Blood Urea Nitrogen: Creatinine ratio at admission to predict hospital stay duration in decompensated heart failure patients at a tertiary care hospital in rural Puducherry, India.

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Abstract:

As the prevalence of heart failure(HF) is increasing, so is the incidence of acute decompensated heart failure(ADHF) leading to hospital admission. With improvements in treatment for ADHF, more people are surviving the ordeal of ADHF and the focus has now shifted to the duration of stay in hospital, with patients eager to go home and resume their daily activities. in literature there is dearth of markers predicting the hospital stay duration, which has traditionally been sodium levels in sodium. Recently BUN: Creatinine ratio (BCR)is garnering significance as prognostic predictor in heart failure.

Method: We did an observational study to study the effect of BCR at admission on the duration of hospital stay in HF patients.

Results: BCR is not significantly associated with duration of hospital stay (p= 0.595), but alcoholism (p=0.026) and blood urea nitrogen (p= 0.040) were significantly associated with the duration of hospital stay in HF

Conclusion: It is wise to take measures to lower BUN levels in hospitalised patients with HF. Limited consumption or abstinence from alcohol after discharge from hospital is still up for debate. Further studies must be done to assess mortality and readmission rates in alcoholics with HF.

Introduction:

Heart failure (HF) is easy to understand as we encounter many cases in day-to-day practise, but defining it quite difficult, it is currently defined as a complex clinical syndrome that results from any structural or functional impairment of ventricular filling or ejection of blood leading to cardinal manifestations of dyspnoea, fatigue, and fluid retention [3]. It can be a chronic condition or have an acute presentation called acute decompensated heart failure (ADHF). As enumerated in the definition of HF, reduced output of heart can cause renin-angiotensin-aldosterone-system (RAAS) activation in kidney, similar response is seen in the sympathetic system.

But these actions are partially compensated by sodium secretary (natriuretic) property of Pro-Natriuretic brain peptide (pro-BNP), which is produced by the walls of chambers of heart. Pro-BNP levels can be measured in serum, and its levels are used in diagnosis of HF. Owing

to the diminished blood supply to kidney, parameters defining kidney function like serum creatinine, blood urea, blood urea nitrogen (BUN) can become deranged.

In literature BCR has been a tool to define the hydration status of patients admitting to hospital with renal ailment.

Materials and methods

This is a prospective study done, done in Vinayaka Mission's medical college and hospital, Karaikal from July 2021 to December 2022, with an aim to find correlation between duration of hospital stay and BCR in ADHF patients admitted to intensive care unit (ICU). A sample size of 40 was calculated based on incidence of heart failure from previous studies [8]. Patients aged 18 and above with heart failure as per Framingham criteria, confirmed by 2D-echocardiography and NTproBNP were included. Patients with chronic kidney disease (CKD), pregnancy, malignancy, those using diuretics, ACE inhibitors were excluded. Standard of care was given during hospital stay as per existing guidelines. Baseline anthropometric measurements, laboratory parameters collected at the time of admission to hospital are considered for correlation for with the duration of hospital stay. Statistical analysis is done by SPSS software version 29. Informed written consent was taken from the participants. The study was approved by institutional ethical committee.

Haemoglobin was measured in g/dL; platelet and WBC count measured per ml, blood urea, BUN, creatinine, random blood sugar (RBS) measured in mg/dL; serum sodium, potassium and chloride levels in mEq/L; duration of hospital stay in days.

Statistical analysis

Expression of continuous variables is done as mean, median and standard deviation was calculated. Categorical variables are shown as percentages and those showing skewed and normal distribution are analysed by Mann-Whitney U test and Student T-test respectively. Random blood sugar, platelet count, BUN/creatinine ratio showed skewed distribution and log regression was applied. Regression analysis was used to find relation between duration of hospital stay and continuous variables.

Results

The mean age of the study subjects is 61.8 years with majority males (62.5%). Past history of coronary heart disease (CAD) is very low in our study. Baseline characteristics are given in tables 1a, 1b. among the categorical variable though alcoholism was seen in only 20% of the subjects it has statistically significant association (p = 0.026) with duration of hospital stay, table 2a, 2b.

Parameter	N= 40
Male	25 (62.5%)
Female	15 (37.5%)
Diabetics	23 (57.5%)
Non-diabetics	17 (42.5)
Hypertensive	18 (45%)
Non-hypertensive	22 (55%)
CAD	13 (32.5%)
Cardiac surgery	3 (7.5%)
Alcoholic	8 (20%)
Smoker	8 (20%)

Table 1a Baseline categorical variables

	Mean	Median	Mode	Std. Deviation
Age	61.80	63.00	60[a]	13.277
Body Mass Index	24.208	24.050	25.6	3.5999
Haemoglobin	11.373	11.250	10.7[a]	2.1438
WBC count	10645.25	8995.00	4700[a]	4656.933
Serum Sodium	135.457	135.250	132.7	4.9264
Serum Potassium	3.9033	3.9650	3.90	.47962
Serum Chloride	100.738	101.050	99.6[a]	4.1745
Serum Creatinine	.900	.900	.6	.2253
Blood Urea	35.71	34.50	21[a]	9.937
Duration of Hospital Stay	6.33	6.50	4	3.083
RBS	166.33	126.50	73	105.854
Platelet	274625.00	238000.00	19900 0[a]	117285.907

Table 1b Baseline continuous variables

Age and body mass index (BMI) had no significant corelation, among biochemical parameters BUN had significant corelation (p= 0.040) and BUN/creatinine ratio had no significant corelation with duration of hospital stay among heart failure patients in this study, table 2c.

Correlation with duration of hospital stay	P value
Alcoholic	0.026
Cardiac surgery	0.127
Smoker	0.518
Mann-Whitney U test	

Table 2a Correlation of hospital stay duration with skewed categorical variables.

Correlation with duration of hospital stay	N	Mean	Std. Deviation	P value
Male	25	6.40	2.915	0.852
Female	15	6.20	3.448	
Diabetics	23	6.00	3.015	0.450
Non-diabetic	17	6.76	3.212	
Hypertensive	18	6.28	2.866	0.931
Non-hypertensive	22	6.36	3.317	
Coronary artery disease	13	5.15	2.340	0.064
Student T-test				

Table 2b Correlation of hospital stay duration with categorical variables.

BUN/creatinine ratio was divided into two groups (<20 &>20) as is generally done in renal impairment patients & the two groups have no significant difference in the duration of hospital stay, table 3.

Parameter	P value
Age	0.971
BMI	0.456
Haemoglobin	0.258
WBC count	0.131
Platelet count	0.921
Serum Sodium	0.179
Serum potassium	0.404
Serum chloride	0.336
Serum creatinine	0.226
BUN	0.040
RBS	0.798
BCR	0.595
Bivariate analysis	

Table 2c Correlation of hospital stay duration with continuous variables.

BCR	N	P value
Less than 20	29	0.131
More than 20	11	
Mann-Whitney U test		

Table 3 Correlation of hospital stay duration with BCR <20 & >20

Discussion

Though traditionally BCR is used to identify pre-renal azotemia in critically ill patients, its role in the same is challenged by recent studies [1,2]. Its role in ADHF is not fully understood. So, we did a study to determine the role of BCR in ICU patients admitted with ADHF and correlated with duration of hospital stay. BCR is found to be not significantly associated with duration of heart failure. BCR is found to be significant in defining renal impairment in HF patients, no such analysis was done in our study. A study done by Monica Dinu et.al showed significant positive effect on renal function, no such comparison is done in our study. But a BCR of <15 was found to be significant in preventing early neurological damage in acute ischemic stroke and is supported by another study done by Mona N. Bahouth et.al [3].

Other parameters like sex of the patient, age, BMI, haemoglobin level, WBC count, Platelet count, Serum Sodium, Serum potassium, Serum chloride, Serum creatinine, RBS, history of smoking, CAD, cardiac surgery had no significant correlation with duration of hospital stay in HF in our study.

But our study found a significant correlation between alcoholism and BUN values. BUN was significantly associated with mortality in a study done by Kentato Jujo et.al, who followed patients for cardiovascular events and readmissions and death for a median duration of 342 days [4], supported by Robert W. Schrier's conclusion that rise in BUN during ADHF admission is associated with increased mortality in 60 days follow-up [5]. BUN which

signifies hydration status and is influenced by increased vasopressin level found in HF (due to neurohormonal activation) and BUN is raised in this situation. This signifies that kidney function is compromised and has an additive effect on mortality of HF [4]. Decreased ejection fraction in HF causes release of vasopressin non-osmotically due to baroreceptor activation in arterial wall [5].

Though low serum sodium and chloride levels are associated with increased mortality in HF as shown by João Pedro Ferreira et.al, its significance with duration of hospital stay was not considered in the study [7]. Review by Luc Djoussé suggests that moderate alcohol consumption may be beneficial to health [9], and it may be beneficial as far as coronary artery well-being is concerned in patients with no history of CAD [10]. But in our study history of alcoholism was significantly associated with duration of hospital stay, though no attempt was made to quantify the amount of alcohol consumed per day. Sadhu JS et.al in his study came to a conclusion that limited consumption of alcohol is beneficial in older patients with HF when compared with complete abstinence [11]. Recent European society of cardiology (ESC) press release advocates on lowering safe drinking limits for patients with pre-HF [12].

Limitations of the study

This is a single centre study with a small sample size. No quantification of the amount of alcohol consumption, pack years of smoking was done.

Conclusion

BCR is not significantly associated with duration hospital stay in HF, but BUN levels and alcohol consumption history had a significant correlation. So it is wise to take measures to lower BUN levels in hospitalised patients with HF. Limited consumption or abstinence from alcohol after discharge from hospital is still up for debate. Further studies must be done to assess mortality and readmission rates in alcoholics with HF.

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