

Burden and Clinical Correlates of Left Ventricular Hypertrophy in Chronic Anemia: A Cross-Sectional Study

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Abstract

Background: Chronic anemia induces adaptive cardiovascular responses that may eventually lead to structural cardiac changes, including left ventricular hypertrophy (LVH), a known predictor of adverse cardiovascular outcomes¹⁻³.

Objective: To determine the prevalence of LVH in patients with chronic anemia and to evaluate its association with the severity and duration of anemia.

Methods: This cross-sectional study included 120 adult patients with confirmed chronic anemia. Clinical profiles, laboratory findings, and echocardiographic parameters were assessed. LVH was defined based on left ventricular mass index (LVMI)^{9,10}.

Results: LVH was present in 52.5% of participants (n=63). The prevalence increased with anemia severity: 20% in mild cases, 48% in moderate cases, and 75% in severe anemia (p<0.001). Mean LVMI values were significantly higher in severe anemia compared to moderate and mild anemia.

Conclusion: LVH is a common finding in chronic anemia and is strongly influenced by both disease severity and duration. Early diagnosis and management of anemia may help prevent adverse cardiac remodeling⁶⁻⁸.

Keywords: Chronic anemia, Left ventricular hypertrophy, Cardiac remodeling, Echocardiography

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Introduction

Anemia remains a major global health concern, particularly in low- and middle-income countries¹. Persistent reduction in hemoglobin levels triggers compensatory physiological mechanisms aimed at maintaining adequate tissue oxygenation, including increased cardiac output and reduced systemic vascular resistance¹².

Over time, sustained hemodynamic stress can result in structural cardiac alterations, especially left ventricular enlargement and hypertrophy²³. LVH is clinically significant because it is associated with an increased risk of heart failure, arrhythmias, and mortality⁸.

Although LVH has been extensively studied in hypertension, its occurrence in chronic anemia has not been sufficiently explored. This study was designed to evaluate the prevalence of LVH in patients with chronic anemia and to identify contributing clinical factors.

Materials and Methods

Study Design and Setting: A hospital-based cross-sectional observational study conducted over one year at a tertiary care center.

Study Population: A total of 120 adult patients diagnosed with chronic anemia were enrolled.

Inclusion Criteria:

- Age ≥ 18 years
- Confirmed anemia based on hemoglobin levels¹
- Duration ≥ 6 months

Exclusion Criteria:

- History of hypertension
- Structural or congenital heart disease
- Known cardiomyopathy
- Chronic alcohol use

Data Collection: Demographic details, hemoglobin levels, duration and etiology of anemia, and echocardiographic parameters were recorded.

Operational Definitions:

- Mild anemia: Hb 10–12 g/dL¹
- Moderate anemia: Hb 7–9.9 g/dL¹
- Severe anemia: Hb <7 g/dL¹
- LVH: LVMI >115 g/m² (males), >95 g/m² (females)⁹

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Statistical Analysis: Categorical variables were compared using chi-square tests, while continuous variables were analyzed using ANOVA. Logistic regression was used to determine independent predictors.

Results

Baseline Characteristics: The mean age was 42.3 ± 13.6 years, with females comprising 58% of participants. Mean hemoglobin level was 8.6 ± 1.9 g/dL.

Etiology: Iron deficiency was the most common cause, followed by chronic kidney disease and megaloblastic anemia.

Severity Distribution:

- Mild: 20.8%
- Moderate: 45.8%

- Severe: 33.3%

Prevalence of LVH: LVH was present in 52.5% of patients. Prevalence increased significantly with severity:

- Mild: 20%
- Moderate: 48%
- Severe: 75% ($p < 0.001$), consistent with prior observations²³⁶.

Echocardiographic Findings: Severe anemia was associated with increased left ventricular mass and chamber size. A mild reduction in ejection fraction was noted, though most values remained within normal limits¹⁰.

Predictors of LVH: Severe anemia and duration >2 years were independently associated with LVH, supporting previous mechanistic studies²⁵¹¹.

Figure 1: Prevalence of LVH by Anemia Severity

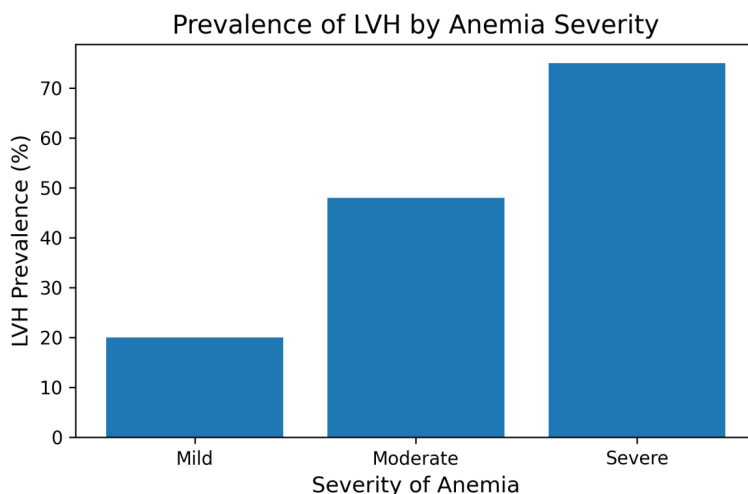
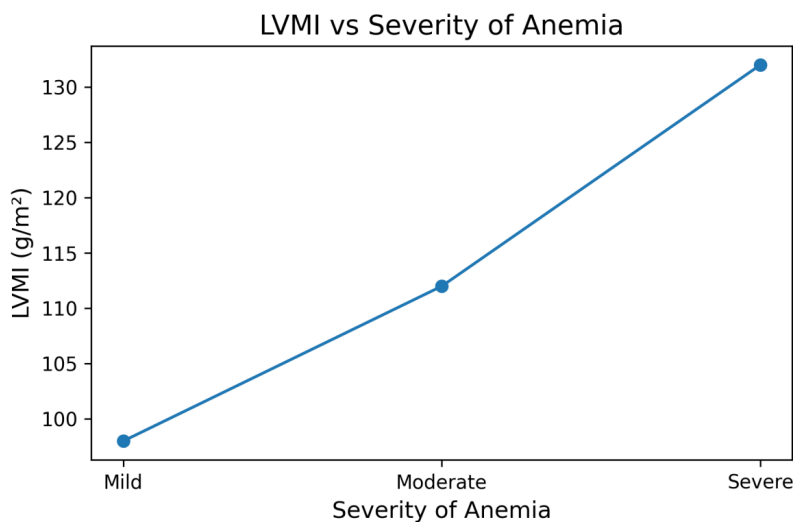


Figure 2: LVMI vs Severity of Anemia



Discussion

This study demonstrates a high prevalence of LVH in patients with chronic anemia, highlighting the role of sustained hemodynamic stress in cardiac remodeling²³.

As anemia worsens, compensatory increases in cardiac output and preload lead to ventricular dilation and

eccentric hypertrophy⁵¹². The association between longer disease duration and LVH reflects the cumulative effect of chronic exposure¹¹.

These findings are consistent with previous studies that have demonstrated the cardiovascular impact of

prolonged anemia, particularly in patients with renal disease and nutritional deficiencies²³⁶.

Limitations

- Single-center study
- Moderate sample size
- Lack of longitudinal follow-up

Conclusion

Chronic anemia is strongly associated with structural cardiac changes, particularly left ventricular hypertrophy. Both severity and duration are key determinants. Early recognition and management are essential to reduce long-term cardiovascular risk⁶⁻⁸.

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