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Original Research Article

Application of HDP Gestosis Score for Predicting Pregnancy-Induced Hypertension in First Trimester Antenatal Patients at a Tertiary Care Center

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Abstract:

Introduction: Pregnancy-Induced Hypertension (PIH) is a significant global health concern, contributing to maternal and fetal morbidity and mortality. Among hypertensive disorders of pregnancy, preeclampsia is particularly severe, characterized by elevated blood pressure and multi-organ dysfunction, leading to complications such as placental abruption, intrauterine growth restriction, and preterm birth. Its complex etiology involves genetic predisposition, immune dysfunction, and vascular abnormalities. Early prediction of PIH is critical for timely intervention and improved outcomes. The HDP Gestosis Score, incorporating clinical and biochemical factors, offers a promising approach for stratifying risk and identifying high-risk patients in the first trimester.

Material and Methods: This prospective observational study was conducted over one year in the Obstetrics and Gynecology Department of a tertiary care center to evaluate the HDP Gestosis Score's predictive ability for PIH. A total of 100 first-trimester antenatal patients meeting inclusion criteria were enrolled. Baseline demographic and clinical data, including maternal age, BMI, family history, and obstetric history, were collected. The HDP Gestosis Score was calculated, and patients were categorized into risk groups. Regular follow-ups included blood pressure monitoring and clinical assessments to track PIH development. Statistical analysis, including sensitivity, specificity, and predictive values, was performed using SPSS 21.1, with significance set at $p < 0.05$.

Results: Among the 100 participants, 52% were categorized as high risk (score ≥3), 33% as moderate risk (score 2), and 15% as low risk (score 1). The score exhibited a high sensitivity of 98.11% and a strong negative predictive value (95.24%), effectively ruling out low-risk patients, while the specificity was moderate at 42.55%. PIH development was significantly higher in patients with a score ≥3, with 96.3% confirmed cases by the final visit, compared to lower scores. Key risk factors associated with higher scores included elevated MAP (>85 mmHg, 26%), obesity (20%), and primigravida status (57%). These findings underline the HDP Gestosis Score's strength as an early risk assessment tool, although its moderate specificity suggests the need for integration with additional diagnostic methods for enhanced predictive accuracy.

Conclusion: The HDP Gestosis Score demonstrated high sensitivity and reliability in predicting Pregnancy-Induced Hypertension (PIH) among first-trimester antenatal patients, enabling early identification of high-risk cases. While its moderate specificity indicates room for improvement, integrating the score with additional diagnostic tools can enhance its accuracy.

Keywords: Pregnancy-Induced Hypertension, HDP Gestosis Score, Preeclampsia Prediction, Antenatal Risk Assessment.

Introduction

Pregnancy-induced hypertension (PIH) remains a significant health concern globally, posing risks to both maternal and fetal well-being. [1] Among the various hypertensive disorders of pregnancy, preeclampsia is particularly noteworthy due to its potential for severe complications, including organ damage and preterm birth. Identifying early markers for the prediction of preeclampsia is crucial for timely intervention and improved maternal-fetal outcomes. [2] In recent years, the HDP Gestosis Score has emerged as a promising tool for the early prediction of preeclampsia. [3]

Preeclampsia is a multifaceted hypertensive disorder that typically occurs after the 20th week of pregnancy. [4] Characterized by elevated blood pressure and organ dysfunction, it poses serious risks to both maternal and fetal health. Complications may include placental abruption, intrauterine growth restriction, preterm birth, and long-term cardiovascular effects for the mother. [5] Fetal complications extend beyond preterm birth and intrauterine growth restriction to include neurodevelopmental issues. [6]

Preeclampsia has a complex etiology involving a combination of genetic and environmental factors. Understanding the interplay between these elements is crucial for refining predictive models. Genetic predisposition, immune dysfunction, and vascular abnormalities contribute to the pathogenesis of preeclampsia. The HDP-Gestosis Score, by incorporating a range of clinical and biochemical factors, attempts to capture this complexity and provide a more nuanced prediction that goes beyond traditional risk factors. [7]

Material and Methods

This prospective observational study was conducted over a duration of one year in the Obstetrics and Gynecology Department at a tertiary care center. The study aimed to evaluate the usefulness of the HDP Gestosis Score in predicting the development of Pregnancy-Induced Hypertension (PIH) in first-trimester antenatal patients attending the antenatal care (ANC) outpatient department (OPD).

A total of 100 antenatal patients in their first trimester, fulfilling the inclusion criteria, were enrolled in the study. Participants were selected consecutively from those attending the ANC OPD during the study period. Inclusion criteria included first-trimester pregnancies, willingness to provide informed consent, and availability for follow-up. Exclusion criteria included patients with known chronic hypertension, pre-existing medical conditions affecting blood pressure, or incomplete antenatal records.

Baseline demographic and clinical data were collected using a structured proforma. Parameters required to calculate the HDP Gestosis Score were recorded, including maternal age, body mass index (BMI), family history of hypertension, and obstetric history. Routine antenatal investigations were performed to assess baseline health and identify any predisposing risk factors. Participants were followed throughout their pregnancy to monitor the development of PIH.

The HDP Gestosis Score was applied to all participants during the first trimester. Patients were categorized into low, moderate, and high-risk groups based on the scoring system. Regular antenatal visits were scheduled as per standard ANC guidelines, with additional visits for high-risk patients. Blood pressure measurements and other clinical parameters were recorded during each follow-up to detect the onset of PIH. Outcomes were documented and analyzed based on gestational age at diagnosis and the severity of PIH.

The collected data were analyzed using statistical software SPSS 21.1. Descriptive statistics were used to summarize demographic and clinical characteristics. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of the HDP Gestosis Score in predicting PIH were calculated. Associations between the HDP Gestosis Score and the development of PIH were assessed using chi-square tests and logistic regression analysis, with a significance level set at $p < 0.05$.

Results

The study included 100 antenatal patients, with a detailed analysis of their age, gravida, and parity distributions. The majority of participants (49%) were aged 21-25 years, followed by 33% aged ≤20 years, 11% aged 26-30 years, and 7% aged >30 years. Regarding gravida status, 61% were primigravida (G1), while 29%, 9%, and 1% were gravida 2 (G2), gravida 3 (G3), and gravida 4 (G4), respectively. In terms of parity, 76% were nulliparous (P0), 20% had one previous birth (P1), and 4% had two previous births (P2). The distribution of participants based on the HDP Gestosis Score revealed varying levels of risk for the development of hypertensive disorders of pregnancy (HDP). Out of the 100 antenatal patients, 52% were classified as having a high risk (score ≥3), 33% had a moderate risk (score 2), and 15% had a mild risk (score 1).

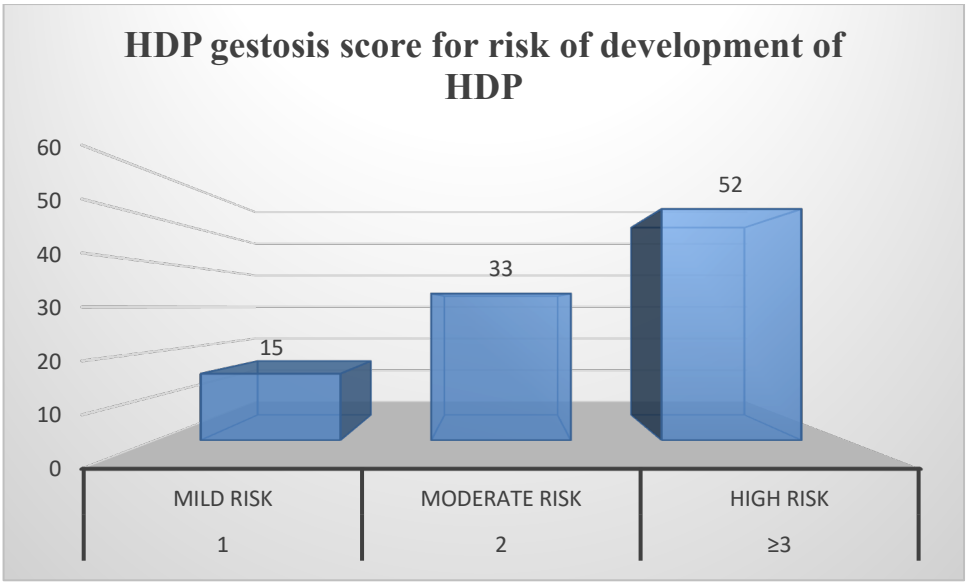

Figure 1: HDP gestosis score for risk of development of HDP

HDP development in patients with HDP Gestosis Scores up to 2 increased with successive ANC visits. By the final visit/admission, 96.3% of patients with a score of 2 developed HDP compared to only 3.7% with a score of 1 ($p < 0.001$). This underscores the higher risk in patients with a score of 2. (Table 1)

Table 1: HDP Development with Visits in Patients Having Score up to 2

Visit	HDP Group	Score 1	Score 2	Total	P Value
2nd ANC Visit	No	15 (41.7%)	21 (58.3%)	36 (100%)	<0.001
	Yes	0 (0%)	12 (100%)	12 (100%)	
3rd ANC Visit	No	14 (51.8%)	13 (48.2%)	27 (100%)	<0.001
	Yes	1 (4.8%)	20 (95.2%)	21 (100%)	
Final Visit/Admission	No	14 (66.7%)	7 (33.3%)	21 (100%)	<0.001
	Yes	1 (3.7%)	26 (96.3%)	27 (100%)	

HDP development in patients with a score ≥3 showed a progressive trend. By the second ANC visit, 84.6% of patients had developed HDP, with all patients affected by the third ANC visit and at the time of final admission ($p < 0.001$).

Table 2: Predictive Ability of HDP Gestosis Score for the Development of High-Risk HDP

Statistic	Value	95% CI
Sensitivity	98.11%	89.93% to 99.95%
Specificity	42.55%	28.26% to 57.82%
Positive Predictive Value	65.82%	60.03% to 71.18%
Negative Predictive Value	95.24%	73.62% to 99.31%
Accuracy	72.00%	62.13% to 80.52%

The HDP Gestosis Score demonstrated high sensitivity (98.11%) and a strong negative predictive value (95.24%), indicating its effectiveness in ruling out high-risk HDP. However, its specificity was moderate (42.55%), with an overall accuracy of 72.00%. (Table 2) The distribution of risk factors among the study participants revealed that the most common factor was primigravida status (57%), followed by MAP > 85 mmHg (26%) and obesity (BMI > 30) (20%). Other notable risk factors included polycystic ovary syndrome (13%), short duration of sperm exposure (12%), and a family history of cardiovascular disease or gestational diabetes mellitus (9% each). Multifetal pregnancies accounted for 8%, while less common factors included maternal chronic kidney disease (5%), autoimmune diseases (4%), and chronic hypertension (3%). Several factors, such as obesity with BMI > 35 kg/m², inherited/acquired thrombophilia, and pregnancies with assisted reproductive techniques (OD/surrogacy), were not observed in the cohort.

Discussion

In our study on applying the HDP Gestosis Score for predicting PIH, 33% of participants were ≤20 years, 49% were 21-25 years, 11% were 26-30 years, and 7% were >30 years, reflecting a

predominantly younger cohort. The prospective study by Meeta Gupta et al. [3] included 473 women with a mean age of 28.4 years, reflecting an older demographic than our study.

Similarly, the study by Tesfaye Abera Gudeta [8] reported a prevalence of PIH in a slightly older population attending hospitals in Southwest Ethiopia. This variation in age groups underscores the importance of considering demographic differences when applying predictive tools like the HDP Gestosis Score.

In our study, 61% were primigravida, 29% gravida 2, 9% gravida 3, and 1% gravida 4. For parity, 76% were nulliparous, 20% had one prior birth, and 4% had two. This demographic profile indicates a predominance of first-time mothers, which is comparable to other studies, such as the one by Ramya Sravani et al. [9], where similar primigravida rates were significant predictors of pre-eclampsia. Our study's distribution of participants according to their HDP Gestosis Score, which predicts the risk of developing hypertensive disorders of pregnancy (HDP), revealed that 15% were at mild risk (score of 1), 33% were at moderate risk (score of 2), and 52% were at high risk (score ≥3).

This distribution highlights a significant portion of high-risk patients, comparable to findings in other studies such as those by Meeta Gupta et al. [3], where a substantial percentage of participants were also identified in the higher risk categories. Similarly, a study by Khanijo et al. [10] found that the gestosis score effectively predicted early-onset pre-eclampsia with a sensitivity of 84.38% and specificity of 93.18%, emphasizing the utility of the gestosis score in early identification and management of high-risk pregnancies. Comparative evaluations, such as the study by Swati Dahiphale et al. [11], which examined both the gestosis score and the uterine artery pulsatility index, underscore the importance of combining different predictive methods to improve accuracy.

In patients with an HDP gestosis score up to 2, HDP development increased with visits. By the third ANC, 95.2% with a score of 2 developed HDP, compared to 4.8% with a score of 1. These findings align with those from other studies, such as the one by Meeta Gupta et al. [3], which emphasized the high predictive accuracy of the gestosis score, with significant correlations observed between higher scores and the development of HDP. The progressive increase in HDP incidence with higher gestosis scores observed during antenatal visits in our study underscores the dynamic nature of pregnancy-related hypertensive disorders. The HDP Gestosis Score showed high sensitivity (98.11%) and a strong negative predictive value (95.24%), effectively identifying nearly all patients at risk for high-risk hypertensive disorders of pregnancy (HDP) while reliably ruling out low-risk cases. This aligns with findings from studies like Meeta Gupta et al. [3], which highlighted its strength as an early diagnostic tool for pre-eclampsia. However, the score's specificity was lower (42.55%), indicating a higher rate of false positives. Similar trends were reported by Manhar et al. [12] and Tesfaye Abera Gudeta et al. [8], who recommended integrating additional risk factors like obesity and maternal health history to improve specificity.

The positive predictive value (65.82%) and overall accuracy (72.00%) indicate moderate reliability in predicting actual cases of HDP, consistent with findings by Khanijo et al. [10] and Shah et al. [7], who emphasized combining the score with diagnostic tools such as Doppler studies. While the score excels in early identification due to its sensitivity, its lower specificity and moderate PPV suggest it is best used alongside other measures, such as biomarkers or multi-marker screening methods, to enhance precision and utility in clinical practice.

In our study of 100 antenatal patients, several key risk factors for HDP were identified. Extremes of maternal age were significant, with 8% aged under 19 years and 4% over 35 years, consistent with findings by Dr. Ramya Sravani et al. [9], who reported higher HDP prevalence at these age extremes due to physiological vulnerabilities. Maternal anemia was noted in 7% of patients, aligning with Tesfaye Abera Gudeta et al. [8], who linked anemia to cardiovascular strain and increased HDP risk.

Obesity (BMI >30) was present in 20%, corroborating research by Manhar et al. [12] that associates obesity with metabolic stress and inflammation, exacerbating HDP risk. Primigravida status was predominant (57%), echoing studies like Meeta Gupta et al. [3], where first-time pregnancies were found more prone to pre-eclampsia due to immune adaptations. Additionally, 12% of participants had short sperm exposure, a risk factor highlighted by studies linking limited paternal antigen exposure to impaired immune tolerance.

Other notable factors included a mean arterial pressure (MAP) >85 mmHg in 26% of patients, a strong predictor of HDP as emphasized in prior studies. Polycystic ovary syndrome (13%) and maternal hypothyroidism (9%) were also prominent, both contributing to hormonal and metabolic disturbances that heighten HDP susceptibility, as shown in studies by Pooja Shah et al. [7] Chronic vascular conditions, family history of pre-eclampsia (7%), and inter-pregnancy intervals >7 years (2%) added to the multifactorial risk landscape. These findings emphasize the need

for comprehensive prenatal care that incorporates these risk factors for early identification and intervention in high-risk pregnancies.

Our study's limitations include a small sample size of 100 patients, single-center design, and potential recall bias from self-reported data. The lack of advanced biomarkers and the cross-sectional nature of the study limit generalizability and causal inferences.

Conclusion

Our study highlights the effectiveness of the HDP Gestosis Score in predicting the risk of Pregnancy-Induced Hypertension (PIH) among first-trimester antenatal patients. With high sensitivity and a strong negative predictive value, the score demonstrated reliability in identifying high-risk cases, though specificity and positive predictive value were moderate.

Key risk factors, including primigravida status, elevated MAP, obesity, and extremes of maternal age, underline the multifactorial nature of PIH. While the study provides valuable insights, its findings are limited by a small sample size, single-center design, and the absence of advanced biomarkers. These results emphasize the need for integrating comprehensive risk assessment tools with the gestosis score to enhance its predictive accuracy and utility in broader clinical practice.

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