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Clinical Profile and Management Outcomes of Hypertensive Disorders of Pregnancy (Pre-eclampsia/Eclampsia) at a Tertiary Care Hospital: A Cross-Sectional Study

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Abstract

Background: Hypertensive disorders of pregnancy (HDP), encompassing gestational hypertension, pre-eclampsia, eclampsia and chronic hypertension with superimposed pre-eclampsia, remain a leading cause of maternal and perinatal morbidity and mortality, particularly in low- and middle-income settings such as South India. Characterising the clinical spectrum and short-term outcomes of these disorders at the tertiary-care level can inform triage, referral and resource allocation.

Objectives: To describe the sociodemographic and clinical profile, management patterns and maternal and perinatal outcomes of women admitted with HDP at a tertiary care teaching hospital.

Methods: This was a STROBE-compliant, hospital-based, cross-sectional study of 240 pregnant women with HDP. Sociodemographic characteristics, diagnostic subtype, admission blood pressure, proteinuria, platelet count, symptoms, antihypertensive and magnesium sulphate use, mode of delivery, maternal complications and perinatal outcomes were summarised using descriptive statistics.

Results: Mean maternal age was 30.1 ± 7.0 years; 132 (55.0%) were from rural areas and 96 (40.0%) were unbooked. Pre-eclampsia with severe features (31.2%) and gestational hypertension (30.8%) predominated; eclampsia occurred in 14 (5.8%). Mean admission blood pressure was 174 ± 20 / 110 ± 11 mmHg. Labetalol (44.6%) was the most frequent antihypertensive and magnesium sulphate was administered to 172 (71.7%). The caesarean rate

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was 58.8%. Maternal ICU admission occurred in 9.6% and maternal mortality in 0.8%. Preterm birth (43.8%), NICU admission (37.5%) and perinatal mortality (8.75%) were common.

Conclusion: HDP in this tertiary-care cohort was associated with substantial maternal and perinatal morbidity, high caesarean and preterm rates, and a notable burden among rural and unbooked women.

Keywords: hypertensive disorders of pregnancy; pre-eclampsia; eclampsia; magnesium sulphate; perinatal outcome; South India

Introduction

Hypertensive disorders of pregnancy (HDP) are among the most common and consequential medical complications of gestation, contributing disproportionately to maternal and perinatal morbidity and mortality worldwide. The spectrum encompasses gestational hypertension, pre-eclampsia (with and without severe features), eclampsia, and chronic hypertension with superimposed pre-eclampsia. Collectively, these disorders complicate a substantial proportion of pregnancies and account for a large share of obstetric intensive-care admissions, iatrogenic preterm deliveries and referrals to tertiary centres [1,2]. In low- and middle-income countries, where antenatal coverage may be incomplete and referral chains fragile, the impact of HDP is amplified by delayed recognition and constrained emergency capacity [3].

The pathophysiology of pre-eclampsia is characterised by abnormal placentation, endothelial dysfunction and a maternal systemic inflammatory response, culminating in hypertension, proteinuria and multi-organ involvement. Biochemical derangements such as raised serum uric acid and lactate dehydrogenase, thrombocytopenia and evidence of haemolysis and hepatic injury (as seen in HELLP syndrome) reflect the severity of endothelial and microvascular compromise and correlate with adverse fetomaternal outcomes [4]. Because effective curative therapy remains limited to timely delivery, the clinical priorities are early identification of at-risk women, control of severe hypertension, seizure prophylaxis with magnesium sulphate, and appropriately timed delivery balanced against fetal maturity [5].

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Preventive and predictive strategies have attracted considerable research interest. Low-dose aspirin in high-risk women, nitric-oxide donors such as isosorbide mononitrate, and biomarker-based risk stratification have each been evaluated with variable success [6]. Notably, several of these efforts have originated in South India and neighbouring regions, including a randomised trial of isosorbide mononitrate conducted at a tertiary institute in Puducherry and community health-worker programmes in rural Karnataka, underscoring the regional salience of the condition and the feasibility of task-shared approaches to identification, emergency treatment and referral [7]. Body mass index and gestational weight gain are further modifiable determinants of pregnancy complications, including hypertensive disease, that are relevant to counselling and prevention [8].

Despite this substantial body of evidence, contemporary descriptions of the clinical profile and short-term management outcomes of women presenting with HDP to tertiary-care facilities in South India remain valuable for local service planning. Such data help quantify the burden of severe disease, characterise the populations most affected—often rural and unbooked women—and benchmark management practices and outcomes against published standards. Understanding the distribution of diagnostic subtypes, the frequency of complications such as HELLP syndrome, abruptio placentae, acute kidney injury and pulmonary oedema, and the corresponding neonatal outcomes can guide resource allocation, staff training and the design of referral pathways [9].

Accordingly, the present cross-sectional study was undertaken to describe the sociodemographic and clinical characteristics, management patterns, and maternal and perinatal outcomes of women admitted with HDP at a tertiary care teaching hospital in South India. The objectives were: (i) to describe the sociodemographic profile and distribution of HDP diagnostic subtypes; (ii) to characterise the clinical and biochemical profile at admission; (iii) to describe management including antihypertensive therapy, magnesium sulphate use and mode of delivery; and (iv) to quantify maternal and perinatal outcomes.

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Methods

Study design and setting

This was a hospital-based, cross-sectional, descriptive study conducted at SLIMS, Pondicherry. The institution serves a mixed urban and rural catchment population and functions as a referral centre for obstetric emergencies. Reporting adheres to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidance for cross-sectional studies.

Study population and sample

The study population comprised 240 pregnant women admitted with a diagnosis of hypertensive disorders of pregnancy. Eligible participants were women with gestational hypertension, pre-eclampsia without severe features, pre-eclampsia with severe features, eclampsia, or chronic hypertension with superimposed pre-eclampsia, diagnosed according to standard obstetric criteria. Women with pre-existing chronic hypertension without superimposed pre-eclampsia and those with incomplete essential records were not included.

Definitions

Diagnostic categories followed conventional definitions: gestational hypertension as new-onset hypertension (systolic blood pressure ≥140 mmHg and/or diastolic ≥90 mmHg) after 20 weeks of gestation without proteinuria or end-organ features; pre-eclampsia as hypertension with proteinuria or maternal end-organ dysfunction; pre-eclampsia with severe features as the presence of severe-range blood pressure, thrombocytopenia, impaired hepatic or renal function, pulmonary oedema, or neurological or visual disturbances; eclampsia as generalised seizures in a woman with pre-eclampsia; and chronic hypertension with superimposed pre-eclampsia as new proteinuria or end-organ features in a woman with pre-existing hypertension. “Booked” status denoted at least the minimum recommended antenatal visits at a recognised facility, and “unbooked” denoted inadequate or absent antenatal care.

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Data collection and variables

Data captured included maternal age, area of residence (rural/urban), booking status, HDP diagnostic subtype, systolic and diastolic blood pressure at admission, gestational age at admission and at delivery, urine protein dipstick grade, platelet count, and the presence of neurological and visual symptoms. Management variables comprised the antihypertensive agent used (labetalol, nifedipine, hydralazine, or a combination) and administration of magnesium sulphate for seizure prophylaxis or treatment. Outcome variables included mode of delivery, maternal complications (postpartum haemorrhage, HELLP syndrome, abruptio placentae, acute kidney injury, pulmonary oedema, and other), maternal intensive-care-unit (ICU) admission, and final maternal outcome. Neonatal and perinatal variables comprised birth weight, intrauterine growth restriction/fetal growth restriction (IUGR/FGR), preterm birth (<37 weeks), neonatal intensive-care-unit (NICU) admission, perinatal outcome category and duration of hospital stay.

Statistical analysis

Continuous variables are summarised as means with standard deviations where available, and categorical variables as frequencies and percentages, based on the full sample of 240 women. No inferential hypothesis testing or modelling was performed, consistent with the descriptive, cross-sectional aim of the study. Denominators reflect the total sample unless otherwise indicated. Analyses and figures were prepared using standard statistical and plotting software.

Results

Sociodemographic characteristics and diagnostic subtypes

Among the 240 women with HDP, the mean maternal age was 30.1 ± 7.0 years. A majority resided in rural areas (132; 55.0%), while 108 (45.0%) were from urban areas. Overall, 144 women (60.0%) were booked and 96 (40.0%) were unbooked, indicating that a substantial minority presented without adequate antenatal care. The distribution of diagnostic subtypes is shown in Table 1 and Figure 1. Pre-eclampsia with severe features was the single most common presentation (75; 31.2%), closely followed by gestational hypertension (74; 30.8%) and pre-eclampsia without severe features (70; 29.2%). Eclampsia was diagnosed in 14 women (5.8%),

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and chronic hypertension with superimposed pre-eclampsia in 7 (2.9%). Taken together, pre-eclampsia with severe features and eclampsia—the categories carrying the greatest risk—accounted for more than one-third of the cohort (37.0%).

Table 1. Sociodemographic characteristics and HDP diagnostic subtypes (N = 240)

Variable	Category	n (%)
Maternal age (years)	Mean ± SD	30.1 ± 7.0
Residence	Rural	132 (55.0)
	Urban	108 (45.0)
Booking status	Booked	144 (60.0)
	Unbooked	96 (40.0)
HDP subtype	Pre-eclampsia with severe features	75 (31.2)
	Gestational hypertension	74 (30.8)
	Pre-eclampsia without severe features	70 (29.2)
	Eclampsia	14 (5.8)
	Chronic HTN with superimposed pre-eclampsia	7 (2.9)

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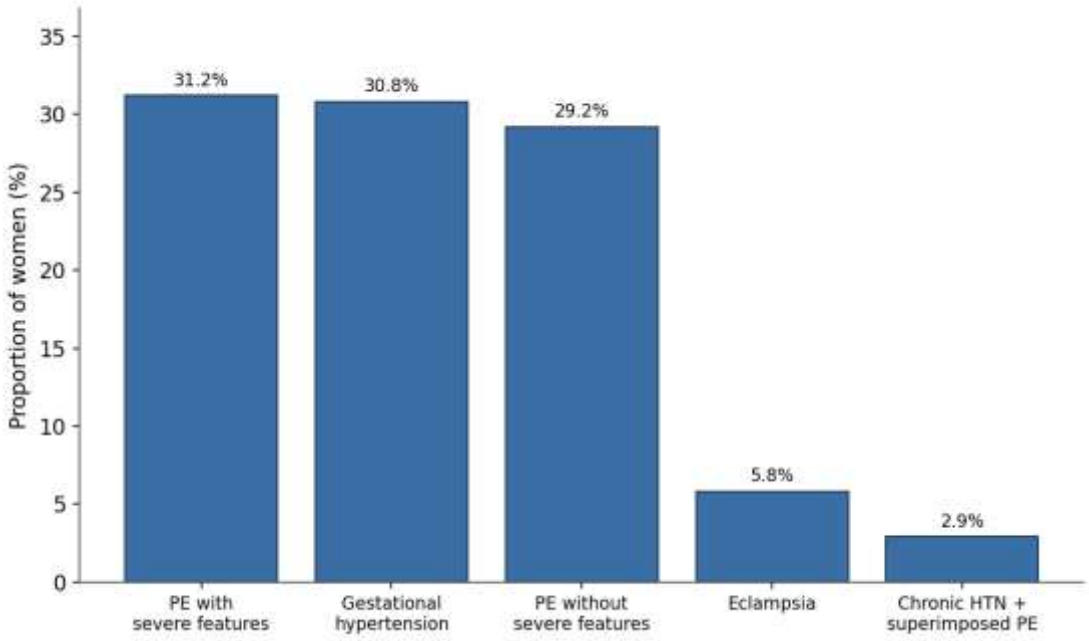

Figure 1. Distribution of hypertensive disorders of pregnancy diagnostic subtypes (%).

Clinical and biochemical profile

At admission, women were markedly hypertensive, with a mean systolic blood pressure of 174 ± 20 mmHg and a mean diastolic blood pressure of 110 ± 11 mmHg, values within the severe range and consistent with the high proportion of severe disease in the cohort. The mean gestational age at admission was 35.6 weeks, reflecting predominantly late-preterm and early-term presentations. Proteinuria was frequent: on urine dipstick testing, 55 women (22.9%) had 1+, 71 (29.6%) had 2+, 33 (13.8%) had 3+ and 18 (7.5%) had 4+ proteinuria, while 40 (16.7%) were negative and 23 (9.6%) had trace proteinuria. Thus, roughly half of the cohort demonstrated 2+ or greater proteinuria, a finding associated with adverse neonatal outcomes in prior work [13]. The mean platelet count was 145,514/μL, consistent with a tendency toward thrombocytopenia in a population enriched for severe disease and HELLP syndrome. Neurological symptoms were reported by 62 women (25.8%) and visual symptoms by 52 (21.7%), both important markers of severity that inform the need for seizure prophylaxis and expedited delivery. These findings are summarised in Table 2.

Table 2. Clinical and biochemical profile at admission (N = 240)

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Variable	Category	Value
Systolic BP (mmHg)	Mean ± SD	174 ± 20
Diastolic BP (mmHg)	Mean ± SD	110 ± 11
Gestational age at admission (weeks)	Mean	35.6
Urine protein (dipstick)	Negative	40 (16.7)
	Trace	23 (9.6)
	1+	55 (22.9)
	2+	71 (29.6)
	3+	33 (13.8)
	4+	18 (7.5)
Platelet count (/μL)	Mean	145,514
Neurological symptoms	Present	62 (25.8)
Visual symptoms	Present	52 (21.7)

Values are n (%) unless otherwise stated.

Management and maternal outcomes

Antihypertensive therapy was administered according to severity and availability. Labetalol was the most frequently used agent (107; 44.6%), followed by nifedipine (81; 33.8%), hydralazine (17; 7.1%) and a combination of agents (16; 6.7%). Magnesium sulphate, the cornerstone of seizure prophylaxis and treatment, was administered to 172 women (71.7%), consistent with the large proportion presenting with severe features or eclampsia [2,11]. The mean gestational age at delivery was 36.9 weeks. Operative delivery predominated: emergency lower-segment caesarean section (LSCS) was performed in 111 women (46.3%) and elective LSCS in 30 (12.5%), giving a total caesarean rate of 58.8% (141 women). Vaginal delivery occurred in 90 women (37.5%) and instrumental vaginal delivery in 9 (3.8%).

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Maternal complications were not uncommon. Postpartum haemorrhage occurred in 21 women (8.8%), HELLP syndrome in 20 (8.3%), abruptio placentae in 16 (6.7%), acute kidney injury in 10 (4.2%) and pulmonary oedema in 7 (2.9%); a further 22 women (9.2%) experienced other complications. Maternal ICU admission was required in 23 women (9.6%). Reassuringly, the majority of women recovered (232; 96.7%), while 6 (2.5%) were referred out for higher-level care and 2 (0.8%) died. These management characteristics and maternal outcomes are detailed in Table 3, and key outcomes are displayed in Figure 2.

Table 3. Management and maternal outcomes (N = 240)

Variable	Category	n (%)
Antihypertensive used	Labetalol	107 (44.6)
	Nifedipine	81 (33.8)
	Hydralazine	17 (7.1)
	Combination	16 (6.7)
Magnesium sulphate	Administered	172 (71.7)
Mode of delivery	Emergency LSCS	111 (46.3)
	Vaginal	90 (37.5)
	Elective LSCS	30 (12.5)
	Instrumental vaginal	9 (3.8)
	Total caesarean	141 (58.8)
Maternal complications	Postpartum haemorrhage	21 (8.8)
	HELLP syndrome	20 (8.3)
	Abruptio placentae	16 (6.7)
	Acute kidney injury	10 (4.2)
	Pulmonary oedema	7 (2.9)
	Other	22 (9.2)

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Maternal ICU admission	Yes	23 (9.6)
Maternal outcome	Recovered	232 (96.7)
	Referred out	6 (2.5)
	Maternal death	2 (0.8)

Neonatal and perinatal outcomes

The mean birth weight was 2410 g, reflecting the combined contributions of prematurity and growth restriction in this population. IUGR/FGR was documented in 62 neonates (25.8%) and preterm birth (<37 weeks) in 105 (43.8%). NICU admission was required for 90 neonates (37.5%). Regarding perinatal outcome, 152 neonates (63.3%) were live-born without major morbidity, 67 (27.9%) were live-born with morbidity, 15 (6.3%) were stillborn and 6 (2.5%) died in the early neonatal period. Perinatal mortality (stillbirth plus early neonatal death) thus amounted to 21 (8.75%). The mean duration of hospital stay was 7.8 days. Neonatal and perinatal outcomes are summarised in Table 4, and the principal maternal and perinatal outcome measures are presented together in Figure 2.

Table 4. Neonatal and perinatal outcomes (N = 240)

Variable	Category	Value
Birth weight (g)	Mean	2410
IUGR/FGR	Present	62 (25.8)
Preterm birth (<37 weeks)	Yes	105 (43.8)
NICU admission	Yes	90 (37.5)
Perinatal outcome	Live birth without major morbidity	152 (63.3)
	Live birth with morbidity	67 (27.9)

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	Stillbirth	15 (6.3)
	Early neonatal death	6 (2.5)
Perinatal mortality	Stillbirth + early neonatal death	21 (8.75)
Hospital stay (days)	Mean	7.8

Values are n (%) unless otherwise stated.

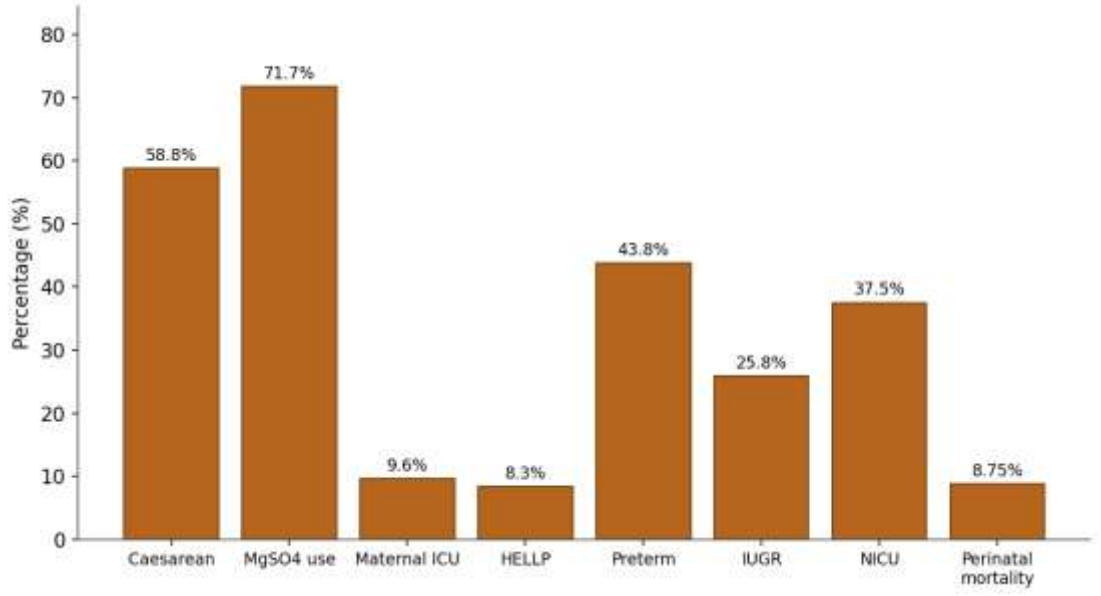

Figure 2. Key maternal and perinatal outcomes (%).

Discussion

In this cross-sectional study of 240 women admitted with hypertensive disorders of pregnancy to a tertiary care teaching hospital in South India, the clinical burden was substantial. Pre-eclampsia with severe features and gestational hypertension were the predominant presentations, admission blood pressures were within the severe range, and more than one-third of the cohort had the highest-risk phenotypes of severe pre-eclampsia or eclampsia. These features were accompanied by high rates of caesarean delivery (58.8%), preterm birth (43.8%), NICU admission (37.5%) and perinatal mortality (8.75%), alongside a maternal ICU admission rate of 9.6% and maternal mortality of 0.8%. The pattern is consistent with the recognised profile of HDP at referral centres

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in India and other low- and middle-income settings, where women frequently present late and with advanced disease [5].

A striking feature of the cohort was the high proportion of rural (55.0%) and unbooked (40.0%) women. Inadequate antenatal booking limits opportunities for blood-pressure surveillance, early detection of proteinuria and timely initiation of preventive measures, and has repeatedly been linked to more severe presentations and worse perinatal outcomes [6]. This observation reinforces the importance of strengthening community-level identification and referral. Task-sharing models in which community health workers are trained to screen for hypertension and pre-eclampsia, initiate emergency treatment and expedite referral have shown feasibility and knowledge gains in rural Karnataka, a South Indian setting closely comparable to the present catchment population [7]. Scaling such approaches, together with improved antenatal coverage, could plausibly shift presentations toward earlier, less severe disease.

The clinical and biochemical profile observed—severe-range hypertension, frequent 2+ or greater proteinuria, a mean platelet count in the low-normal range, and neurological and visual symptoms in roughly a quarter of women—mirrors the multi-system nature of severe pre-eclampsia. Higher-grade proteinuria has been associated with worse neonatal outcomes in a tertiary referral setting, supporting its continued relevance as a marker of severity despite the shift toward diagnostic criteria that no longer mandate proteinuria [8]. Biochemical markers such as serum uric acid and lactate dehydrogenase, though not analysed here, have been proposed as adjuncts to predict adverse fetomaternal outcomes and could enrich future risk-stratification protocols in this population. The occurrence of HELLP syndrome in 8.3% and acute kidney injury in 4.2% highlights the potential for rapid multi-organ deterioration; obstetric acute kidney injury in particular warrants vigilance given its contribution to maternal morbidity [9].

Management in the cohort was broadly aligned with contemporary standards. Labetalol and nifedipine were the mainstays of antihypertensive therapy, and magnesium sulphate was administered to nearly three-quarters of women, appropriate given the high prevalence of severe features and eclampsia and its established role in preventing and treating seizures [10]. The high caesarean rate reflects the frequent need for expedited delivery in the setting of severe maternal disease, non-reassuring fetal status, growth restriction and prematurity, and is characteristic of

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tertiary referral practice. Adjunctive strategies such as epidural analgesia have been explored for blood-pressure control in severe pre-eclampsia, though the evidence base remains limited [11]. Preventive interventions—including low-dose aspirin in high-risk women and nitric-oxide donors such as isosorbide mononitrate, the latter studied in a randomised trial at a South Indian tertiary institute—offer avenues to reduce the incidence of preterm pre-eclampsia and merit integration into antenatal pathways where feasible. Attention to modifiable risk factors including maternal body mass index and gestational weight gain provides a further, population-level lever for prevention [12].

The maternal and perinatal outcomes observed carry clear service-delivery implications. The maternal mortality of 0.8% and ICU admission rate of 9.6%, while lower than the associated perinatal losses, indicate that even at a tertiary centre a meaningful fraction of women experience life-threatening complications. The perinatal mortality of 8.75%, driven by stillbirth and early neonatal death and compounded by high rates of prematurity and growth restriction, underscores that neonatal outcomes are the principal determinant of the overall burden. Strengthening the continuum of care—from community identification and prompt referral, through severity-appropriate acute management, to neonatal intensive care—is therefore essential [13]. The regional relevance of several cited studies from South India, including the isosorbide mononitrate trial in Puducherry and the community health-worker programmes in Karnataka, situates these findings within a locally applicable evidence base [14].

Conclusion

In this cross-sectional analysis, hypertensive disorders of pregnancy at a South Indian tertiary care hospital were characterised by a predominance of severe pre-eclampsia and gestational hypertension, severe-range admission blood pressures, and a heavy burden among rural and unbooked women. Management was consistent with standard practice, yet maternal and perinatal morbidity remained high, with elevated caesarean, preterm-birth, NICU-admission and perinatal-mortality rates.

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References

1. Kumar N, Yadav A. Perinatal Outcome in Women with Hypertensive Disorders of Pregnancy in Rural Tertiary Center of Northern India: A Retrospective Cohort Study. Curr Pediatr Rev. 2019;16(1):71-78. doi:10.2174/1573396315666191017100030

2. Narkhede AM, Karnad DR. Preeclampsia and Related Problems. Indian J Crit Care Med. 2018;25(Suppl 3):S261-S266. doi:10.5005/jp-journals-10071-24032

3. Moharana JJ, Mishra R, Nayak AK. A Study on Serum Lactate Dehydrogenase and Uric Acid in Preeclampsia and Eclampsia: Can they Predict Adverse Fetomaternal Outcome? Int J Appl Basic Med Res. 2018;13(2):95-100. doi:10.4103/ijabmr.ijabmr_626_22

4. Kumar N, Singh AK. Maternal serum uric acid and calcium as predictors of hypertensive disorder of pregnancy: A case control study. Taiwan J Obstet Gynecol. 2019;58(2):244-250. doi:10.1016/j.tjog.2019.01.014

5. Kumar N, Singh AK, Maini B. Impact of maternal serum uric acid on perinatal outcome in women with hypertensive disorders of pregnancy: A prospective study. Pregnancy Hypertens. 2017;10:220-225. doi:10.1016/j.preghy.2017.10.002

6. Ponmozhi G, Keepanasseril A, Mathaiyan J, Manikandan K. Nitric Oxide in the Prevention of Pre-eclampsia (NOPE): A Double-Blind Randomized Placebo-Controlled Trial Assessing the Efficacy of Isosorbide Mononitrate in the Prevention of Pre-eclampsia in High-Risk Women. J Obstet Gynaecol India. 2018;69(Suppl 2):103-110. doi:10.1007/s13224-018-1100-1

7. Saxena U, Lachyan A, Goyal C, et al. Comparison of 75 mg versus 150 mg aspirin for the prevention of preterm preeclampsia in high-risk women at a tertiary level hospital: study protocol for a randomized double-blind clinical trial. Trials. 2014;25(1):679. doi:10.1186/s13063-024-08520-z

8. Salam RA, Das JK, Ali A, Bhaumik S, Lassi ZS. Diagnosis and management of preeclampsia in community settings in low and middle-income countries. J Family Med Prim Care. 2015;4(4):501-506. doi:10.4103/2249-4863.174265

9. Charanthimath U, Vidler M, Katageri G, et al. The feasibility of task-sharing the identification, emergency treatment, and referral for women with pre-eclampsia by community health workers in India. Reprod Health. 2018;15(Suppl 1):101. doi:10.1186/s12978-018-0532-5

10. Ramadurg U, Vidler M, Charanthimath U, et al. Community health worker knowledge and management of pre-eclampsia in rural Karnataka State, India. Reprod Health. 2016;13(Suppl 2):113. doi:10.1186/s12978-016-0219-8

11. Ray A, Ray S. Epidural therapy for the treatment of severe pre-eclampsia in non labouring women. Cochrane Database Syst Rev. 2017;11(11):CD009540. doi:10.1002/14651858.CD009540.pub2

12. Cavin N, Santana de Roberts R, Jim B. Acute Kidney Injury in Obstetric Patients. Contrib Nephrol. 2018;199:162-178. doi:10.1159/000517697

13. Alves Ferreira AC, Dos Santos Guedes SM, Rodrigues TCGF, Barbosa PO, Cavalli RC. Proteinuria is associated with worse outcomes in babies born to mothers with preeclampsia: A retrospective cohort study at a tertiary referral hospital in Brazil. Int J Gynaecol Obstet. 2018;169(1):285-291. doi:10.1002/ijgo.16007

14. Santos S, Voerman E, Amiano P, et al. Impact of maternal body mass index and gestational weight gain on pregnancy complications: an individual participant data meta-analysis of European, North American and Australian cohorts. BJOG. 2019;126(8):984-995. doi:10.1111/1471-0528.15661