

A Correlation Study on Serum Biomarker and Biochemical Parameters in Acute Heart Failure with Duration of Hospital Stay among Patients with Acute Heart Failure

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ABSTRACT

Aims and background: Cardiac biomarker like serum N-terminal pro-B-type natriuretic peptide (NT-proBNP) has revolutionized the diagnosis of heart failure and also plays an important role in prognosticating heart failure. Limited data exist in correlating the level of cardiac biomarkers and biochemical parameters with duration of hospital stay in patients with clinical evidence of acute heart failure.

Materials and methods: Our study comprised of 200 inpatients diagnosed with acute heart failure both men and women using convenience sampling method. It is a prospective observational study. The inpatients were from the Department of Cardiology of Shridevi Institute of Medical Sciences and Research Hospital, Tumkur, Karnataka, India. The duration of study was from April 2022 to Sep 2023.

Results: There was a positive correlation observed in serum NT-proBNP and potassium values with the duration of stay in the inpatients with acute heart failure ($p < 0.05$). Serum NT-proBNP was highly significant over a week stay at hospital with a median value of 4784 pg/mL ($p < 0.05$).

Conclusion: The current study highlights the role of serum NT-proBNP and potassium ion as biomarker as well as prognostic factor in the morbidity of acute heart failure in patients.

Clinical significance: The estimation of their serum levels may help in early prediction of duration of stay in hospital.

Keywords: Acute heart failure, Duration of stay, In-patients, N-terminal pro-B-type natriuretic peptide, Prospective observational study.

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INTRODUCTION

Heart failure is an ailment which is a consequence of functional or structural cardiac conditions that damage the capability of the heart to support the physiological movement.¹ It is a universal pandemic as it disrupts around 26 million people across the globe.²

Biomarkers indicate the existence, grade, and prognosis of heart failure.³ Cardiac biomarker like serum N-terminal pro-B-type natriuretic peptide (NT-proBNP) has revolutionized the heart failure analysis and is a vital protagonist in prognosticating heart failure.⁴

Limited data exist in correlating the level of cardiac biomarkers and biochemical parameters with duration of stay of patients in hospital with clinical evidence of acute heart failure. Hence, the present study is being taken up to correlate the values of NT-proBNP and serum electrolytes with duration of hospital stay and mortality during the course of treatment and follow-up.

The burden of heart failure in India is high, nevertheless reliable statistics is deficient as of scarce observation classifications.⁵ The prevalence of heart failure is on an increasing trend in India as there is upsurge in the risk factors of cardiovascular diseases. There will be substantial financial burden due to the prolonged stay of hospital after acute heart failure and connected with morbidity after treatment.⁶

Several reactions like inflammation, oxidative stress, and myocyte injury drive the progression of heart failure.⁷ The last decade as seen the introduction of estimation of various biomarkers in diagnosing heart failure.⁸

Assessing prognosis of heart failure can be done by estimating multiple biomarkers.⁷ Initial evaluation of NT-proBNP is one of the extensively used diagnostic tool in heart failure patients.⁸

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Several studies have focused on prognostic role of natriuretic peptides across different periods of follow-up.⁹

Hence, there is a need to correlate the values NT-proBNP and serum electrolytes with duration of hospital stay during the course of treatment and follow-up.

AIMS AND BACKGROUND

- Estimation of serum NT-proBNP and serum electrolytes in inpatients diagnosed with acute heart failure.
- Evaluation of the association between serum biomarker levels and electrolytes level with the duration of stay in hospital during the course of treatment and follow-up.

MATERIALS AND METHODS

Our study comprised of 200 inpatients diagnosed with acute heart failure by cardiologist. Both men and women were selected using convenience sampling method. It is a prospective observational study. The in patients were from the Department of Cardiology of SIMS & RH, Tumkur, Karnataka, India. The duration of study was from April 2022 to Sep 2023.

Informed consent from subjects included in the study and Institutional ethical clearance (Ref SIMSRH/IEC/22-23/187) was gained.

Source of data was Lab records and patient data collected from Hospital record.

Inclusion Norms

Patients in the age group 30–70 years. All patients were in-patients who were newly diagnosed with acute heart failure (both male and female).

Exclusion Norms

Patients suffering from acute coronary syndrome omitted.

Biochemistry lab investigation data and patient data collected from acute heart failure in-patients of Shridevi Institute of Medical Sciences and Research Hospital formed the method of collection of data.

Blood Collection

From median cubital/basilic vein 5 mL venous blood was collected under strict aseptic precautions into BD red capped plain Vacutainers. The collected blood was allowed to stand for 10 min at room temperature for clotting. Using Remi8RC centrifuge, the clotted blood vacutainers were centrifuged at 3000 rpm for 10 minutes. On the same day, serum parameters were assayed.

The NT-proBNP was quantified by enzyme-linked fluorescent assay (ELFA) technique utilizing MINIVIDAS l'Étoile, France instrument. The VIDAS NT-proBNP2 measurement range is from 15 to 25,000 pg/mL. Serum electrolytes were estimated by ISE method by instrument Sensa Core, Hyderabad, Telangana, India.

Statistical Analysis

Variables like NT-proBNP, Na, K, and Cl were expressed in mean, median, standard deviation and interquartile range. Correlation of duration of stay with NT-proBNP, Sodium ion (Na⁺), Potassium ion (K⁺), and Chloride ion (Cl⁻) was calculated using Spearman's rank correlation coefficient. The median differences in parameters between different groups of duration of stay was compared using Kruskal–Wallis test. The *p*-value < 0.05 was considered statistically significant. The SPSS (V-25) was used for the analysis.

RESULTS

The study consisted 81 (40.5%) female patients and 119 (59.5%) male patients with mean age of 55.60 ± 15.52 years (Table 1). Statistically significant intensification of serum NT-proBNP and potassium was observed in comparison with the hospital stay time in patients with acute heart failure (Tables 2 to 4 and Fig. 1). The median serum NT-proBNP levels at 1–2 days was 1002 pg/mL and it significantly prognoses to 4785 pg/mL between 6 and 7 days and it declined after 7 days to 2975.5 pg/mL. There were no significant differences observed in serum levels of sodium and chloride (Tables 2 to 4 and Fig. 2). Duration of stay had positive correlation of 0.251 and 0.209, respectively, with serum NT-proBNP and potassium (Fig. 1).

Table 1: Demographic table

Variables	Frequency
Sex	
Male	119 (59.5%)
Female	81 (40.5%)
Age in years (Mean ± Std. deviation)	55.60 ± 15.52
Total	200

Table 2: Study parameter outcomes

Parameters	Mean ± SD	Median (IQR)	Min	Max
NT-proBNP	6037.4 ± 7624.4	2884.0 (739.0–8482.0)	23	28000
Na	137.6 ± 9.1	140.0 (131.0–146.0)	116	156
K	5.1 ± 0.7	5.0 (5.0–6.0)	3	7
Cl	100.8 ± 7.5	98.0 (94.0–107.0)	85	121

IQR, interquartile range

Table 3: Correlation of duration of stay with parameters

Parameters	Correlation	<i>p</i> -value
NT-proBNP	0.251**	<0.001
Na	0.005	0.942
K	0.209**	0.003
Cl	–0.029	0.686

**Statistically significant

Table 4: Comparison of parameters with duration of stay

Parameters	Duration of stay (Median, IQR)				<i>p</i> -value
	1–2 days	3–4 days	5–6 days	≥7 days	
NT-proBNP pg/mL	1002.0 (281.3–3574.3)	2502.5 (947.8–6657.3)	4784.0 (1521.0–17705.0)	2975.5 (923.5–14463.3)	0.002*
Na ⁺ mmol/L	140.0 (132.0–146.0)	139.5 (131.0–146.0)	140.0 (124.5–146.0)	141.0 (136.0–146.0)	0.483
K ⁺ mmol/L	5.0 (4.0–5.0)	5.0 (5.0–5.0)	5.0 (5.0–6.0)	5.0 (5.0–6.0)	0.006*
Cl ⁻ mmol/L	100.0 (94.0–106.8)	99.0 (94.0–107.0)	98.0 (94.0–107.0)	95.5 (94.0–105.8)	0.771

*Statistically significant at *p* < 0.05. Kruskal–Wallis test applied

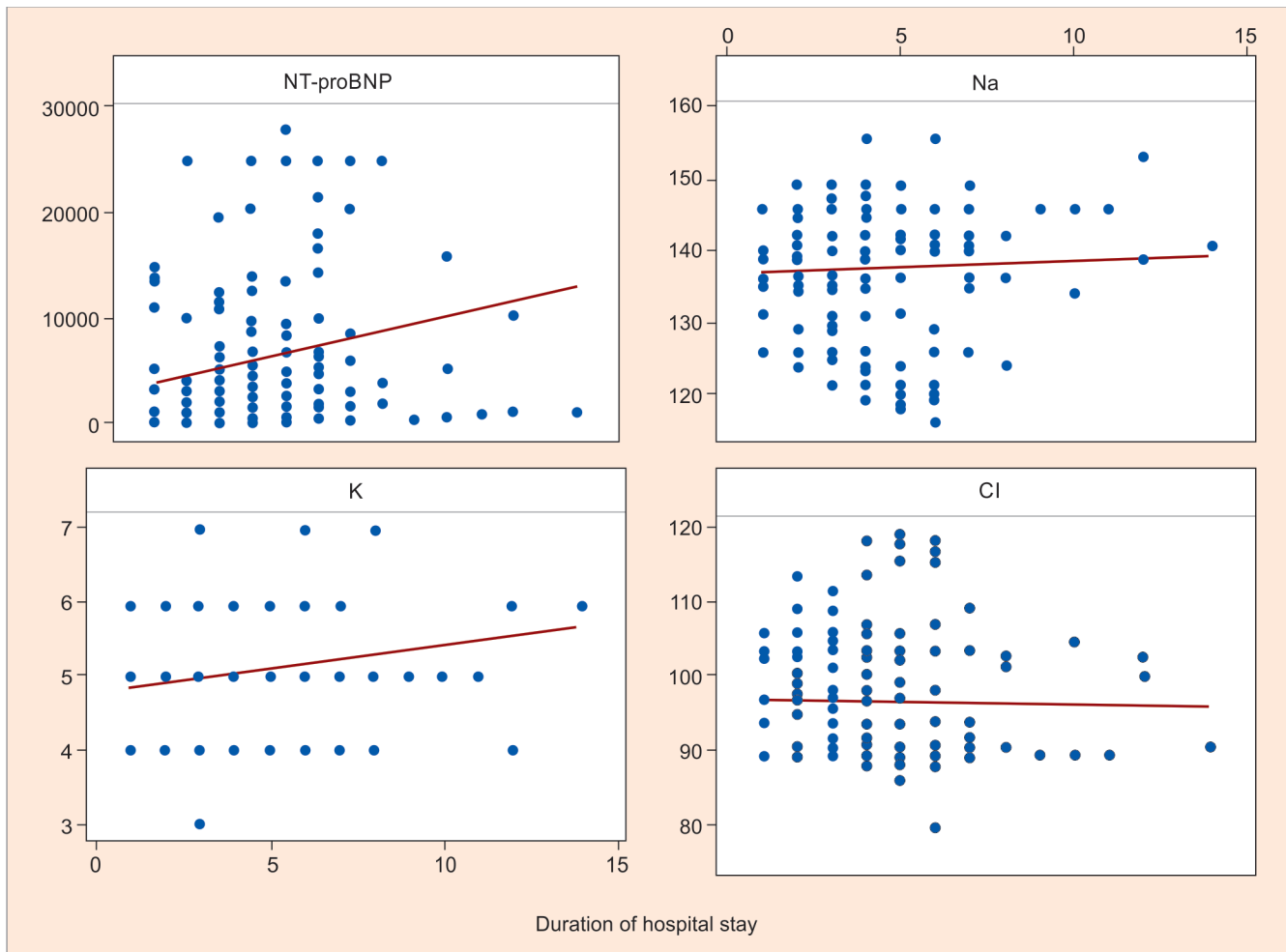


Fig. 1: Correlation of duration of stay with parameters

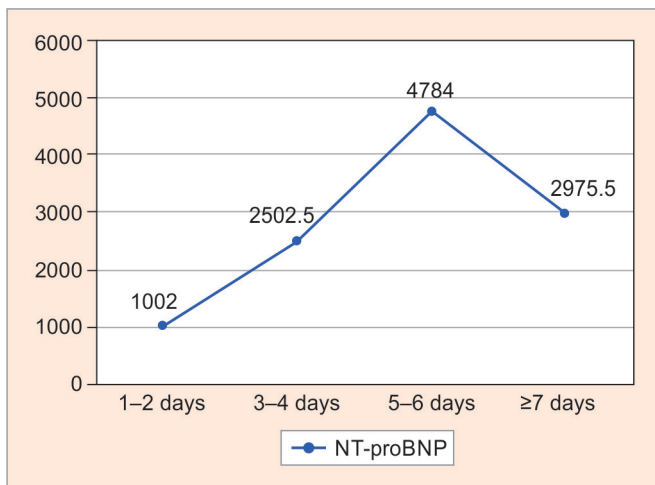


Fig. 2: Relationship of NT-proBNP with duration of stay (median values)

DISCUSSION

Serum NT-proBNP has altered the diagnosis of heart failure as well it plays a vital role in foreseeing heart failure. Elevations in NT-proBNP are known to predict morbidity and mortality in patients.¹⁰

Our study demonstrates significant spiraling of serum NT-proBNP in comparison with the duration of stay in the inpatients with acute heart failure. The NT-proBNP predicts adverse outcomes in patients with acute heart failure.¹¹

Serum potassium ion is an indicator of renal functioning. In the current study, there is evidence of significant high levels in comparison with the duration of stay in the inpatients with acute heart failure. Stepping up of serum potassium ions along with stay of hospital is an indicator of deteriorating renal function.¹²

Biomarkers are regularly monitored parameters that indicate a process taking place in an individual.¹² The NT-proBNP biomarker and electrolytes were estimated to evaluate 7 days admission and morbidity results post treatment. Although, NT-proBNP is a well-established prognostic marker in adult population, the clinical application of NT-proBNP to foresee the time of hospital stay is novel.¹³

The serum biomarker NT-proBNP not only useful in adult population, but also can be used in pediatric cardiac care as well.⁶

Inflammatory regulation and autoimmune response of the body are indicated by raised biomarker levels.^{14,15} The NT-proBNP is a cardiac hormone. The NT-proBNP reveals degree of cardiac stretch, which can be used for treating of heart failure and to envisage consequences in patients with hereditary heart disease and pulmonary hypertension.¹⁶

Increased levels of biomarkers indicate additional cardiac impairment resulting in acute heart failure as well approximating extended in-hospital extent of stay. This study helps in calculating appropriate time of treatment and additional changes by physicians. Hence, these cardiac biomarkers can be valuable tools for risk stratification and better patient care with an aim of enhancing post therapeutic results.

The results of present study emphasize the role of serum NT-proBNP and potassium ion as biomarker as well as prognostic factor in the morbidity of acute heart failure in patients. The estimation of their serum levels may help in early prediction of duration of stay in hospital. The above simple and affordable estimations can lead on to additional sophisticated investigations. Supplementary studies are essential to look at a larger perspective.

Limitations

There are many limitations in the current study. The prospective study in a single center with a small sample size confines the broad application of the results of this effort. The above simple and affordable estimations can lead on to additional sophisticated investigations. Supplementary studies are essential to look at a larger perspective.

CONCLUSION

The current study highlights the role of serum NT-proBNP and potassium ion as biomarker as well as prognostic factor in the morbidity of acute heart failure in patients. The estimation of serum levels of them has a probable role in duration of stay in hospital.

The capability to foresee adverse consequences from acute heart failure clinical data has significant inferences for detecting patients who may benefit from early interventions. These biomarkers can be beneficial tools for risk determination and enhanced patient care supervision. Further research on the efficacy of cardiac biomarker levels as an indicator for latent heart failure difficulties will prepare surgeons with information necessary to decrease adverse outcomes.

Clinical Significance

Serum NT-proBNP and potassium ion act as biomarker as well as prognostic factor in the morbidity of acute heart failure in patients. These estimations are simple, reliable, and affordable which can be deployed at peripheral level also.

The estimation of their serum levels may help in early prediction of duration of stay in hospital. This will prepare both patient relatives and hospital for optimal utilization of resources.

Ethical Approval

The Institutional ethical clearance (Ref SIMSRH/IEC/22-23/187) was gained.

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