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Original research article

Echocardiographic changes in patients with severe anemia: clinical descriptive study

[1]Dr. Somashekhara G, [2]Dr. Swati, [3]Dr. Mallikarjuna Reddy, [4]Dr. Anuradha H

[1]Associate Professor, Department of Cardiology, Vijayanagara Institute of Medical Sciences, Bellary, Karnataka, India

[2]Senior Resident, Department of Medicine, Vijayanagara Institute of Medical Sciences, Bellary, Karnataka, India

[3]Professor, Department of Medicine, Vijayanagara Institute of Medical Sciences, Bellary, Karnataka, India

[4]Assistant Professor, Department of Anesthesia and Critical Care, Vijayanagara Institute of Medical Sciences, Bellary, Karnataka, India

Corresponding Author:
Dr. Anuradha H

Abstract

Anaemia is the result of a wide variety of causes that can be isolated, but more often coexist. Globally, the most significant contributor to the onset of anaemia is iron deficiency so that IDA and anaemia are often used synonymously, and the prevalence of anaemia has often been used as a proxy for IDA. It is generally assumed that 50% of the cases of anaemia are due to iron deficiency 15, but the proportion may vary among population groups and in different areas according to the local conditions. The clinical examination included resting pulse, blood pressure, nail changes, jugular venous pressure, pedal oedema, heart sounds, murmur heard, liver and spleen size and features of congestive heart failure. All patients have a complete haematological examination and peripheral smear examination. Electrocardiogram was recorded for all patients in the resting state. Eccentric hypertrophy was seen in 34 out of 100 patients, of which 24 were females and 10 were males. Eccentric hypertrophy was slightly more in females (36.9%) compared to males (28.6%).

Keywords: Echocardiographic changes, severe anemia, eccentric hypertrophy

Introduction

Anaemia is a global public health problem affecting both developing and developed countries with major consequences for human health as well as social and economic development. It occurs at all stages of the life cycle, but is more prevalent in pregnant women and young children. In 2002, iron deficiency anaemia (IDA) was considered to be among the most important contributing factors to the global burden of disease [1].

The term "anaemia", is generally used in medicine for reduction below normal in concentration of haemoglobin or red blood cells in blood. It must be remembered that the mean normal value and the lower limits of the "normal" range depend upon the age (childhood or adult life) and gender. The most common type of anaemia is nutritional anaemia among it more important one is the Iron Deficiency Anaemia. More than half of the world's undernourished population lives in India [2, 3].

Anemia is often multifactorial and is not an independent phenomenon. For the classification and diagnosis, the hematologic parameters, the underlying pathological mechanism and patient history should be taken into account [4].

In one third of the patients, anemia is due to nutritional deficiency, including iron, folate, or vitamin B12 deficiency; moreover, anemia of chronic disease accounts for about another third of the cases. However, in one third of patients anemia cannot be explained by an underlying disease or by a specific pathological process, and for this reason it is defined "unexplained anemia". Unexplained anemia might be due to the progressive resistance of bone marrow erythroid progenitors to erythropoietin, and a chronic subclinical proinflammatory state [5].

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Among the other causes of anaemia, heavy blood loss as a result of menstruation, or parasite infections such as hookworms, ascaris and schistosomiasis can lower blood haemoglobin (Hb) concentrations [7].
Acute and chronic infections, including malaria, cancer, tuberculosis, and HIV can also lower blood Hb concentrations. The presence of other micronutrient deficiencies, including vitamins A and B12, folate, riboflavin, and copper can increase the risk of anaemia. Furthermore, the impact of haemoglobinopathies on anaemia prevalence needs to be considered within some population [8].

Methodology
Source of data: All patients diagnosed with severe anemia in the department of general medicine, were taken as subjects and who satisfy the inclusion criteria.

Method of collection of data: Patients with severe anemia with haemoglobin less than 7gm% were included after applying the exclusion criteria. Detailed history was taken for all patients, which included history of breathlessness, palpitations, chest pain, swelling of legs. The clinical examination included resting pulse, blood pressure, nail changes, jugular venous pressure, pedal oedema, heart sounds, murmur heard, liver and spleen size and features of congestive heart failure. All patients have a complete haematological examination and peripheral smear examination. Electrocardiogram was recorded for all patients in the resting state. Routine posterior-anterior chest roentgenogram was taken in all cases. All echo were done using 3.7, 5MHz and 2.0, 2.5MHz probe. The various echo parameters were analysed.

Sample size: 100 cases.

Study design: Prospective observational study.

Inclusion criteria
a) Patients with Hb <7gm
b) Age group between 15 to 40 years

Exclusion criteria
a) Age <15yrs and >40yrs
b) Pregnancy.
c) Patients with known ischemic heart disease, hypertensive heart disease, cardiomyopathy, congenital heart disease.
d) Patients with valvular heart disease.
e) Patients with Chronic kidney disease.
f) Patients with pulmonary disease.
g) Patients with other hyper dynamic circulatory states like hyperthyroidism, Beriberi, AV fistula, fever

If patients had congestive cardiac failure due to anemia, they were included in the study two weeks later after failure was controlled.

Results
In our study a total of 65 patients had increased LV mass with respect to body surface area; remaining 35 patients had normal LV mass. Out of 65, 21(60%) were male and 44(67.7%) were females. Increased LV mass was slightly higher in females when compared to males, there was no significant p value when we compared increased LV mass with respect to gender of the patients.

Table 1: Prevalence of increased LV mass in relation to Gender

LV mass g/sq. m	Gender		Total(n=100)	P Value
	Female(n=65)	Male(n=35)		
Normal lv mass	21(32.3%)	14(40%)	35(35%)	0.442

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Increased lv mass	44(67.7%)	21(60%)	65(65%)	0.442

Chi-Square Test/Fisher Exact Test

When analysis of concentric hypertrophy was done, our study showed total of 27 patients had concentric hypertrophy out of which 15 were females and 12 were males. Concentric hypertrophy was slightly more in males (34.3%) compared females (23.1%).

Table 2: Prevalence of Concentric Hypertrophy according to Gender

Concentric Hypertrophy	Gender		Total
	Female	Male	
No	50(76.9%)	23(65.7%)	73(73%)
Yes	15(23.1%)	12(34.3%)	27(27%)
Total	65(100%)	35(100%)	100(100%)

Eccentric hypertrophy was seen in 34 out of 100 patients, of which 24 were females and 10 were males. Eccentric hypertrophy was slightly more in females (36.9%) compared to males (28.6%).

Table 3: Prevalence of Eccentric Hypertrophy according to Gender

Eccentric Hypertrophy	Gender		Total
	Female	Male	
No	41(63.1%)	25(71.4%)	66(66%)
Yes	24(36.9%)	10(28.6%)	34(34%)
Total	65(100%)	35(100%)	100(100%)

In our study, systolic dysfunction was defined as EF < 45% and diastolic dysfunction that is heart failure with preserved ejection fraction is defined as EF >45%. LV dysfunction was seen in 47 patients out of 100 patients. Out of 47 patients with lv dysfunction, systolic dysfunction was seen in 33 patients. Remaining 14 patients had diastolic dysfunction, 53 patients had no LV dysfunction. Out of 33 patients with systolic LV dysfunction, 17 were females and 16 were males. In our study systolic LV dysfunction was predominantly seen in males (45.7%) compared to females (26.2%) with statistically significant p value of 0.047.Out of 14 patients with diastolic LV dysfunction, 10 were females and 4 were males. Diastolic dysfunction in females was 15.4% when compared to males 11.4%. There was no significant p value when we compared diastolic dysfunction with respect to gender of the patients, which suggests diastolic dysfunction was equal in both the gender.

Table 4: Prevalence of LV Dysfunction in relation to Gender

Variables	Gender		Total	P Value
	Female	Male		
Syst. dysfunction				
No	48(73.8%)	19(54.3%)	67(67%)	0.047*
Yes	17(26.2%)	16(45.7%)	33(33%)	
Dia. Dysfunction				
No	55(84.6%)	31(88.6%)	86(86%)	0.765
Yes	10(15.4%)	4(11.4%)	14(14%)	
Total	65(100%)	35(100%)	100(100%)	

Chi-Square Test/Fisher Exact Test

Presence of systolic dysfunction is significantly more with male patients than female patients (45.7% vs 26.2%) with P=0.047*Concentric hypertrophy was correlated with systolic and diastolic dysfunction of left ventricle. Out of 27 patients with concentric hypertrophy 12 patients had systolic dysfunction and 6 had diastolic dysfunction, 9 patients had neither systolic nor diastolic dysfunction

Table 5: Correlation of Concentric Hypertrophy with Systolic Dysfunction

Concentric Hypertrophy	Systolic Dysfunction	
	No	Yes
No	52(77.6%)	21(63.6%)
Yes	15(22.4%)	12(36.4%)
Total	67(100%)	33(100%)

Table 6: Correlation of Concentric Hypertrophy with Diastolic Dysfunction

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Concentric Hypertrophy	Diastolic Dysfunction	
	No	Yes
No	65(75.6%)	8(57.1%)
Yes	21(24.4%)	6(42.9%)
Total	86(100%)	14(100%)

Eccentric hypertrophy was correlated with systolic and diastolic dysfunction of left ventricle, out of 34 patients with eccentric hypertrophy 18 patients had systolic dysfunction and 8 patients had diastolic dysfunction, remaining 8 patients neither had systolic dysfunction nor diastolic dysfunction. Eccentric hypertrophy is significantly associated with both systolic and diastolic dysfunction.

Table 7: Correlation of Eccentric Hypertrophy with Systolic Dysfunction

Eccentric Hypertrophy	Systolic Dysfunction	
	No	Yes
No	51(76.1%)	15(45.5%)
Yes	16(23.9%)	18(54.5%)
Total	67(100%)	33(100%)

P=0.002**, Significant, Chi-Square Test

Eccentric Hypertrophy is significantly associated with Systolic dysfunction with P value of 0.002.

Table 8: Correlation of Eccentric Hypertrophy with Diastolic Dysfunction

Eccentric Hypertrophy	Diastolic Dysfunction	
	No	Yes
No	60(69.8%)	6(42.9%)
Yes	26(30.2%)	8(57.1%)
Total	86(100%)	14(100%)

P=0.049*, Significant, Chi-Square Test

Eccentric hypertrophy is significantly associated with Diastolic dysfunction with p value of 0.049*.
In our study we also correlated ECG changes in severe anemia patients. Following parameters were studied these include Prolongation of p wave duration, LVH with volume overload, LVH with pressure overload. All the 100 patients had sinus tachycardia, left ventricular hypertrophy was seen in total of 39 patients, out of 39 patients with LVH 23 were females and 16 were males. LVH was more seen in males (45.7%) compared to females (35.3%).

Discussion

Anemia is a very common disease worldwide more so in developing regions. Approximately 10% of adult men and 90% of adult women in India have iron deficiency and it is the most common cause of anemia in our country. The prevalence of iron deficiency anemia is greater among infants, pregnant women, and the poor [9].
In our study a total of 100 patients with severe anemia between 15 to 40 years of age were enrolled in which females were 65 and males 35 with mean age of 26.91. Females were predominantly affected with severe anemia.
All patients with haemoglobin <7 gms were included in the study to determine the changes in cardiovascular system.
According to the study by Nikitha Hegde *et al* fatigue and breathlessness were most common feature; our study also showed the same [9].
The prevalence of LV dysfunction in in our study was 47% in which 33 patients had systolic dysfunction and 14 patients had diastolic dysfunction. Systolic dysfunction was more prevalent than diastolic dysfunction. When systolic dysfunction was compared with gender of patients, 45.7% of males had systolic dysfunction when compared to females 26.2%. Systolic dysfunction was predominant in males.
A study by Dr. C.R. Jothi, Dr. R. Umarani and Dr. K. Baburaj significant number of patients had diastolic dysfunction. The low incidence of systolic dysfunction in their study can be explained by the case selection. Study was done in 70 patients with severe anemia which included patients with haemoglobin less than 7 g%, patients aged more than 12 years, those with cardiac diseases other chronic diseases [10]. Our study excluded patients with age more than 40 years, previous cardiac diseases and chronic diseases.
Goncharova *et al* studied left ventricular (LV) function in anemic patients by tissue myocardial Doppler echo in 54 patients with severe iron deficiency anemia (IDA) before treatment and after one month of treatment with sorbifer combined with triovit. Concluded that diastolic dysfunction was found in the

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majority of patients with anemia which improved one month after treatment [11].
Concentric hypertrophy and eccentric hypertrophy were correlated with systolic and diastolic dysfunction. In our study, there were 33 patients with systolic dysfunction and 14 patients had diastolic dysfunction alone and remaining 53 patients had no LV dysfunction.
Prevalence of concentric hypertrophy was 27% and eccentric hypertrophy was 34%. A study by Farquana Qushnood *et al*. [12] showed predominant eccentric hypertrophy in severe anemic patients our study also showed predominant eccentric hypertrophy.
When eccentric hypertrophy was correlated with systolic and diastolic dysfunction, our study showed predominant systolic dysfunction (52.9%). Systolic dysfunction was common in our study compared to other study because our study all patients had severe anemia with mean Hb 5.42gms/dl when compared to other study where the mean Hb was 7.96. Systolic dysfunction in these patients could be due to high output failure (persistent tachycardia and high stroke volume).
In our study we noticed that 53 patients had no LV dysfunction despite of severe anemia, the reason could be that our study included younger population with mean age 26.91±7.38.
There are conflicting reports of Ejection Fraction in literature while Bahl *et al*., [13]. And Panwar *et al*., [14]. noted a decreased EF in anemic subjects. In the present study EF was found to be low in only 47% and normal in remaining.
There was a statistically high association between anemia and left ventricular hypertrophy. This was consistent with Hussein *et al* 59 who had examined the relation between anemia and LVH.

Conclusion

Severe anemia leads to increase in LV mass in which predominantly patients had eccentric hypertrophy whereas few had concentric hypertrophy. Both systolic and diastolic dysfunction can be present in anemia.

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