

Heart Failure in Pregnant Women with Hypertensive Disorders of Pregnancy and Its Incidence and Associated Predictors

Abu Huraira¹, Sania Akhtar²

¹Assistant Professor, Department of Cardiology, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India.

²Medical Officer, Department of Obstetrics and Gynaecology, Sadar Hospital, Aurangabad, Bihar, India

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Corresponding Author: Dr. Sania Akhtar

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Abstract:

Background: Pregnancy-related hypertension disorders can have a major impact on maternal morbidity and can cause heart failure and other negative cardiovascular consequences. It is critical to identify high-risk women early in order to improve maternal outcomes

Aim: To determine the incidence of heart failure and identify potential predictors among pregnant women with hypertensive disorders of pregnancy.

Methodology: Hospital based prospective observational study was devised for 120 women with Hypertension during pregnancy, over a period of one year, in the Department of Cardiology, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India. All necessary demographic, obstetrical, clinical, and laboratory variables were assessed. Planned statistical analysis was done using SPSS.

Results: The prevalence of heart failure was 120 participants (10.0%). The maximum number of cases was recorded for women with eclampsia (30.0%) and pre-eclampsia with severe manifestations (16.7%). Women who suffered from heart failure had significantly higher average values of systolic blood pressure, diastolic blood pressure, and serum creatinine compared to those that did not have heart failure. Systolic blood pressure ≥ 160 mmHg exhibited the largest odds ratio value (2.85); nonetheless, none of the examined predictors reached statistical significance.

Conclusion: Heart failure was a significant potential consequence for pregnant women with pregnancy-related hypertension illnesses. Risk assessment may be aided by cardiovascular monitoring for severe hypertension and renal impairment.

Keywords: Heart failure, hypertensive disorders of pregnancy, pre-eclampsia, eclampsia, maternal outcomes, risk factors.

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Introduction

Pregnancy-related hypertension disorders (HDP) are a major global source of illness and mortality in mothers and newborns. Pre-eclampsia, eclampsia, prenatal hypertension, and persistent hypertension during pregnancy are these conditions [1]. Elevated blood pressure, systemic endothelial dysfunction, inflammation, and organ damage are some of the characteristics that characterise them. HDP can have a wide-ranging effect on the mother's cardiovascular health in addition to raising her blood pressure. One of the more serious cardiovascular problems is heart failure, which can have an immediate negative impact on a mother's health and cause pregnancy issues [2].

When the heart is unable to pump enough blood to sustain the mother's body, a dangerous clinical condition known as heart failure occurs. Significant

physiological changes, including elevated heart rate, cardiac output, and blood volume, occur during pregnancy. In pregnant women with hypertensive problems, these alterations may put additional strain on the cardiovascular system, but they are well tolerated in normal women [3]. Additional variables that might cause cardiac decompensation include fluid redistribution, endothelial dysfunction, increased afterload, and decreased ventricular relaxation. Women with a history of severe pre-eclampsia, eclampsia, or a cardiovascular disease may be at a higher risk of experiencing heart failure during pregnancy or the postpartum period [4].

Heart failure and pregnancy-related hypertension diseases are intricately linked. Pre-eclampsia can cause general vascular dysfunction, vascular permeability, and disruptions in fluid balance, while

chronic hypertension puts additional strain on the heart. Acute cardiac problems, pulmonary congestion, and impaired ventricular function can result from these pathways [5]. The risk of heart failure may also be raised by other risk factors, including advanced maternal age, obesity, diabetes mellitus, chronic renal disease, a history of hypertension, multiple births, and delayed diagnosis or treatment. The degree of hypertension, the existence of severe pre-eclampsic symptoms, and the timing of birth can all have an impact on maternal cardiovascular outcomes [6].

A significant clinical and epidemiological concern in the prevalence of heart failure during pregnancy is hypertensive diseases. The reported frequency, however, may vary based on the population studied, the definition of heart failure, severity of the hypertensive disorder, type of the hypertensive disorder, diagnostic facilities, and length of maternal follow-up [7]. Heart failure can occur during pregnancy, labour or the post-natal period and a thorough clinical evaluation is crucial. Symptoms include breathlessness, orthopnoea, persistent tachycardia, chest discomfort and pulmonary congestion, which if recognized early would lead to timely investigation and management [8]. Clinical examination, echocardiography, electrocardiography and cardiac biomarkers may assist in diagnosis and differentiate heart failure from normal physiologic changes of pregnancy.

To understand the factors that determine the risk of heart failure in pregnant women with hypertensive conditions, is crucial for better risk assessment and clinical decision making. Patient demographic, obstetric history, pre-existing medical conditions, severity of hypertension, laboratory abnormalities and cardiac dysfunction could be helpful clues in identifying women at high risk [9]. Knowledge of these predictors will help to develop appropriate monitoring strategies, timely referral to specialist care and individual management of mother and child during pregnancy and postpartum. In addition, early detection of such high-risk patients can help in timely diagnosis and avert the escalation of cardiovascular complications.

The present research intends to determine the prevalence of heart failure in pregnant women suffering from hypertensive disorders and to identify the biochemical, demographic, obstetrical, and clinical risk factors for this condition. Finding out how common HF is and what variables put this high-risk population at danger is the driving force for the research [10]. The results have the potential to enhance maternal health outcomes, doctors' ability to detect at-risk patients, and early intervention and surveillance programs. Reducing maternal morbidity and mortality and enabling evidence-based treatment of hypertensive illnesses during pregnancy may be possible with a better

understanding of the prevalence and risk factors for heart failure.

Methodology: The current study set out to ascertain the prevalence of heart failure and its predictors in pregnant patients with hypertensive conditions. A systematic observation system was used to measure maternal demographic, obstetric, clinical and laboratory parameters. The study was conducted for 1 year and the total number of pregnant women who were eligible for the study were 120. All the collected data were analysed by proper statistical method to find the factors associated with heart failure.

Study Design: A prospective observational study design was adopted in the study. All pregnant women who were diagnosed with hypertensive disorders of pregnancy were recruited and followed throughout the hospital admission and during the postpartum period as outlined in the study protocol. Clinical findings, appropriate investigations and echocardiographic evaluation (as indicated) were used to assess the occurrence of heart failure. By examining the relationship between clinical indicators, maternal features, and the incidence of heart failure, the potential predictors of heart failure were evaluated.

Study Area: The study was carried out in Department of Cardiology, Anugrah Narayan Magadh Medical College and hospital, Gayaji, Bihar, India. The clinical setting used for assessing pregnant women with hypertensive disorders of pregnancy and suspected cardiovascular complications was the hospital. Eligible subjects were recruited from the relevant obstetric and cardiology services and clinical assessments were done in conjunction with the medical team responsible for the treatment.

Study Duration: This study was carried out for a one-year time period from January 2025 to December 2025.

Study Participants: The study included a total of 120 pregnant women with hypertensive disorders of pregnancy. Every eligible patient who visited or was hospitalised to the study hospital throughout the study period was included in the study. The study population consisted of women with pre-eclampsia, eclampsia, chronic hypertension with superimposed pre-eclampsia, or pregnant hypertension. Before enrolment, participants provided written informed permission.

Inclusion Criteria

- Women of childbearing age (18 years or older) who are pregnant.
- Women who have been diagnosed with a hypertensive disorder of pregnancy based on clinical definition.

- Women who attended or were admitted to the hospital studied.
- Women who agreed and signed an informed consent form to participate in the study.
- Women who had clinical data available on them and follow-up data available for the study protocol.

Exclusion Criteria

- Previously diagnosed heart failure in females.
- Women with a known severe structural heart disease or cardiomyopathy before the onset of the current pregnancy.
- Women who have a severe haemodynamic defect and major congenital heart disease.
- Women who refused to participate in the study or stopped.
- Women for whom the information and/or outcome assessment were not available.

Sample Size: The study comprised 120 pregnant women with pregnancy-related hypertension problems. The number of patients was judged appropriate for a one-year observational study conducted at a single facility. In order to achieve the necessary sample size for the study, eligible volunteers were recruited one after the other until the necessary number of participants was obtained. In addition to looking at correlations between specific maternal and clinical features and the incidence of heart failure, the study looked at the rate of heart failure among the recruited patients.

Procedure: The demographic and clinical data of each participant were collected on a structured data collection form. Data was provided on the age of the woman, place of residence, number of children, gestational age at enrolment, hypertension type, previous obstetric history, and pertinent medical comorbidities. Information regarding the severity of hypertension, presenting symptoms, blood pressure readings and treatment received were recorded from clinical assessments and hospital records.

A clinical examination was made for the detection of features suggestive of involvement of the cardiovascular system. Special emphasis was laid on breathlessness, orthopnoea, tachycardia, peripheral oedema, raised jugular venous pressure and pulmonary congestion. Where indicated and available, laboratory investigations such as haemoglobin, platelet count, renal and liver function, and urine protein assessment were documented. When clinically suitable, echocardiography, electrocardiography, and cardiac biomarkers (B-type natriuretic peptide or N-terminal pro-B-type natriuretic peptide) were performed. The treatment team used clinical assessment, clinical investigations, and imaging to diagnose heart failure rather than depending just on a single symptom or investigation.

The patients were observed both during the index hospital stay and during the postpartum period in accordance with the study protocol. Heart failure's onset, severity, requirement for critical care, and relevant outcomes for moms were all recorded. The primary finding was that of heart failure in the 120 women enrolled. Other clinical and laboratory factors and maternal morbidity were considered as potential predictors, such as maternal age, parity, gestational age, type and severity of the hypertensive disorder, blood pressure, pre-existing medical conditions, renal function, and other factors. All information was coded and entered into a database for statistical analysis

Statistical Analysis: The data was entered, verified, and analysed using the Statistical Package for the Social Sciences (SPSS). Categorical data, such as the type of hypertension condition and the presence of heart failure, were presented using frequencies and percentages. Continuous variables such as maternal age, systolic and diastolic blood pressure, laboratory values, and others were rounded to the nearest whole number if the data was somewhat normally distributed, or to the nearest whole number if the data was skewed.

By dividing the total number of research participants by the number of individuals with heart failure, and then multiplying the result by 100, the incidence proportion of heart failure was calculated. Depending on the case, we utilised either the chi-square test or Fisher's exact test to match categorical variables. Then, according to their distribution, the continuous variables were compared using either the Independent-samples t-test or the Mann-Whitney U test. The goal of conducting logistic regression analysis was to find factors that may be used as independent predictors of heart failure. The number of outcome events needed to be high enough to allow reliable modelling, and adjusted odds ratio and 95% confidence interval values were to be provided. If the p-value was less than 0.05, it was considered significant.

Results

The section details the profile of hypertension disorders, the frequency of heart failure during the observation period, and the clinical and demographic information of the 120 pregnant women with hypertensive disorders. It also investigates the association between heart failure and certain obstetric, clinical and maternal risk factors, such as severity of hypertensive disorders, blood pressure and renal function. The results were summarised using descriptive statistics and inferential analyses were performed to investigate possible predictor factors of heart failure.

Table 1 displays the clinical and demographic information assessed in 120 pregnant women with hypertensive disorders of pregnancy. The variables

considered were age group, place of residence, parity and pre-existing medical conditions. As could be seen from Table 1, the age group of 25-29 years had the greatest percentage (35.0%), followed by 30-34 years (28.3%). The majority of the participants were rural (63.3%) and 56.7% multigravida. As far as their pre-existing medical conditions were concerned, 18.3% reported having

chronic hypertension, 11.7% of the participants reported having diabetes mellitus, and 5.0% of the participants reported having chronic kidney disease, with 65.0% of the participants having none of the medical conditions assessed. These results showed that the study population was mainly made up of women in the age group of 25-34 years, from rural areas and multigravida women.

Table 1: Study Participants' Clinical and Demographic Features (N = 120)

Variables	Frequency (n)	Percentage (%)
Age group (years)		
18-24	24	20.0
25-29	42	35.0
30-34	34	28.3
≥35	20	16.7
Residence		
Rural	76	63.3
Urban	44	36.7
Parity		
Primigravida	52	43.3
Multigravida	68	56.7
Pre-existing medical conditions		
Chronic hypertension	22	18.3
Diabetes mellitus	14	11.7
Chronic kidney disease	6	5.0
No recorded comorbidity	78	65.0

The 120 individuals were divided up according to the type of pregnancy-related hypertension illness, as indicated in Table 2. Eclampsia, chronic hypertension with pre-eclampsia, gestational hypertension, and pre-eclampsia with or without severe symptoms were the four groups into which they were placed. As shown in Table 2, the most prevalent condition was pre-eclampsia without severe symptoms, with 38 participants (31.7%). Gestational hypertension was the second most

common, with 34 participants (28.3%), and pre-eclampsia with severe features was the third most common, with 30 individuals (25.0%). Ten participants (8.3%) had eclampsia and 8 (6.7%) had chronic hypertension with superimposed pre-eclampsia. These results showed that pre-eclampsia was the biggest diagnostic category in the study population, both with and without severe pre-eclampsia.

Table 2: Distribution of Hypertensive Disorders of Pregnancy (N = 120)

Type of hypertensive disorder	Frequency (n)	Percentage (%)
Gestational hypertension	34	28.3
Pre-eclampsia without severe features	38	31.7
Pre-eclampsia with severe features	30	25.0
Eclampsia	10	8.3
Chronic hypertension with superimposed pre-eclampsia	8	6.7
Total	120	100.0

The number of women diagnosed with heart failure during the prescribed observation period is displayed in Table 3 for the group of 120 women diagnosed with hypertensive disorders of pregnancy. Patients were categorised based on whether or not heart failure occurred throughout the follow-up period. During the observation period, 108 participants (90.0%) did not develop heart

failure, while 12 (10.0%) did develop heart failure (Table 3). The incidence proportion was thus 10.0% of the study participants. These results suggested that heart failure developed in some women with hypertensive disorders during pregnancy, underlining the need for proper evaluation and surveillance of these women who are known to be at risk of heart failure.

Table 3: Incidence of Heart Failure Among Study Participants (N = 120)

Heart failure status	Frequency (n)	Percentage (%)
Heart failure present	12	10.0
Heart failure absent	108	90.0
Total	120	100.0

The distribution of heart failure cases by the type of hypertensive disorder of pregnancy is shown in Table 4, with 120 participants included in the study. The total number of participants in each diagnostic group is compared to the number and percentage who developed heart failure. Table 4 shows that the heart failure incidence rate was 30.0% in women who had eclampsia, 16.7% in those who had severe pre-eclampsia, and 12.5% in those who had chronic hypertension on top of pre-eclampsia. There were

fewer incidences of pre-eclampsia without severe symptoms (5.3%) and gestational hypertension (2.9%) in women. These results indicated that the more severe the hypertensive state, the more likely the heart failure was to be. These were most common in the presence of eclampsia. This was partly because of the small numbers of cases with heart failure, however, which meant this did not allow for strong comparisons between the diagnostic groups.

Table 4: Distribution of Heart Failure According to the Type of Hypertensive Disorder

Type of hypertensive disorder	Total participants (n)	Heart failure cases (n)	Incidence within group (%)
Gestational hypertension	34	1	2.9
Pre-eclampsia without severe features	38	2	5.3
Pre-eclampsia with severe features	30	5	16.7
Eclampsia	10	3	30.0
Chronic hypertension with superimposed pre-eclampsia	8	1	12.5
Total	120	12	10.0

Table 5 shows a comparison between selected clinical parameters of pregnant women who developed HF and those who did not. Parameters were maternal age, systolic and diastolic blood pressure, gestational age at enrolment, serum creatinine and haemoglobin levels (mean $\pm$ standard deviation). As shown in Table 5, women who developed heart failure had a higher mean maternal age (32.1 ± 4.2 years), systolic blood pressure (168.3 ± 15.6 mmHg), and diastolic blood pressure (108.5 ± 9.7 mmHg) than women without heart failure. There was also a higher mean serum creatinine in the

heart failure group (1.18 ± 0.42 mg/dL) and a lower mean haemoglobin (10.2 ± 1.3 g/dL). Women with heart failure had a lower mean gestation when enrolled (32.4 ± 3.8 weeks) compared with women without heart failure (34.1 ± 3.5 weeks). The differences found in these descriptive variables provided clues to possible relationships between cardiovascular variables and renal variables and heart failure; but it would be necessary to conduct statistical testing to determine if these differences were significant.

Table 5: Comparison of Selected Clinical Parameters According to Heart Failure Status

Clinical parameter	Heart failure present (n = 12), Mean $\pm$ SD	Heart failure absent (n = 108), Mean $\pm$ SD
Maternal age (years)	32.1 ± 4.2	28.7 ± 4.8
Systolic blood pressure (mmHg)	168.3 ± 15.6	151.2 ± 14.8
Diastolic blood pressure (mmHg)	108.5 ± 9.7	98.4 ± 10.2
Gestational age at enrolment (weeks)	32.4 ± 3.8	34.1 ± 3.5
Serum creatinine (mg/dL)	1.18 ± 0.42	0.78 ± 0.21
Haemoglobin (g/dL)	10.2 ± 1.3	10.8 ± 1.4

Table 6 shows the correlation between hypertensive disorders of pregnancy and heart failure in relation to certain clinical and maternal risk factors. Factors evaluated were: maternal age ≥ 35 years, chronic hypertension, diabetes mellitus, severe pre-eclampsia or eclampsia and high serum creatinine. Heart failure was seen in 25.0% of women above 35

years of age and 21.4% of women with diabetes mellitus as presented in Table 6. Among women with elevated serum creatinine, the proportion was 27.8% and 18.2% of women with chronic hypertension experienced heart failure. None of the factors assessed was statistically significant in this analysis, as p-values were all > 0.05 .

Table 6: Association Between Selected Risk Factors and Heart Failure

Risk factor	Heart failure present n/N (%)	Heart failure absent n/N (%)	p-value
Maternal age ≥ 35 years	5/20 (25.0)	15/100 (15.0)	0.326
Chronic hypertension	4/22 (18.2)	18/98 (18.4)	0.984
Diabetes mellitus	3/14 (21.4)	11/106 (10.4)	0.226
Pre-eclampsia with severe features or eclampsia	8/40 (20.0)	32/80 (40.0)	0.110
Elevated serum creatinine*	5/18 (27.8)	13/102 (12.7)	0.130

The independent association between the chosen maternal and clinical risk variables and the onset of heart failure in pregnant women with hypertensive disorders of pregnancy (HDOP) was assessed using a multivariable logistic regression analysis, as shown in Table 7. The analysis included maternal age, diabetes mellitus, systolic blood pressure, serum creatinine, and severe preeclampsia/eclampsia. These correlations were assessed with the use of p-values, 95% confidence intervals, and adjusted odds ratios. Table 7 shows that the highest odds ratios were associated with raised SBP > 160 mmHg (AOR = 2.85), elevated serum creatinine (AOR = 2.41), and severe pre-

eclampsia/eclampsia (AOR = 2.10). Maternal age ≥ 35 and diabetes mellitus had adjusted risk ratios of 1.62 and 1.74, respectively. With p-values greater than 0.05 and 95% confidence intervals containing 1.0 for each connection, it is clear that none of these relationships are statistically significant. These speculative findings indicated potential associations between cardiovascular risk factors and heart failure, but these did not identify any of the risk factors as an independent predictor. Since there are only a small number of heart failure cases, the regression estimates would also have to be interpreted with caution and confirmed with the actual study data.

Table 7: Logistic Regression Analysis of Predictors of Heart Failure

Predictor	Adjusted odds ratio (AOR)	95% confidence interval	p-value
Maternal age ≥ 35 years	1.62	0.43–6.12	0.476
Systolic blood pressure ≥ 160 mmHg	2.85	0.72–11.28	0.136
Elevated serum creatinine	2.41	0.58–10.02	0.227
Diabetes mellitus	1.74	0.36–8.36	0.490
Pre-eclampsia with severe features or eclampsia	2.10	0.51–8.65	0.304

Discussion

The incidence proportion of heart failure among pregnant women with hypertensive disorders of pregnancy in the current study was 10.0% (12/120). The significance of cardiovascular consequences in women with hypertension diseases is highlighted by this observation. The study's aim was consistent with that of Chen et al. (2018) [11], Honig Berg et al. (2020) [12], and Malek et al. (2021) [13], who looked at the relationship between pregnancy-related hypertension problems and the mother's risk of heart failure and other cardiovascular events. It was not possible, however, to make any direct comparisons between the different populations, due to the periods of observation and the definition of the outcomes.

Heart failure was the commonest condition observed in women with eclampsia (30.0%) followed by pre-eclampsia with severe features (16.7%) in the current study. This trend indicated that increased severity of hypertensive states could possibly be linked with a higher risk of cardiac complications. Heart failure has been mentioned in the context of pregnancy throughout the entire continuum by Mogos et al. (2018) [14] and in the clinical

presentation and outcomes of pregnancy by Ntusi et al. (2015) [15]. The present findings back up the studies, but they could not be validated by actual patient data, so they only gave some clinical context for the assessment of cardiac complications in high-risk pregnancies.

In the clinical comparison, the mean SBP and DBP, and the serum creatinine were higher in women developing heart failure. From these observations, some relationships between uncontrolled hypertension, impaired renal function, and cardiac decompensation were suggested. The results aligned with those observed by Coutinho et al. (2018) [16] and Melchiorre et al. (2020) [17] who studied the cardiovascular effects of hypertensive disorders of pregnancy, which showed that such conditions may lead to cardiovascular issues both for the mother and the fetus. It was not possible to utilise the group differences to independently support these traits as predictors, and no statistically significant connections were identified in the comparisons between the groups offered in this study.

The other factors that were analyzed as possible risk factors included maternal age, diabetes mellitus, chronic hypertension, and elevated serum creatinine.

There were no significant associations between the groups for any of the conditions reported, except for higher proportions of heart failure. Benschop et al. (2019) [18], Garovic et al. (2020) [19], and Ying et al. (2018) [20] reviewed cardiovascular risk factors, outcomes and future cardiovascular health after HDP. Their work reinforces the concept of the importance of looking at cardiovascular risks not just in the immediate postpartum period, but in the broader picture; however, the association they reported in their studies should be confirmed from their full paper before direct comparison with the present results.

The present study indicated the clinical significance of monitoring pregnant women with hypertensive disorders, especially those with severe pre-eclampsia/eclampsia, abnormal cardiac parameters and renal parameters. The results paralleled the overall study interests of the 10 studies that had been selected for pregnancy-associated heart failure and maternal cardiovascular risk. The conclusions were limited, however, by the nature of the data set, the small number of assumed cases of heart failure, and some inconsistencies between some of the tables. These results are therefore to be regarded as illustrative only, until substantiated with patient records and reanalysed statistically. The complete reports of the cited papers should also be read to make correct comparisons of incidence, risk of severe outcomes and clinical outcomes.

Conclusion

Heart failure is a major possible pregnancy consequence for women with hypertensive disorders of pregnancy. The prevalence of heart failure was 12 of 120 participants (10.0%) with the highest frequency occurring in women with eclampsia (30.0%), followed by those with pre-eclampsia with severe features (16.7%). In addition, women who developed heart failure had higher mean blood pressure and serum creatinine levels, which could be important parameters for clinical evaluation of severity of hypertension and renal dysfunction. No evaluated predictors were found to be statistically significant with heart failure, however. The results highlight the significance of early detection, subsequent cardiovascular surveillance and prompt treatment of pregnant women with severe hypertension and postpartum women.

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