ISSN: 0975-3583,0976-2833 VOL15, ISSUE 09, 2024

Original Research Article

A Study Of Correlation Of Admission Serum Chloride Levels With Duration Of Stay In Acute Decompensated Heart Failure

Akshath A Hegde [1], Abhay Kiran P[2], Arjun Krishnakumar [3], Shivanaik Rayanaikar[4], Niranjan Gangoor [5]*

[1]Senior Resident, General Medicine, Father Muller Medical College, Mangaluru

[2]Senior Resident, General Medicine, Chamarajanagar Institute of Medical Sciences, Chamarajanagar

[3,4]Senior Resident, General Medicine, Belagavi Institute of Medical Sciences, Belagavi

[5]Senior Resident, General Medicine, S R Patil Medical College and Research Centre, Badagandi

***Corresponding author:** Dr. Niranjan Gangoor, Senior Resident, General Medicine, S R Patil medical college and research centre, Badagandi

Abstract:

Background: Heart failure is a major health problem especially with the changing lifestyle. It is one of the most common causes for hospital admission especially among the elderly population. Acute decompensated heart failure results in recurrent hospitalisation increasing the morbidity. It also causes poor quality of life and economic burden. Identifying the precipitating factor and studying the prognostic factors can guide the therapeutic management. **Objective.** To estimate admission serum chloride levels in acute decompensated heart failure and to study correlation of admission serum chloride levels with the duration of stay in these patients**. Methods:** This study was carried out in the Department of General Medicine, Karnataka Institute of Medical Sciences, Hubballi. Cases were selected among patients who had presented to KIMS hospital, IPD section with

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 09, 2024

the signs and symptoms of acute decompensated heart failure considering the inclusion and exclusion criteria and were studied between December 2020 to December 2022 (2years). **Result:** Mean age of 106 patients studied is 52.46 years. 59 (57%) of the patients were males. Coronary artery disease was the most common risk factor (66%) for ADHF in the population studied. Mean serum chloride level during admission is 98.56meq/L. Duration of hospital stay in tertile I, II and III were 9, 7.7 and 6.7 days respectively. A low serum chloride level, hypotension and use of inotropes correlated with longer duration of stay in hospital. Serum chloride level during admission was inversely correlated with the duration stay (p=<0.001).

Conclusion: Serum chloride level is a significant prognostic factor in acute decompensated heart failure. It plays a key role in neurohormonal regulation of the disease. Hypochloraemia also contributes to development of diuretic resistance. Having serumchloride within normal range helps diuretic therapy in ADHF

Keywords: Heart failure, serum chloride, diuretics

INTRODUCTION: Cardiovascular death is currently the leading cause of death in India[1]. Heart failure (HF)is a common final pathway for most chronic cardiovascular diseases including hypertension, coronary artery disease, and valvular heart disease[2]. Estimated prevalence of heart failure in India due to coronary heart disease, hypertension, obesity,diabetes and rheumatic heart disease to range from 1.3 to 4.6 million, with an annual incidence of 0.4 - 1.8 million. The prevalence of HF in India is possibly on the rise as India remains doubly burdened by the rise in the risk factors of traditional cardiovascular disease (CVD) and by the persistence of pre-transitional diseases such as rheumatic heart disease (RHD), endomyocardial fibrosis, tuberculous pericardial disease and anaemia. Because of a growing and ageing population, the total number of heart failure patients still continues to rise[3].

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 09, 2024

The result of industrialization such as hypertension, coronary artery disease adding up to the conventional ones that are still contributing to heart failure in India such as RHD may probably contribute to this higher prevalence[1].

Acute decompensated heart failure (ADHF) refers to the rapid onset or worsening of symptoms of HF[2]. Most episodes of acute HF result from worsening of chronic HF, but ~20% are due to new-onset HF that can occur in the setting of acute coronary syndrome, acute valvular dysfunction, hypertensive urgency, or postcardiotomy syndrome[2] . ADHF is the most common cause of hospital admissions among patients older than 65 years of age and is responsible for more than 1 million hospitalizations annually in theUnited States[4]. Acute decompensated heart failure is a common and growing medical problem associated with major morbidity and mortality[5].

Intravenous loop diuretics are an essential component of current treatment and are administered to approximately 90 percent of patients who are hospitalized with heart failure[6]. Electrolyte abnormalities often accompany heart failure (HF) because of the activated neurohormone systems such as the renin-angiotensin-aldosterone system (RAAS) and arginine vasopressin system, and because of decongestive therapy with loop and thiazide diuretics[7]. Hyponatremia has prognostic value in both acute decompensated HF (ADHF) and chronic HF failure patients[8]. By definition, serum sodium concentration decreases cannot happen independently. An anion such as chloride or bicarbonate must be lowered concurrently with the sodium in order to maintain electroneutrality. Although serum chloride is typically thought of as a passive anion connected to sodium content, mounting evidence suggests otherwise[9].

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 09, 2024

Since decades, it has been known that the primary ion responsible for the renal salt-sensing systems is chloride[10,11]. A family of serine-threonine kinases [With-No-Lysine (K), WNK] has recently been demonstrated to play a key role in the regulation of sodium chloride homeostasis, the actions of the renin–angiotensin–aldosterone system, and the transporters upon which loop and thiazide diuretics work[12]. It is noteworthy that chloride appears to bind specifically to the catalytic region of these kinases, controlling their capacity to phosphorylate crucial sodium-regulatory pathways[13,14].

Serum chloride may be a significant prognostic factor in ADHF due to its direct role in regulating neurohormonal activation and sodium homeostasis, two crucial pathways inheart failure[15].

Material and Methods: Single Centre Prospective observational study was done among cases were selected from patients presenting to KIMS hospital IPD section with acute decompensated heart failure, considering the inclusion and exclusion criteria. Duration of study was two years. **SAMPLING:** 106 patients presenting with acute decompensated heart failure to Medicine department, KIMS hospital during the study period will be taken for the study

Inclusion Criteria:

- Patients more than 18 years of age
- Patients admitted to hospital with acute decompensated heart failure

Exclusion Criteria:

- Chronic dialysis therapy
- Sepsis
- Acute coronary syndrome or myocarditis

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 09, 2024

- Pregnancy
- Patients who didn't receive loop diuretic

Methods of Collection of Data:

Ethical committee approval and informed consent was taken before starting the study. A detailed history was elicited from the patients, and general physical examination and systemic examination of all 117 patients was carried out. Data was collected in a pre-requisite proforma. The all relevant investigations were obtained

Statistical Analysis:

Data were entered into Microsoft Excel and statistical analysis was carried out in SPSS software version 17.0. Qualitative variables like age categories, gender, symptoms, co- morbid conditions habits and requirements of inotropes were presented as frequency and percentages. Quantitative variables like serum chloride, hospital stay were presented as mean (standard deviation). Serum chloride level was categorised into tertiles and reports as percentages. Bar diagrams and pie charts were used for graphicalrepresentation of data. Independent t test was used to compare the hospital stay across the gender, co-morbid conditions and requirement of inotropes. One-way ANOVA was used to find the difference in hospital stay across the tertiles of serum chloride levels. A p value of less than 0.05 was considered as statistically significant.

Results: We have recruited 106 participants for the purpose of the study. Out of 106, 31 (29.3%) were 46-60 years of age, followed by 29 (27.4%) in 31-45 years, 25 (23.6%) were 61-75 years of age. Of all the recruited participants, more than

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 09, 2024

half, 59 (55.7%) were men and theremaining 47 (44.3%) were women.

Table- 1 Distribution of symptoms among study population

Symptoms	Number	Percentage
Breathlessness		
No	17	16.0
Yes	89	84.0
Cough		
No	65	61.3
Yes	41	38.7
Pedal oedema		
No	30	28.3
Yes	76	71.7
Chest pain		
No	77	72.6
Yes	29	27.4
Palpitation		
No	74	69.8
Yes	32	30.2
Decreased U/O		
No	100	94.3
Yes	6	5.7

Out of 106, 89 (84%) of the participants had breathlessness, 41 (38.7%) had

cough, 76 (71.7%) had pedal edema, 29 (27.4%) has chest pain, 32 (30.2%) had

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 09, 2024

palpitation and 6 (5.7%) had decreased urine output respectively.

Of all, 36 (34.3%) had diabetes, 17 (16%) had hypertension, 7 (6.6%) had CKD, 8 (7.6%) had COPD and 11 (10.4%) had CVA respectively. About 69 (65.1%) had CAD, 30 (28.3%) had DCM and 7 (6.6%) had valvular cardio vascular disease.

Table-2 Distribution of habits among study population

Habits	Number	Percentage
Alcohol		
No	79	74.5
Yes	27	25.5
Smoking		
No	87	82.1
Yes	19	17.9

Nearly one-fourth of the participants, 27 (25.5%) had the habit of taking alcoholand 19 (17.9%) had the habit of smoking.

About 7 (6.6%) of the all the recruited participants were in need of inotropes andthe remaining 99 (93.4%) did not require inotropes.

Table-3 Distribution of serum chloride levels among study population

Serum chloride levels	Number	Percentage
Tertile 1 (<98)	41	38.7
Tertile 2 (98-101)	32	30.2
Tertile 3 (>101)	33	31.1
Total	106	100.0

.

Serum chloride level was divided into tertiles. Ablut 41 (38.1%) of the

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 09, 2024

participants values had fell in the first tertile (<98), 32 (30.2%) of the values were in tertile two and the remaining 33 (31.1%) of the values were in tertile three.

Table-4 Comparison of hospital stay across the serum chloride levels.

Serum chloride	Total	Mean stay	SD	Median	Min-max	P value
Tertile 1 (<98)	42	9.0	4.8	8	3-20	0.03
Tertile 2 (98-101)	32	7.7	3.2	7	3-17	
Tertile 3 (>101)	33	6.7	2.6	7	3-15	

*one way ANOVA

The mean (SD) hospital stay across the first tertile was 9 (4.8), second tertile was 7.7 (3.2) and third tertile was 6.7 (2.6) respectively. There was a significant difference in chloride level was observed between the tertiles and this difference was significant with the p value of 0.03.

Table-5 Comparison of hospital stay across the gender

Gender	Mean	SD	Median	Minimum	Maximum	P value
Male	7.1	2.8	7	3	15	0.02
Female	8.9	4.7	7	3	20	

*Independent t test

The mean (SD) hospital stay among male was 7.1 (2.8) and among females was 8.9 (4.7) respectively. The mean was higher in females when compared to males and this was significant with the p value of 0.02.

The mean (SD) hospital stay among the patients without diabetes mellitus was 7.8

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 09, 2024

(3.9) and among the patients with diabetes mellitus was 8.2 (3.9) respectively. The mean was higher in the patients with diabetes mellitus than without diabetes (8.2 Vs 7.8). But this association was not significant with the p value of 0.59.

The mean (SD) hospital stay among the patients without hypertension was 7.8 (3.7) and among the patients with hypertension was 8.5 (4.9) respectively. The difference in stay between the two groups was not significant with the p value of 0.56.

The mean (SD) hospital stay among the patients without CKD was 8.0 (4.0) days and among the patients with hypertension was 6.9 (2) respectively. The difference in stay between the two groups was not significant with the p value of 0.23.

The mean (SD) hospital stay among the patients without COPD was 7.8 (3.9) and among the patients with COPD was 8.8 (3.9) respectively. The difference in stay between the two groups was not significant with the p value of 0.54.

The mean (SD) hospital stay among the patients without history of CVA 8.1 (4.0) days and in those patients with history of CVA was 6.5(1.8) respectively. The difference in stay between the two groups was significant with the p value of 0.03.

Table-6 Comparison of hospital stay and inotropes

Inotropes	**Mean**	**SD**	**Median**	**Minimum**	**Maximum**	**P value**
Not needed	7.5	3.5	7	3	20	0.02
Needed	13.6	5.3	15	7	20	

.

The mean (SD) hospital stay among the patients who did not require inotropes was 7.5 (3.5) days and among the patients who required inotropes was 13.6 (5.3) days respectively. The difference in stay between the two groups was statistically

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 09, 2024

significant with the p value of 0.02. Correlation of various parameters with hospital stay:

Table- 7: Correlation of various parameters with hospital stay

Hospital stay	Correlation coefficient (r)	P value
Chloride	-0.38	<0.001
Age in years	0.07	0.49
SBP	-0.13	0.17
DBP	-0.28	0.004
RR	-0.01	0.94
SPO2	0.09	0.33
Hb	-0.03	0.72
Platelet	-0.17	0.09
Urea	-0.11	0.24
Creatinine	0.10	0.31
Sodium	-0.05	0.63
Potassium	0.06	0.56
EF	0.06	0.52

Serum chloride levels was negatively correlated with hospital stay. Higher the chloride levels lower will be the duration of hospital stay and this correlation (Pearsoncorrelation coefficient r=-0.38) was statistically significant with a p value of less than SBP, DBP, RR, Hb, platelet count, Urea and Sodium had negative correlation with hospital stay.

Discussion: In the present study which is a single centre, prospective observational study, the primary objective was to study serum chloride levels during admission in

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 09, 2024

ADHF as a prognostic factor. We also studied the correlation between serum chloride levels duringadmission with the duration of stay in hospital.

Among the 106 patients who were included in this study had varied presentation and were studied by dividing them into 3 tertiles, tertile I (S. chloride level <98meq/L),tertile II (S. chloride level from 98meq/L to 101 meq/L) and tertile III (S. chloride level >101meq/L) based on serum chloride levels during admission.

Abhishek Goyal et al in their study have found that serum chloride level during admission and duration of stay are inversely co-related. Meaning that, lower levels of serum chloride are associated with prolonged hospital stay. They also found that serumsodium and chloride levels during admission were correlated.

In Justin L. Grodin et al[16] study, it was found that serum chloride level during admission in ADHF was a good prognostic factor both in terms of duration of stay and incidence of mortality. Serum chloride levels was found to be inversely correlated withduration of stay. It was also found that low serum chloride level was associated with increased incidence of mortality after multivariable adjustment for other risk factors.

Sample size of present study is comparable with that of Abhishek Goyal et al study. University of Pennsylvania Cohort and Cleveland Clinic Cohort had larger sample sizebecause of longer duration of study.

The mean age of study population in present study is 52.56±16.70 years. In University of Pennsylvania Cohort and Cleveland Clinic Cohort the mean ages of study population were 62.9 and 68.7 yearsrespectively.

In comparison with respect to gender distribution, it was found that in present study 55.66% were, males and 44.33% were females. In Abhishek Goyal et al study,

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 09, 2024

53.8% were males and 46.2% were females. University of Pennsylvania Cohort study had 54.3% males and 45.7% females. 70% were males and 30% were females in Cleveland Clinic Cohort. Gender distribution in the present study is comparable with that of University of Pennsylvania Cohort.

In comparison with respect to risk factors, coronary artery disease is present in 65.7% of the population of present study and 77.4% of population of Abhishek Goyal et al study. It can be noted that coronary artery disease is the most common risk factor in both the studies. Diabetes mellitus is present in 34.3% of population of present study and 61.6% of Abhishek Goyal et al study. Systemic hypertension is present in 16% of population of present study and 66.4% of population of Abhishek Goyal et al study. COPD was present in 7.6% and 7.78% of population of the present study and Abhishek Goyal et al study respectively which is comparable. 6.6% of the population in present study and 13.1% of population in Abhishek Goyal et al study were found to have chronic kidney disease.

The average serum chloride level during admission in the present study is98.58±5.6meq/L. In Abhishek Goyal et al study, it was 97.96±7.27meq/L. In present study tertile I had highest percentage of patients i.e. 38.7% while in Abhishek Goyal etal study it is tertile II that had highest percentage of patients i.e. 41.3%.

It is observed that serum chloride levels among study population is distributed normally in both the present study and Abhishek Goyal et al study. At admission, 70 patients had serum chloride levels within normal range i.e. in between 96 and 106meq/L. 28 patients had hypochloremia i.e. chloride levels less than 96meq/L. This can be attributed to elevated arginine vasopressin levels in patients of HF causing dilutional hypochloremia. Diuretic use also contributes to development of hypochloremia.

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 09, 2024

In the present study patients presenting with ADHF were divided into 3 tertiles based on serum chloride levels during admission as tertile I, tertile II and tertile III. In the present study mean durations of stay in hospital in tertile I, tertile II and tetile III were 9, 7.7 and 6.7 respectively. They also showed a significant inverse correlation with serum chloride levels during admission (p value <0.001). In Abhishek Goyal et al study mean durations of stay in hospital in tertile I, tertile II and tetile III were 8,7 and 6 respectively. Present study was comparable to Abhishek Goyal et al study as both the studies showed significant inverse correlation of serum chloride levels during admission with duration of stay in patients with ADHF.

Conclusion: In this study we correlated serum chloride levels during admission with the duration of stay in ADHF. It was found that serum chloride levels were independently and inversely correlated with duration of stay. Hence serum chloride is an important prognostic factor in ADHF in terms of length of stay in hospital. Devising a chloride-sparing strategy might help in improving prognosis inpatients with ADHF

References:

1. Huffman MD, Prabhakaran D. Heart failure: epidemiology and prevention in India. The National medical journal of India. 2010 Sep;23(5):283.

2. HARRISON I. ON LOOKING INTO HARRISON'S PRINCIPLES. Pharos. 2020:17

3. Groenewegen A, Rutten FH, Mosterd A, Hoes AW. Epidemiology of heart failure. European journal of heart failure. 2020 Aug;22(8):1342-56.

4. Lloyd-Jones D, Adams R, Carnethon M, et al. Heart disease and stroke statistics -- 2009 update: a report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Circulation

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 09, 2024

2009;119:e21-e181

5. Developed in Collaboration With the American College of Chest Physicians and the International Society for Heart and Lung Transplantation, Endorsed by the Heart Rhythm Society, Hunt SA, Abraham WT, Chin MH, Feldman AM, Francis GS, GaniatsTG, Jessup M, Konstam MA, Mancini DM. ACC/AHA 2005 guideline update for the diagnosis and management of chronic heart failure in the adult—summary article: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Update the 2001 Guidelines for the Evaluation and Management of Heart Failure). Journal of the American College of Cardiology. 2005 Sep 20;46(6):1116-43.

6. Emerman CL, De Marco T, Costanzo MR, Peacock WF. 368 Impact of intravenousdiuretics on the outcomes of patients hospitalized with acute decompensated heart failure: insights from the ADHERE® Registry. Journal of Cardiac Failure. 2004 Aug 1;10(4):S116-7.

7. Goldsmith SR. Francis GS, Cowley AW Jr, Levine TB, Cohn JN. Increased plasmaarginine vasopressin levels in patients with congestive heart failure. J Am Coll Cardiol.1983;1:1385-90.

8. Gheorghiade M, Abraham WT, Albert NM, Gattis Stough W, Greenberg BH, O'Connor CM, She L, Yancy CW, Young J, Fonarow GC. Relationship between admission serum sodium concentration and clinical outcomes in patients hospitalized for heart failure: an analysis from the OPTIMIZE-HF registry. European heart journal.2007 Apr 1;28(8):980-8

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 09, 2024

9. Berend K, van Hulsteijn LH, Gans RO. Chloride: the queen of electrolytes? Eur J Intern Med 2012;23:203–211.

10. Briggs JP, Schnermann JB. Whys and wherefores of juxtaglomerular apparatus function. Kidney Int 1996;49:1724–1726.

11. Briggs J. The macula densa sensing mechanism for tubuloglomerular feedback. FedProc 1981;40:99–103.

12. Subramanya AR, Yang CL, McCormick JA, Ellison DH. WNK kinases regulate sodium chloride and potassium transport by the aldosterone-sensitive distal nephron. Kidney Int 2006;70:630–634.

13. Piala AT, Moon TM, Akella R, He H, Cobb MH, Goldsmith EJ. Chloride sensing by WNK1involves inhibition of autophosphorylation. Sci Signal 2014;7:ra41

14. Ponce-Coria J, San-Cristobal P, Kahle KT, Vazquez N, Pacheco-Alvarez D, de LosHeros P, Juarez P, Munoz E, Michel G, Bobadilla NA, Gimenez I, Lifton RP, Hebert SC, Gamba G. Regulation of NKCC2 by a chloride-sensing mechanism involving the WNK3 and SPAK kinases. Proc Natl Acad Sci USA 2008;105:8458–8463.

15. Testani JM, Hanberg JS, Arroyo JP, Brisco MA, Ter Maaten JM, Wilson FP, Bellumkonda L, Jacoby D, Tang WW, Parikh CR. Hypochloraemia is strongly and independently associated with mortality in patients with chronic heart failure. Europeanjournal of heart failure. 2016 Jun;18(6):60-8.

16. Grodin JL, Carter S, Bart BA, Goldsmith SR, Drazner MH, Tang WW.

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 09, 2024

Direct comparison of ultrafiltration to pharmacological decongestion in heart failure: a per□ protocol analysis of CARRESS□HF. European journal of heart failure. 2018 Jul;20(7):1148-56.