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Effect of Iron Deficiency Anemia on Autonomic Nervous System in Adolescent Girls

Gunjan Jain[1], Namrata Kaushik[2], J. L. Agarwal[3], P. N. Singh[4], Manoj Kumar Jain[5].

[1]Assistant Professor Physiology Department G S Medical College & Hospital Pilkhuwa Hapur, [2]Assistant Professor Physiology Department G S Medical College & Hospital Pilkhuwa Hapur, [3]Professor Physiology department Saraswathi Institute of Medical Sciences Hapur, [4]Professor Physiology Department G S Medical College & Hospital Pilkhuwa Hapur, [5]Associate Professor Medicine Department G S Medical College & Hospital Pilkhuwa Hapur

Abstract

Introduction: Anemia is a major health problem especially among the economically disadvantaged segments of population in developing countries like India. Involvement of Autonomic Nervous System (ANS) in cases of anemia has been a matter of considerable speculation. Slight to moderate impairment may be observed in mental and motor development of infants with Iron deficiency anaemia (IDA).

Material & Method: Study included 30 apparently healthy adolescent girls as control and 90 adolescent girls as cases having IDA. Haemoglobin was done and blood pressure and ECG were recorded.

Result: Mean rise in SBP And DBP and Mean RR interval was significantly reduced in anemic patient as compared to control subjects.

Conclusion: We found significant relation between Mean rise in SBP And DBP and Mean RR interval in IDA

Keywords: *IDA, ANS, SBP, DBP, RR interval.*

Introduction

Anemia is a major health problem especially among the economically disadvantaged segments of population in developing countries like India. The prevalence rate is highest being 30% in developing countries as compared to 8% in developed countries[1]. Studies in India show that 65% infants and toddlers, 60% of Children (1-6 years of age), 88% adolescent girls and 85% pregnant women are anemic. The commonest form in these patients is iron Deficiency Anemia (IDA)[2].

WHO expert group proposed that "anemia is considered to exist" when Hb is below 12gm/dL (venous blood) in adult non-pregnant females and below 13gm/dL in adult male[3].

Iron has been found having role in development of CNS, synthesis of neurotransmitter, myelination[4]. Iron being a component of several essential enzymes like succinyl dehydrogenase; cytochrome reductase is also required for neuronal metabolic activity[5]. In Brain, Iron is concentrated in oligodendrocyte largely in white matter, then grey matter. Oligodendrocytes requires iron to synthesize fatty acids and cholesterol for myelin production, which is mainly concern with the conduction in nerve fiber[6].

Involvement of Autonomic Nervous System (ANS) in cases of anemia has been a matter of considerable speculation. Slight to moderate impairment may be observed in mental and motor development of infants with IDA[7]. Hence the study was carried out to evaluate the effect of IDA on ANS.

Corresponding Author:
Dr. Namrata Kaushik
Assistant Professor Physiology Department G S Medical College & Hospital Pilkhuwa Hapur. Address: F 108 KW Srishti Raj nagar extension Ghaziabad
e-mail: namrataeras@gmail.com

Material & Method

The study was carried out in department of Physiology in collaboration with department of Pathology in Saraswathi Institute of Medical Sciences, Hapur between the period from 1st Jan. 2014 to 31st Dec. 2014. This study included 30 apparently healthy adolescent girls as control and 90 adolescent girls as cases having Iron deficiency anaemia (IDA) confirmed by their hemoglobin (Hb) level & general blood picture (GBP). Age of the girls was between 10 to 19 years. The cases were further divided into 3 categories based on the Hb level. Category A include mild anemia (N =30) Hb level 11-11.9 gm/dl, Category B include moderate anemia (N =30) Hb level 8-10.9 gm/dl, Category C include severe anemia (N =30) Hb level < 8.0 gm/dl[8]. Hemoglobin estimation was done by Autohemology Analyzer (lab life nobel III, RFCL limited New delhi).

Recording of resting ECG (lead 2) was done by Hygeia Pro Digital Three channel ECG machine. A base line ECG was recorded in lying down position then subject was asked to stand & remain motionless. Continuous ECG was recorded for 3 minutes. Then RR interval calculated and compared with normal values.

Blood pressure (BP) was recorded by Sphygmomanometer in lying down position. Then subject was asked to immerse hand in cold water, temperature was maintained at 4˚-6˚, BP was measured from other arm at 30 second interval for 2 minutes

Stastical analysis was done using SPSS version17 for determination of correlation between anemia and R-R Interval & BP

Result

In normal subjects Mean rise in the Systolic blood pressure (SBP) was 22.40±2.74 and rise in diastolic blood pressure (DBP) was 17.86±3.48, and mean RR interval was 1.03 ±0.05. In mild anemia mean rise in SBP was 17.06 ±3.55, mean rise in DBP was 11.26 ± 2.13.and mean RR interval was 1.01± 0.04. In moderate anemia mean rise in SBP was 16.73 ±2.85, mean rise in DBP was 11.00 ± 1.46 and mean RR interval was 0.98± 0.04. In severe anemia mean rise in SBP was 16.66 ±2.94, mean rise in DBP was 11.00 ± 1.46 and mean RR interval was 0.96± 0.06.

Mean rise in SBP And DBP was significantly reduced in anemic patient (<.001) as compared to control subjects as shown in table 1.

Mean RR interval was significantly reduced in anemic patient (<.001) as compared to control subjects as shown in table 1.

Rise in mean value of SBP and DBP was statistically significant when we compare normal vs mild, normal vs moderate and normal vs severe as shown in table 2.

Mean RR interval were compared and significant difference was found only in normal vs moderate and normal vs severe, mild vs severe as shown in table 2.

Table 1

Haemoglobin Vs ANS						
One Way ANOVA						
	Normal	Mild	Moderate	Severe	F value	P value
Rise in SBP	22.40±2.74	17.06 ±3.55	16.73 ±2.85	16.66±2.94	25.35	<.001
Rise in DBP	17.86±3.48	11.26 ± 2.13	11.00 ± 1.46	11.00± 1.46	65.89	<.001
RR Interval	1.03 ±0.05	1.01± 0.04	0.98± 0.04	0.96± 0.06	9.24	<.001

Table 2

Post HOC Bonferroni (P value)						
	Normal Vs Mild	Normal Vs Moderate	Normal Vs Severe	Mild Vs Moderate	Mild Vs Severe	Moderate Vs Severe
Rise in SBP	<.001	<.001	<.001	1.00	1.00	1.00
Rise in DBP	<.001	<.001	<.001	1.00	1.00	1.00
RR Interval	1.00	0.010	<.001	0.35	0.003	0.56

Discussion

In this study we attempted to establish effects of grades of IDA on autonomic nervous system. in normal subjects mean rise in SBP and DBP was significantly more as compared to different grades of anemia. Mean RR interval was significantly more in normal subjects then anemic group. Most of the scientific studies on the effects of iron deficiency anemia deals with infants, young children and pregnant women. however very few studies dealing with the effect of IDA on autonomic nervous system have been reported. Hence this study was carried out to evaluate the effect of IDA on ANS.

Nagi *et. al*. demonstrate decrease in SBP and DBP in mild and moderate cases of anemia[9]. Studies done by Nityanand *et. al.* and K Singh *et. al* on patients on severe anemia also showed a decrease in resting SBP and DBP[10, 11].Whereas study done by Kapoor *et. al.* showed no change in resting SBP in mild, moderate and severe anemic cases[12]. Mani *et. al*. observed resting SBP to be significantly more in anemic children[13]. Cold pressor test is known to stimulate nor-metanephrine and metanephrine release from the neurons and adrenal medulla[14]. A blunting of BP response in the present study points towards decrease in sympathetic activity IDA response. Similar response seen in study done by Bedi *et. al*. but on malnourished children[15].

Nityanand observed abnormal postural tachy-cardia index along with normal atropine response implying dysfunction of afferent limb of para sympathetic reflex arch[10].

Involvement of ANS in cases of anemia has been matter of considerable speculation. A short circulatory time occurs as compensatory mechanism in anemic to maintain tissue oxygenation. It naturally leads to an increase in resting heart rate which was present in our study and others. Another well known mechanism for physiological compensation is decreased hemoglobin oxygen affinity in tissues leading to increase oxygen extraction of anemic blood by the tissues which occurs due to increase in concentration of 2, 3 Biphosphoglycerate (2, 3 BPG) in RBC's in anemia.

2, 3 BPG shift the hemoglobin oxygen dissociation curve to the right thus allowing the tissues to strip hemoglobin of its oxygen[12]. Kapoor *et. al* suggested that increase in resting heart rate in anemic could be due to depleted cardiac reserve[12].

Conclusion

In this study we assessed that in IDA, autonomic function was deranged. So, there should be an increased awareness in medical fraternity and population in general, of deleterious effect of IDA. Hence need for prevention, early detection and intervention of IDA in adolescents is required to reduce the autonomic complication.

Conflict of Interest: Nil

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Ethical Clearance: Obtained

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