CODEN (USA): IAJPBB ISSN: 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES

http://doi.org/10.5281/zenodo.582319

Available online at: http://www.iajps.com *Research Article*

EVALUATION OF ESSENTIAL ELEMENT LEVELS IN THALASSEMIA MAJOR PATIENTS OF QUETTA CITY, PAKISTAN

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Abstract:

Objective: *The aim of this study was to evaluate essential element levels in thalassemia major patients of Quetta city, Pakistan.*

Methods: *A single cohort, observational based study design was adopted. Evaluation of some essential element levels in thalassemia major patients was investigated through flame photo meter, CBC analyzer and commercially available kits.. The investigations were conducted on 325 thalassemia major patients of both genders. Investigated data were arranged by SPSS v. 20 and consider significant when p values were <0.05.*

Results: *Three hundred twenty five thalassemia major patients take part in study. One hundred and seventy five (53.8%) respondents were males in majority and maximum patients were from the age group of 6-10 years. In term of ethnic group, the maximum thalassemia major patients were Pathan (n= 92, 28.3%). Majority of thalassemia major patients had A+ blood group (28.6% and n= 93). Zinc (51.6144±7.22) showed maximum concentration of 66.79 mmol/L and minimum concentration of 37.30 mmol/L. Copper (147.66±9.13) had maximum concentration 160.12 mmol/L and minimum concentration of 106.72 mmol/L. Calcium (8.3499±0.171) was resulted with maximum concentration of 8.89 mmol/L and minimum concentration of 8.02 mmol/L. Chlorides (101.98±0.56) showed maximum concentration of 103.2 mmol/L and minimum concentration of 100.5 mmol/L while sodium (134.99±1.105) showed maximum concentration of 137.2 and minimum of 131.6 mmol/L. Potassium (4.7047±0.121) had maximum concentration of 4.95 mmol/L and minimum concentration of 4.00 mmol/L in this study. From CBC, the hemoglobin concentration was (6.52 ± 1.16) and RBCs counts were (4.75 ± 0.52) which had maximum concentration of 9.2 g/dL.*

Conclusion: *The current study concluded that zinc and calcium concentration was low from normal range concentration, while copper, sodium and potassium levels were high from the normal level of these elements.*

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Please cite this article in press as Fahad Saleemm et al, ***Evaluation of Essential Element Levels in Thalassemia Major Patients of Quetta City, Pakistan****, Indo Am. J. P. Sci, 2017; 4(05).*

INTRODUCTION:

The one of most common genetic disease of the world is thalassemia (1). The main thalassemia affected areas are Middle East to Mediterranean basin, north and South East Asia. 2 - 4% of the world is thalassemia gene carrier (2, 3). So about 0.06 million children from all over the world are thalassemia carrier (4). Thalassemia is a vast spreading inherited blood disorder all over the world (5). It is very challenging disorder by its mismanagement. The latest study and research works showed that a patient can survive but with some disturbance in minerals of the body as well as irregular metabolism, endocrine system of the body and iron chelation (6).

In Pakistan about 32 to 45% of young generation suffered from thalassemia which is an inherited disease (7, 8). 6% of the population is the gene carrier of thalassemia (9). The premarital blood screening and prenatal investigations can secure the coming generation from thalassemia (10). In this context, blood consist of plasma and cells while plasma consists of 94% of water and minerals and 6-7 % proteins (11). The requirement of sodium is 134-145 mmol/L in blood. The high concentration from the normal level is called hypernatremia and low concentration is called hyponatremia which can cause the worst condition if not treated on time (12). The relation of sodium level with hemoglobin is directly proportion to each other (13). The pH and osmotic pressure are maintained by the balance concentration of potassium and it also helpful in carbohydrate metabolism (14). While the 66% existing anion in body is chloride which is helpful for digestive system, pH and osmotic pressure level of the gases in blood. The normal level of the zinc in the body is 12 µmol/L (14) while 85% is in bones and 0.1 % in plasma. Zinc is very essential for defense, growth and hormonal mechanism of the human body (15). Zinc with copper are correlated for metabolic activities (16). Zinc is an energy producing element for metabolism of proteins, carbohydrates and nucleic acids (17). Copper is present in traces**,** due to presence of antioxidant properties it works as antibacterial and helps in protein formation named ceruloplasmin which provides the protection from free-radical cell injury. A study based on copper and zinc serum levels in carriers of thalassemia major (18) exposed that hypozincemia is mostly present in thalassemia patients, but without copper deficiency. The misbalanced levels of minerals produce the complications related to disease. Hyperzincuria caused the release of Zn from hemolyzed red cells which create the deficiency of zinc. Acute and chronic infections and hemochromatosis, which is a common complication of thalassemia, are produced due to the Hypercupremia. While hypernatremia is the responsible for renal damage(19). Therefore, current study was aimed to assess the level of essential elements in thalassemia major patients of Quetta city, Pakistan.

MATERIAL & METHODOLOGY:

Study design, settings and inclusion criteria

This study was consisted of thalassemia patients from Quetta City. Quetta is a ninth largest city of Pakistan and provincial capital of Baluchistan (20). This study was designed as a single cohort and was conducted at the Thalassemia City Care Centre, Quetta. This centre provides the facilities of blood transfusion and medical treatments for thalassemic patients from all over the province.

Sampling procedure and techniques

Collected samples (n=325) were from thalassemia care centre, Sandeman Provincial Hospital; Quetta Balochistan during the months of June-August 2016. The blood samples were taken from Clinical research laboratory of Bolan Medical Complex and Sandeman Provincial Hospital Quetta. The blood samples were collected and labeled in sample bottles without anticoagulant and a set of well labeled bottles with anticoagulant (K_2EDTA, 1mg/ml). The blood samples without anticoagulant were used for minerals detection (sodium, potassium, chloride and calcium) and samples with anticoagulant were used to investigate the zinc, copper and complete blood count (CBC).

Statistical methods

For data analysis used SPSS for Window 22 (21). Hemoglobin levels and plasma minerals were expressed by mean and standard deviation. The categorical variables like age, gender, ethnicity, weight and height and history of participant were expressed in percentage and frequency. Spearmen rank correlation was used to show the association in variables of the study. P value considered significant when it less than 0.05.

RESULTS:

The number of participants was 325 and male respondents were in majority with the frequency of one hundred and seventy five (53.8%) and maximum age group was from 6-10 years. From ethnic group, the pathans were in majority (n= 92, 28.3%). Majority of thalassemia major patients had A+ blood group (28.6% and n= 93) as shown in Table 1.

Table 1: Demographic characteristics of the study respondents (N=325)

Characteristics	Frequency (n)	Percentage (%)
Age in years (7.25±3.95)		
1-5	126	38.8
6-10	130	40.0
11-15	69	21.2
Gender		
Male	175	53.8
Female	150	46.2
Ethnic status		
Pathan	92	28.3
Baloch	77	23.7
Sindhi	28	8.6
Panjabi	60	18.5
Brahvi	35	10.8
Others	33	10.2
Weight in KGs(19.18±7.67)		
0-10	54	16.6
11-20	141	43.4
21-30	107	32.9
31-40	23	7.1
Height in cm(121.23±25.56)		
1-70	5	1.5
71-140	218	67.1
141-210	102	31.4
Blood group		
A+	93	28.6
A-	26	8.0
B+	55	16.9
B-	22	6.8
AB+	19	5.8
AB-	12	3.7
O+	85	26.2
O-	13	4.0
Anyone suffering from thalassemia major		
Yes	105	32.3
No	220	67.7
Anyone suffering from thalassemia minor		
Yes	112	34.5
No	213	65.5

From the essential element levels, Zinc (51.6144 ± 7.22) showed concentration from 66.79 to 37.30 mmol/L. Copper (147.66 ± 9.13) had 160.12 mmol/L maximum concentration and minimum concentration was 106.72 mmol/L. Calcium (8.3499 ± 0.171) was resulted with concentration of 8.89-8.02 mmol/L, Chlorides (101.98 ± 0.56) showed concentration from 103.2 to 100.5 mmol/L while sodium (134.99 ± 1.105) showed maximum concentration of 137.2 and 131.6 mmol/L was minimum. Potassium (4.7047 ± 0.121) had maximum concentration of 4.95 mmol/L and minimum concentration of 4.00 mmol/L in this study. The hemoglobin (6.52 ± 1.16) and RBCs counts (4.75 ± 0.52) had maximum concentration of 9.2g/dL and low concentrations were 4.0g/dL (Table 2).

Table 2: Minerals descriptive statistics (n=325)

	Minimum	*Maximum*	*Mean*	*Std. Deviation*
Zinc concentration in mmol/L	37.30	66.79	51.6144	7.22390
Copper concentration in mmol/L	106.72	160.12	147.662	9.13747
Calcium concentration in mmol/L	8.02	8.89	8.3499	0.17183
Chloride concentration in mmol/L	100.5	103.2	101.980	0.5694
Sodium concentration in mmol/L	131.6	137.2	134.995	1.1054
Potassium concentration in mmol/L	4.00	4.95	4.7047	0.12196
Hemoglobin concentration in g/dL	4.0	9.2	6.529	1.1608
RBC count in 10'' 12/1	3.9	6.5	4.757	0.5294

Table 3 presents the relationship among different demographic characters, with BMI and RBC count. The strong relationship appeared in age with hemoglobin and RBCs, gender with hemoglobin and RBCs, weight with hemoglobin and RBCs and height with hemoglobin and RBCs. While ethnic group's relationship with hemoglobin and red blood cell counts was non-significant.

Table 3: Relationship among demographic characters

Demographic characters	*φc value*	*P value*	*Type of relationship*
Age – Hemoglobin	0.584	0.001	Significant/Strong
Age – RBCs	0.481	0.001	Significant/Moderate
Gender – Hemoglobin	0.676	0.001	Significant/Strong
Gender – RBCs	N/A	0.212	N/A
Ethnic group – Hemoglobin	N/A	0.515	N/A
Ethnic group - RBCs	***0.515***	0.001	Non significant
Weight – Hemoglobin	***0.590***	0.001	Significant/Strong
Weight – RBCs	***0.450***	0.001	Significant/Moderate
Height - Hemoglobin	***0.540***	0.001	Significant/Strong
Height - RBCs	***0.393***	0.001	Significant/Moderate
BMI- Hemoglobin	***0.713***	0.001	Significant/Strong
BMI- RBCs	***0.377***	0.001	Significant/Moderate

DISCUSSION

Thalassemia major is spread fast in Balochistan due to the traditional culture which promotes the consanguineous marriages especially in rural areas. This study related to thalassemia city care centre in Quetta where Thalassemic patients from all over the province come for blood transfusion and medical treatments to this centre and are registered at the Sandeman Provincial Hospital, Quetta Balochistan and Bolan Medical Collage and Hospital, Quetta, Balochistan.

Essential elements play very important role in the growth, metabolism and enzymatic reactions in the body. In the current study analyzed different elements in thalassemia major patients and found that zinc concentration was low from normal range concentration of zinc and observed concentration range from 37.30 to 66.79 mmol/L in targeted patients of thalassemia major. While reported the high level of copper from normal range which was similar to the other reported studies (22-24). The

copper concentration was from 106.72-160.12 mmol/L in thalassemia major patients. In this study the zinc concentration was at reduce level in children as compare to the young. The deficiency of zinc in thalassemia major patients cause due to the reduce intake of zinc and iron chelation therapy (25). Another factor of loss of zinc from body is in urine secretion which raise the glomerular filtration rate of zinc which also responsible for high concentration of zinc released from hemolyzed RBCs (22). From other research studies, it was reported that low level of zinc concentration is due to the growth retardation (19, 26). So it may be suggested that addition of zinc in diet for thalassemia major patients solve the issue of zinc deficiency. Iron introduced in the body during blood transfusion in the form of hemoglobin and during that iron required the enzymes and cofactors which based on copper and helpful to release the iron in hemoglobin synthesis which also causes the Hypercupremia (22, 25). Hypercupremia also caused due to the hemochromatosis which is a basic complication in thalassemia major patients (27). As well as acute and chronic infection in the body is a main reason of hypercupremia. Thalassemia patient required the blood transfusion time to time which raise the level of iron absorption and cause the deposition of iron in the body tissues and cause the visceral hemochromatosis (24).

Calcium level in thalassemia patients remain low from the normal level of calcium in the body, in this study the level of calcium in patients was from 8.02 to 8.89mmol/L. Hypothyroidism is a syndrome mostly present in thalassemia major patients due to the iron deposition in parathyroid glands (28) and it is also responsible for hypocalcaemia in the patients (19, 29, 30). In the current study the sodium and potassium levels were high from the normal level. The concentration of sodium and potassium which reported in thalassemia patients were from 131.6-137.2 and 4.00-4.95 respectively in this study. The raised level of sodium in thalassemia major patients is due to the iron deposition in access which causes the renal damages (27). As well as the raised level of potassium in thalassemia major patients is due to the transfusion of blood and due to its storage, the potassium leaked in plasma from hemolyzed RBCs (31).

CONCLUSION:

The current study concluded that zinc and calcium concentration was low from normal range concentration, while the copper, sodium and potassium levels were high from the normal level of these elements in thalassemia major patients.

Disclosure

The authors have no conflict of interest to declare. No funding was received for this study.

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