



ANALYSIS OF ST SEGMENT CHANGES IN PATIENTS OF SEVERE IRON DEFICIENCY ANEMIA BELONGING TO SOUTH REGION OF BIHAR STATE: A CROSS SECTIONAL STUDY

Physiology

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ABSTRACT

Anemia is one of the commonest blood disorders with a significant degree of morbidity and mortality. It has multi factorial etiology with iron deficiency being the most common cause contributing around 50% of the World's total anemia burden. Prevalence is significantly high in people of low socio economic groups with preponderance in female gender. Irrespective of the causes, iron deficiency anemia results into low hemoglobin in the blood which ultimately decreases oxygen delivery to the body tissues. This adversely affects the cardiovascular hemodynamics putting extra workload on heart. If anemia persists for longer duration, various structural and functional changes take place in the heart. These changes are thereby depicted in Electrocardiographic (ECG) recordings. Studies have shown that including many changes in ECG recordings of patients with iron deficiency anemia, ST segment changes in the form of ST segment depression are important findings. As the people belonging to south region of Bihar state come from low socioeconomic group and are at nutritionally deprived condition, they are very much vulnerable to suffer from iron deficiency anemia. The present study was aimed to observe ST segment changes in patients of severe iron deficiency anemia from this region. 160 subjects were included in our study satisfying the inclusion criteria, out of which 150 subjects finally completed the study (65 males and 85 females). A total of 70 patients (46.67%) were having Hb concentration levels less than 8.0 g/dl and they fell in the severe or very severe grade of anemia. We found in our study that 38 subjects i.e. 25.33% (n = 150) had ST segment depression as one of the various ECG changes. We also observed that these changes were directly correlated with the severity of iron deficiency anemia. We concluded from our study that cardiac ischemia was resulted in the patients of iron deficiency anemia which was ascribed in the form of ST segment depression in ECG recordings. Specific and emergent measures must be taken to deal with iron deficiency anemia in order to mitigate its deleterious effects on cardiovascular health.

KEYWORDS

Iron Deficiency Anemia, ST Segment Depression, Hemoglobin Concentration.

INTRODUCTION

Anemia is a very common blood disorder with great morbidity and in many cases can lead to death if left untreated¹. World Health Organization (WHO) defines anemia in adults as a hemoglobin concentration of < 13 g/dl in males and < 12 g/dl in females (< 11 g/dl in pregnant females)¹. World Health Organization (WHO) also grades severity of anemia on the basis of hemoglobin concentration as depicted in the following table²:

Grading of Anemia	Hb Conc. (g/dl) in Female > 15 years of age		Hb Conc. (g/dl) in Male > 15 years of age
	Non Pregnant	Pregnant	
Cut off value (g/dl)	12	11	13
Mild	11 – 11.9	10 – 10.9	11 – 12.9
Moderate	8 – 10.9	7 – 9.9	8 – 10.9
Severe	< 8	< 7	< 8

Anemia has multi factorial etiology but iron deficiency is the most common cause accounting approximately half of the world's total anemia burden³. The prevalence of anemia is significantly high in people of low socio economic groups with preponderance in female gender^{2,3}.

According to the recently published data from IIPS and MoHFW (2017) based on NFHS-4 conducted during 2015 – 16, the prevalence of anemia in India is 50.3% despite the rigorous efforts of government to reduce the prevalence of anemia by health education campaign and free distribution of Iron Folic Acid (IFA) tablets. The same study showed that 60.4% non pregnant women of age between 15 – 49 years had hemoglobin concentration < 12 g/dl while 32.3% men of same age group had same hemoglobin concentration⁴. In one regional cross sectional study conducted in Indira Gandhi Institute of Medical Sciences, Patna, Bihar it was found that out of 200 adolescent girls the prevalence of anemia was 50% (43.3% mild, 3.3% moderate and 3.3% severe)⁵.

Considering the data of NFHS-4 (2015 - 16), among the people of Gaya district of Bihar state 25.7% men of age 15 – 49 years and 61.8% women of same age range are anemic^{6, 7}. This represents the south

region of Bihar state which is an agricultural belt and most of the inhabitants are of low socio economic status availing poor health care facilities.

The clinical features of anemia range from quite obvious signs and symptoms to asymptomatic cases depending upon the severity of the anemia. Common signs and symptoms of iron deficiency anemia include tiredness, pale skin, noticeable heartbeats (palpitations), anxiety, headache and dizziness, feeling short of breath, dry and damaged hairs and skin, sore or swollen tongue and oral cavity, restless legs, brittle or spoon shaped nails (koilonychia) etc.

Irrespective of the causes, iron deficiency anemia results into low hemoglobin which ultimately decreases oxygen delivery to the body tissues. This adversely affects the cardiovascular hemodynamics putting extra work load on heart to supply adequate amount of blood and oxygen to various organs of the body. If the anemia is not treated effectively and the condition persists for longer duration various structural and functional changes take place in the heart. These changes are thereby depicted in electrocardiographic (ECG) recordings⁸.

Shashikala GV et al. (2014) in their study titled correlation between hemoglobin level and electrocardiographic (ECG) findings in anemia: A cross sectional study, found that positive ECG findings were clustered more in patients with increasing severity of anemia. 50 – 75% of patients having hemoglobin concentration of 1 – 5 % showed ST changes in terms of ST segment depression⁹.

A study titled Electrocardiographic changes in patients with chronic anemia, conducted by Serbian researchers M. Stanojevic and S. Stankov (1998) showed, electrocardiographic changes were directly related to the severity of anemia and they were more prominent and prevalent in patients of severe anemia. Significant ST segment depression was recorded at rest typically in patients suffering from more severe form of anemia¹⁰.

Mohit Khatri et al. conducted one study in Krishna Institute of Medical Sciences (2018), a tertiary care hospital located in Karad, Maharashtra,

India. When they compared the severity of anemia with the presence of ST segment changes, they found that ST segment changes were present in 30 cases of mild, 68 cases of moderate and 35 cases of severe anemia and there was a significant association between anemia and presence of ST segment changes¹¹.

As anemia is quite prevalent in people residing in South region of Bihar state, it is very important to study the Electrocardiographic changes in them because they are one of the significant indicators of cardiovascular health. In view of this fact we conducted the present study to see the ST segment changes in patients of severe iron deficiency anemia belonging to south region of Bihar state.

AIM & OBJECTIVES

Aim of our study was to observe the ST segment changes in patients of severe iron deficiency anemia residing in south region of Bihar state.

Objectives of our present study were as follows:

1. To stratify the anemic subjects into mild, moderate and severe groups and to compare the ST segment changes among them.
2. To design a strategy targeting patients of severe iron deficiency anemia having significant ST segment changes in order to correct the anemia to combat the overt cardiovascular morbidity and related mortality.

MATERIAL & METHOD

People between 25 to 35 years of age were randomly selected for our study among the patients visiting in the Out Patient Department (OPD) of Medicine at Anugrah Narayan Magadh Medical College, Gaya (Bihar) which is located in south region of Bihar. After clinical evaluation of patients for anemia (like non specific symptoms such as weakness, lethargy, easy fatigability etc. and examination of lower palpebral conjunctiva for presence or absence of pallor), they were subjected to estimation of their hemoglobin concentration. The anemic subjects were then classified into mild, moderate and severe groups according to their hemoglobin levels. Other laboratory investigations like serum iron level, red cell distribution width (RDW), serum Ferritin level etc. were also done to ascertain the diagnosis of iron deficiency anemia. Standard 12 lead Electrocardiograms were plotted for each patients and data obtained were analyzed.

INCLUSION CRITERIA

Patients satisfying the following criteria were included in our study

1. Young people between age group 25 – 35 years.
2. Non pregnant and non nursing females with normal menstruation.
3. Subjects having clinical sign of anemia as pallor.
4. Hemoglobin concentration of less than 12 gm%.

EXCLUSION CRITERIA

Patients with following conditions were excluded from our study

1. Recent history of major blood loss.
2. History of any chronic disease like tuberculosis, chronic liver disease, Diabetes mellitus, hypo or hyperthyroidism, chronic respiratory disease etc.
3. Hematological disorders other than anemia.
4. Pregnant, lactating and menstruating females.
5. Unwilling patients.

Selected subjects were asked to visit to the Physiology Department of Anugrah Narayan Magadh Medical College, Gaya (Bihar) in the next morning at 09:00 AM in empty stomach. After taking informed and written consent subjects were examined as follows:

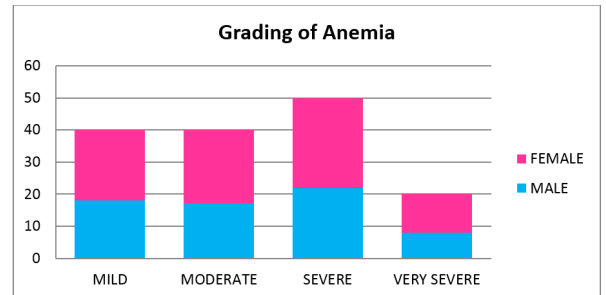
1. 12 lead Electrogram was taken using CardiArt 6208 view ECG machine of BPL in lying down position with standard settings of 1 mV voltage showing 10 mm deflection and paper speed of 25 mm/sec.
2. Blood sample was taken for the estimation of Total RBC count, Hb concentration, PCV, Serum Iron, Serum Ferritin and Peripheral Blood Smear Examination using conventional methods.
3. WHO data were accepted for blood indices. Serum Ferritin levels of 10 mcg/L or less were accepted as characteristic for iron deficiency anemia as stated in William's Hematology 13th Edition¹. A total of 160 subjects with low Ferritin level and Hb Concentration of less than or equal to 12.0 gm/dl were selected for our study.
4. ST segment changes (elevation or depression) were noted in these subjects. Goldberger ECG data were accepted for their normal values⁵.

OBSERVATION

Out of the 160 subjects included in our study, 150 completed the entire study programme among them 65 were males and 85 were females. They were further grouped into different grades of anemia (mild, moderate, severe and very severe) according to their Hb concentrations.

Table: 1 (Grading of Anemia)

Grade of Anemia	Mild	Moderate	Severe	Very Severe	Total
Hb Conc. (g/dl)	Male: 12.9 – 11.0 Female: 11.9 – 11.0	10.9 – 8.0	7.9 – 5.0	4.9 – 4.4	
Male	18	17	22	8	65
Female	22	23	28	12	85
Total	40	40	50	20	150



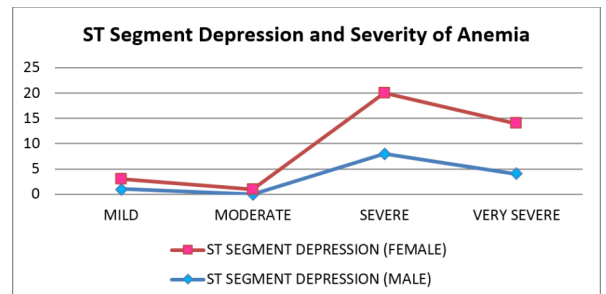
We observed in our study that 85 female subjects (n=150) i.e. 56.67% were suffering from iron deficiency anemia of different grades. 65 male subjects i.e. 43.33% were also suffering from some grade of iron deficiency anemia. We noted that severity of anemia was more in female subjects than that in their male counterparts.

When we observed the ST segment changes in our study subjects we found ST segment depression as most predominant form of ST segment change. None of our study subjects shown ST segment elevation in any of their ECG leads. ECG criteria of ST segment depression as horizontal ST segment shift of at least 0.1 mV from iso-electric line measured for at least 0.06 seconds was considered as positive finding. ST segment changes were than compared among subjects with different grades of anemia. Results so obtained were tabulated and analyzed as follows:

Table: 2 (ST Segment Depression and Severity of Anemia)

Grade of Anemia (Hb Conc. in g/dl)	Mild (Male: 12.9 – 11.0 Female: 11.9 – 11.0)		Moderate (10.9 – 8.0)		Severe (7.9 – 5.0) (%)		Very Severe (4.9 – 4.4)		Total
	Male	Female	Male	Female	Male	Female	Male	Female	
ST Segment Depression	1	2	0	1	8	12	4	10	38 (25.33)
Total	3		1		20		14		

P value < 0.0001 (Very Significant); n = 150



Out of 150 subjects we included in our study, 38 (25.33%) had ECG changes in the form of ST segment depression. We observed that these changes were directly correlated with the severity of iron deficiency anemia, both in male and female subjects.

DISCUSSION

We found in our study that 38 subjects (25.33%) with iron deficiency anemia had ST segment changes, especially in the form of ST depression and these changes were seen more frequently in subjects with severe or very severe form of iron deficiency anemia. Our findings

were very much in accordance with the findings of Manish Jain et al¹⁰, Mohit Khatri et al¹¹ and Pandya Neha H et al¹² which have shown almost similar results. In our study we have also noted that ST segment depression was more common among the female subjects.

As we know, the ST segment is the region between the end of ventricular depolarization and beginning of ventricular repolarization, marked in a standard ECG from end of QRS complex to the beginning of T wave. In clinical terms it is the vital part of cardiac cycle in which the myocardium maintains contraction to expel blood from the ventricles^{13,14,15}.

Iron deficiency anemia along with its increasing severity leads to hypoxia resulting into myocardial ischemia (along with ischemia of other organs). The cardiovascular remodeling due to the hemodynamic changes in anemia also adversely affects the oxygenation of cardiac myocardium. These are depicted as ST segment changes in ECG in patients of iron deficiency anemia.

ECG being a cheap, non invasive, easy to perform and accurately interpretable tool can be effectively used as a diagnostic and/or screening tool in patients of iron deficiency anemia belonging to south region of Bihar state in order to find the ST segment changes which is a powerful marker for myocardial ischemia. Timely detection of these potentially fatal conditions and their prompt intervention can lead to significant reduction in mortality and morbidity. Furthermore, specific health strategies (like nutritional supplements, screening programs etc.) can be planned targeting these vulnerable groups.

CONCLUSION

From the findings of our study we concluded that anemia (in our case, more specifically iron deficiency anemia) has many deleterious effects on the cardiovascular function, cardiac ischemia being one of them. It is depicted as various ST segment morphologies, more importantly as ST segment depression. The condition of iron deficiency anemia can turn into a potential risk of cardiac diseases if left untreated. Therefore, it is advised to deal with the treatable causes of anemia very promptly considering this as an emergency in order to mitigate the adverse cardiac functions.

FUNDING

We did not receive any extra or intramural funding for this research work.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest associated with this manuscript.

ACKNOWLEDGEMENT

We gratefully acknowledge our sincere thanks to the subjects participated in this study.

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