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Original Research Article

Frequency of Iron Deficiency Anemia as a Sole Factor for Heart Failure Exacerbation in Patients Presenting to Tertiary Care Hospitals

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Abstract:
Objective: To determine the frequency of iron deficiency anemia in patients with heart failure exacerbation presenting to tertiary care hospitals. **Study Design:** A hospital-based cross-sectional investigation was performed. **Place and Duration of Study:** The research was carried out in the Cardiology Department of Lady Reading Hospital, Peshawar, Pakistan, between 21st July 2025 and 21st October 2025. **Methodology:** The study enrolled 145 individuals, aged 20–70 years, who had heart failure with an acute deterioration, using consecutive enrolment. Iron deficiency anaemia was identified on the basis of haemoglobin concentration, serum ferritin and transferrin saturation. Statistical processing was performed with Statistical Package for the Social Sciences, version 30. Following stratification, associations were examined through the Chi-square or Fisher exact test. Statistical significance was accepted when the p-value was ≤0.05. **Results:** Mean age was 54.88 ± 9.34 years, mean body mass index was 26.27 ± 2.80 kg/m^2 and mean complaint duration was 9.41 ± 5.55 days. There were 88 (60.7%) males and 57 (39.3%) females. Iron deficiency anaemia was found in 62 (42.8%) patients, whereas 83 (57.2%) patients had no iron deficiency anaemia. Patients above 45 years showed more iron deficiency anaemia compared with patients aged 45 years or below, 57 (46.0%) versus 5 (23.8%), although this difference was not significant (p=0.093). Education level had significant association (p=0.035), whereas gender, body mass index, profession, residence and complaint duration showed no significant association. **Conclusion:** Iron deficiency anaemia was frequently found in patients having heart failure exacerbation.

Keywords: Anaemia, Heart failure, Iron deficiency, Iron deficiency anaemia, Peshawar, Risk factors.

INTRODUCTION

Heart failure exacerbation is a frequent medical condition where the signs and symptoms of heart failure get worsened either gradually or acutely, resulting in increased dyspnoea, oedema, tiredness and decreased exercise tolerance.1 Heart failure exacerbation may occur due to various reasons, which include poor patient adherence to treatment regimen, infections, poorly controlled blood pressure, arrhythmias, excessive intake of salt and fluids, myocardial ischaemia and anaemia.2 At the time of exacerbation, there is inadequate cardiac output that does not meet the bodily needs of an individual, while fluid overload puts additional strain on the heart.3 Some of the signs and symptoms of this condition include pulmonary congestion, elevated jugular venous pressure, crepitations at the base of the lungs and oedema.4

Iron deficiency anemia is one of the frequently occurring abnormalities in heart failure patients, which can be seen with or without anemia.5 Iron is an essential component in hemoglobin synthesis and also plays a vital role in energy generation and cardiac muscles.6 Hence, the deficiency of iron can

lower oxygen-carrying capacity and also decrease functional capability of the heart. The development of anemia in heart failure patients can lead to increased fatigue, weakness, shortness of breath, and decreased exercise tolerance that gets even worse in heart failure patients.7 The development of iron deficiency can occur due to poor nutrition, chronic inflammation, reduced iron absorption, gastrointestinal bleeding or increased iron demand.8 Management of iron deficiency anaemia in heart failure patients involves establishing the reason behind the development of this disease and correction of iron deficiency in addition to usual therapy for heart failure.9 Testing includes haemoglobin, serum ferritin and transferrin saturation levels, although additional tests might be conducted depending on the assumed cause of anaemia. Improving nutrition and treating deficiencies of nutrients might help in selected cases, but iron replacement is necessary when iron deficiency is established.10 Oral iron administration might be effective in some patients, but its efficacy might be poor in case of heart failure because of low absorption of the drug and side effects.11 Patients with iron deficiency and heart failure use intravenous iron when oral therapy is not appropriate or adequate for this patient.

This study needs to be conducted because iron deficiency anaemia is a prevalent and easily curable problem in patients with heart failure, but its involvement in the exacerbation of heart failure may not be recognized properly in many cases. Patients with iron deficiency anaemia might suffer from increased symptoms and decreased oxygen delivery, resulting in additional strain on the compromised heart. There is a lack of local data about the prevalence of iron deficiency anaemia as a possible single cause of heart failure exacerbation, particularly among our population.

METHODOLOGY

A descriptive cross-sectional study was carried out at Cardiology Department of Lady Reading Hospital, Peshawar, during the period from 21st July 2025 until 21st October 2025. 145 eligible patients were recruited. Sample size was estimated through World Health Organization sample size software by keeping confidence level at 95%, margin of error at 8% and expected occurrence of iron deficiency anaemia at 40.7% in patients having worsening heart failure.12 Participants were enrolled by using consecutive non-probability sampling.

Permission for conducting the study was taken from the ethical committee and CPSP before beginning the study, under Ethical Certificate No. 305/LRH/MTI. Male and female patients between 20 and 70 years were eligible if they presented with heart failure and acute worsening of heart failure according to the defined study criteria. Patients were not included if they had acute coronary syndrome, poorly controlled hypertension, arrhythmias, chronic kidney disease, surgery during previous 3 months, active bleeding, pregnancy or breastfeeding. Written informed consent was obtained from participants before information was collected. The study purpose was explained to patients and privacy of their information was kept.

Following consent, demographic details were entered in a proforma. Information included age, gender, BMI, occupation, socioeconomic status, education, duration of symptoms and place of residence. A detailed clinical patient history was obtained about symptoms and previous diseases. Physical examination was carried out for general status and cardiovascular signs. Findings suggestive of worsening heart failure were checked, including jugular venous pressure, lung crackles, peripheral oedema, S3 gallop, hepatomegaly, central venous pressure and recent body weight changes. Echocardiographic assessment included left ventricular ejection fraction, left atrial volume index, left ventricular hypertrophy and E/e′ ratio. Venous blood was collected from each participant by a fourth-year resident through venepuncture with aseptic precautions. Five mL blood was obtained; 2 mL was transferred into an EDTA tube for complete blood count, while 3 mL was put in a plain tube for iron profile and specimens were transferred to the laboratory. Findings related to iron deficiency anaemia and other variables were entered into the proforma.

Heart failure was diagnosed when BNP was above 35 pg/mL or NT-proBNP above 125 pg/mL, with either two major Framingham criteria or one major plus two minor criteria and echocardiography demonstrated at least one specified abnormal finding. Echocardiographic findings included LVEF below 40% measured using Simpson biplane technique or LVEF of 50% or above with diastolic dysfunction or left ventricular thickening. Left ventricular thickening or related abnormality was identified when left atrial volume index reached 34 mL/m^2 or more, LV mass index reached 115 g/m^2 or more in males or 95 g/m^2 or more in females or E/e′ was 13 or above. Acute heart failure exacerbation was defined by a fall in LVEF of at least 10% from previous baseline or worsening filling function with E/e′ above 15 and left atrial volume index above 34 mL/m^2, plus at least two clinical signs. Clinical signs were JVP above 8 cm from sternal angle in 45° position, bilateral crackles involving more than one-third of lung fields, new or increased peripheral oedema graded 2+ or more on 0-4 scale, newly present or recognized S3 gallop, hepatomegaly more than 3 cm below costal margin, CVP above 16 cmH_2O or increase in weight above 2 kg within 3 days compared with baseline. Iron deficiency anaemia was diagnosed when haemoglobin was below 13 g/dL in

males or below 12 g/dL in females, with either ferritin below 100 µg/L or ferritin between 100 and 299 µg/L along with transferrin saturation below 20%. In this study, iron deficiency anaemia was treated as the possible single associated condition for exacerbation if both heart failure exacerbation and iron deficiency anaemia criteria were fulfilled, after excluding predefined alternative conditions under eligibility rules.

Statistical analysis was performed using IBM SPSS version 30. Categorical data such as gender, socioeconomic status, education, residence, profession and iron deficiency anaemia were expressed in frequencies and percentages. Continuous measurements such as age, BMI and duration of complaints were reported as mean ± standard deviation. Iron deficiency anaemia was compared after stratification by age, gender, BMI, profession, socioeconomic status, education, complaint duration and residence. Chi-square test or Fisher's exact test was used for comparisons following stratification, and p-value ≤0.05 was considered statistically significant.

RESULTS

A total of 145 patients were included in this study. The mean age of the patients was 54.88 ± 9.34 years, mean BMI was 26.27 ± 2.80 Kg/m^2 and the mean duration of complaints was 9.41 ± 5.55 days. Majority of the patients were male 88 (60.7%). More than half of the patients 55 (37.9%) were doing job and 76 (52.4%) belonged to middle socioeconomic status. Regarding education level, secondary educated patients were most common 47 (32.4%) and urban residents were slightly more 76 (52.4%) as compared to rural 69 (47.6%) (Table 1).

Table 1. Patient Demographics n=145

Demographics	Mean ± SD
Age (Years)	54.88 ± 9.34
BMI (Kg/m^2)	26.27 ± 2.80
Duration of Complaints (days)	9.41 ± 5.55
Gender	
Male n (%)	88 (60.7%)
Female n (%)	57 (39.3%)
Profession	
Jobless n (%)	49 (33.8%)
Job n (%)	55 (37.9%)
Business n (%)	41 (28.3%)
Socioeconomic Status	
Low n (%)	45 (31.0%)
Middle n (%)	76 (52.4%)
High n (%)	24 (16.6%)
Education Level	
Uneducated n (%)	41 (28.3%)
Primary n (%)	37 (25.5%)
Secondary n (%)	47 (32.4%)
Higher n (%)	20 (13.8%)
Residential Status	
Rural n (%)	69 (47.6%)
Urban n (%)	76 (52.4%)

The frequency of iron deficiency anaemia were found in 62 patients, which accounts for 42.80% of the total study population, whilst 83 patients (57.20%) were not having iron deficiency anaemia (Table 2).

Table 2. Frequency of Iron Deficiency Anemia as a Sole Factor for Heart Failure Exacerbation n=145

Iron Deficiency Anemia	Frequency	% age
Yes	62	42.80%
No	83	57.20%
Total	145	100%

The association of iron deficiency anaemia with various demographic factors were also examined. Age group more than 45 years were having higher frequency of iron deficiency anaemia 57 (46.0%) as compared to younger patients 5 (23.8%), however this association were not reaches statistical significance (p=0.093). No significant association were found between gender and iron deficiency anaemia, as male patients 38 (43.2%) and female patients 24 (42.1%) were showing almost similar frequencies (p=0.898). Education level were found to be significantly

associated with iron deficiency anaemia (p=0.035), where patients with higher education were having lowest frequency 3 (15.0%) as compared to primary educated patients who were showing highest frequency 20 (54.1%). Socioeconomic status was showing a borderline association (p=0.058), where low socioeconomic patients were having higher frequency 22 (48.9%) as compared to high socioeconomic group 5 (20.8%). No significant associations were observed for BMI, profession, residential status and duration of complaints with iron deficiency anemia (Table 3).

Table 3. Association of Iron Deficiency Anemia with Demographic Factors n=145

Demographic Factors	Sub Groups	Iron Deficiency Anemia		p-value
		Yes n (%)	No n (%)	
Age (years)	≤45	5 (23.8%)	16 (76.2%)	0.093**
	>45	57 (46.0%)	67 (54.0%)	
Gender	Male	38 (43.2%)	50 (56.8%)	0.898*
	Female	24 (42.1%)	33 (57.9%)	
BMI (Kg/m^2)	≤25	18 (34.6%)	34 (65.4%)	0.138*
	>25	44 (47.3%)	49 (52.7%)	
Profession	Jobless	19 (38.8%)	30 (61.2%)	0.249*
	Job	21 (38.2%)	34 (61.8%)	
	Business	22 (53.7%)	19 (46.3%)	
Socioeconomic Status	Low	22 (48.9%)	23 (51.1%)	0.058**
	Middle	35 (46.1%)	41 (53.9%)	
	High	5 (20.8%)	19 (79.2%)	
Education Level	Uneducated	17 (41.5%)	24 (58.5%)	0.035**
	Primary	20 (54.1%)	17 (45.9%)	
	Secondary	22 (46.8%)	25 (53.2%)	
	Higher	3 (15.0%)	17 (85.0%)	
Residential Status	Rural	33 (47.8%)	36 (52.2%)	0.240*
	Urban	29 (38.2%)	47 (61.8%)	
Duration of Complaints (Days)	≤5	25 (36.8%)	43 (63.2%)	0.170*
	>5	37 (48.1%)	40 (51.9%)	

*Chi-Square Test, **Fisher Exact Test

DISCUSSION

The frequency of iron deficiency anaemia were found to be 62 (42.80%) in patients with heart failure exacerbation, which is considerably high and suggesting a significant burden of this condition in tertiary care settings. This finding is somewhat comparable to Rehman et al. 13 who reported anaemia prevalence of approximately 41.9% in hospitalised heart failure patients, indicating a similar pattern in South Asian tertiary care populations. However, Elamin et al. 14 reported a notably higher prevalence of 51% amongst Sudanese heart failure patients and Graham et al. 15 also found anaemia in 46% of prevalent heart failure patients, both of which are slightly higher than present findings. These differences may be attributable to variations in study population characteristics, geographical differences, dietary habits and definitions used for iron deficiency anaemia across different studies. The significance of iron deficiency even without overt anaemia in cardiac patients were further highlighted by Misiewicz et al. 16 who reviewed nine studies and reported iron deficiency prevalence ranging from 29% to 57% in acute coronary syndrome cohorts, with iron deficiency independently predicting cardiovascular death and non-fatal myocardial infarction (HR 1.52, 95% CI 1.03–2.26; p=0.037), which further supports the clinical importance of iron deficiency identification in heart failure patients.

Male participants formed the larger proportion in the current study, with 88 (60.7%) patients, which is comparable with the findings reported by Liu et al. 17 where males accounted for 128 (69.2%) of heart failure patients with anaemia. Similarly, Grote Beverborg et al. 18 observed male predominance in their heart failure population, with 664 (75.4%) participants being male. The greater representation of males may be related to the comparatively higher occurrence of cardiovascular risk factors, including hypertension, coronary artery disease and smoking, among men. These factors may increase the likelihood of developing heart failure and related complications.

Education level were found to be significantly associated with iron deficiency anaemia (p=0.035) in present study, where higher educated patients were having lowest frequency 3 (15.0%) whilst primary educated patients were showing highest frequency

20 (54.1%). This finding gets indirect support from Elamin et al. 14 who reported that anaemia management were very limited in their cohort, with 189 (71.1%) patients receiving no anaemia specific treatment, which may also reflect poor health awareness and limited health seeking behaviour in less educated populations. Similarly, low socioeconomic patients were showing higher frequency of iron deficiency anaemia 22 (48.9%) as compared to high socioeconomic group 5 (20.8%), which is biologically plausible as poor socioeconomic status is strongly linked with inadequate dietary iron intake and reduced access to healthcare.

The frequent occurrence of iron deficiency anaemia among individuals with heart failure can be explained through several biological mechanisms. Grote Beverborg et al. 18 reported that iron deficiency was related to reduced haemoglobin, increased NT-proBNP concentrations and enhanced inflammatory activity. Their whole blood transcriptome analysis also identified 89 genes with differential expression. In addition, Ying et al. 19 used Mendelian randomisation to investigate the genetic relationship between anaemia and heart failure. Their findings indicated that genetically predicted anaemia increased the likelihood of heart failure (OR 1.12, 95% CI 1.04–1.20; p=0.002), whereas heart failure was also linked with greater risk of anaemia (OR 1.40, 95% CI 1.24–1.59; $p=1.79\times10^{-7}$). These findings indicate a two-way causal association between the two conditions and may partly explain their frequent coexistence in patients with heart failure exacerbation in the current study. Regarding management, Kansagara et al. 20 reviewed the available evidence and reported that intravenous iron treatment could provide improvement in short-term symptoms and quality of life among symptomatic heart failure patients having iron deficiency. However, the evidence for erythropoiesis-stimulating agents was not sufficient to demonstrate clear improvement in overall health outcomes. Additionally, Kumral et al.21 demonstrated that early reticulocyte response 72–120 hours after intravenous iron therapy could identify treatment responders, with a delta reticulocyte increase of more than 9% predicting haemoglobin rise with 90% specificity and patients achieving haemoglobin increase of more than 1 g/dL were having significantly fewer heart failure related emergency visits 24% versus 66% (p=0.004) and lower two year mortality 16% versus 46% (p=0.011), suggesting that timely iron supplementation in such patients may significantly improves clinical outcomes.

This study has a number of limitations which should be considered. First of all, it was a single-center study, thus the obtained results cannot be generalized to the wider population. The number of participants, 145, was relatively small, which could influence the statistical power of the study. The cross-sectional nature of the study did not allow establishing causality between iron deficiency anaemia and exacerbation of heart failure. In addition to that, there were a number of confounding factors such as dietary habits, medications and the severity of heart failure, which were not controlled properly in the study.

CONCLUSION

In the current research study, it has been concluded that iron deficiency anaemia was a considerably common occurrence amongst the patients admitted with heart failure exacerbation at the tertiary care hospital and it was found to be highly prevalent in the current research study population. It is suggested that iron deficiency anaemia testing be made a mandatory component of heart failure management protocol at the tertiary care hospital.

Ethical Approval

The study was undertaken only after ethical clearance had been obtained from the Institutional Ethical Committee of the hospital. All necessary ethical requirements were fulfilled before commencement of the research.

Patients' Consent

Each participant was informed about the study and written consent was obtained before inclusion in the research.

Competing Interests

The author declares that no conflict of interest was present in relation to this research.

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