Study of Electrocardiographic Changes in Mild, Moderate and Severe Anaemia in a Tertiary Care Hospital

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ABSTRACT

Introduction: Anaemia is one of the most common nutritional burden of world. Anaemia is one of the common most leading causes of disabilities and death. Current research aimed to study the electrocardiographic changes in mild, moderate and severe anaemia.

Material and Methods: Observational cross-sectional study was conducted in 300 patients in a tertiary care hospital and teaching institute in western Maharashtra.

Results: The association of age and grading of anaemia saw that there was significant association between the two (x^2=33.01) (df=4) (p= <0.0001). The study saw the association between gender and severity of anaemia. The association was significant (x^2=6.55) (df=2) (p=0.038). In our study we studied the association between heart rate and severity of anaemia, we found high significant association between severity and heart rate (x^2=60.16) (df=4) (p=<0.0001). The current study also looked for any association between severity of anaemia and ECG changes and found that the association to be highly significant. The changes were seen more as the severity of anaemia increased (x^2=49.20) (df=2) (p=<0.0001).

Conclusion: Our study helps to give an idea about different ECG changes present in Anaemia patients and their association with severity of Anaemia. This study also helps in making necessary plan to diagnose cardiovascular complications of Anaemia with the help of ECG and treat them promptly.

Keywords: Electrocardiographic, Anaemia

INTRODUCTION

Anaemia is one of the most common nutritional burden of world. Anaemia is one of the common most leading causes of disabilities and death.[1]

The term "anaemia", is generally used in medicine for reduction below normal in concentration of haemoglobin or red blood cells in blood. It must be remembered that the mean normal value and the lower limits of the "normal" range depend upon the age (childhood or adult life) and gender. The most common type of anaemia is nutritional anaemia among it more important one is the Iron Deficiency Anaemia. More than half of the world's undernourished population lives in India.[2]

A study by WHO on anaemia during 1993-2005, showed worldwide prevalence of anaemia to be 25%.[3]

The National Family Health Survey-3 (NFHS-3) suggests that prevalence of anaemia is 56%. Whereas according to National Nutrition Monitoring Bureau Survey (NNMBS) 2006, the prevalence of anaemia in Males is 68.6% whereas in Females it is 69.7%.[4]

Therefore, deficiency of iron which may be due to either physiological or pathological reason can affect mental and physical growth resulting in decreased learning capacity and work productivity. Iron Deficiency Anaemia is characterized by a defect in haemoglobin synthesis, resulting in hypochromic and microcytic red blood cells.[5]

Iron deficiency can result either due to decreased nutritional supply, increased demand or blood loss due to any reason. Anaemia has significant negative impact on the health of any individual at any age it varies from poor scholastic performance and cognitive impairment in children to being an indirect causes of maternal mortalities.[6]

High prevalence of anaemia (Haemoglobin <12 gm%) among adolescent girls in India, causes 1.8% loss of GDP.[7]

Iron, an important micronutrient essential for various functions in human body. Iron is essential for cellular growth, differentiation, oxygen binding, transport, storage, enzymatic reactions, immune function, cognitive function, mental and physical growth etc. Therefore, deficiency of iron which may be due to either physiological or pathological reason can affect mental and physical growth resulting in decreased learning capacity and work productivity. The incidence of electrocardiographic abnormalities varies significantly in different studies ranging from 10-80%. There are great variety of opinion available in literature, regarding reports of ECG changes in anaemia.[8,9]

Current research aimed to study the electrocardiographic changes in mild, moderate and severe anaemia with objectives to evaluate variations in ECG waves, segments and intervals in anaemia and to correlate ECG changes with mild, moderate and severe anaemia.

MATERIAL AND METHODS

Observational cross-sectional study was conducted on 300 patients in a tertiary care hospital and teaching institute in western Maharashtra. The study was done for a period

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of 24 months which was done between October 2016 and November 2018. During the period, 18 months was taken for data collection from October 2016 to March 2018 and data was analysed for a period of 6 months till October 2018.

Inclusion criteria
1. Patients age more than 18 years.
2. Patients diagnosed as anaemic irrespective of aetiology in which Hb levels are below 13 gm% are selected for the study.
3. Patient willing to participate in the study.

Exclusion criteria
1. Patients with history of smoking, alcoholism.
2. Patients with Diabetes Mellitus.
3. Patients who are diagnosed cases of Hypertension.
4. Patients who are known cases of Ischaemic heart disease, coronary artery disease, chronic anaemia.

Source of data and data collection: The study had anaemic cases from medicine wards and OPD from Krishna hospital and medical research centre Karad. The nature and purpose of this study was explained to the subjects and informed consent was obtained from those willing to participate in the study. The study also obtained the consent of the institutional ethical committee.
This included investigations like:

1. Hb levels by fully automated analyser.
2. ECG by electrocardiograph machine.

RESULTS

The association of age and grading of anaemia saw that there was significant association between the two ($x^2=33.01$) (df=4) (p= <0.0001). The age had an effect on severity of anaemia. There was a slight increase in cases of moderate and severe anaemia as the age increased. This is because of the failure to meet the demand as patients usually neglect their nutrition and health as age increases (Table 1, Figure 1). The study saw the association between gender and severity of anaemia. The association was significant ($x^2=6.55$) (df=2)
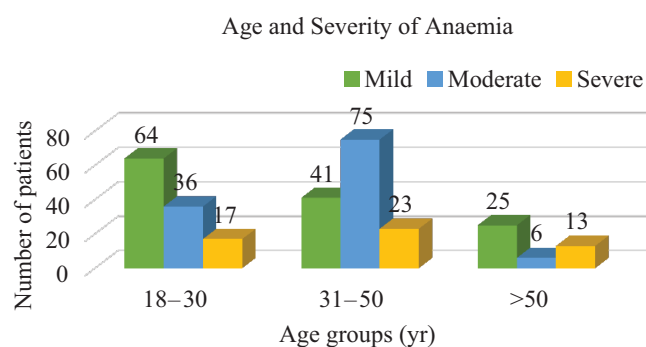
Figure-1: Age and grading of anaemia

Severity of anaemia	18 – 30	31 – 50	>50	Total
Mild	64(49.23%)	41(31.53%)	25(19.23%)	130
Moderate	36(30.76%)	75(64.1%)	6(5.12%)	117
Severe	17(32.07%)	23(43.39%)	13(24.52%)	53
	117(39%)	139(46.33%)	44(14.66%)	300
$X^2 = 33.01$, df=4, p < 0.0001				

Table-1: Age and grading of anaemia

Gender and Severity of Anaemia	Males	Females	Total
Mild	63(48.46%)	67(51.53%)	130
Moderate	38(32.47%)	79(67.52%)	117
Severe	21(39.62%)	32(60.37%)	53
Total	122(40.66%)	178(59.33%)	300
$X^2 = 6.55$, df=2, p = 0.038			

Table-2: Gender and Severity of Anaemia

Severity of anaemia	60 – 90	91 – 110	>110	Total
Mild	55(42.3%)	73(56.15%)	2(1.5%)	130
Moderate	63(53.84%)	46(39.31%)	8(6.15%)	117
Severe	6(11.32%)	30(56.6%)	17(32.07%)	53
	124(41.33%)	149(49.66%)	27(9%)	300
$X^2 = 60.16$, df=4, p < 0.0001				

Table-3: Heart rate and severity of anaemia

Severity of Anaemia and ECG changes	ECG Changes Present	ECG Changes Absent	Total
Mild	52(40%)	78(60%)	130
Moderate	88(75.21%)	29(24.78%)	117
Severe	46(86.79)	7(13.20%)	53
Total	186(62%)	114(38%)	300
$X^2 = 49.20$, df=2, p < 0.0001			

Table-4: Severity of Anaemia and presence of ECG changes

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Severity of Anaemia and ECG changes		Mild	Moderate	Severe	Total
Total number of cases		130	117	53	300
ST Segment	Depression	22	54	27	103
	Elevation	0	4	1	5
	Flat	8	10	7	25
Total ST Segment Changes		30	68	35	133
T Wave	Inversion	18	43	18	79
	Tall	0	1	0	1
	Flat	6	2	0	8
Total T Wave Changes		24	46	18	88
Prolonged QT Interval		0	1	3	4

Table-5: ECG Abnormalities according to the severity of anaemia

Severity of Anaemia and ST Segment Changes	Present	Absent	Total
Mild	30(23.07%)	100(76.92%)	130
Moderate	68(58.11%)	49(41.88%)	117
Severe	35(66.03%)	18(33.96%)	53
Total	133(44.33%)	167(55.66%)	300
$X^2 = 42.93$, df=2, p < 0.0001			

Table-6: Severity of anaemia and presence of ST Segment Changes

| Severity of Anaemia and T Wave Changes	Present	Absent	Total
Mild	24(18.46%)	106(81.53%)	130
Moderate	46(39.31%)	71(60.68%)	117
Severe	18(33.96%)	35(66.03%)	53
Total	88(29.33%)	212(70.66%)	300
$X^2 = 13.59$, df=2, p = 0.001			

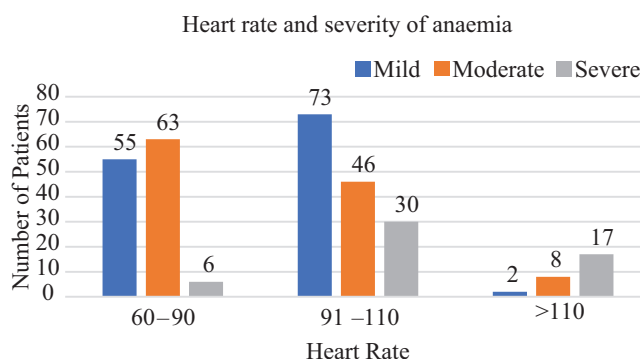**Table-7:** Severity of anaemia and presence of T Wave Changes

Severity of Anaemia and Prolonged QT Interval	Present	Absent	Total
Mild	0	130(100%)	130
Moderate	1(0.8%)	116(99.14%)	117
Severe	3(5.66%)	50(94.33%)	53
Total	4(1.33%)	296(98.66%)	300
$X^2 = 9.50$, df=2, p = 0.009			

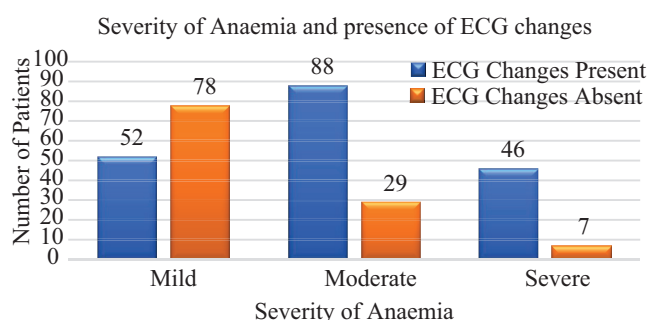**Table-8:** Severity of anaemia and presence of Prolonged QT Interval
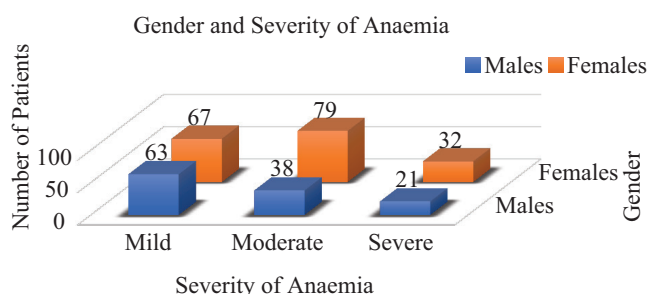
Figure-2: Gender and Severity of Anaemia

Figure-3: Heart rate and severity of anaemia

(p=0.038) (Table 2) (Figure 2). In our study we studied the association between heart rate and severity of anaemia, we found high significant association between severity and heart rate. (x^2=60.16) (df=4) (p=<0.0001). The results are almost similar to most of the other studies. It is like a compensatory mechanism wherein the heart rate increase to compensate to provide appropriate oxygen delivery to the organs (Table 3, Figure 3). The current study also looked for any association between severity of anaemia and ECG changes and found

that the association to be highly significant. The changes were seen more as the severity of anaemia increased. (x^2=49.20) (df=2) (p=<0.0001) (Table 4, Figure 4).

There were 22 (7.3%) patients who belonged to mild anaemia who had ST segment depression and 8(2.6%) who had flat ST segment and 18 (6%) who had t wave inversion and 6(2%) who had flat T wave. Among the moderate anaemia group

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Figure-4: Severity of Anaemia and presence of ECG changes

we had more cases that is 54(18%) who had ST segment depression and 4(1.3%) who had ST elevation and 10(3.3%) who had flat ST segment. There were 43(14.3%) who had T wave inversion and only 1 patient with tall T wave and 2 who had flat T wave. Among the severe anaemia group, we had 27 (9%) who have ST depression and 1(0.3%) who had ST elevation and 7(2.3%) who had flat ST segment. There were 18 (6%) who had T wave inversion. In Mild anaemia cases, 2 (0.67%) patients had LVH and 1 (0.33%) had difference RR interval. In Moderate anaemia cases, 6 (2.00%) patients had LVH and 1 (0.33%) had Prolonged QT interval while 3 (1.00%) patients had difference RR interval. While in severe anaemia cases, 27 (9.00%) patients had LVH, 3 (1.00%) patients had Prolonged QT interval while other 3 (1.00%) had difference RR interval. (Table 5)

In our study, when we compared the severity of Anaemia with the presence of ST segment changes, we found that ST segment changes were present in 30 cases of mild, 68 cases of moderate and 35 cases of severe anaemia. There was significant association between Severity of anaemia and presence of ST Segment Changes. (x^2=42.93) (df=2) (p =< 0.0001) (Table 6)

In our study, when we compared the severity of Anaemia with the presence of T Wave Changes, we found that T Wave Changes were present in 24 cases of mild, 46 cases of moderate and 18 cases of severe anaemia. In our study, we found significant association between the Severity of anaemia and presence of T Wave Changes. (x^2=13.59)(df=2) (p =< 0.001) (Table7)

In our study, Prolonged QT Interval was absent in all cases of mild, but it was present in 1 case of moderate and 3 cases of severe anaemia. There was significant association between the Severity of anaemia and presence of Prolonged QT Interval. (x^2=9.50) (df=2) (p = 0.009) (Table 8)

DISCUSSION

The gradings of anaemia among the patients in our study were 130(43.3%) patients who had mild anaemia and 117(39%) who had moderate and 53(7.67%) who had severe anaemia. The study had more mild to moderate cases as they are usually neglected as symptoms are less and subtle.

The association between age and grading of anaemia saw that there was significant association between the two.

The age had an effect on severity of anaemia. There was slight increase in cases of moderate and severe anaemia as

the age increased. This may be due to the failure to meet the demand as patients usually neglect their nutrition and health as age increases. In our study we observed that there were majority of the patients that is 186(62%) who had ECG changes associated with anaemia. There were only 114(38%) who didn't have any ECG changes.

The study by Neha H. Pandya et al, had similar findings where males had more cases of mild anaemia as compared to females. But moderate anaemia was present equally and in cases of severe anaemia females were more than males.[10]

The current study also looked for any association between severity of anaemia and ECG changes and found that the association to be highly significant. The changes were seen more as the severity of anaemia increased.

Contradictory findings were seen in the study by Neha H. Pandya et al, where no association was found between severity and ECG changes, ECG changes were seen in all the groups.[10]

There were 22 (7.3%) patients who belonged to mild anaemia who had ST segment depression and 8(2.6%) who had flat ST segment and 18 (6%) who had T wave inversion and 6(2%) who had flat T wave.

Among the moderate anaemia group, we had more cases that is 54(18%) who had ST segment depression and 4(1.3%) who had ST elevation and 10(3.3%) who had flat ST segment. There were 43(14.3%) who had T wave inversion and only 1 patient with tall T wave and 2 who had flat T wave.

Among the severe anaemia group, we had 27 (9%) who have ST depression and 1(0.3%) who had ST elevation and 7(2.3%) who had flat ST segment. There were 18 (6%) who had T wave inversion.

The study by Neha H. Pandya et al, also had similar findings ECG abnormality as the current study. There were 3(1.3%) patients who belonged to mild anaemia who had ST segment depression and 2(1%) who had flat ST segment and 2 (1%) who had T wave inversion and 2(1%) who had flat T wave. In moderate group, 5(2%) had ST depression and 4(1.5%) had T wave inversion. In severe group, 6(2.5%) had ST depression, 2 had ST elevation and 1 had T wave inversion. In their study ST segment changes were present in Lead I, II, III, avF, V_4-V_6 and T wave changes were present in Lead V_4-V_6.[10]

In a study conducted by by Neha H. Pandya et al, they found 17 cases which had ST segment changes and the association of anaemia with ST segment changes was significant. In a study conducted by Neha H. Pandya et al, they found 8 cases having T wave abnormality which was found to be significant.[10]

CONCLUSION

Anaemia is one of the most common preventable diseases in India. Out of all complications of Anaemia, cardiovascular complications are easily diagnosed by the safest and cheapest investigation, which is ECG. We found majority of the patients with Anaemia are having ECG changes.

We observed that there were more number of females having anaemia. Mild cases of anaemia were more than moderate or

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severe. Age also had an effect on severity of anaemia as did gender, with increasing severity of anaemia in increasing age and female sex. The patients in our study showed significant association between the severity of anaemia and increased heart rate.

Majority of the patients in our study had shown ECG changes, with significant association between the severity of anaemia and presence of ECG changes. There were specific associations between the severity of anaemia and presence of ST segment changes, T wave changes and presence of prolonged QT interval.

Our study helps to give an idea about different ECG changes present in Anaemia patients and their association with severity of Anaemia. This study also helps in making necessary plan to diagnose cardiovascular complications of Anaemia with the help of ECG and treat them promptly.

Limitations of study

- We have not included the aetiology and duration of anaemia.
- We have not included the bone marrow picture.
- As our study was observational cross-sectional study, we were not able to study the association between Electrocardiographic changes and myocardial ischaemia

REFERENCES

1. World Health Organization. Anaemia prevention and control [Internet] Geneva: WHO; 2011. [accessed on 20 Aug 2016]. Available at www.who.int/medical_devices/initiatives/anaemia_control/en
2. Johansen D, Ytrehus K, Baxter GF. Exogenous hydrogen sulfide (H 2 S) protects against regional myocardial ischemia–reperfusion injury. Basic research in cardiology. 2006;101:53-60.
3. Worldwide prevalence of anaemia 1993-2005 WHO global database on anaemia
4. National Nutrition Monitoring Bureau, Diet and Nutritional Status of Rural Population and Prevalence of Hypertension among adults in Rural areas, NNMB Technical Report No. 24. Hyderabad: NNMB, NIN; 2006
5. Girija PL. Anaemia among women and children of India. Ancient science of life. 2008;28:33.
6. Provan D. Mechanism and management of iron deficiency anaemia. Br J Haematol. 1999;105(Suppl 1):19–26.
7. Grantham-McGregor S, Ani C. A review of studies on the effect of iron deficiency on cognitive development in children. The Journal of nutrition. 2001;131:649S-68S.
8. WHO guidelines for control of anaemia, adolescent divison, Ministry of Health And Family Welfare, Government of India. 2013
9. Ellis LB, Faulker JM. The heart in anaemia. New Eng J Med. 1939; 220:943-5.
10. Pandya NH, Desai KS, Naik S, Mehta A, Jadeja JM. Effects of Mild, Moderate and Severe Anaemia on ECG. Indian Journal of Applied Basic Medical Sciences. 2011;13:1-5.
11. Porter WB. Heart changes and physiologic adjustments in hookworm anaemia. Am Heart J. 1937;13:550.
12. Hunter A. The heart in anaemia. Quart J Med. 1946; 15:107.
13. Ministry of Health and Family Welfare, Government of India. Guidelines for control of Iron deficiency anaemia. New Delhi: Ministry of Health and Family Welfare,Government of India; 2013. Available at: http://www.unicef.org/india/10._National_Iron_Plus_Initiative_Guidelines_for_Control_of_IDA.pdf. Accessed 18 January 2017.
14. Winsor T, Burch GE. The electrocardiogram and cardiac state in active sickle-cell anemia. American Heart Journal. 1945;29:685-96.
15. Shashikala GV, Shashidhar PK, Anita Herur SC, Shailaja SP, Roopa BA, Sukanya VB. Correlation between haemoglobin level and electrocardiographic (ECG) findings in anaemia: a cross-sectional study. Journal of clinical and diagnostic research: JCDR. 2014;8:BC04.

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