An echocardiographic study of cardiac functions in patients of severe anemia

Dr. Saakshi Sarin, Dr. Tejinder Talwar, Dr. BK Agrawal and Tarika

Abstract
Anemia is world’s second leading cause of disability and widely prevalent among all age groups. Studies done in patients with diabetes, CKD or CAD have supported an association between anemia and left ventricular diastolic dysfunction. The current study was undertaken to seek whether low Hb level is related to left ventricle structure and left ventricle filling pressure in patients. Total 60 patients, 30 with severe anemia and 30 normal subjects were taken using simple random sampling. All patients were subjected to various investigations such as CBC, PBF, Chest X-ray, ECG, 2Dechocardiography etc. Data study findings show significant changes in terms of cardiac functions such as left ventricle end diastole dimension EDV, SV, EF, CO, Cardiac index, left ventricle mass index etc. in study group as compared to control group. Based on the findings of the study it was concluded that conventional echocardiography is a simple test for detecting left ventricular dysfunction in patients of severe anemia and suggest the need for correction of anemia to reverse and prevent left ventricular dysfunction.

Keywords: Anemia, echocardiography, cardiac functions, left ventricular dysfunction

1. Introduction
Anemia is major public health problem and remains one of the most prevalent and enfeebling morbidities suffered by individuals in the developing world and is a critical co morbid factor contributes to the excess mortality in these regions [1]. The WHO Global Database on Anemia estimated the prevalence of anemia worldwide at 25 % with the prevalence being as high as 43% in the developing countries [2, 3]. Africa and Asia account for more than 85% of the absolute burden in the high risk groups and India is the worst hit affecting 74.3% of population [4]. Anemia reduces oxygen delivery to tissue and causes a compensatory cardiovascular response [5]. Anemia has been convincingly shown to be a powerful predictor of rehospitalization rates and survival in chronic heart failure [6]. Hemodynamic changes accompanying severe anemia include increased preload, reduced peripheral vascular resistance, and increased cardiac output. These adaptive responses may ultimately lead to a detrimental increase in the left ventricular mass. Anand et al. [7] have reported that 1gm/dl increase in hemoglobin concentration is associated with 4.1gm/m2 decrease in the left ventricular mass index during 24 week period. Anemia has shown to be associated with reversible elevations in plasma catecholamines and alpha 2 receptors density among patients with renal failure. Finally, chronically increased myocardial work and adrenergic stimulation caused by decreased oxygen carrying capacity may ultimately lead to progression of heart failure and may accelerate adverse ventricular remodeling [8]. Several studies in patients with diabetes, chronic kidney disease or coronary artery disease have supported an association between anemia and left ventricular diastolic dysfunction [9-11]. The purpose of present study is to seek whether low hemoglobin level is related to left ventricular structure and left ventricular filling pressure in patients.
2. Review of Literature
Hussain et al. [12], conducted a transthoracic Doppler echocardiographic study in 200 patients to evaluate the relationship between anemia and diastolic dysfunction of the heart. Among the anemic group 12 participants had left ventricular hypertrophy while no subject from the control group had left ventricular hypertrophy. The correlation was statistically significant. Among these participants who had diastolic dysfunction, 6 participants were having left ventricular hypertrophy and 2 participants had not. The correlation between left ventricular hypertrophy due to anemia and diastolic dysfunction was statistically highly significant.

Simsek H et al. [13], studied 97 patients who had iron deficiency anemia and 50 healthy subjects. Compared to control group, patients with iron deficiency anemia showed significantly longer maximum P wave duration, P wave dispersion, mitral inflow deceleration time and isovolumetric relaxation time. Based on the findings study concluded that Iron deficiency anemia may be associated with prolonged wave duration and dispersion as well as impaired diastolic left ventricular filling.

Nair D et al. [10] performed a cross sectional study to evaluate the association of anemia with diastolic dysfunction and left ventricular hypertrophy in outpatients who had coronary artery disease. The prevalence of diastolic dysfunction ranged from 8% of participants who didn’t have anemia to 13% in those who had moderate anemia to 24% in those who had severe anemia. Anemia was found to be strongly associated with diastolic dysfunction but not with left ventricular hypertrophy in this community based sample of outpatients who had established coronary disease.

Dasarthy et al. [14], studied thirty patients of severe anemia and observed an increase in LV end diastolic volume, pre ejection period index and isometric contractions. There was increased LV mass, non-compliance of LV, increased cardiac output and cardiac index.

3. Methodology
This study was conducted at M.M. Institute of Medical Sciences and Research, Mullana, Ambala. Total 60 patients were selected from OPD and indoor wards of medical department using simple random sampling. Out of 60 patients, 30 patients of severe anemia (Hb<7gm/dl) between 20-50 years of age comprised Group 1 (Study group). Group 2 (Control group) comprised of 30 age and sex matched normal subjects. All patients were subjected to detailed history and systemic examination after taking consent. They were subjected to various investigation such as CBC, PBF, Reticulocytes count, MCV, MCH, MCHC, Platelet count, BT, CT Serum creatinine, Urine examination, RBS,TSH, Bone marrow aspiration,(wherever indicated), USG abdomen in patients with raised(serum creatinine ), Chest X-ray, ECG and 2D echocardiography.

Patients with underlying disorder of cardiovascular system, DM, Thyroid, CRF, and chronic respiratory distress were excluded from the study. Subjects were treated as per standard treatments schedule except beta blockers, which were withheld one week before echocardiographic study.

3.1 Data Analysis
Statistical analysis was done using percentage, mean values, standard deviation, standard errors, Chi² test with yates correction, and unpaired t test, p values <0.005 was considered statistically significant and of <0.001 was considered statistically highly significant.

4. Results
- The mean age in group 1 was 31.3±8.65 years as compare to 32±8.77 years in group 2. Male: female ratio being 0.42:1.
- 63.33% of the patients had microcytic hypochromic picture in the peripheral blood film. Mean hemoglobin in anemic case group was 2.5-5.5gm/dl and in control group was 11-13 gms/dl.
- Cardio thoracic ratio was significantly more in patients with severe anemia when compared to control group (p<0.001)
- EA ratio being the most sensitive and specific parameter for diastolic dysfunction was 1.1±0.19 in group 1 and 1.22±0.12 in group 2. The difference was statistically significant (p<0.005)
- Mean of DT of E was 183.73±28msec in group 1 and 170.32±17.19 msec in group 2. The difference was statistically significant (p<0.05)
- The mean IVRT of 97.64±15.12 msec was significantly higher in group 1 as compared to85.46±11.01 msec in group 2 (p<0.01)
- In group 1 13.3% patients were found to have diastolic dysfunction. None in the group 2 have diastolic dysfunction.
- In group 1, 56.5% had left ventricular hypertrophy while none from the group 2 had left ventricular hypertrophy of the anemic patients (group1) who had LVH, 23.5% had diastolic dysfunction. Among the remaining without LVH, none had diastolic dysfunction.

<table>
<thead>
<tr>
<th>Dimensions (mm)</th>
<th>GROUP 1</th>
<th>GROUP 2</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LVIDd</td>
<td>41-58</td>
<td>50.2±5.55</td>
<td>40-56</td>
</tr>
<tr>
<td>LVIDs</td>
<td>24-41</td>
<td>31±5.05</td>
<td>25-41</td>
</tr>
<tr>
<td>IVSd</td>
<td>6-12</td>
<td>8.52±1.64</td>
<td>6-11</td>
</tr>
<tr>
<td>IVSs</td>
<td>12-20</td>
<td>12.3±3.2</td>
<td>9-15</td>
</tr>
<tr>
<td>LVPWd</td>
<td>6-14</td>
<td>8.48±1.98</td>
<td>6-11</td>
</tr>
<tr>
<td>LVPWs</td>
<td>10-18</td>
<td>14.1±2.23</td>
<td>10-17</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LV Index (%)</th>
<th>GROUP 1</th>
<th>GROUP 2</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF</td>
<td>74.5 ±10.1</td>
<td>71.32±8.29</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>FS</td>
<td>36.5 ±9.63</td>
<td>31.56±7.74</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>
International Journal of Applied Research

Table 3: Showing left ventricular mass and left ventricular mass index n=60

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Group 1</th>
<th>Group 2</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LV Mass (gm)</td>
<td>193.4±63.51</td>
<td>155.3±40.27</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>LV Mass Index (gm/m²)</td>
<td>128±45.74</td>
<td>96.8±12.33</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

Table 4: Showing hemodynamic parameters n=60

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Group 1</th>
<th>Group 2</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart rate (bpm)</td>
<td>89.52±14.58</td>
<td>77.4±8.82</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Cardiac Output (l/min)</td>
<td>8.2±3.01</td>
<td>5.8±1.51</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Cardiac Index (l/min/m²)</td>
<td>5.52±2.4</td>
<td>3.4±0.76</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>PVR</td>
<td>11.32±4.73</td>
<td>15.02±3.93</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

5. Discussion

In present study, cardiac output as well as cardiac index was significantly higher as validated by studies done of cardiac functions in anemia. The high cardiac output may be because of various factors such as increased preload as evidenced by increased LVIDd, increased myocardial contractility, afterload reduction by decreased vascular resistance and increased LVIDd, increased myocardial contractility, of various factors such as increased preload as evidenced by increased LV Mass and LV Mass Index.

In the present study EF was found to be insignificantly raised because of increased preload, better myocardial contractility and decreased afterload.

The detrimental effect of anemia on diastolic functions of the heart as observed in present study was consistent with the studies undertaken by Takahashi M et al and Panwar et al.

There are conflicting reports of Ejection Fraction in literature while Bahl et al. And Panwar et al. Noted a decreased EF in anemic subjects, Khan et al. found EF to be increased. In the present study EF was found to be insignificantly raised because of increased preload, better myocardial contractility and decreased afterload.

The detrimental effect of anemia on diastolic functions of the heart as observed in present study was consistent with the studies undertaken by Takahashi M et al and Panwar et al.

There was a statistically high association between anemia and left ventricular hypertrophy. This was consistent with Hussein et al. Who had examined the relation between anemia and LVH.

A highly statistical correlation between LVH due to anemia and diastolic dysfunction of the heart had been found in the study. This was consistent with studies predominantly done in cohorts that had established kidney disease that found anemia to be linked to LVH.

6. Conclusion

Cardiac dysfunction, predominantly involving LV diastolic function is not uncommon in patients with severe anemia. Left ventricular mass is found to increase in patients of severe anemia. Features of congestive heart failure may develop in patients of anemia with significant increase in LV mass which leads to decreased compliance and diastolic dysfunction. Conventional echocardiography is a simple test for detecting LV dysfunction in patients of severe anemia and suggests the need for correction of anemia to reverse and prevent left ventricular dysfunction.

7. References