Antepartum eclampsia (n=18)
Mean	20920.28	36520.36	60030.34	70250.46
SD	10690.29	23569.74	28720.31	23638.03
Median	19220	32420.5	67090	74130

It was seen that there was a significant difference between the different categories of HDP ($p<0.05$).

Discussion

Hypertensive disorders of pregnancy (HDP) continue to be a

perplexing unresolved issue in the field of obstetrics. The mechanism by which pregnancy triggers or worsens hypertension remains unresolved despite extensive research efforts spanning many decades. Despite advancements in obstetrical and neonatal care, the capacity to accurately forecast hypertensive illnesses has not shown considerable progress, even though it has resulted in a decrease in illness and death rates. In India, the occurrence rate of hypertensive disorders in pregnancy was 7.8%, with preeclampsia affecting 5.4% of the studied population [7]. The occurrence of eclampsia in industrialized nations is around 1 in 2000 births, but in poor countries, it is believed to be around 1 in 100 to 1 in 1700 instances [8, 9].

Among the 100 women with high blood pressure in the research group, 20 (20%) had gestational hypertension, 22 (22%) had non-severe preeclampsia, 40 (40%) had severe preeclampsia, and 18 (18%) had antepartum eclampsia. The average age of moms without hypertension in the control group was 25.85 years, whereas the average age of mothers with hypertension in the study group was 24.48 years. Research conducted by Begum Z *et al*., Basirat *et al*., and Choudhury *et al*. also provide comparable findings, indicating that there is no significant association between maternal age and the occurrence of hypertension in both hypertensive and normotensive groups.[10-12] Nevertheless, Mujawar *et al*. found a significant difference in maternal age across the groups ($p<0.05$), with a mean age of 26.4±4.48 years in the control group and 23.6±4.16 years in the preeclampsia group [13].

The disparity in parity across mothers was statistically significant ($p<0.05$), with a higher proportion of first-time moms in the study group (hypertensive) compared to the control group (Normotensive) women. In the research conducted by Kaur G *et al*, similar findings were seen. The incidence of pregnancy-induced hypertension (PIH) was higher among first-time mothers (primigravida), with 17% of them getting PIH. Among women who had been pregnant before (multigravida), the prevalence of PIH was 7.14%. However, no statistically significant correlation was found [14]. The disparity in gestational age between the two groups exhibited statistical significance ($p<0.05$). The average gestational age was 37.3±2.7 weeks in the group without high blood pressure and 36.4±3.6 weeks in the group with high blood pressure. Al-bayati MM *et al* conducted a research which found that the average gestational age for normotensive moms was 37.11±1.98 weeks, whereas for hypertensive mothers it was 35.72±1.93 weeks. This difference was statistically significant with a p-value of less than 0.001 [15].

The average systolic blood pressure (SBP) of women with hypertensive disorders of pregnancy (HDP) was 150.70±18.72 mmHg, whereas the average SBP of mothers without hypertension was 110.40±10.15 mmHg. This difference in SBP between the two groups was statistically significant ($p<0.001$). The average diastolic blood pressure (DBP) of hypertensive moms was 105.66±12.48 mmHg, whereas that of normal mothers was 75.5±5.50 mmHg. This difference was statistically significant ($p<0.001$), which aligns with results from several previous research [16, 17].

The average blood β-hCG level of moms with severe preeclampsia was greater than that of mothers with non-severe preeclampsia. The investigations conducted by Begum Z *et al* and Mujawar *et al*. observed similar findings, with the case group of preeclampsia exhibiting elevated levels of blood β-hCG [12-14]. The β-hCG levels in primigravida women were significantly different between control (normotensive) and study (hypertensive) moms ($p<0.001$). Similarly, there was a statistically significant difference ($p<0.001$) in the levels of β-hCG among multigravida, with hypertensive women having greater amounts. When comparing the β-hCG levels between primigravidae and multigravidae in the control group (normotensives), no statistically significant difference was observed ($p>0.05$). A statistically significant difference ($p<0.05$) was seen in the β-hCG levels between primigravida and multigravida individuals in the study group (hypertensives), with greater levels found in the primigravida patients. Research conducted by Mooney RA *et al*. revealed a decline in maternal blood hCG levels as parity increased. The decline in hCG levels was consistent throughout each week of gestation from 15-20. In contrast to this parity has no impact on MSAFP and MSAFP MoM [18].

In a study conducted by Singh A *et al*. (2016) [19], it was shown that the levels of serum βHCG were considerably greater in participants with pregnancy-induced hypertension (41500±14000 mIU/ml) compared to healthy pregnant control subjects (22500±4500 mIU/ml). In this case, the elevated production of βHCG was a result of either aberrant placental invasion or placental immaturity [19]. In comparable research, Nandini *et al*. (2012) [20] found that the serum βHCG level was substantially higher in women who had PIH (65315±10237 mIU/ml) compared to healthy pregnant control individuals (26088±11391 mIU/ml) with a p-value of less than 0.001 [20].

Conclusion

Early detection of hypertensive disorders of pregnancy (HDP) may lead to better outcomes for both the mother and the fetus, reducing the risk of death and complications. This is because timely diagnosis allows for proper medical intervention and treatment. The serum β-hCG level was elevated in women with hypertensive disorders of pregnancy compared to those without hypertension. The levels of the above factors are elevated in patients with severe preeclampsia compared to those with non-severe preeclampsia. Additionally, primigravid hypertension women had greater levels of these factors compared to multigravida hypertensive women. Thus, determining the serum β-hCG levels may aid in the prompt identification of HDP and also act as a gauge for the intensity of the condition. Therefore, more research is necessary on a larger group of patients in order to validate the importance of blood β-hCG as a screening test for hypertensive disorders of pregnancy (HDP).

Conflict of Interest

Not available

Financial Support

Not available

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