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Physiology

ELECTROCARDIOGRAPHIC ST SEGMENT DEPRESSION AND T WAVE ABNORMALITIES IN ANEMIA: A COMPARATIVE STUDY

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ABSTRACT

BACKGROUND: Anemia is an important medical problem involving multiple organ systems and has strong implications on the health and economic indicators of the country. Cardiac symptoms such as dyspnea, palpitation and sometimes sub sternal pain may develop during the course of anemia. The prevalence of electrocardiographic abnormalities in anemia varies significantly in different studies. Electrocardiogram (ECG) findings of a patient with anemia and coexistent sinus tachycardia can mimic acute coronary emergency.

AIM: To study the prevalence of ST segment depression and T wave abnormalities in ECG in patients with anemia (Hemoglobin < 9g/dl) and compare it with non-anemic control subjects (Hemoglobin >12 g/dl).

METHODS: Eighty subjects were recruited for this comparative study. Forty subjects had hemoglobin less than 9 g/dl. Forty age and sex matched controls were recruited with hemoglobin more than 12 g/ dl. Electrocardiography (12 lead) was done on all subjects recruited for the study and the ECG finding of the patients with anemia was compared with the control subjects. Statistical analysis of data was done by chi square test.

RESULT: Among the 40 cases in the study group with anemia, ECG of 7 patients showed ST segment depression (17.5%) when compared with 40 controls where none had ST segment depression (p value = 0.012). T wave inversion was found in 8(20%) anemia cases while only 2(5%) controls (p=0.087) had the same. T wave flattening was observed in 25(62%) patients and 12(30%) controls (p=0.007).

CONCLUSION: In our study it was found that anemia is associated with ST segment depression and T wave abnormalities in ECG.

KEYWORDS : Anemia, ECG changes, ST depression, Twave inversion,

INTRODUCTION:

Anemia is a significant public health problem all over the world, more so in a developing country like India and having economic and social implications. It affects various organs including the heart and reported to be one of the common causes of hyper dynamic state of heart at rest[1]. Cardiac symptoms such as dyspnea, palpitation and sometimes substernal pain may develop during the course of anemia. Based on the severity and time period of prevalence, it can lead to congestive cardiac failure even in the absence of cardiac comorbidity[2]. Hence, treatment of the same at the appropriate time can prevent complications.

In clinical practice, electrocardiography is most often used to evaluate patients with suspected ischemic heart disease.

An ECG is the recording ("gram") of the electrical activity ("electro") generated by the cells of the heart ("cardio") that reaches the body surface. This electrical activity initiates the heart's muscular contraction that pumps the blood to the body. Each ECG recording electrode provides the summation of this electrical activity that it "sees" from its particular position on the body surface. Observation of the 12 views provided by the routine clinical ECG allows us to "move around" this electrical activity as though we are seeing the heart from various view points[3].

Many cardiac abnormalities can be detected by ECG interpretation, including enlargement of the heart muscle, electrical conduction blocks, insufficient blood flow and death of heart muscle due to a blood clot[4].

Anemia is reported to be one of the nonspecific causes for ST segment depression and T wave inversion (in the absence of coronary artery disease). When sinus tachycardia coexists, ECG can perfectly mimic an acute coronary emergency[2]. Hence medical personnel working in emergency and cardiac care units should watch out for such a possibility. They should be aware of the varied clinical presentation of anemia and the ensuing ECG changes mimicking cardiac events, hence leading to missing out of the primary cause and leading to unnecessary follow up investigations.

As there exists diverse opinion in literature on the electrocardiographic changes in anemia[2,5,6]; we conducted this study to find out the prevalence of ST segment depression and T wave changes which are the cardinal ECG findings in myocardial ischemia.

OBJECTIVE:

To compare the prevalence of ST segment depression and T wave abnormalities in electrocardiogram (ECG) between anemic patients with hemoglobin less than 9g/dl and non-anemic subjects with hemoglobin more than 12 g/dl.

MATERIALS AND METHODS

Study Design

This was a comparative study conducted in the Department of Physiology and Cardiology, Amrita Institute of Medical Science (AIMS) Kochi for a period of one year. Approval was obtained from Institutional Ethics Committee. Informed consent was obtained from the patients for inclusion in the study. Patients in the age group 20-60 years from various clinical departments in AIMS whose hemoglobin level were found to be less than 9g/dl were included in the study as cases. Same number of age and sex matched healthy subjects with hemoglobin more than 12 g/dl were taken as controls. Total number of subjects recruited for study was 80, out of which 40 were patients with anemia and the remaining 40 subjects served as controls. ECG was done for both the groups and analyzed for ST segment depression and T wave changes. Those with hypertension, old coronary artery disease, cardiomyopathies, valvular heart disease, hypokalemia and digitalis users were excluded from the study. Subjects with preexisting structural cardiac diseases and hypokalemia were excluded by

analyzing their echocardiogram and serum potassium levels respectively.

Method:

According to the World Health Organization (WHO), anemia is defined as haemoglobin levels less than12 g/dl in women and less than 13 g/dl in men[7]. Hemoglobin level of the study population was estimated by automated analyzer which provided data on the severity of anemia. Resting 12 lead electrocardiography was done in all subjects at a paper speed of 25 mm/s and standardized at 0.1 mV/mm.
The following were studied.
ST segment - depression
T wave - inversion or flattening
The ST depression was judged to be present if the J point was depressed by 1 mm or more and was followed by a horizontal or downward sloping ST segment for at least 0.08 second in one or more of the 12 leads except aVR[8].

T wave inversion was confirmed whenever there was negative T wave with amplitude > 1mm in limb leads or > 2mm in precordial leads in at least one of the leads except aVR, V1 and lead III. Flattened T waves were said to occur when the amplitude is less than 1mm in the limb leads and less than 2mm in the precordial leads[8].

Statistical analysis was carried out using IBM SPSS Statistics 20 windows software. Chi-square test was used to compare the discrete variable distribution between the two groups. P value less than 0.05 was considered statistically significant.

RESULTS:

The patients recruited for the study were in the 20 to 60 years age group for both cases and controls arms.

The mean age for anemia cases and controls were 42.43 $\pm$ 10.81 and 45.50 $\pm$ 11.46 years respectively.

The mean hemoglobin values were 7.97 $\pm$ 0.82 for the case group (patients with anemia) and 13.33 $\pm$ 1.07 for the controls.

ST segment depression in ECG was seen in 7 out of 40 anemia cases (17.5%). In the control group none had ST depression. On analysis, p value was found to be 0.012 which is statistically significant.

T wave inversion was found to be present in 8(20%) out of 40 cases and 2(5%) out of the 40 controls. The difference was statistically borderline significant (p=0.087).T wave flattening was seen in 25(62%) patients of the case arm and 12 (30%) subjects out of the 40 controls . The p value was found to be 0.007 which was statistically significant.

Table 1. ECG changes among cases and controls.

Variables	Cases n = 40	Controls n = 40	p value
ST depression	7 (17.5%)	0 (0%)	0.012
T wave inversion	8 (20%)	2 (5%)	0.087
T wave flattening	25(62.5%)	12 (30%)	0.007

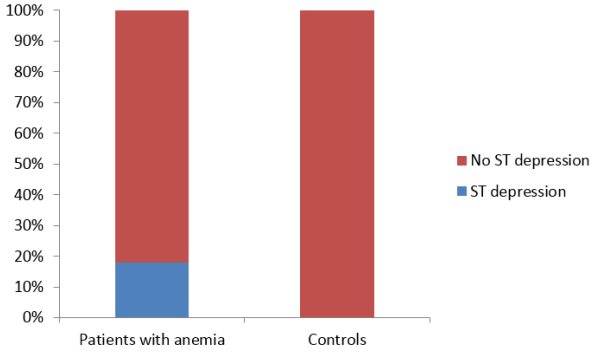

Fig 1. ST depression in anemia

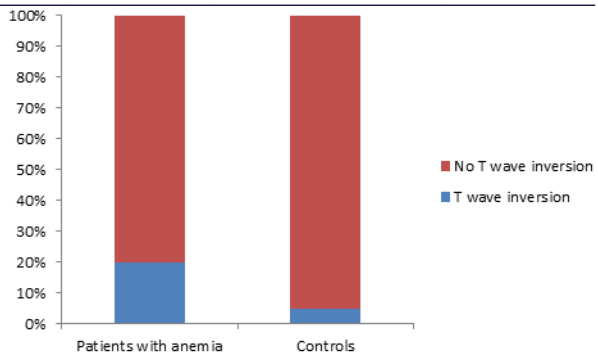

Fig 2. T Wave inversion in anemia

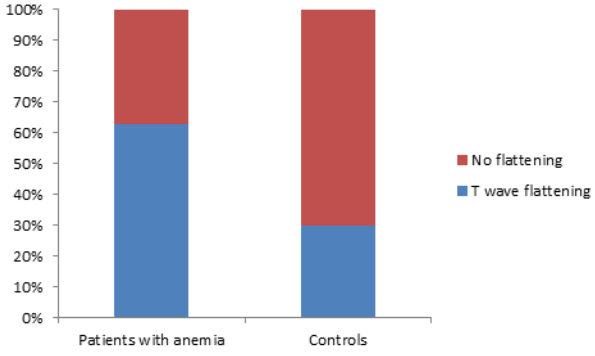

Fig 3.T Wave flattening in anemia

DISCUSSION

Electrocardiographic abnormalities in anemia have been reported to vary considerably in different studies[2,5,6]. According to the World Health Organization (WHO) criteria of grading anemia based on haemoglobin level, those with haemoglobin level between 9 and 12 g/dl were considered to have mild anemia[8]. As mild anemia was not expected to have cascading effects on the cardiovascular system, we included cases with haemoglobin of less than the aforementioned level.

The parameters of ECG focused by our study were ST segment depression and T wave abnormalities. The T wave abnormalities encountered were T wave inversion and flattening.These two parameters are the cardinal ECG findings in myocardial ischemia. So also, in most of the previous literature, the authors mentioned these two parameters as the common ECG abnormality.

The results of our study showed that 7 out of the 40 cases (17.5%) had ST depression in ECG. None of the controls had ST depression. This was statistically significant with a p value of 0.012.

A study conducted by Stanojevic M, et al[2] has shown ST depression in 3% patients. This was much less compared to our study. However, it would be prudent to mention that unlike our study they included patients with mild anemia also. Hence, it would be pertinent not to compare our study findings with that of Stanojevic M, et al. In addition, they subjected their study patients to stress test. Out of their total patients, 33% of them were found to have ST depression during stress test. As stress test was not mandated in our study, we did not compare our findings with the aforementioned test as done by Stanojevic M, et al.

Pandya N, et al[5] conducted a study on 75 patients of anemia. These patients were classified into mild, moderate and severe category. Their findings were fairly similar to our study where 20% of moderate anemia cases had ST depression . Their study findings had inferred that the ECG abnormalities were chiefly due to sub endocardial ischemia.

ST depression has also been seen in the studies conducted by Mani A, et al[9], Shashikala G V, et al[10] and Manjiri, et al[11].We have noted that studies which included more patients with severe anemia (Hemoglobin less than 5 g/dl) were likely to have the above mentioned

electrocardiogram finding.

The ST segment depression in our study with patients of anemia can be attributed to the same cause (subendocardial ischemia) as our findings also corroborate with the findings of the above mentioned studies.

Our study revealed T wave inversion in 20% of cases and 5% of controls which was statistically borderline significant (p value =0.087). T wave flattening was seen in 62.5% cases and 30% controls which was statistically significant (p value = 0.007).

A cross- sectional study conducted by Mohit K, et al[12]in 300 anemia patients showed 26 % patients to have T wave inversion and 3% with T wave flattening. Our study patients on the contrary had more T wave abnormalities probably due to the fact that the severity of anemia was more in our study patients when compared to the former study.

A study done by Pandya N, et al divided the cases into mild, moderate and severe anemia. It was found that 8 out of 75 cases (11%) in their study had T wave inversion. The prevalence of T wave inversion in their study was less, probably due to the fact that the proportion of mild anemia cases were more in their study.

Renuka B, et al[13] in their study which involved 100 cases of anemia had prevalence of T wave inversion in 11% of cases. Similar proportion of T wave abnormalities has also been mentioned in studies conducted by Shashikala G V, et al[10] and Singh N K, et al[6].

When compared to majority of the studies mentioned above which were cross sectional prevalence studies, our study was a comparative study carried out by comparing the mentioned ECG parameters with same number of age and sex matched healthy individuals without anemia. Moreover, in our study, all the patients found to have ECG abnormalities were subjected to echocardiography to rule out any structural heart disease.

ECG changes seen in our study patients can be attributed to metabolic disturbances in myocardium from oxygen deficiency caused by diminution of oxygen carrying capacity of the blood because of anemia. Hence depressed ST segments with or without T wave changes (inverted or flattened T waves) in patients with anemia in our study reaffirms the fact that myocardial ischemia leads to these ECG changes and is in tune with the findings of other studies[10,14] .

Doctors and emergency room personnel should be aware of the fact that ECG changes as evidenced in ischaemic heart disease, can occur even in the presence of isolated anemia without any significant myocardial damage and ECG changes in anemia is reversible on correction of anemia. This is important so that unnecessary investigations and therapeutic measures are not initiated.

CONCLUSION

It is evident from our study that anemia leads to significant ECG abnormalities in the form of ST segment depression and T wave changes. It further reinforcs the fact that the ECG changes are attributable to myocardial ischemia due to deficient oxygen carrying capacity of the blood in anemic patients.

LIMITATIONS

We had not considered the duration and etiology of anemia in the present study. Further study with a larger study population with a prolonged duration would yield better results.Then would prove useful in strengthening and validating the findings of our study. Multicentre study is also likely to be more representative especially in a large country like India.

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