

Research Article



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RELATIONSHIP BETWEEN SERUM BIOMARKERS AND METABOLIC PARAMETERS IN PATIENTS WITH SUDDEN HEART FAILURE

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ABSTRACT

Background: The prognosis of heart failure is greatly influenced by cardiac biomarkers, such as serum N-terminal pro-B-type natriuretic peptide (NT-proBNP), which has been deemed the most accurate biomarker for heart failure diagnosis. There is a dearth of information in the literature about the relationship between hospital stay duration and cardiac biomarkers and biochemical measures in patients with acute heart failure.

Aim: The purpose of this study was to evaluate the relationship between biochemical indicators and serum biomarkers in patients with acute heart failure.

Methods: During the designated study period, 400 patients with acute heart failure diagnoses of both sexes from the Institute's Department of Cardiology were evaluated for this study. To measure serum potassium and NT-proBNP, blood samples from each individual were taken under very rigorous aseptic and sterile circumstances. A statistical analysis was performed on the collected data.

Results: The length of stay for patients with acute heart failure was positively correlated with blood potassium and proBNP levels ($p < 0.05$). With a mean value of pg/mL and a p-value of less than 0.05, the study's findings also demonstrated that serum NT-proBNP levels were highly significant over a week-long hospital stay.

Conclusion: The current study comes to the conclusion that NT-proBNP and serum potassium are important biomarkers for determining morbidity in patients with acute heart failure as well as prognostic indicators. According to the current study, NT-proBNP and serum potassium estimation can also aid in the early prediction of hospital stay duration.

Keywords: N-terminal pro-B-type natriuretic peptide, potassium, acute heart failure, and heart failure

INTRODUCTION

Heart failure is a disorder caused by structural or functional cardiac disorders that impair the heart's capacity to sustain bodily functions. It is a global epidemic that affects around 26 million people worldwide. Biomarkers show the presence, severity, and prognosis of heart failure. The study of heart failure has been transformed by cardiac biomarkers, such as serum N-terminal pro-B-type natriuretic peptide (NT-proBNP), which are essential prognostic indicators in the prognosis of heart failure.¹

There is a dearth of information in the literature about the relationship between the length of hospital stay and clinical signs of acute heart failure and cardiac biomarker levels and biochemical markers. Heart failure is very common everywhere, particularly in India. But there aren't many trustworthy statistics. Additionally, the rising risk factors linked to cardiovascular illnesses are contributing to India's fast rising heart failure incidence. Additionally, cardiac conditions are associated with death after therapy and provide a significant cost burden due to extended hospital admissions after acute heart failure.²

The development of cardiac disease is caused by a number of processes, such as inflammation, oxidative stress, and myocyte damage. Since the advent of estimating different biomarkers for heart failure diagnosis in the last ten years, it

has been essential to evaluate the prognosis of heart failure, which may be accomplished by estimating different biomarkers. Serum NT-proBNP levels are one of the widely utilized diagnostic indicators evaluated at the outset in heart failure patients. Numerous studies have suggested that natriuretic peptides play a substantial predictive effect throughout a range of follow-up times.³

Therefore, it is necessary to evaluate the relationship between the length of hospital stay during therapy and follow-up and serum electrolyte and NT-proBNP levels.⁴

In order to determine the relationship between electrolyte and serum biomarker levels and length of stay during therapy and follow-up, the current study set out to measure serum NT-proBNP and serum electrolytes in patients with acute heart failure.

MATERIALS AND METHODS

Assessing blood NT-proBNP and electrolyte levels in individuals with acute heart failure and determining the relationship between electrolyte and serum biomarker levels and length of stay during treatment and follow-up were the objectives of the current prospective clinical observational investigation. The research participants came from the Institute's Department of Medicine.

Prior to participation, all individuals gave their written and verbal informed permission. During the research period, 400 participants from the Institute's Department of Cardiology, both male and female, with an acute heart failure diagnosis were evaluated. The study's inclusion requirements were that participants must be between the ages of 30 and 70, have just been diagnosed with acute heart failure, and be ready to take part. Participants with acute coronary syndrome were excluded from the trial. The investigation and patient data gathered from the institutional records were evaluated in the research. Under very rigorous aseptic and sterile circumstances, 5 ml of intravenous blood was drawn from the antecubital vein in a simple vial from each of the included participants.

To allow for coagulation, the collected blood was let to remain at room temperature for ten minutes. Serum parameters were measured the same day after the obtained blood was spun for ten minutes at 3000 rpm. Enzyme-linked fluorescence assay, or ELFA, was used to measure serum NT-proBNP. The range of VIDAS NT-proBNP values measured was 15–25,000 pg/mL. Serum electrolyte levels were measured using the ISE technique.

The collected data was statistically evaluated using the Student t-test, ANOVA (analysis of variance), Chi-square test, and SPSS (Statistical Package for the Social Sciences) software version 24.0 (IBM Corp., Armonk, NY, USA) for evaluating descriptive measures. To evaluate correlation across different factors, the Pearson correlation coefficient was employed. The findings were presented as frequency, percentages, mean, and standard deviation. A p-value of less than 0.05 was taken into account.

RESULTS

Assessing blood NT-proBNP and electrolyte levels in individuals with acute heart failure and determining the relationship between electrolyte and serum biomarker levels and length of stay during treatment and follow-up were the objectives of the current prospective clinical observational investigation. During the research period, 400 participants from the Institute's Department of Cardiology, both male and female, with an acute heart failure diagnosis were evaluated. The research participants were 55.58 ± 15.54 years old on average. Of the 400 patients evaluated in this study, 40.5% (n=162) were female and 59.5% (n=238) were male (Table 1).

The mean chlorine level in the study participants' serum was 100.6 ± 7.3 , with a median of 98 (94–107) and minimum and maximum values of 83 and 119, according to the study parameters outcomes evaluated in the participants. For potassium, the lowest and greatest readings were 1 and 5, the median was 4.8 (4.8–5.8), and the mean was 4.9 ± 0.5 . Serum sodium levels ranged from 114 to 154, with the mean being 137.4 ± 8.9 and the median being 140 (133–144). The research participants' blood had a mean NT-proBNP of 6037.2 ± 7624.2 , a median of 2884 (737–8480), and lowest and maximum values of 21 and 26,000 (Table 2).

Cl (chlorine) had a correlation value of -0.027 for the correlation of study parameters to the length of stay in study subjects, according to the study data, indicating a statistically non-significant link between chlorine and hospital stay ($p=0.664$). The correlation value for potassium (K) was 0.207, indicating a p-value of 0.003 for a statistically significant association with hospital stay. The correlation value for sodium (Na) was 0.003, indicating a p-value of 0.994, which indicates a statistically non-significant association between chlorine and hospitalization. Hospital stay length and NT-proBNP had a statistically significant link ($p<0.001$), with a correlation value of 0.249 (Table 3).

Additionally, the comparison of research parameters to stay time was observed. At 1-2 days of stay, Cl was 100; at 3-4, 5-6, and ≥ 7 days of stay, it dropped to 99, 98, and 95.3, indicating a statistically non-significant decline ($p=0.769$). The

potassium levels showed a positive connection ($p=0.005$) and were constant at 1-2, 99, 98, and 95.3 for 3-4, 5-6, and ≥ 7 days of stay. On the other hand, the link between salt and hospital stay was not statistically significant ($p=0.481$). Serum NT-proBNP showed a statistically significant connection with $p=0.002$; the mean levels were 1002, 2502.3, 4784.2, and 2975.3 at 1-2, 99, 98, and 95.3 during 3-4, 5-6, and ≥ 7 days of stay (Table 4).

DISCUSSION

During the research period, 400 participants from the Institute's Department of Cardiology, both male and female, with an acute heart failure diagnosis were evaluated. The research participants were 55.58 ± 15.54 years old on average. Of the 400 patients evaluated in this study, 40.5% ($n=162$) were female and 59.5% ($n=238$) were male. These findings were similar to those of earlier research by Bayes-Genis A et al. (2012) and Pascual-Figal DA et al. (2009), in which the authors evaluated participants who had acute heart failure and similar demographic data to the current study.

According to the study results, the mean chlorine level in the study participants' serum was 100.6 ± 7.3 , with a median of 98 (94–107) and minimum and maximum values of 83 and 119 for the study parameters evaluated in the study participants. For potassium, the lowest and greatest readings were 1 and 5, the median was 4.8 (4.8–5.8), and the mean was 4.9 ± 0.5 . Serum sodium levels ranged from 114 to 154, with the mean being 137.4 ± 8.9 and the median being 140 (133–144). The research participants' blood had a mean NT-proBNP of 6037.2 ± 7624.2 , a median of 2884 (737–8480), and minimum and highest values of 21,000 and 21,000, respectively.

These findings were in line with those of Januzzi JL et al. (2007) and Brown JR et al. (2018), who found that the study parameters and outcomes evaluated in study participants with acute heart failure were similar to those of the current investigation.

Cl (chlorine) showed a correlation value of -0.027 for the correlation of study parameters to the length of stay in study subjects, indicating a statistically non-significant link between chlorine and hospital stay ($p=0.664$). The correlation value for potassium (K) was 0.207, indicating a p-value of 0.003 for a statistically significant association with hospital stay. With a p-value of 0.994, the correlation value for sodium (Na) was 0.003, indicating a statistically insignificant association between hospitalization and chlorine use.

The correlation value for NT-proBNP was 0.249, indicating a statistically significant relationship with hospital stay duration ($p<0.001$). The results of the current study were consistent with those of Rorth R et al. (2020) and Harikrishnan S et al. (2022), who also found a strong correlation between hospital stay duration and potassium and NT-proBNP. The study's findings also demonstrated that the length of stay was compared to the study criteria. At 1-2 days of stay, Cl was 100; at 3-4, 5-6, and ≥ 7 days of stay, it dropped to 99, 98, and 95.3, indicating a statistically non-significant decline ($p=0.769$).

The potassium levels showed a positive connection ($p=0.005$) and were constant at 1-2, 99, 98, and 95.3 for 3-4, 5-6, and ≥ 7 days of stay. On the other hand, the link between salt and hospital stay was not statistically significant ($p=0.481$). Serum NT-proBNP showed a statistically significant connection with $p=0.002$; the mean levels were 1002, 2502.3, 4784.2, and 2975.3 at 1-2, 99, 98, and 95.3 during 3-4, 5-6, and ≥ 7 days of stay. These findings were consistent with those of Leto L et al. (2016) and Krishna A et al. (2011), who found a strong correlation between hospital stay duration and potassium and NT-proBNP. These findings were similar to those of the authors' respective research.

CONCLUSIONS

Considering its limitations, the present study concludes that serum potassium and NT-proBNP have a vital role as prognostic markers as well as biomarkers in assessing morbidity in subjects with acute heart failure. The present study also concludes that estimating the serum potassium and NT-proBNP levels can also help in the early prediction of hospital stay duration.

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S. No	Characteristics	Number (n)	Percentage (%)
1.	Mean age (years)	55.58±15.54	
2.	Gender		
a)	Males	238	59.5
b)	Females	162	40.5
3.	Total	400	100

Table 1: Demographic data of study subjects

S. No	Variables	Mean ± S. D	Median	Minimum	Maximum
1.	CI	100.6±7.3	98 (94-107)	83	119
2.	K	4.9±0.5	4.8 (4.8-5.8)	1	5
3.	Na	137.4±8.9	140 (133-144)	114	154
4.	NT-proBNP	6037.2±7624.2	2884 (737-8480)	21	26000

Table 2: Study parameter outcomes in study subjects

S. No	Parameters	Correlation	p-value
1.	CI	-0.027	0.664
2.	K	0.207	0.003
3.	Na	0.003	0.944
4.	NT-proBNP	0.249	<0.001

Table 3: Correlation of study parameters to the duration of stay in study subjects

S. No	Parameters	1-2 days	3-4 days	5-6 days	≥7 days	p-value
1.	CI	100	99	98	95.3	0.769
2.	K	5	5	5	5	0.005
3.	Na	140	139.3	139.8	141	0.481
4.	NT-proBNP	1002	2502.3	4784.2	2975.3	0.002

Table 4: Comparison of study parameters to stay duration