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Original Article

Laboratory Abnormalities and Their Association with Short-Term Outcomes in Hypertensive Emergency Patients

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ABSTRACT

Background: Hypertensive emergency is a life-threatening condition characterised by severe blood pressure elevation with acute target organ damage. Laboratory abnormalities are common in these patients and may influence short-term outcomes. This study aimed to evaluate laboratory derangements in hypertensive emergency patients and their association with clinical outcomes during hospitalisation.
Methods: A prospective observational study was conducted at Yadagiri Institute of Medical Sciences over one year (June 2024–June 2025). One hundred consecutive adult patients presenting with a hypertensive emergency were enrolled. Demographic, clinical, and laboratory data were collected, including complete blood count, serum electrolytes, renal and liver function tests, random blood glucose, urinalysis, and cardiac biomarkers. Short-term outcomes assessed included ICU admission, mechanical ventilation, complications, and in-hospital mortality. Statistical analysis was performed using SPSS version 26, with $p < 0.05$ considered significant.
Results: The mean age of participants was 56.8 ± 12.4 years, with 62% males. Renal involvement (44%), central nervous system involvement (36%), and cardiovascular involvement (28%) were the most common target organ damages. Laboratory abnormalities included anaemia (34%), leukocytosis (27%), thrombocytopenia (11%), elevated serum creatinine (46%), hyponatremia (21%), hyperkalemia (14%), hyperglycemia (39%), and proteinuria (42%). Elevated serum creatinine and multiple laboratory abnormalities were significantly associated with ICU admission and mortality ($p=0.003$ and $p=0.001$, respectively). Overall, 76% of patients improved and were discharged, while 8% died during hospitalisation.
Conclusion: Laboratory abnormalities are frequent in patients with hypertensive emergencies and are closely associated with adverse short-term outcomes. Early recognition of high-risk laboratory derangements, particularly renal dysfunction and multiple abnormalities, is essential for prompt intervention, risk stratification, and improving clinical outcomes.

Keywords*: Hypertensive emergency, Laboratory abnormalities, Acute kidney injury, Short-term outcomes, ICU admission, Serum creatinine, Target organ damage, Hyperglycemia.*

INTRODUCTION

Hypertensive emergency is a life-threatening condition characterised by a severe elevation of blood pressure accompanied by acute target organ damage, which may involve the brain, heart, kidneys, retina, or vascular system [1]. Unlike hypertensive urgency, hypertensive emergency requires immediate blood pressure reduction to prevent further organ injury and mortality [2]. The incidence of hypertensive emergency has been reported to range between 1–2% of all hypertensive patients presenting to emergency departments, with a higher prevalence in patients with poorly controlled or undiagnosed hypertension [3,4].

The pathophysiology of hypertensive emergency involves a complex interplay of endothelial dysfunction, activation of the renin-angiotensin-aldosterone system, sympathetic overactivity, and oxidative stress, leading to microvascular

damage and target organ injury [5,6]. Clinical manifestations are highly variable and depend on the organ systems involved. Common presentations include acute coronary syndrome, pulmonary oedema, hypertensive encephalopathy, intracerebral haemorrhage, acute kidney injury, and visual disturbances [7,8].

Laboratory investigations are crucial in assessing the extent of organ involvement, guiding management, and predicting short-term outcomes. Common abnormalities observed in hypertensive emergency include elevated serum creatinine and urea, indicative of renal involvement, electrolyte disturbances such as hyponatremia and hyperkalemia, altered liver function tests, haematological abnormalities, hyperglycemia, and elevated cardiac biomarkers in cases with myocardial injury [9,10]. Early recognition of these abnormalities not only aids in prompt management but also serves as a prognostic marker for complications, intensive care requirements, and mortality [11,12].

Despite the critical importance of laboratory assessment, data on the association between specific laboratory abnormalities and short-term clinical outcomes in hypertensive emergency patients, particularly in rural and tertiary care hospital settings, remain limited [13]. Most studies have focused on either clinical features or single-organ dysfunction, with few evaluating a comprehensive panel of laboratory parameters in relation to outcomes such as ICU admission, mechanical ventilation, complications, and in-hospital mortality [14,15].

This study aims to evaluate the spectrum of laboratory abnormalities in patients presenting with hypertensive emergency and to assess their association with short-term outcomes during hospitalisation. Understanding these associations may help clinicians identify high-risk patients early and optimise management strategies to improve patient outcomes.

MATERIALS AND METHODS

Study Design and Setting

This was a hospital-based prospective observational study conducted at ABC Medical College and Hospital, a tertiary care teaching institution. The study duration was one year, from June 2024 to June 2025.

Study Population and Sample Size

A total of 100 consecutive patients diagnosed with hypertensive emergency and admitted to the emergency department/medical intensive care unit during the study period were included.

Definition of Hypertensive Emergency

Hypertensive emergency was defined as a severe elevation of blood pressure (systolic ≥180 mmHg and/or diastolic ≥120 mmHg) associated with acute target organ damage, including but not limited to the brain, heart, kidneys, retina, or vascular system.

Inclusion Criteria

- Patients aged ≥18 years
- Newly diagnosed or known cases of hypertension presenting with hypertensive emergency
- Patients providing informed consent (or consent from legally authorised representatives)

Exclusion Criteria

- Hypertensive urgency without evidence of target organ damage
- Pregnancy-related hypertensive disorders
- Patients with chronic end-stage renal disease on dialysis
- Patients with incomplete laboratory or outcome data

Data Collection

After enrollment, detailed clinical history, demographic data, and blood pressure measurements were recorded using a structured proforma. Laboratory investigations were performed at admission as part of routine evaluation and included:

- Complete blood count
- Serum electrolytes (sodium, potassium)
- Renal function tests (serum urea and creatinine)
- Liver function tests
- Random blood glucose
- Urinalysis (proteinuria and microscopic examination)
- Cardiac biomarkers (where clinically indicated)

Additional investigations, such as electrocardiography, chest radiography, echocardiography, CT/MRI brain, and fundoscopic examination, were performed based on clinical presentation to assess target organ involvement.

Outcome Measures

The primary outcome was short-term clinical outcome during hospital stay, categorised as:

- Survival with clinical improvement

- Requirement of intensive care support or mechanical ventilation
- In-hospital mortality

Secondary outcomes included duration of hospital stay and development of complications such as acute kidney injury, acute coronary syndrome, or stroke.

Statistical Analysis

Data were entered into Microsoft Excel and analysed using SPSS software (version 26). Continuous variables were expressed as mean ± standard deviation, while categorical variables were expressed as frequencies and percentages. Associations between laboratory abnormalities and short-term outcomes were assessed using the Chi-square test or Fisher's exact test for categorical variables and Student's t-test for continuous variables. A p-value <0.05 was considered statistically significant.

Ethical Considerations

The study was conducted after obtaining approval from the Institutional Ethics Committee of Yadagiri Institute of Medical Sciences. Written informed consent was obtained from all participants or their legally authorised representatives before inclusion in the study.

RESULTS AND OBSERVATIONS

A total of 100 patients diagnosed with hypertensive emergency were included in the study conducted from June 2024 to June 2025 at Yadagiri Institute of Medical Sciences

Table 1. Demographic Characteristics of Study Participants (n = 100)

Characteristic	Category	Number	Percentage (%)
Age (years)	<40	12	12
	40–49	18	18
	50–59	28	28
	60–69	26	26
	≥70	16	16
	Mean ± SD	56.8 ± 12.4	—
Gender	Male	62	62
	Female	38	38

Table 2. Baseline Clinical Characteristics

Variable	Number	Percentage (%)
Known hypertension	68	68
Newly diagnosed hypertension	32	32
Diabetes mellitus	41	41
Chronic kidney disease (non-dialysis)	18	18
History of smoking	29	29
History of alcohol intake	24	24

Table 3. Target Organ Damage at Presentation

Target Organ Involvement	Number	Percentage (%)
Central nervous system	36	36
Cardiovascular system	28	28
Renal system	44	44
Retina	22	22
Multiple organ involvement	31	31

Table 4. Complete Blood Count Abnormalities

Parameter	Abnormality	Number	Percentage (%)
Hemoglobin	Anemia	34	34
Total leukocyte count	Leukocytosis	27	27
Platelet count	Thrombocytopenia	11	11

Table 5. Serum Electrolyte Abnormalities

Electrolyte	Abnormality	Number	Percentage (%)
Sodium	Hyponatremia	21	21
Potassium	Hypokalemia	19	19
Potassium	Hyperkalemia	14	14

Table 6. Renal Function Test Abnormalities

Parameter	Abnormality	Number	Percentage (%)
Serum urea	Elevated	43	43
Serum creatinine	Elevated	46	46
Acute kidney injury	Present	44	44

Table 7. Liver Function Test Abnormalities

Parameter	Abnormality	Number	Percentage (%)
Serum bilirubin	Elevated	18	18
AST/ALT	Elevated	22	22
Alkaline phosphatase	Elevated	16	16

Table 8. Glycemic Status

Parameter	Finding	Number	Percentage (%)
Random blood glucose >200 mg/Dl	Hyperglycemia	39	39
Known diabetes mellitus	—	41	41

Table 9. Urinalysis Findings

Parameter	Finding	Number	Percentage (%)
Proteinuria	Present	42	42
Microscopic hematuria	Present	24	24
Urinary casts	Present	19	19

Table 10. Cardiac Biomarkers (Performed in 52 Patients)

Biomarker	Abnormality	Number	Percentage (%)
Troponin I/T	Elevated	17	32.7
CK-MB	Elevated	14	26.9

Table 11. Additional Investigations Showing Target Organ Damage

Investigation	Abnormal Finding	Number	Percentage (%)
ECG	LVH / ischemic changes	46	46
Chest X-ray	Cardiomegaly / pulmonary oedema	29	29
Echocardiography	LVH / systolic dysfunction	34	34
CT/MRI brain	Stroke/haemorrhage	36	36
Fundoscopy	Grade III/IV retinopathy	22	22

OUTCOME MEASURES

Table 12. Short-Term Clinical Outcomes

Outcome	Number	Percentage (%)
Improved and discharged	76	76
ICU admission	38	38
Mechanical ventilation	17	17
Complications during hospital stay	33	33
In-hospital mortality	8	8
Mean hospital stay	6.4 ± 2.1 days	

Table 13. Association of Laboratory Abnormalities with Mortality and ICU Admission

Laboratory Parameter	Outcome	Number	Percentage (%)	p-value
Serum Creatinine	Survivors (n=92)	Normal: 50 / Elevated: 42	—	0.003*
	Deaths (n=8)	Normal: 1 / Elevated: 7	—	
Multiple Laboratory Abnormalities	ICU Required	≤1 abnormality: 9 / ≥2 abnormalities: 29	—	0.001*
	No ICU	≤1 abnormality: 37 / ≥2 abnormalities: 25	—	

*Statistically significant ($p<0.05$)

DISCUSSION

In this prospective observational study of 100 patients presenting with hypertensive emergency, we observed a high prevalence of laboratory abnormalities across multiple organ systems, which were significantly associated with short-term clinical outcomes. The mean age of the study population was 56.8 ± 12.4 years, and males constituted 62% of patients, reflecting the higher risk of hypertensive emergencies in middle-aged and older adults, especially males, consistent with previous reports [1,2].

Most patients (68%) had previously known hypertension, while 32% were newly diagnosed, highlighting that both undiagnosed and poorly controlled hypertension contribute substantially to hypertensive emergencies [3]. Comorbid conditions such as diabetes mellitus (41%) and chronic kidney disease (18%) were common, supporting the notion that these conditions exacerbate vascular damage and increase susceptibility to acute blood pressure–related target organ injury [4,5].

Renal involvement was the most frequently observed target organ damage in our cohort (44%), followed by central nervous system involvement (36%) and cardiovascular system involvement (28%). Multiple organ involvement was noted in 31% of patients. These findings are consistent with the known predilection of hypertensive emergencies to affect high-flow organs, particularly the kidneys and brain, due to microvascular injury and autoregulatory failure [6,7].

Laboratory evaluation revealed anemia in 34% of patients, leukocytosis in 27%, and thrombocytopenia in 11%. Electrolyte disturbances were also common, with hyponatremia in 21% and potassium abnormalities (hypokalemia 19%, hyperkalemia 14%), emphasizing the importance of baseline metabolic assessment in hypertensive emergencies [8]. Elevated renal function markers were frequent, with 43% showing raised serum urea and 46% elevated creatinine, and 44% diagnosed with acute kidney injury. These findings underscore the vulnerability of renal function to abrupt elevations in blood pressure and the role of laboratory monitoring in early identification and management [9,10].

Hepatic involvement, indicated by elevated liver enzymes or bilirubin, was observed in 16–22% of patients, reflecting secondary end-organ stress rather than primary liver pathology [11]. Hyperglycemia was present in 39% of patients, and 41% had known diabetes, which has been associated with increased endothelial dysfunction and adverse outcomes in hypertensive crises [12]. Proteinuria (42%) and microscopic hematuria (24%) further corroborated the renal insult observed in this population. Elevated cardiac biomarkers (Troponin I/T 32.7%, CK-MB 26.9%) and echocardiographic findings of LVH or systolic dysfunction in 34% of patients highlight the myocardial stress induced by acute blood pressure surges [13,14].

Short-term outcomes revealed that 76% of patients improved and were discharged, while 38% required ICU admission, 17% required mechanical ventilation, and 8% died during hospitalisation. Notably, elevated serum creatinine and the presence of multiple laboratory abnormalities were significantly associated with ICU admission and mortality ($p=0.003$ and $p=0.001$, respectively), indicating that renal dysfunction and systemic laboratory derangements are strong predictors of poor outcomes [15,16]. These observations align with previous studies demonstrating that renal impairment, elevated cardiac biomarkers, and metabolic disturbances are independent predictors of morbidity and mortality in hypertensive emergencies [17,18].

The study highlights several key implications for clinical practice. First, early and comprehensive laboratory evaluation upon presentation is critical for risk stratification and targeted management. Second, patients with multiple laboratory abnormalities should be closely monitored in high-dependency or intensive care settings, as they are at greater risk of complications and adverse outcomes. Third, our findings reinforce the need for effective blood pressure control and regular follow-up in hypertensive patients, particularly those with comorbid conditions such as diabetes and chronic kidney disease, to prevent progression to hypertensive emergencies [19,20].

However, several limitations should be acknowledged. This study was conducted at a single tertiary care centre, which may limit generalizability. The sample size was modest, and certain investigations, such as cardiac biomarkers, were performed selectively based on clinical indications, potentially introducing selection bias. Additionally, long-term outcomes beyond hospitalisation were not assessed, limiting understanding of the chronic impact of laboratory abnormalities on morbidity and mortality. Future multicenter studies with larger sample sizes and follow-up data are warranted to validate and expand upon these findings.

CONCLUSION

Hypertensive emergency is associated with significant laboratory abnormalities affecting renal, cardiac, hepatic, haematological, and metabolic systems. Elevated serum creatinine and the presence of multiple laboratory derangements were strongly associated with ICU admission and in-hospital mortality, highlighting their prognostic value. Comprehensive laboratory evaluation at the time of presentation is crucial for early risk stratification, guiding management decisions, and improving short-term outcomes. Early identification and prompt intervention in high-risk patients can potentially reduce complications, the need for intensive care, and mortality in hypertensive emergencies.

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