International Journal of Medical and Pharmaceutical Research

Online ISSN-2958-3683 | Print ISSN-2958-3675
Frequency: Bi-Monthly
Available online on: https://ijmpr.in/

Original Article

A Cross-Sectional Study on Clinical and Laboratory Abnormalities in Patients Presenting with Hypertensive Emergency in A Rural Medical College Hospital

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Received: 06-12-2025
Accepted: 22-12-2025
Available online: 11-01-2026

ABSTRACT

Background: Hypertensive emergency is a life-threatening condition characterised by a sudden and severe elevation of blood pressure with acute target organ damage. It contributes significantly to cardiovascular and cerebrovascular morbidity and mortality, particularly in resource-limited rural settings where hypertension often remains inadequately controlled.

Objectives: To study the clinical presentation, laboratory abnormalities, and target organ involvement in patients presenting with hypertensive emergency at a rural tertiary care medical college hospital.

Materials and Methods: A hospital-based cross-sectional study was conducted at KVG Medical College and Hospital, Sullia, over a period of 18 months (July 2022 to January 2024). Fifty adult patients (≥18 years) presenting with hypertensive emergency were included using purposive sampling. Detailed clinical evaluation, fundoscopic examination, laboratory investigations, and imaging studies were performed. Blood pressure was recorded at admission, after 1 hour, and after 24 hours. Data were analysed using descriptive statistics with SPSS version 20.0.

Results: The mean age of patients was 62.3 ± 14.7 years, with a male predominance (62%). A prior history of hypertension was present in 90% of patients, and 15.5% were non-compliant with antihypertensive therapy. Dyspnea and orthopnoea (56%) were the most common presenting symptoms. Fundoscopic abnormalities were observed in 92% of patients, predominantly Grade 2 hypertensive retinopathy. Renal involvement was common, with proteinuria present in 72% and ultrasonographic evidence of medical renal disease in 30% of patients. Pulmonary oedema was the most frequent chest X-ray finding (50%). Among symptomatic patients, CT brain revealed ischemic stroke in 24% and hemorrhagic stroke in 14%. Mean systolic and diastolic blood pressures showed a progressive decline over the 24 hours of hospitalisation.

Conclusion: Hypertensive emergencies in this rural population were largely associated with chronic uncontrolled hypertension and poor medication adherence, leading to significant multisystem target organ damage. Early diagnosis, prompt management, and effective long-term control of hypertension are essential to reduce morbidity and mortality.

Keywords*: Hypertensive emergency, target organ damage, hypertensive retinopathy, rural population, hypertension.*

INTRODUCTION

Hypertension remains one of the most prevalent non-communicable diseases worldwide and is a major contributor to cardiovascular morbidity and mortality. According to the World Health Organization, hypertension affects more than 1.2 billion adults globally, with a disproportionately rising burden in low- and middle-income countries, including India [1]. Poor awareness, inadequate treatment, and suboptimal drug compliance significantly contribute to uncontrolled blood pressure and its complications.

A hypertensive emergency is defined as a severe elevation of blood pressure, typically ≥180/120 mmHg, accompanied by evidence of acute target organ damage, involving the brain, heart, kidneys, retina, or vascular system [2]. Unlike hypertensive urgency, hypertensive emergencies require immediate blood pressure reduction under close monitoring to prevent irreversible organ damage and death.

Hypertensive emergencies account for approximately 1–2% of all hypertensive patients but are associated with high morbidity and mortality if not promptly recognized and treated [3]. The clinical presentation is heterogeneous and depends on the organs involved, with common manifestations including acute pulmonary edema, hypertensive encephalopathy, ischemic or hemorrhagic stroke, acute kidney injury, and retinal hemorrhages or papilledema [4].

Target organ involvement in hypertensive emergencies results from failure of autoregulatory mechanisms and endothelial dysfunction, leading to increased vascular permeability, ischemia, and tissue edema [5]. Fundoscopic examination plays a crucial role in identifying hypertensive retinopathy and papilledema, which serve as markers of chronic injury and acute damage, respectively [6]. Similarly, laboratory parameters such as proteinuria, elevated serum creatinine, and electrolyte abnormalities reflect renal involvement, while imaging studies including chest X-ray, echocardiography, ultrasonography, and computed tomography are essential for assessing cardiovascular, renal, and neurological complications.

Despite the growing burden of hypertension in India, particularly in rural areas, data on the clinical and laboratory profile of hypertensive emergencies in rural tertiary care hospitals remain limited [7]. Factors such as poor health literacy, irregular follow-up, inadequate access to healthcare facilities, and medication non-compliance further exacerbate the risk of hypertensive crises in rural populations [8].

Understanding the spectrum of clinical presentations, laboratory abnormalities, and imaging findings in patients presenting with hypertensive emergencies is essential for early diagnosis, timely intervention, and prevention of adverse outcomes. Therefore, the present study was undertaken to evaluate the clinical profile, laboratory abnormalities, and target organ involvement among patients presenting with hypertensive emergencies at a rural medical college hospital.

MATERIALS AND METHODS

Study Setting

This study was conducted at KVG Medical College and Hospital, Sullia, a tertiary care teaching hospital that caters to a heterogeneous patient population. The hospital provides comprehensive emergency and inpatient services, making it an appropriate setting for evaluating patients presenting with hypertensive emergencies.

Study Design

A **hospital-based cross-sectional study** was undertaken to assess the clinical profile and target organ involvement among patients presenting with hypertensive emergencies.

Study Period

The study was conducted over 18 months, from July 2022 to January 2024, allowing for adequate case accrual and assessment of clinical patterns.

Study Population

The study population included **adult patients (≥18 years)** of either sex presenting to the outpatient or inpatient departments of KVG Medical College and Hospital with features of hypertensive emergency and who consented to participate in the study.

Sampling Method

A purposive sampling technique was employed. Patients fulfilling the predefined inclusion criteria were consecutively enrolled during the study period.

Sample Size

The sample size was calculated based on a previous study by Mahesh Dave et al., which reported a 3% prevalence of visual deficits in patients with hypertensive emergencies.

Using the formula:

$$n = \frac{4pq}{L^2}$$

where

p = 3%,

q = 97%,

L = 5% (allowable error),

The calculated sample size was 46.56, which was rounded off to 50 patients to ensure adequate representation.

Selection Criteria

Inclusion Criteria

1. Patients aged 18 years and above, of either sex.
2. Severe elevation of blood pressure is defined as systolic blood pressure ≥180 mmHg and/or diastolic blood pressure ≥120 mmHg.
3. Presence of acute target organ damage, either clinically or confirmed by laboratory or imaging investigations, attributable to hypertension.

Exclusion Criteria

1. Patients previously included in the study (repeat admissions).
2. Patients with valvular heart disease.
3. Patients not willing to provide informed consent.

Methodology and Patient Evaluation

All eligible patients presenting with hypertensive emergencies during the study period were evaluated using a predesigned and pretested proforma. A detailed medical history was obtained, followed by a comprehensive physical examination.

Blood pressure measurements were recorded using a standard mercury sphygmomanometer at the time of admission, after 1 hour, and after 24 hours of hospitalization. Hypertensive emergency was defined as blood pressure ≥180/120 mmHg with evidence of acute target organ damage.

A thorough systemic examination was performed, including evaluation of the cardiovascular, respiratory, gastrointestinal, and central nervous systems.

Diagnostic Investigations

All patients underwent baseline and relevant diagnostic investigations, which included:

- Fundoscopic examination
- Electrocardiography (ECG)
- Echocardiography
- Urine analysis for proteinuria
- Renal function tests (RFT)
- Serum electrolyte analysis
- Chest X-ray

Additional investigations such as computed tomography (CT) of the brain and other imaging studies were performed based on clinical indications.

Electrocardiography

ECG was evaluated for evidence of left ventricular hypertrophy (LVH), strain patterns, and myocardial ischemia.
LVH was diagnosed using:

- **Sokolow–Lyon criteria**:
  - S in V1 + R in V5 or V6 ≥35 mm
  - R in aVL ≥11 mm
- **Cornell voltage criteria**:
  - S in V3 + R in aVL >28 mm in men
  - S in V3 + R in aVL >20 mm in women

Computed Tomography of the Brain

CT imaging was performed in patients with neurological symptoms to identify conditions such as hypertensive encephalopathy, cerebral infarction, intracerebral haemorrhage, and subarachnoid haemorrhage. CT scans also aided in excluding mass lesions and alternative causes of altered sensorium.

Fundoscopic Examination

Fundoscopic examination was performed in all patients to assess hypertensive retinopathy. In elderly patients with poor fundus visualisation due to cataract, pupillary dilatation using tropicamide eye drops was done, and ophthalmology consultation was obtained when required.

Hypertensive retinopathy was graded according to the Keith–Wagener–Barker classification:

- **Grade I**: Mild arteriolar narrowing
- **Grade II**: Marked arteriolar narrowing with arteriovenous crossing changes
- **Grade III**: Retinal hemorrhages, exudates, cotton-wool spots
- **Grade IV**: Grade III changes with papilledema

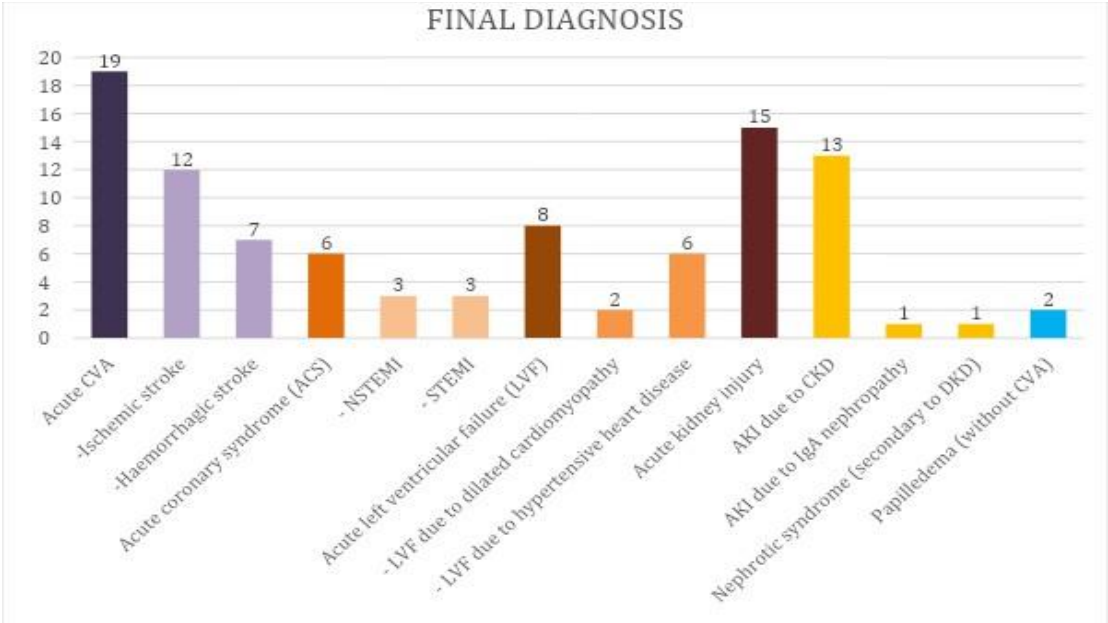
Ultrasonography of Abdomen
Ultrasonography was performed to evaluate medical renal disease, indicated by increased renal cortical echogenicity and loss of corticomedullary differentiation.

Statistical Analysis
Data were entered and analyzed using Statistical Package for Social Sciences (SPSS) version 20.0 and Microsoft Excel 2013. Descriptive statistics such as mean, standard deviation, frequencies, and percentages were used. Results were presented using tables, bar diagrams, and pie charts. A p-value <0.05 was considered statistically significant.

RESULTS AND OBSERVATIONS

Table 1: Demographic Characteristics of the Study Population (n = 50)

Variable	Category	n (%)
Age Group (years)	30–39	5 (10%)
	40–49	7 (14%)
	50–59	8 (16%)
	60–69	15 (30%)
	70–79	10 (20%)
	80–89	5 (10%)
Mean age ± SD (years)	—	**62.3 ± 14.7**
Gender	Male	31 (62%)
	Female	19 (38%)



Graph 1: Diagnosis on presentation if Hypertensive Emergency (Target Organ Damage)

Table 2: Clinical Presentations in Hypertensive Emergency

Presenting Complaint	n (%)
Dyspnea and Orthopnoea	28 (56%)
Edema and Oliguria	17(34%)
Hemiparesis/Hemiplegia	14(28%)
Altered level of consciousness	8(16%)
Chest pain	6 (12%)
Headache	4(8%)

Table 3: Clinical Characteristics and Blood Pressure Profile of the Study Population (n = 50)

Variable	Category / Time Point	n (%) / Mean ± SD
History of Hypertension	Yes	45 (90%)
	No	5 (10%)
Drug Compliance*(n = 45)*	Compliant	38 (84.5%)
	Non-compliant	7 (15.5%)
Systolic Blood Pressure (mmHg)	At admission (0 hour)	197.6 ± 12.9

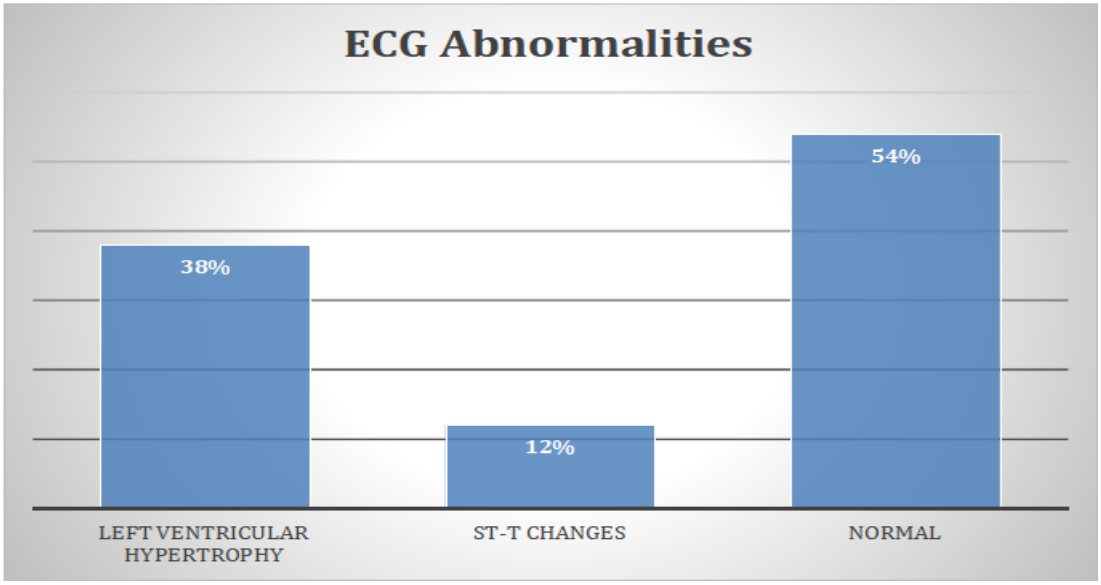
	After 1 hour	180.4 ± 14.6
	After 24 hours	160.4 ± 15.2
Diastolic Blood Pressure (mmHg)	At admission (0 hour)	116.4 ± 8.8
	After 1 hour	104.4 ± 9.6
	After 24 hours	94.4 ± 12.1

Table 4: Fundoscopic Findings and Laboratory Parameters of the Study Population (n = 50)

Variable	Category / Parameter	n (%) / Mean ± SD
Fundoscopic Findings	Hypertensive retinopathy	46 (92%)
	Normal fundus	4 (8%)
Grades of Hypertensive Retinopathy*(n = 46)*	Grade 1	8 (16%)
	Grade 2	25 (50%)
	Grade 3	11 (22%)
	Papilloedema	2 (4%)
Proteinuria	Present	36 (72%)
	Absent	14 (28%)
Laboratory Parameters	Serum urea (mg/dL)	53.7 ± 42.1
	Serum creatinine (mg/dL)	2.8 ± 2.9
	Serum sodium (mEq/L)	138.6 ± 5.6
	Serum potassium (mEq/L)	4.5 ± 0.8

Table 5: Dyslipidemia and Chest X-ray Findings in the Study Population (n = 50)

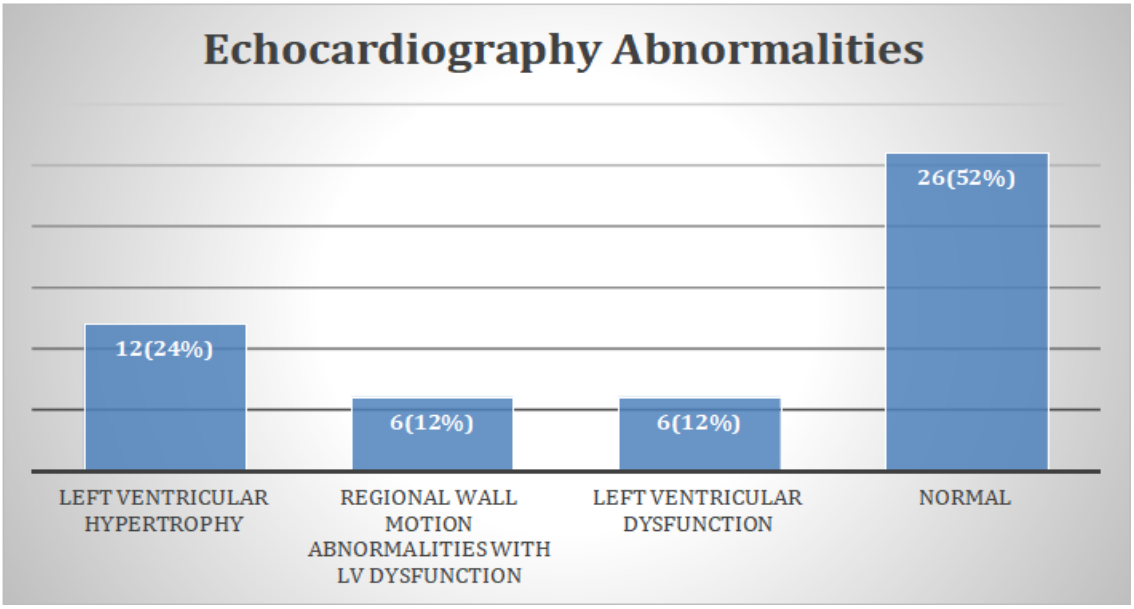
Variable	Category	n (%)
Dyslipidemia	Present	18 (36%)
	Absent	32 (64%)
Chest X-ray Findings	Pulmonary edema	25 (50%)
	Cardiomegaly	12 (24%)
	Normal	23 (46%)
Pattern of Chest X-ray Abnormalities	Isolated pulmonary edema	15 (30%)
	Isolated cardiomegaly	2 (4%)
	Pulmonary edema with cardiomegaly	10 (20%)



Graph 2: Electrocardiogram (ECG) Findings

Table 6: Imaging Findings in the Study Population (n = 50)

Investigation	Finding	n (%)
USG Abdomen	Medical renal disease	15 (30%)
	Normal study	35 (70%)
CT Brain*(n = 19)*	Acute ischemic stroke	12 (24%)
	Acute hemorrhagic stroke	7 (14%)



Graph 3: Echocardiography Findings

DISCUSSION

Hypertensive emergencies represent a critical spectrum of hypertension-associated complications requiring immediate medical attention due to the risk of irreversible target organ damage. The present hospital-based cross-sectional study evaluated the clinical, laboratory, and imaging abnormalities among patients presenting with hypertensive emergencies in a rural tertiary care hospital, providing valuable insight into disease patterns in this underserved population.

Demographic Profile

In the present study, the mean age of patients was **62.3 ± 14.7 years**, with the majority belonging to the **60–69 years age group (30%)**, followed by 70–79 years (20%). This age distribution is consistent with previous studies, which have demonstrated that hypertensive emergencies predominantly affect older individuals due to long-standing uncontrolled hypertension and age-related vascular changes [9,10]. Male predominance (62%) observed in this study aligns with findings reported by Zampaglione et al. and Saguner et al., possibly reflecting higher exposure to cardiovascular risk factors and poorer healthcare-seeking behavior among males [4,11].

Clinical Presentation

Dyspnea and orthopnoea were the most common presenting complaints (56%), indicating acute cardiac involvement, particularly pulmonary edema. Similar observations have been reported in studies by Vaughan and Delanty and Martin et al., where acute left ventricular failure was a leading manifestation of hypertensive emergencies [3,12]. Neurological manifestations such as hemiparesis, altered consciousness, and headache were also frequently observed, underscoring the vulnerability of cerebral circulation to abrupt blood pressure elevations.

History of Hypertension and Drug Compliance

A prior history of hypertension was present in **90%** of patients, highlighting chronic uncontrolled blood pressure as the principal predisposing factor for hypertensive emergencies. Despite this, **15.5%** of known hypertensive patients were non-compliant with medications. Poor drug adherence has been consistently identified as a major precipitating factor for hypertensive crises, particularly in rural settings where health literacy and follow-up are suboptimal [13,14]. This finding reinforces the importance of patient education and regular monitoring.

Blood Pressure Trends

Mean systolic and diastolic blood pressure values showed a progressive and significant reduction over 24 hours of hospitalization, reflecting effective acute management. Similar BP reduction patterns have been documented in studies evaluating standardized emergency antihypertensive protocols [15]. Controlled reduction is essential to prevent hypoperfusion-related complications, particularly in cerebral and renal circulation.

Fundoscopic and Renal Findings

Fundoscopic abnormalities were observed in **92%** of patients, with **Grade 2 hypertensive retinopathy** being the most common finding. Papilledema was present in **4%**, signifying acute target organ damage. Fundoscopy remains a simple yet invaluable bedside tool for assessing chronic vascular injury and acute hypertensive damage, as emphasized by Keith–Wagener–Barker and subsequent studies [6,16].

Renal involvement was evident in the form of **proteinuria (72%)**, elevated serum urea and creatinine, and ultrasonographic features of medical renal disease in **30%** of patients. These findings are comparable to studies by Lip et al. and Chobanian et al., which identified renal dysfunction as a frequent complication of hypertensive emergencies [17,18].

Cardiovascular and Chest X-ray Findings

Pulmonary edema was the most common chest X-ray abnormality (50%), followed by cardiomegaly (24%). Overlapping findings of pulmonary edema and cardiomegaly in 20% of patients indicate acute decompensation on a background of chronic hypertensive heart disease. These findings mirror those reported in earlier Indian studies, highlighting heart failure as a dominant manifestation of hypertensive emergencies [19].

Neurological Imaging Findings

CT brain imaging performed in symptomatic patients revealed **acute ischemic stroke (24%)** and **hemorrhagic stroke (14%)**. The predominance of ischemic stroke is consistent with global data, although the proportion of hemorrhagic strokes remains higher in hypertensive populations compared to normotensive individuals [20]. Early neuroimaging is therefore crucial for accurate diagnosis and management planning.

Dyslipidemia and Risk Factor Clustering

Dyslipidemia was present in **36%** of patients, reflecting clustering of cardiovascular risk factors in hypertensive individuals. This association significantly increases the risk of target organ damage and adverse outcomes, as demonstrated in multiple epidemiological studies [21].

Clinical Implications

The findings of this study emphasize that hypertensive emergencies in rural populations are largely preventable and often arise from chronic uncontrolled hypertension and poor medication adherence. Early detection, regular follow-up, patient education, and strengthening primary healthcare services are critical in reducing the burden of hypertensive emergencies.

CONCLUSION

Hypertensive emergencies predominantly affected elderly patients with long-standing hypertension, with poor blood pressure control and medication non-compliance being major contributing factors. Cardiovascular, neurological, renal, and retinal involvements were common, highlighting the multisystem impact of uncontrolled hypertension. Fundoscopic examination and basic laboratory and imaging investigations proved valuable in detecting target organ damage. Early recognition, prompt management, and improved long-term hypertension control—especially in rural populations—are essential to reduce morbidity and mortality associated with hypertensive emergencies.

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