

## Original Research Article

# Electrocardiographic abnormalities in severe anaemia and its reversibility after correction of anaemia in North Karnataka, India

S. M. Biradar<sup>1</sup>, Renuka Holiyachi<sup>3</sup>, Mohd Shannawaz<sup>2</sup>, V. Ravi Teja<sup>1\*</sup>

<sup>1</sup>Department of Medicine, <sup>2</sup>Department of Community Medicine, <sup>3</sup>Department of Anaesthesia, Shri B. M. Patil Medical College, Hospital and Research Center, BLDE (deemed to be University), Vijayapura, Karnataka, India

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**\*Correspondence:**

Dr. V. Ravi Teja,

E-mail: [drvatturiraviteja@gmail.com](mailto:drvatturiraviteja@gmail.com)

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### ABSTRACT

**Background:** Anaemia is one of the commonest clinical problems in our country. It affects various organs including the heart. Clinical manifestations of anaemia referable to cardiovascular system may closely simulate symptoms and signs of organic heart disease. It includes some electrocardiogram (ECG) changes also. ECG changes in anaemia show correlation to haemoglobin (Hb) concentration and the changes are reversible after correction of anaemia. In this study, the main objective was to study electrocardiographic changes in patients with severe anaemia and ECG reversibility after treatment of anaemia.

**Methods:** 50 patients admitted in medicine wards of Shri B. M. Patil Medical College, Hospital and Research Center, Vijayapura for severe anaemia (Hb concentration less than or equal to 7 gm %) were studied for ECG changes. All patients were reassessed for reversibility of changes after treatment.

**Results:** Out of 50 patients with severe anaemia, 20 patients were having Hb % of 3 to 5 gm %. Of which 16 patients were having ECG changes (10 were females and 6 were males). All ECG changes were reverted to normal after correction of anaemia, except one patient (showed pre-treatment T wave inversion and post-treatment flat T waves).

**Conclusions:** ECG abnormalities in patients with severe anaemia are more common in females. ECG abnormalities in patients with severe anaemia (Hb 5 gm %) can get reverted to normal after correction of anaemia.

**Keywords:** Haemoglobin concentration, Anaemia, ECG changes

### INTRODUCTION

Anaemia is one of the commonest clinical problems in our country. Anaemia has two principle effects. One, decrease in the amount of oxygen transported by each unit volume of blood, thus tending to produce tissue hypoxia and other is decrease in blood viscosity associated with reduction in red cell mass.<sup>1</sup>

Most of the clinical features of anaemia are due to the consequences of diminished oxygen carrying power of the blood to the tissues and cardiovascular and ventilatory adjustments to compensate the decrease in red cell mass. The clinical presentation depends upon the rapidity of the

onset of anaemia, its severity, age of the patient and capacity of the cardiovascular system to adjust to it.<sup>2</sup> Anaemia affects various organs including the heart. It is one of the commonest causes of hyperdynamic state of the heart at rest.<sup>3</sup> This leads to increased oxygen demand to myocardium and subsequently supply demand mismatch resulting in myocardial ischemia or infarction. The cardiac disturbances persist as long as anaemia is severe and quite strikingly these changes can be rapidly reverted by partial correction of anaemia.<sup>3,4</sup>

Clinical manifestations of anaemia referable to cardiovascular system may be associated with the signs and symptoms of heart disease. On the other hand, severe

anaemia may exaggerate heart failure or coronary insufficiency in a pre-existing cardiac or coronary disease.

Therefore it is necessary to diagnose and correct anaemia to evaluate the extent to which anaemia is partially or entirely responsible for the symptoms and signs.<sup>5</sup> With reduction in haemoglobin (Hb) content of 25% or less, the blood volume is increased; there is generalized vascular dilatation in muscles and skin, a rise in venous blood pressure and a high cardiac output with tachycardia.<sup>6</sup> Congestive heart failure, angina pectoris and ECG changes in anaemia are correlated to the severity of anaemia and increase in cardiac output.<sup>7</sup> Many studies have shown evidence of congestive heart failure and ECG changes in patients with sickle cell anaemia and leukaemia.<sup>8</sup>

**METHODS**

In the view of above background, the specific aims and objectives of this study are: to study electrocardiographic changes in patients with severe anaemia, to correlate ECG changes with Hb concentration, and to study their reversibility after treatment of anaemia.

For this purpose, 50 patients admitted in medicine wards of Shri B. M. Patil Medical College, Hospital and Research Center, Vijayapura from December 2019 to March 2020 for severe anaemia (Hb concentration less than or equal to 7 gm %) were studied for ECG changes. All patients were reassessed for reversibility of changes after treatment.

The sample size was calculated with 95% confidence level and margin of error of ±10%. A sample size of 50 subjects was considered for the study to determine the “electrocardiographic abnormalities in severe anaemia and its reversibility after correction of anaemia” with finite population correction.

The calculation was done by using the formula:

$$n = z^2p(1 - p)/d^2$$

Where z=z statistic at 5% level of significance, d is margin of error and p is anticipated prevalence rate of electrocardiographic abnormalities (15.5%).<sup>1</sup>

The type of study was prospective cross-sectional study and sampling design used was purposive sampling design.

Criteria for inclusion of cases in the study was taken as male and female patients with Hb less than 7 gm % and age 15 years and above.

Criteria for exclusion was following: recent history of major blood loss; pre-existing heart disease like valvular heart disease, congenital heart disease and thyrotoxicosis; systemic disorders, which are likely to affect cardiorespiratory dynamics, like renal failure, cor pulmonale, tuberculosis and other respiratory diseases; presence of skeletal disorders or neuromuscular diseases

which are likely to affect exercising capacity like kyphoscoliosis and polio myelitis; pregnant and cases with leukemia.

All patients were studied for following ECG changes which include sinus tachycardia, T wave changes like flat T wave and T wave inversion, and ST segment depression.

Later, all patients were subjected to deworming treatment, oral or parenteral iron therapy or blood transfusion for correction. All the parameters were reassessed after increase in Hb percentage by 3-5 gm %.

Standard protocols to measure ECG were used in the study approved by hospital management of Shri B. M. Patil Medical College, Hospital and Research Center, BLDE (deemed to be University), Vijayapura, Karnataka.

All characteristics were summarized descriptively. For continuous variables, the summary statistics of mean± standard deviation (SD) were used. For categorical data, the number and percentage were used in the data summaries. Data were analyzed using Statistical Package for the Social Sciences (SPSS) software v.23 (IBM Statistics, Chicago, USA) and Microsoft office 2007.

**RESULTS**

Out of 50 patients, 32 (64%) were males and 18 (36%) were females. Microcytic hypochromic anaemia was majorly found (44%) followed by dimorphic type of anaemia (32%). 20 patients had Hb in the range of 3 to 5 gm%. The changes observed are shown in Table 1. ECG changes were seen in 16 patients, of which 10 patients were female and 6 patients were males. In 9 patients there were ST segment changes. T wave changes were seen in 6 patients. Sinus tachycardia is seen in 10 patients. Inferior wall was most commonly affected.

**Table 1: Number of patients having various ECG changes.**

Findings	Male	Female	Total
Sinus tachycardia	4 (40%)	6 (40%)	10
T wave changes	2 (33%)	4 (67%)	06
ST segment changes	3 (33%)	6 (67%)	09

20% of patients having Hb % less than 5 have normal ECG findings. 62% patients have sinus tachycardia, 37% have T wave changes, and 56% patients have ST segment depression. ECG changes according to various Hb % levels in anaemia in anaemia patients are depicted in Table 2.

On day 1 mean Hb % of 5.6 gm has normal ECG findings, mean Hb % of 4.6 gm has sinus tachycardia, mean Hb % of 4.2 gm has T wave changes, and mean Hb % of 3.2 gm has ST segment depression. The difference at day 1 was statistically significant (p<0.05).

**Table 2: ECG changes according to various Hb % levels.**

ECG change	Day 1 Hb %		Day 4 Hb %	
	Mean	SD	Mean	SD
Normal	5.6	0.0	8.4	0.0
Sinus tachycardia	4.6	0.7	7.0	0.7
T waves changes	4.2	0.8	6.8	0.8
ST segment depression	3.2	0.1	6.6	0.1
P value	<0.001*		0.432	

\*Significant at 5% level of significance (p<0.05)

**Table 3: Type of anaemia among total cases.**

Type of anaemia	Number	%
Dimorphic	16	32
Macrocytic	12	24
Microcytic hypochromic	22	44
Total	50	100

## DISCUSSION

In the present study, out of 50 patients with severe anaemia (Hb concentration 7 gm %), 20 patients had Hb in the range of 3 to 5 gm %. Out of 20 patients, 16 patients showed ECG changes. These changes were sinus tachycardia, ST segment depression and T wave inversion.

On an average, Hb increased by 3-5 gm %. All ECG changes disappeared after treatment, except in one patient who had pre-treatment T wave inversion and post treatment T wave flattening. All patients were subjected to 2-D echocardiography to exclude any organic heart disease.

No chamber hypertrophy or QRS abnormality were found in the present study. There is a great diversity on reports of ECG changes in anaemia.<sup>9</sup> ECG abnormalities range from minor repolarization alterations to bundle branch block in anaemia.<sup>10</sup> Decrease in QRS amplitude, T wave flattening and minor degrees of atrioventricular conduction defects have been noted.<sup>11</sup> ST-T wave changes were also noted.<sup>12</sup> The changes in ECG may be proportional to severity of anaemia.<sup>7</sup> Incidence of ECG changes was higher in patients with Hb % 1 to 5 gm %. 50-75% showing ST depression, 29-50% showing T wave changes and 25-30% showing left ventricular hypertrophy (LVH).<sup>13</sup>

In the present study, Hb % of patients was in the range of 3 to 7 gm % and ECG changes were seen in patients with Hb % 3 to 5 gm %. (Not less than 2 gm %). Most studies have shown dramatic improvement in clinical and electrocardiographic changes after correction of anaemia.<sup>14</sup>

We have not considered the type of anaemia, duration of anaemia or bone marrow picture in the present study and treatment modality was independent to ECG changes.

## CONCLUSION

Severe anaemia can produce ECG abnormalities and may raise the suspicion of true ischaemic heart disease. These changes are more common in females and in those with Hb % of 5 gm %. After treatment and correction of anaemia (increase in Hb % by 3-5%) these abnormalities show reversibility of changes.

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