To Study the Electrocardiographic Changes in Chronic Severe Anemic Patients

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Conflicts of Interest: Nil.

Abstract

Background: Anemia is defined as reduction of total circulatory red cell mass below normal limits, it is measured by reduction in hematocrit, and reduction in Hemoglobin concentration of blood. Several studies in patients with diabetes, chronic kidney disease, or coronary artery disease have supported an association between anemia and left ventricular(LV) diastolic dysfunction

Aims and Objectives: To record the electrocardiographic changes in chronic severe anaemic patients. To compare the findings with control group.

Material and Methods: This study was conducted at M.M. Institute of Medical Sciences and Research, Mullana, ambala. 50 patients of severe anemia (Hemoglobin<8gm/ dl) between 20 to50 years of age free of cardio-respiratory diseases were taken from OPD and indoor wards of medicine department during Oct 2012 to Dec 2014 . 50 age and sex matched controls were taken for comparative study. All the patients were scrutinized and investigated as per the plan. All were subjected to evaluation by electrocardiogram.

Results: In our study there the changes were due to hypoxia of the myocardium occurred due to decreased oxygen carrying capacity of blood because of decreased Hb concentration. So the abnormalities were chiefly due to subendocardial ischemia showing abnormal pattern of ST segment (depression, in some cases elevation) & T wave (inversion) in ECG without associated QRS abnormality.

Conclusion: Electrocardiogram can be used as a sensitive tool to assess morbidity associated with severly ill patients.

Keywords: Electrocardiogram, chronic severly ill patients, X ray, RFT.

Introduction

Anemia remains one of the most prevalent and enfeebling morbidities suffered by individuals in the developing world and is a co-morbid factor contributing to the excess mortality in these regions (WHO, 2001). Anemia is a major public health problem throughout the world, particularly in the developing countries.[1]Anemia is defined as reduction of total circulatory red cell mass below normal limits, it is measured by reduction in hematocrit, and reduction in Hemoglobin concentration of blood. It can include decreased oxygen-binding ability of each Hemoglobin molecule due to deformity of RBCs or lack numerical development as in some other types of Hemoglobin deficiency. The WHO Global Database on Anemia estimated the prevalence of anemia worldwide at

25 percent with the prevalence being as high as 43% in the developing countries Africa and Asia account for more than 85% of the absolute burden in high-risk groups and India is the worst hit affecting 74.3% of population.[2,3,4]The National Family Health Survey-3 (NFHS-3) data suggests that anemia is widely prevalent among all age groups, and is particularly high among the most vulnerable-nearly 58% among pregnant women, 50 % among non-pregnant non-lactating women, 56% among adolescent girls (15-19 years), 30% among adolescent boys and around 80% among children under 3 years of age[5].

Hemoglobin levels to diagnose anemia at sea level (g/dl)[6]

Age groups	No Anemia	Mild	Moderate	Severe
6-59 months	≥11	10-10.9	7-9.9	<7
5- 11 years	≥11.5	11-11.4	8-10.9	<8
12-14 years	≥12	11-11.9	8-10.9	<8
Non-pregnant Women	≥12	11-11.9	8-10.9	<8
Pregnant women	≥11	10-10.9	7-9.7	<7
Men	≥13	11-12.9	8-10.9	<8

Heart is affected according to the degree and severity of anemia and presence or absence of secondary circulating changes in the body. Anemia may lead to increased cardiac output, increased heart rate, vasodilatation and in long term it may lead to cardiac enlargement & left ventricular hypertrophy. Mild anemia seems to be compensated by shift in oxygen dissociation curve. Over all oxygen consumption is unaltered in anemia. However when Hemoglobin level falls below 7gm/dl, there is an increase in cardiac output both at rest and after exercise. As there is increase in stroke volume and heart rate and a state of hyperkinetic circulation develop as is evident by tachycardia, arteriolar and capillary pulsation, wide pulse pressure and haemic murmur. Vasodilatation with reduced after load play a major role in hyperkinetic circulatory response to anemia. Systemic vascular resistance is decreased in proportion to severity of anemia.[7] The abnormalities found in electrocardiogram (ECG) were due to myocardial hypoxia resulting from decreased oxygen carrying capacity of the blood. To overcome myocardial hypoxia various hemodynamic and non hemodynamic mechanisms come to play a role to compensate for anemia. But in the long term, hemodynamic alterations lead to gradual development of cardiac enlargement & hypertrophy. So if anemia remains untreated it may lead to cardiac complications which lead to poor prognosis.[8,9]Anand et al[10] reported that 1g/dl decrease in Hemoglobin concentration is associated with a increased 4.1 g/m^2 in left ventricular mass index during 24-week period. Increased left ventricular mass consistently has been demonstrated to be a significant factor for poor prognosis of myocardial ischemia may also be precipitated from reduced oxygen carrying capacity combined with increased left ventricular mass and increased wall stress. Several studies in patients with diabetes, chronic kidney disease, or coronary artery disease have supported an association between anemia and left ventricular(LV) diastolic dysfunction. It is well known that cardiac symptoms such as dyspnoea, palpitations and sometimes steno-cardiac pain may develop in the course of anemia. The incidence of electrocardiographic abnormalities varies significantly in different studies ranging from 10-80%[11,12].

Material and Method

This study was conducted at M.M. Institute of Medical Sciences and Research, Mullana, ambala. 50 patients of severe anemia (Hemoglobin<8gm/ dl) between 20 to50 years of age free of cardio-respiratory diseases were taken from OPD and indoor wards of medicine department during Oct 2012 to Dec 2014. 50 age and sex matched controls were taken for comparative study. All patients were subjected to detailed history and systemic

examination as per proforma attached after taking consent. All patients were subjected to following investigations at the beginning of the study-

- CBC: Hb, TLC, DLC, ESR, PBF for type of anemia, Reticulocyte count, MCV, MCH, MCHC, Platelet count, BT, CT
- Complete urine examination
- RBS
- RFT
- TSH,T_3,T_4(if required)
- X-ray chest PA view.
- Standard 12 lead ECG.
- Resting ECG recorded

Inclusion Criteria:
- Chronic Anemia with Hb <8gm/dl.
- Duration of anemia>3months. The symptoms such as dizziness, palpitation, weakness, and appetite loss were continued for 3 months or more.

Exclusion Criteria:
- Underlying disease of cardiovascular system like IHD, RHD, Congenital Heart Disease,Systemic arterial hypertension etc.
- Endocrinal disease.
- Renal and renovascular disease.
- Respiratory disease.

Observations

Group I - Severe anemia patients (study group)

Group II- Normal population (control group)

TABLE 1 : SHOWING SEX DISTRIBUTION

SEX	GROUP I n =50	GROUP II n= 50	PERCENTAGE (%)
MALE	18	18	36%
FEMALE	32	32	64%

In the study group I (case) as well as group II (control) , 18(36%) were male and 32(64%) were females shown in table 1. Male to Female ratio was 0.56:1.

TABLE 2: SHOWING AGE DISTRIBUTION

AGE GROUPS (YEARS)	GROUP I(CASE) n=50	GROUP II(CONTROL) n=50	PERCENTAGE (%)
20-30	24	24	48%
31-40	18	18	18%
41-50	8	8	16%

Data regarding age distribution is shown in table 2. Patients distribute in three age groups according to their age . Out of 50 patients 24(48%) were between the age group of 20-30 years, age group 31-40 consist of 18(36%) patients, age group 41-50 consist of 8(16%) patients. There was no statistically significant difference between the two groups both case and control was comparable for age and sex.

TABLE- 3: SHOWS MARITAL STATUS OF THE STUDY GROUP.

MARITAL STATUS	CASE n= 50	PERCENTAGE (%)
SINGLE	12	24%
MARRIED	38	76%
TOTAL	50	100%

In the study group out of 50 patients 12(24%) were single and 38(76%) were married.

As observed on peripheral blood film examination the type of anemia in group I(case) is shown in table 6. Majority of the patients showed microcytic hypochromic blood film in concordance with the high prevalence of iron deficiency anemia.

TABLE 4: SHOWING CARDIO-THORACIC RATIO.

CARDIO-THORACIC RATIO	GROUP I (case)	GROUP II (control)
Range	0.4-0.6	0.4-0.5
Mean	0.49±0.05	0.47±0.02

The mean cardiothoracic ratio 0.49±0.05 in GROUP I (case) as compared to 0.47±0.02 in group II (control). The difference is statistically significant ($p<.05$).

TABLE 5: SHOWS P WAVE ABNORMALITY

	GROUP I (case)	GROUP II (control)
P-WAVE ABNORMALITY	4(8%)	1(2%)

P- Wave abnormality recorded in 4(8%) patients in group I and in 1(2%) patients in group II. The difference was statistically not significant ($P < 0.1$).

TABLE 6: SHOWS PR- INTERVAL CHANGES

	PR-INTERVAL (RANGE)	MEAN	PR- INTERVAL ABNORMALITY	PERCENTAGE
GROUP I (case)	0.10-0.20	0.14±.02	Nil	-
GROUP II (control)	0.12-0.20	0.14±0.2	Nil	-

The mean PR- INTERVAL in GROUP I (case) was .14±.02/sec which was same as in group II (control) and was no PR-Interval abnormality recorded in both groups.

TABLE 7: SHOWS QRS COMPLEX CHANGES

	GROUP I (case) n=50	GROUP II (control) n=50
LVH	14(28%)	2(4%)

In group I (case) 14(28%) shows changes of LVH which was significantly higher than the group II (control) 2(4%)(p<0.05).

TABLE 8 : SHOWS QTc INTERVAL CHANGES

	GROUP I (case) n=50	GROUP II (control) n=50
LVH	14(28%)	2(4%)

There was no QTc interval chances recorded in both group I (case) and group II (control).

TABLE 9: SHOWS ST CHANGES.

	ST segment changes	ELEVATION	DEPRESSION
GROUP 1(case)	22(44%)	6(12%)	16(32%)
GROUP 11(control)	NIL	NIL	NIL

There were significant ST changes recorded in 22(44%) patients ST segment elevation seen in 6(12%) patients and 16(32%) shows depression in group I(case). There were no ST segment changes recorded in group II (control). These differences were statically significant (p<0.05).

TABLE 10 : SHOWS T-WAVE CHANGES.

	GROUP I (case) n= 50	GROUP II (control) n=50
T-wave	18(36%)	**Nil**

In group I (case) 18(36%) patients shows T-wave inversion, there were no T- wave change recorded in group II (control). T wave changes were higher in case

group as compare to control which were statically significant (p<.05).

NO U-wave and Arrhythmias recorded in both case and control group.

Discussion

In the present studyP- wave abnormality recorded in 4(8%) patients in study group and in 1(2%) patient in control group. The difference was statistically not significant(P < 0.1).

ShaShiKala GV, ShaShidhar PK, Anita Herur et al[13] conducted a study in 100 anemic adults, in that study they didn't recorded any P-wave abnormality in any patient.

In this study no P-R Interval abnormality recorded in both case and control group.

ShaShiKala GV, ShaShidhar PK, Anita Herur et al[13] did not find any P-R interval abnormality.

In the present study in group I (case) 14(28%) shows changes of LVH which was statistically significantly higher than the group II (control) 2(4%) (P<0.5).ShaShiKala GV, ShaShidhar PK, Anita Herur et al[13] conducted a study in 100 anaemic adults, Hemoglobin level and resting ECG were recorded and Left Ventricular Hypertrophy (LVH) recorded in 25-30% of patients.One of the ECG changes noted in our study is LVH, indicating cardiac enlargement. Cardiac enlargement without other etiologies has been observed more frequently in patients with anemia, particularly in patients with low Hb was due to increased work of heart, but now it has been attributed to insufficient O_2 supply to the myocardium.

In the present study there were significant ST changes recorded in 22(44%) patients ST segment elevation seen in 6(12%) patients and 16(32%) shows depression in group I(case). there were no ST segment changes recorded in group II (control). The difference was significantly higher(P<0.001)

In the present study in group I (case) 18(36%) patients shows T-wave inversion, there were no T- wave change in group II (control). T wave changes were significantly higher in study group.(P<0.001).In the present study such alterations in electrical conduction was seen in more percentage of patients with <5gm. Similar observations were made in a study of anaemic patients with Hb level of 4-5gm% or less conducted by ShaShiKala GV, ShaShidhar PK, Anita Herur et al[13]. Unlike in ischemic pattern, the ECG changes due to anemia, especially T-wave changes reverted back to normal within a week of correction of anemia.

Summary And Conclusion

The following observations were made-

1. In the present study female 32(64%) were more as compare to male 18(36%) in both case and control group. The male and female ratio was 0.56:1.

2. In the present study out of 50 patients 24(48%) were between the age group of 20-30 years, age group 31-40 consist of 18(36%) patients, age group 41-50 consist of 8(16%) patients.

3. The mean cardiothoracic ratio 0.49±0.05 in GROUP I (case) as compared to 0.47±0.02 in group II (control). The difference was statistically significant (p<.05).

4. P- wave abnormality recorded in 4(8%) patients in group I and in 1(2%) patients in group II. Which was not significant (p<.1).

5. The mean PR- INTERVAL in GROUP I (case) was .14±.02/sec which was equal group II(control). There was no PR-Interval abnormality recorded in both groups.

6. In group I (case) 14(28%) patients shows changes of LVH which was significantly higher than the group II (control) 2(4%). The difference was statistically significant (p<.05).

7. ST changes recorded in 22(44%) patients. ST segment elevation seen in 6(12%) patients and 16(32%) shows

depression in group I(case). There were no ST segment changes recorded in group II (control).The difference was statistically significant (p<.05).

8. In group I (case) 18(36%) patients shows T-wave inversion, there were no T- wave change in group II (control) and the difference was statistically significant (p<.05).

Conclusion

The ECG abnormalities found in anemic patients were due to hypoxia of the myocardium. Tachycardia may give rise to this type of pattern in ECG. But in our study in some cases we found abnormalities in ECG even in absence of tachycardia. That suggest the changes were due to hypoxia of the myocardium occurred due to decreased oxygen carrying capacity of blood because of decreased Hb concentration. So the abnormalities were chiefly due to subendocardial ischemia showing abnormal pattern of ST segment (depression, in some cases elevation) & T wave (inversion) in ECG without associated QRS abnormalities. Cardiac enlargement, dilatation & hypertrophy of left ventricle was found particularly in chronic anemia. Thus, it can be concluded that diagnosing anaemia in critical care can be supported by ECG changes to avoid misdiagnosis and also as dramatic clinical and ECG recovery can be achieved with anaemia correction.

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