Section: General Medicine

Original Research Article

ASSESSMENT OF LEFT VENTRICULAR FUNCTION IN PATIENTS WITH VARIOUS GRADES OF ANEMIA BY TWO-DIMENSIONAL ECHOCARDIOGRAPHY /COLOUR DOPPLER EXAMINATION

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Abstract

Background: Anaemia affects people of all ages and is the second most common source of disability worldwide. It has been established that anemia and dysfunctional left ventricular diastole are related. Left ventricular (LV) function is a significant indicator of cardiac morbidity and mortality. Echocardiography plays a significant role in the assessment of LV function. To study left ventricular function in patients with anemia. We assessed the left ventricular function in patients with various grades of anemia and also correlated it with the severity of anemia using 2D echocardiography and colour Doppler examination. **Materials and Methods:** This observational study was conducted on 102 patients with various grades of anemia in the department of general medicine at Susheela Tiwari Government Hospital. All patients were subjected to various investigations such as 2D echocardiography, a 12-lead ECG, a chest X-ray PA view, and haematological measurements. All the findings were recorded, tabulated, and subjected to appropriate statistical analysis. **Result:** Data study findings showed the statistically significant association of various grouped variables and echo parameters with the severity of anemia like LVEF, LVEDd, LVESd, IVSTd, PWId, and LVMI with a significant 2 tailed Pearson correlation coefficient p<=0.005. **Conclusion:** In the present study, evidence of systolic and diastolic dysfunction in the left ventricle was found in the form of increased left ventricular dimensions. Also, evidence of diastolic dysfunction was seen more predominantly with increasing severity of anemia. Further studies with a larger sample size are required to substantiate the findings.

INTRODUCTION

Anemia is the most common form of nutritional deficiency in both developed and developing countries. World Health Organization (WHO) defines Anemia as hemoglobin levels < 13 g/dL (hematocrit < 39 %) in males, < 12 g/dL (hematocrit < 36 %) in non-pregnant females, and < 11 g/dL (hematocrit <33 %) in pregnant females.[1] WHO estimates that 42 % of pregnant women, 30 % of non-pregnant women (aged 15 to 50 years), 47 % of preschool children (aged 0 to 5 years), and 12.7 % of men older than 15 years worldwide are anemic.[2] Iron deficiency is the predominant cause of anemia across countries, with women more commonly afflicted than men.[3]

In the last decade, anemia was recognized as an important comorbid factor in heart failure, a factor limiting physical activity, responsible for a poor quality of life, and a predictor of unfavourable outcomes. It has reported that myocardial contractility would decrease when hemoglobin was below 7 g/dL and chronic anemia would result in increased LV end-diastolic pressure as well as decreased functional reserve.[4,5] Left ventricular (LV) function is an important predictor of cardiac morbidity and mortality. Approximately 50% of HF patients present with evidence of left ventricular systolic dysfunction manifested as a low left ventricular ejection fraction.[6] The role of echocardiography in the assessment of LV function is well established and has been expanded over the last few years with the development of new methodologies. Echocardiography can assess LV

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global and regional function, as well as systolic and diastolic function. Till now several studies in patients with diabetes, chronic kidney disease or coronary artery disease have supported an association between anemia and left ventricular diastolic dysfunction. The purpose of present study is to assess left ventricular function in patients with various grades of anemia and to correlate left ventricular function with severity of anemia using 2D Echocardiography /Colour Doppler Examination.

MATERIALS AND METHODS

This was a cross-sectional study conducted on 102 patients with various grades of anemia in the department of General Medicine at Susheela Tiwari Government Hospital. Ethical approval was obtained from institutional ethical committee and written consent was obtained from all patients after explaining in detail the entire research protocol. Anemia was classified using WHO grading of anemia.

Investigations included the following:

2D Echocardiography measurements
12 lead ECG
Chest X ray PA view
Hematological Measurements

Parameters assessed in 2D ECHO examination:

Left Ventricular Ejection Fraction (LVEF)
Left ventricular end diastolic dimension (LVEDD)
Left Ventricular Mass Index [LVMI]
Fractional Shortening

Formulas used

Left Ventricular Ejection Fraction was calculated using 4 chamber view on Echocardiography on Parasternal Long axis view by the formula:

(LVEF)= EDV-ESV / EDV × 100

Modified Simpson's Rule was used for calculation of EDV, ESV and LVEF.

Fractional Shortening was computed by the formula:

FRACTIONAL SHORTENING% = (LVEDD-LVESD) / LVEDD× 100

Where

LVEDD= Left Ventricular End Diastolic Dimension
LVESD= Left Ventricular End Systolic Dimension

Left Ventricular Mass Index [LVMI] was calculated by CUBE formula using linear method of calculation.

LVMI=LVM (left ventricular mass)/body surface area

Left ventricular mass=0.8{1.04[([LVEDD + IVSD +PWD] 3 - LVEDD3)]} + 0.6

Where

LVEDD = LV end-diastolic dimension (mm)
IVSD = interventricular sepal thickness at end-diastole (mm)
PWD = posterior wall thickness at end-diastole (mm)

All data was tabulated and subjected to appropriate statistical analysis.

RESULTS

Descriptive

In our study, a total of 102 patients with various grades of anaemia were enrolled in which females were 58; males were 44 and the mean age was 48.83±10.03 years [Figure 1]. Majority of cases had moderate anemia (36.3%) followed by severe anemia (34.3%) and mild anemia (29.4%). The other echocardiographic characteristics of the study participants are represented in [Table 1].

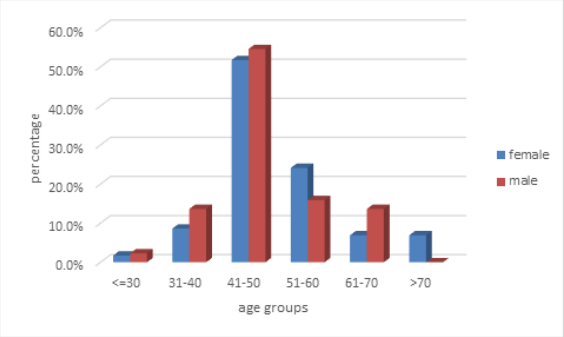

Figure 1: Association between sex and age group

Table 1: Descriptive analysis of all parameters

	Minimum	Maximum	Mean	Std. Deviation
Age	22.00	76.00	48.83	10.03
Hb levels(g/dl)	4.60	12.90	8.67	2.19
LVEF%	59.00	66.00	62.59	1.78
LVEDd(cm)	4.20	4.90	4.55	0.16
LVESd(cm)	2.84	3.62	3.27	0.18
IVSTd (cm)	0.73	1.10	0.94	0.12
PWId (cm)	0.10	1.06	0.87	0.10
LVMI(g/m2)	122.00	205.00	155.55	28.25
Fractional shortening	17.95	35	27.89	4.26

Data are expressed as mean±SD. LVEF-Left Ventricular Ejection Fraction, LVEDd -Left Ventricular end diastolic diameter, LVESd -Left Ventricular End Systolic Diameter, IVSTd -End diastolic thickness of ventricular septum, PWId -End diastolic thickness of LV posterior wall, LVMI -Left Ventricular mass index

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Echocardiographic parameters

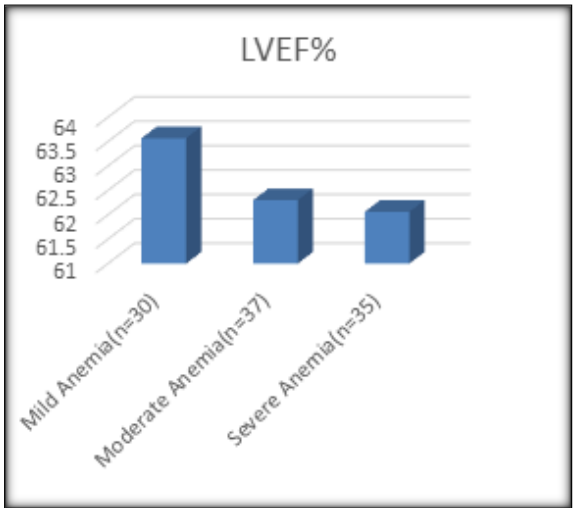
There was statistically significant association of various grouped variables and echo parameters with severity of anemia like LVEF, LVEDd, LVESd, IVSTd, PWId, LVMI and with significant 2 tailed Pearson Correlation coefficient p<=0.005 [Table 2]

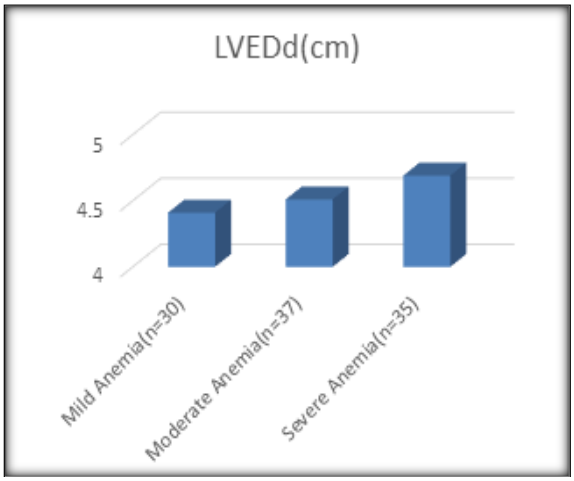
Table 2: Comparison of various grouped variables and echo parameters according to severity of anemia

	Mild Anemia(n=30)		Moderate Anemia(n=37)		Severe Anemia(n=35)		F value	Significance
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation		
Hb levels (g/dl)	11.58	0.57	8.51	0.48	6.35	0.84	527.58	<0.001
LVEF%	63.57	1.36	62.30	1.78	62.06	1.81	7.40	0.001
LVEDd(cm)	4.41	0.09	4.51	0.12	4.69	0.14	49.30	<0.001
LVESd(cm)	3.21	0.18	3.35	0.17	3.25	0.16	5.99	0.004
IVSTd (cm)	0.77	0.06	1.01	0.03	1.01	0.05	310.49	<0.001
PWId (cm)	0.83	0.05	0.86	0.05	0.91	0.15	5.95	0.004
LVMI(g/m2)	125.93	4.72	160.86	26.05	175.31	20.64	51.33	<0.001
Fractional shortening	27.21	3.75	25.79	4.42	30.68	2.82	16.06	<.001
Age	46.97	8.079	51.00	10.157	48.14	11.202	1.47	.233

Data are expressed as mean±SD.

LVEF% was 63.57±1.36 % in mild cases, 62.30±1.78% in moderate while it was lowest in severe cases with 62.06±1.81. LVEDd (cm)was 4.41±0.09 cm in mild cases, 4.51±0.12cm in moderate while it was largest in severe cases with 4.69±0.41 cm. LVESd (cm)was 3.31±0.18 cm in mild cases, 3.35±0.17cm in moderate while in severe cases it was 3.25±0.16 cm. IVSTd (cm)was .77±0.06 cm in mild cases, 1.01±0.03cm in moderate while in severe cases it was 1.01±0.05 cm. PWID (cm)was .83±0.05 cm in mild cases, 0.86±0.05cm in moderate while in severe cases it was 0.91±0.15 cm. LVIM (gm/m2)was 125.93±4.72 in mild cases, 160.86± 26.05 in moderate while in severe cases it was 175.31±20.64. Fractional shortening was 27.21± 3.75 in mild cases, 25.79± 4.42 in moderate while in severe cases it was 30.68±28.82. No significant difference was seen among LVESd (cm), IVSTd (cm), PWID (cm) values of females and males.





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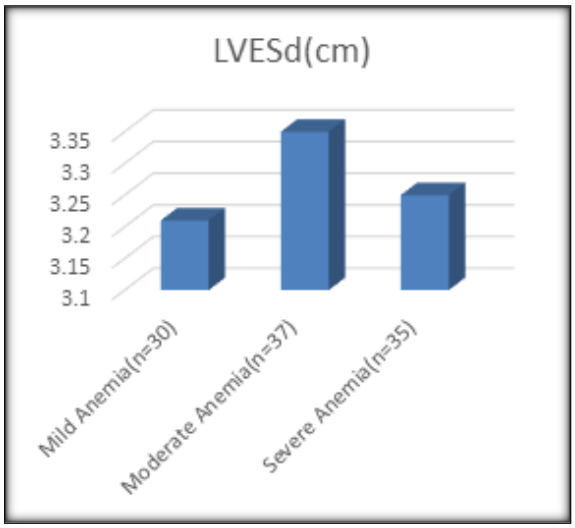
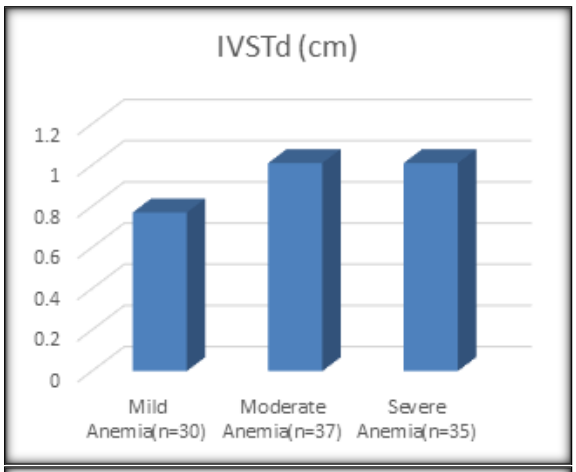
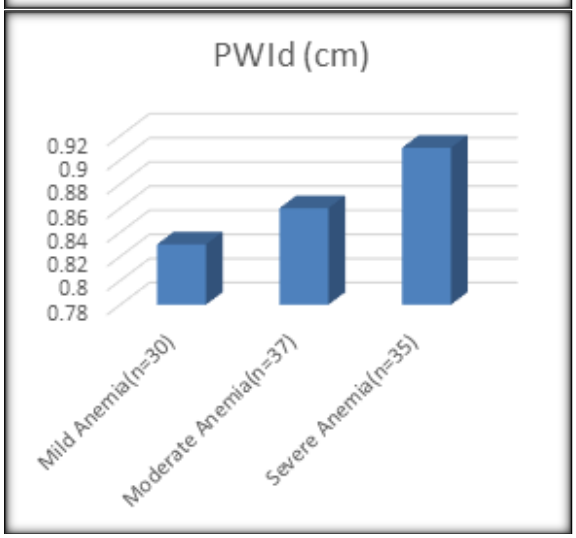
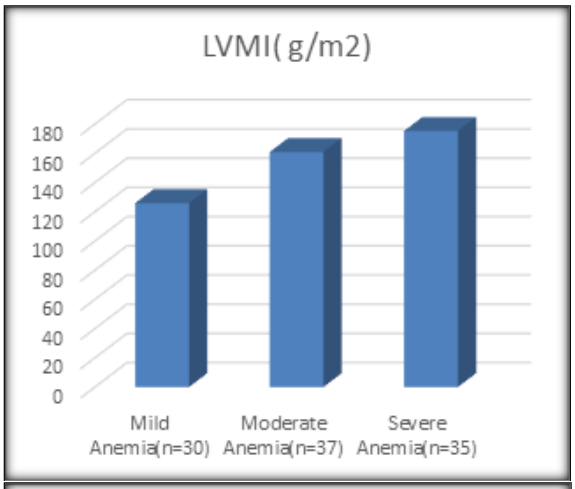








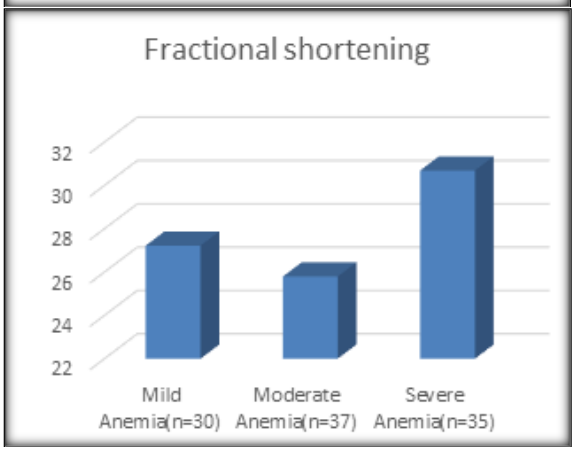
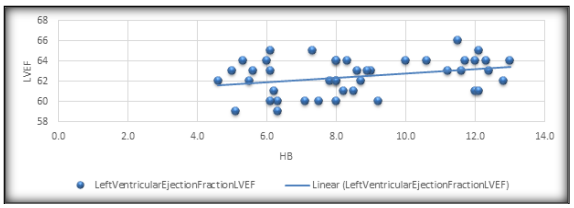


Figure 2: showing the comparison of LVEF, LVEDd, LVESd, IVSTd, PWId, LVMI, and Fractional Shortening according to severity of anemia.

Correlation of hemoglobin with other parameters

Weak positive and statistically significant association (r=.3) existed between Hb and LVEF which implies that as hemoglobin increases LVEF also increases (weak). Strong negative and statistically significant association (r=-.7) existed between Hb and LVEDd which implies that as hemoglobin increases LVEDd decreases. Strong negative and statistically significant association (r=-.7) existed between Hb and IVSTd which implies that as hemoglobin increases IVSTd decreases. Weak negative and statistically significant association (r=-.2) existed between Hb and LVMI which implies that as hemoglobin increases LVMI also increases (weak).



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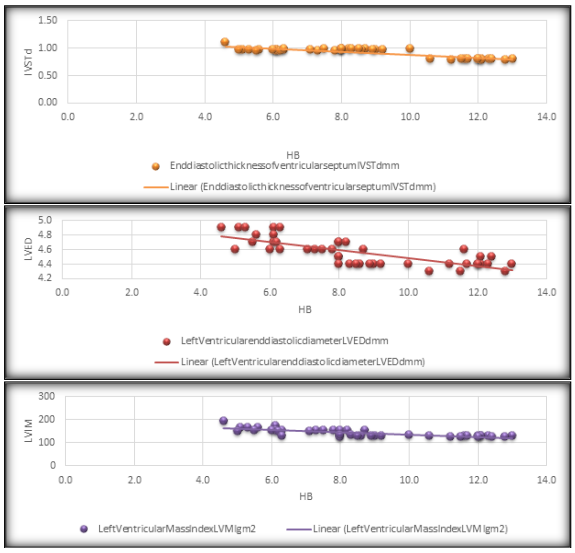

Figure 3: showing the correlation between HB and LVEF, IVSTd, LVEDd, LVMI.

DISCUSSION

In accordance with the study conducted by Patidar et al,[7] and Sarin et al,[8] Females predominated in our study. Female predominance in our study could be attributed due to various factors which include blood loss due to menstruation, poor intake, malabsorption, and pregnancy related factors. We found that the mean hemoglobin levels were 8.67±1.67gm/dl which was approximately similar to the studies conducted by kim et al,[9] and Hakk Simsek et al.[10] In contrast, in a study by Jeong Cho et al,[11] the mean Hb was 5.8 ± 1.4, this difference could be explained by the fact that majority of patient in this study have moderate anemia.

The mean LVEF in the present study was 62.59±1.78%. In a study by Cho et al,[11] the mean EF% was 63.4 ± 4.4 . In a study by Kim et al,[9] the mean EF% was 63.89±7.99. Regarding the EF level, it was observed that it was well within the normal limit however it was reduced in moderate and severe anemia. The result of this study was proximate to the study done by Dr. C.R. Jothi.[12] This result corresponded to fact that myocardial contractility would decrease when hemoglobin was below 7 g/dL and subsequent lead to decrease EF. There are conflicting reports of Ejection Fraction in literature while Bahl et al and Panwar et al noted a decreased EF in anemic subjects.[13,14]

The mean LVEDd and LVESd in present study was 4.54±.16 cm (4.2-4.9) and 3.27±.175 (2.84-3.62) cm. LVEDd (cm) was largest in severe cases with 4.69±0.41 cm. Left ventricular end-systolic (2.2 ±0.4 mm) and Left ventricular end-systolic stress (3.3±0.5) was significantly greater in the patients with severe anemia according to the study conducted by Bahl et al.[13] The increase in LVIDs is attributed to hyperdynamic circulatory state. Anemia is known to cause vascular and cardiac changes mainly increased preload and decreased afterload. These factors increase systolic wall stress. Over time this stress weakens the LV and leads to LV systolic dysfunction. In the study by Shen et al,[15] there were no significant differences between mild and no anemia between LVEDs (all $P > 0.05$). However that was significantly higher in patients with moderate anemia which was in accordance to the present study.

The IVSTd was significantly less in mild anemia then moderate and severe anemia. In a study by Dhundasi et al,[16] no statistically significant difference was found for means of IVSTs of patients with anemia and without anemia ($t = 1.889$, $p > 0.05$). The IVSd in anemic patients in a study by Sarin et al,[8] was 8.52±1.64. The septal wall thickness in the study by Cho et al,[11] was 8.8 ± 1.5 mm and posterior wall thickness was 8.0 ± 1.3 mm.

In present study regarding the mean of posterior wall thickness, it was found that mean of PWTD was 89±0.14 for male and 0.85±0.06 for female which corresponded to the results of Hakki Simsek et al.[10] Both study showed that PWTD have normal thickness but with upper limit. The results of the present study were in accordance with Qiao Zhou et al study.[17] Both study showed that septal wall thickness are elevated in severe and moderate group while Posterior Wall thickness are elevated in severe group only, this related to fact that as consequence to structural remodeling in hyperdynamic circulatory, increasing in septal wall thickness preceded posterior wall thickness.

In a study by Patidar et al,[18] the LV mass was significantly increased in patients with severe anemia. Our study showed that LV mass was elevated in all group of severity. This is mainly related to a persistently hyperdynamic circulatory state in patients with IDA, which is associated with remodeling of the myocytes and vasculature. Also the present study was consistent with the study by Jothi et al.[12] The increased LV mass reflects a hypertrophic response to chronic volume overload state, which is well documented in literature.

CONCLUSION

As per this Echocardiographic study of left ventricular function in patients of anemia presenting to a tertiary care centre in Kumaon region of Uttarakhand, anemia was more in females than in males. Evidence of systolic dysfunction on left ventricle was found in form of increased left ventricular dimensions. Also in present study evidence of diastolic dysfunction was noted in the form of increased left ventricular dimensions and was noted more predominantly with increasing severity of anemia.

Limitations

In present study Iron profile& vitamin B12 were not available in the centre so type of anemia was not taken in account. Also sample size of the study was less. This was a cross-sectional study, so of for correction of anemia, effects of the hemoglobin

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concentration on heart functions could not be assessed as follow ups were not done in the study.

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