Certain hematological values of the ß-thalassaemia major among Mosul population

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Abstract

Ninety seven blood samples of the Beta-thalassemic patients were collected from patients registered in Mosul thalassemic center for the period 2001-2002 distributed in (52 males with 64% and 45females with 46% ratio) aged 3.5-24 years old, and 87 blood samples of apparently healthy volunteers aged 3.5-24 years old too distributed in (56males with 65% and 31females with 35% ratio) for the same age and period time collected from Ibn Al-Ather Teaching Pediatric Hospital in Mosul City. From Hemoglobin (Hb), Packed Cell Volume (PCV %) and blood groups determined two trails, analysis showed, there were no significant differences ($p<0.05$) between and within groups of age, sex and Hb values for normal and B-thalassemic major patients, while there was a significant differences ($p<0.05$) between and within groups of, PCV and Hb values. The B-thalassemic index was less than 0.75, this equal to about 8.50g/dl Hb value. Beta-thalassaemia major can classify in the first time to four levels as: very sever, sever, mild and moderate status, those have hemoglobin values as: less than 7.50, 7.50-8.00, 8.00-8.50 and 8.50-9.30g/dl. The blood group of Beta-thalassemic can be arranged in decreasing order O^+, A^+, B^+, AB^+, O^- and A^- with samples distribution 48.61, 23.61, 22.22, 2.28, 1.39 and 1.39% respectively. The good and preferred Beta-thalassaemic life time of patient was in the age group 6-12 yrs old (higher Hb value, hemoglobin ratio and PCV).

Key words: ß-thalassemia major, hematological changes, Hemoglobin, Packed cell volume, Blood group.

Introduction

Thalassaemia affects people of Mediterranean, African and Asian origin (1). The distribution of Beta-Thalassaemia major gene appears to be 5-25%.Molecular characterization and prenatal diagnosis of beta 3-thalassaemia is essential. In certain countries (Italy, Turkey, Pakistan, India and China), 5.47% in Greece, 4% in Saudi Arabia, 4.5% in Malaysia, 4% in Oman and 4.5-5% in Iraq. (2, 3, 4). There are three Beta-thalassaemic center established in Iraq, two of them are in Baghdad state and the 3rd one is established in IBN Al-Atheer Teaching Pediatric Hospital in Mosul, about 550 patients were registered in the thalassaemic center/ Ninevah City for the period 1997-2001, (5). Mainly, there are alpha and beta thalassaemia. However, there are three types of Beta-thalassaemia (major, intermediate, and minor Beta-thalassaemia). Beta-thalassaemia major was considered the most important one, which is characterized by progressive anemia manifested during the 2nd six month of life, associated with splenomegaly and chronic hemolytic anemia which sustain life (6).depend on blood transfusion to the molecular defect in B-thalassaemia result in the absence or reduced ß-chain production of globin protein, imbalance in globin chains production. Absence of ß-chain partner caused unstable and precipitate of globin in the red cell giving rise to large intracellular inclusions, which interferes with red cell maturation, So there is a variable degree of intramedullary destruction of the RBC were become microcytic hypochromic appearance, which destroyed in the spleen later, So anemia will be resulted and causing with the blood transfusions to other mentioned complications (7, 8).

Treatment depend mainly on adequate blood transfusion giving desferrioxamine , folic acid, vitamin C, splenoctomy and bone marrow transplantation (BMT), but the disease remain incurable with complication due to body iron overload as a result of blood transfusions associated with growth retardation , cephalofacial deformity, diabetes mellitus, heart failure, blood born disease, pallor, haemosiderosis, Jaundice and increased susceptibility to infections.(8,9).

There are two possibilities of inheritance as a mode of Beta-thalassaemia as:

1. All children must inherit a normal gene from their parents (Fig.1), however, if one of the parents is carrier, the child may inherit a normal or a thalassaemia gene, so there is a one in two (50%) chance of inheriting the thalassaemia gene from the carrier parent, this will result in thalassaemia trait. On the other hand, there is one in two (50%) chance of inheriting the normal gene from the carrier parent and this will result in completely normal child. None of these two varieties of inheritance can lead to thalassaemia major (Fig. 2), (10).

2. When both of the parents are Beta-thalassaemia carrier: That is to say, they are a "couple at risk". These parents have a one in four (25%) chance in each pregnancy of having a child with thalassaemia trail, and a on in four (25%) chance that the child will inherit a normal gene from both parents and so will be completely normal. These chances are the same in each pregnancy (Fig. 3).

The aim of this study was to evaluate the hematological changes of Beta-thalassaemia major cases in Mosul city with the age and sex distribution, and to monitor may be in order to control it.

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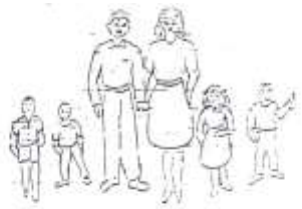

Figure (1) : Inheritance of normal gene from normal parents

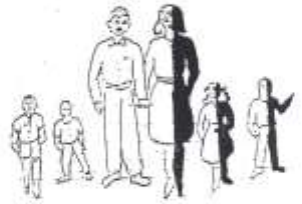

Figure (2) : One of the parents is carrier

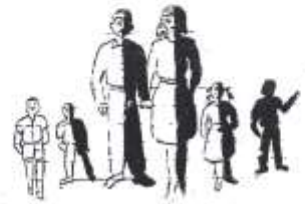

Figure (3) : Both of the parents are carrier

Materials and Methods

Normal and Thalassaemic subjects:

This study was carried out on 97 thalassaemic patients with age ranged between 3.5-24.0 years (52 males and 45 females) attending to "Ibn Al-Atheer Teaching Hospital in Mosul City, and conducted during 2001-2002, and correspond with the normal subjects (control group) consists of 87 healthy volunteers with age ranged between 3.5-24.0 years (66 males and 21 females) at the same experimental studying period and from the same region.

Blood samples: at the morning, about 5ml of fasting venous blood was drawn from capital vein using disposable needle and syringe blood was collected, divided into two parts 1st part contains 3ml added to ethylene diamine tetracetic acid (EDTA) anticoagulant tube, which used for hemoglobin (Hb) and packed cell volume (PCV) determinations while the 2nd contains 2ml was pored into dry clean plastic plan tube, used immediately for blood group estimation.

Hb Ratio calculation:

1. partional group/mean of total groups Hb ratio of normal or Beta-thalassaemic group.
2. Beta-thalassaemia index = Hb value of Beta-thalassaemic group/Hb value of normal group.

Determination of blood groups, Hb value and PCV percentages:

Blood groups and Rh factor were determined in normal and thalassaemic samples according to Makarem (1974). Hemoglobin value (Hb g/dl) was measured using Randox kit based on the conversion of Hb to cyanomethemoglobin, light absorption. of the product was measured spectrophotometrically at 540nm wave length. Packed cell volume (PCV %) was measured by microhaematocrit method using plain microhaematocrit tubes: compacted cell volume was measured and calculated as PCV%.

Statistical analysis: Data were analyzed statistically by using the factorial experimental conducted completely randomized design (CRD) according to Steel and Torrie (11) using the a+nalysis of variance, (SAS computer program), at probability <0.05 .

Results:

Age and sex effect on hemoglobin value:

All the (97) thalassemic patients had Hb level below normal subjects. Table (1) show the distribution of Hb g/dl ± S.E of female and male in relation to age ranged from 3.5 to 24yrs old of the ß-thalassemic patients registered in Mousl Thalassaemic Center for the period 1997-2001 A.D.

Table (1): hemoglobin value and Hb ratio distributions of Beta-thalassaemic patients in relation to age and sex in Mosul population.

Age (year)	Control Group				Beta-thalassaemic patients			
	Sex	Sample %	Hb mean ±S.E	Hb ratio	Sex	Sample %	Hb mean ±S.E	Hb ratio
3.5-6	F	11.11	11.50±0.00	0.95	F	0.70	8.47±0.69	0.74
	M	88.89	13.63±0.76	1.08	M	0.60	7.57±1.16	0.55
	Total	100.00	13.39±0.99	1.06	Total	0.63	8.02±1.13	0.60
7-12	F	33.33	12.25±0.61	1.01	F	0.65	7.94±1.07	0.65
	M	66.67	13.58±0.93	1.07	M	0.68	8.54±0.68	0.63
	Total	100.00	13.14±1.04	1.04	Total	0.65	8.24±0.93	0.63
13-18	F	44.44	12.44±0.62	1.03	F	0.65	7.93±1.05	0.64
	M	55.56	13.40±0.39	1.06	M	0.60	7.62±0.86	0.57
	Total	100.00	12.97±0.70	1.02	Total	0.61	7.76±0.94	0.60
19- 24	F	50.00	12.33±1.80	1.02	F	0.59	7.15±0.98	0.58
	M	50.00	10.00±0.87	0.79	M	0.61	7.67±0.46	0.77
	Total	100.00	11.17±1.82	0.88	Total	0.60	7.56±0.62	0.68
general mean 3.5-24	F	34.72	12.13±0.78	1.00	F	0.65	7.88±1.02	0.65
	M	65.28	12.65±0.75	1.00	M	0.62	7.85±0.92	0.62
	Total	100.00	12.67±1.14	1.00	Total	0.62	7.90±0.91	0.63

There were significant differences between Hb mean value and sex (female or male) at $p<0.05$. There was a significant sex difference according to Hb level was found between cases and normal control groups ($p<0.05$). Sex difference was found in hemoglobin concentration between male and female patients, hemoglobin concentration in males was higher than in female thalassemic patients. The Hb values of the males were higher than that Hb values of females in both normal and thalassemic patients as seen from the Hb ratios. The Beta-thalassaemic index was 0.75 as a maximum limit index (about 8.50g/dl Hb value), the moderate Beta-thalassaemic index was 0.65 for female, 0.62 for male and 0.63 for both. The Beta-thalassaemic index is the first time used as a parameter in this study. The Hb general mean values of the Beta-thalassaemic patients were 7.88, ,7.85 and 7.90g/dl for female, male and both respectively, and there were lower than that Hb general mean values of the normal 12.13 , 12.65 and 12.67g/dl for female, male and both respectively.

Age and blood group effect on hemoglobin value:
Table (2) show the distribution of blood groups of A^+,B^+,AB^+,O^+,A^-,O^- and Hb for normal and Beta-thalassaemic patients in relation to age with the monitoring that, there were no samples obtained for Beta-thalassaemic AB^- and B^- blood groups nor for the normal individuals in Mosul population. In addition, there were no samples obtained for normal blood groups A^- and O^- found in Mosul, may be due to very few ratios in Mosul population. Table (2) show no significant differences ($p>0.05$) between and within each groups of normal and Beta-thalassaemic patients in age and blood groups with Hb values. Therefore, no effect of the blood groups on Hb values under age groups of this study. The general mean blood group "O^+" frequency of the Beta-thalassaemic patients was higher (48.00%) than that group (O^+) of the normal individuals(41.00%) and higher than other blood groups in Beta-thalassaemic and normal individuals.

Table (2). Blood group, hemoglobin values and Hb ratio distribution of beta-thalassemic patients In relation to age in Mosul population.

Age (year)	N	Normal individuals (Control)			Beta-Thalassaemic patients			
	Blood group	Sample %	Hb Mean± S.E	Hb ratio	Blood group	Sample %	Hb mean± S.E	Hb ratio
3.5-6.0	A+	33.33	14.17±0.68	1.12	A+	11.11	8.15±1.20	1.03
	B+	11.11	14.00±0.00	1.10	B+	38.89	8.03±0.99	1.02
	AB+	------	----------	------	AB+	-------	----------	------
	O+	55.56	1 12.80±0.86	1.01	O+	44.44	8.30±0.94	1.05
	A-	-------	----------	------	A-	5.56	5.30±0.00	0.67
	O-	-------	----------	------	O-	------	----------	------
	Total	100.00	13.39±0.99	1.07	Total	100.00	8.02±1.13	1.02
7-12	A+	22.22	13.38±1.18	1.06	A+	27.78	8.32±1.01	1.05
	B+	5.56	13.00±0.00	1.03	B+	11.10	9.30±0.00	1.18
	AB+	11.11	13.25±1.06	1.05	AB+	5.56	7.30±0.00	0.92
	O+	61.11	13.05±1.13	1.03	O+	55.56	8.09±0.89	1.02
	A-	-------	----------	------	A-	-------	----------	-----
	O-	-------	----------	------	O-	-------	----------	-----
	Total	100.00	13. ±1.04	1.04	Total	100.00	8.24±0.93	0.96
13-18	A+	11.11	11.50±0.00	0.91	A+	22.21	7.58±0.68	0.91
	B+	11.11	13.00±0.00	1.03	B+	16.67	7.20±1.01	0.89
	AB+	16.67	13.00±0.00	1.03	AB+	5.56	7.00±0.00	1.05
	O+	61.11	13.23±0.56	1.04	O+	50.00	8.28±0.82	0.80
	A-	-------	----------	------	A-	-------	----------	-----
	O-	-------	----------	------	O-	5.56	6.30±0.00	0.80
	Total	100.00	12.97±0.70	1.02	Total	100.00	7.76±0.94	0.98
19-24	A+	16.67	14.00±0.00	1.10	A+	33.33	7.87±0.46	1.00
	B+	16.67	10.00±0.00	0.79	B+	22.22	8.10±0.23	1.03
	AB+	16.66	13.00±0.00	1.03	AB+	-------	----------	-----
	O+	50.00	10.00±0.86	0.79	O+	44.45	7.05±0.46	0.89
	A-	------	----------	-----	A-	-------	----------	-----
	O-	------	----------	-----	O-	-------	----------	-----
	Total	100.00	11.17±1.82	0.88	Total	100.00	7.56±0.62	0.96
general mean 3.5-24.0	A+	21.04	13.93±0.47	1.10	A+	23.61	7.98±0.84	1.01
	B+	10.53	12.50±0.00	0.97	B+	22.22	8.16±0.56	1.03
	AB+	10.54	13.13±0.33	1.04	AB+	2.28	7.15±0.00	0.91
	O+	57.89	12.21±0.71	0.94	O+	48.61	7.93±0.78	1.00
	A-	-------	----------	-----	A-	1.39	5.30±0.00	0.97
	O-	-------	----------	-----	O-	1.39	6.30±0.00	0.80
	Total	100.00	12.67±1.14	1.00	Total	100.00	7.90±0.91	1.00

There were no significant different values between Hb mean and any of the blood group at $p<0.05$ level.

There were no samples of blood groups of B^- and AB^- for both normal and Beta-thalassaemic patients in Mosul population and nor of A^- and O^- blood groups for normal individuals seen in Mosul population too, because they are very few samples ratios in Mosul population. The blood groups could be arranged in decreasing order as: O^+, A^+, AB^+,B^+ according to the their samples% distribution (57.89, 21.05, 10.54 and 10.53 % respectively) in normal Mosul population. While the blood groups of Beta-thalassaemic patients could be arranged in decreasing order as: O^+, A^+, B^+ AB^+ , O^- and A^- according to their samples% distribution (48.61, 23.61, 22.22, 2.28, 1.39 and 1. 39% respectively) in Mosul population. Therefore, the most Beta-thalassaemic disease was taken place with O^+ blood group people, followed by A^+ group.

Age and packed cell volume effect on Hemoglobin value:

Table (3) shows the distribution of PCV and Hb values for the normal and Beta-thalassaemic patients in relation to the age. The relationship of Hb value with PCV was found in increasing order distribution of normal Hb individuals as 12.00, 13.00 , 13.00 , 14.00 , 14.00 and 15.00g/dl for PCV increasing order too (35.00, 36.00, 37.00, 37.50, 45.00 and 46.00%) for 3.5-6.0 years old group and so on for the increasing order distribution of Hb values and PCV percentages of the increasing ages 7-12 , 13-18 and 19-24 years old of normal persons groups. On the other hand, the increasing order distribution of Hb values and PCV% of Beta-thalassaemic patients were 5.30, 6.30, 7.00, 7.30, 8.27, 9.00, 9.30 and 9.30g/dl with relation to increasing order of PCV 17.00, 20.00, 22,00, 23.00, 26.00, 27.00, 28.00, and 29.00% respectively forage 3.5-6.0yrs old group. Other distribution of Hb values increasing order in relation to PCV increasing order too for age 7-12, 13-18 and 19-24yrs old groups took the same distribution manner.

Table (3): hemoglobin value and packed cell volume distribution of Beta-Thalassaemic patients in relation to age in Mosul popula

Age (year)	Normal individuals (Control)				Beta-Thalassaemic patients			
	Sample %	PCV %	Hb mean± S.E	Hb ratio	Sample%	PCV %	Hb mean± S.E	Hb ratio
3.5-6	22.22	55.00*	12.00±0.58*	0.94	5.56	17.00*	5.30±0.00**	0.67
	22.22	36.00*	13.00±0.00*	1.02	5.56	20.00*	6.30±0.00**	0.80
	11.12	37.00*	13.00±0.00*	1.02	11.11	22.00*	7.00±0.00**	0.89
	22.22	37.50*	14.00±0.00*	1.10	11.11	23.00*	7.30±0.00**	0.93
	11.11	45.00	14.00±0.00	1.10	38.88	26.00*	8.27±0.21**	1.05
	11.11	46.00	15.00±0.00	1.18	5.56	27.00*	9.30±0.00**	1.14
	------	-------	----------	------	11.11	28.00*	9.30±0.00**	1.18
	------	-------	----------	------	11.11	29.00*	9.30±0.00**	1.18
Total	100.00	38.33	13.39±0.99	1.05	100.00	24.33	8.07±1.13	1.03
7-12	27.78	35.00*	12.10±0.55**	0.95	11.11	22.00*	7.00±0.00**	0.89
	16.67	35.50*	12.50±0.00**	0.98	22.22	23.00*	7.30±0.00**	0.93
	16.66	36.00*	13.00±0.00**	1.02	11.11	25.00*	8.00±0.00**	1.02
	16.67	37.00*	13.67±0.29**	1.08	22.22	26.00*	8.30±0.00**	1.05
	5.56	37.50*	14.00±0.00**	1.10	22.22	28.00*	9.15±0.17**	1.16
	5.55	45.00	14.50±0.00	1.14	5.56	30.00*	9.40±0.00**	1.19
	11.11	46.00	15.00±0.00	1.18	5.56	33.00*	10.00±0.00*	1.27
Total	100.00	37.48	13.14±1.04	1.03	100.00	25.83	8.24±0.93	1.05
13-19	27.78	35.00*	12.10±0.55**	0.95	5.56	20.00*	6.30±0.00**	0.80
	38.89	36.00*	13.00±0.00**	1.02	5.56	20.90*	6.30±0.00**	0.80
	22.22	37.00*	13.50±0.00**	1.06	27.77	22.00*	7.00±0.00**	0.89
	11.11	45.00	14.00±0.00	1.10	5.56	23.00*	7.30±0.00**	0.93
	------	-------	----------	------	16.66	25.00*	12.97±0.70*	1.02
	-------	-------	----------	------	22.22	26.00*	8.30±0.00**	1.05
	-------	-------	----------	------	5.56	27.00*	9.00±0.00**	1.14
	-------	-------	----------	------	11.11	29.00*	9.30±0.00**	1.18
Total	100.00	45.94	12.97±0.70	1.02	100.00	24.33	7.76±0.00	0.99
19-24	33.33	32.00*	9.50±0.55**	0.75	11.11	20.60*	6.30±0.00**	0.80
	33.33	34.00*	10.50±0.55**	0.83	11.11	22.00*	7.30±0.00**	0.93
	16.67	36.00*	13.00±0.00**	1.02	33.33	23.00*	7.30±0.00**	0.93
	16.67	38.00*	14.00±0.00**	1.10	22.22	25.00*	7.95±0.06**	1.01
	------	-------	----------	------	22.23	26.00*	8.30±0.00**	1.05
Total	100.00	34.33	11.17±1.82	0.88	100.00	23.73	7.56±0.62	0.96
general mean	26.06	39.42*	13.39±0.99**	1.05	21.08	24.00*	8.07±1.13**	1.03
3.5-24	25.49	38.86*	13.14±1.04**	1.03	24.10	26.71*	8.24±0.93**	1.05
	25.11	38.25*	12.97±0.70**	1.02	21.09	24.11*	7.76±0.94**	0.99
Total	23.34	35.00*	11.17±1.82**	0.88	33.73	23.32*	7.56±0.62**	0.96
	100.00	37.95	12.71±1.12	1.00	100.00	24.45	7.87±0.87	1.00

* significant values, ** highly significant values. at $p<0.05$ level.

Discussion:

Anemia was more common in female than in male thalassemic patients which is probably due to social reasons.This is finding is an agreement with finding of Saraya et al (12) and Moayad M.(13). This was in contast with reports from other counties were patients are treated in favour of a supertransfusion programme (maintaining Hb level above 12 (g/dl) or by hypertransfusion programme were the Hb level never allowed to drop below 9 g/dl (14). Gabutti et al (15) stated that patient with in adequately blood transfusion are maintained at low Hb level (5-7 g/dl) their residual erythropoitic capacity played a key part setting Hb level and transfusion requirement. The Hb values of the males were higher than that Hb values of females in both normal and Beta-thalassaemic patients as seen from the Hb ratios. The Beta-thalassaemic index was 0.75 as a maximum limit index (about 8.50g/dl Hb value), the moderate Beta-thalassaemic index was 0.65 for female, 0.62 for male and 0.63 for both. The Beta-thalassaemic index is the first time used as a parameter in this study. These results were agreed with the results reported by Pearson (16).

Table (2) show no significant differences ($p>0.05$) between and within each groups of normal and Beta-thalassaemic patients in age and blood Groups with Hb values . Therefore, no effect of the blood groups on Hb values under age groups of this study. No references found to compare these results. The general mean blood group "O^+" frequency of the Beta-thalassaemic patients was higher (48.00%) than that group (O^+) of the normal individuals(41.00%) and higher than other blood groups in Beta-thalassaemic and normal individuals, this result was agreed with the results reported by the Moayad M., (2002). There were no samples of blood groups of B^- and AB^- for both normal and Beta-thalassaemic patients in Mosul population and nor of A^- and O^- blood groups for normal individuals seen in Mosul population too, because they are very few samples ratios in Mosul population. The blood groups could be arranged in decreasing order as: O^+, A^+, AB^+,B^+ according to the their samples% distribution (57.89, 21.05, 10.54 and 10.53 % respectively) in normal Mosul population. While the blood groups of Beta-thalassaemic patients could be arranged in decreasing order as: O^+, A^+, B^+ AB^+ , O^- and A^- according to their samples% distribution (48.61, 23.61, 22.22, 2.28, 1.39 and 1. 39% respectively) in Mosul population.

Therefore, the most Beta-thalassaemic disease was taken place with O^+ blood group people, followed by A^+ group, this conclusion was agreed with the conclusion of Awad, (1999), who observed that O^+ followed by A^+ blood groups are more common, and disagreed with Al-Anzy.(13).Table (3) show significant differences ($p<0.05$) between and within each groups of normal and Beta-thalassaemic patients in the Hb values and PCV for the various four age groups under study. These results were agreed with the conclusion reported by Moayad M, (13). and Awad, (17).

The Hb values and PCV (hematological tests) of Beta-thalassaemic major patients have very severely anemia level with a hemoglobin value less than 7.50g/dl and PCV <25.00%, and sever anemia level with a hemoglobin value 7.56-8.00g/dl and PCV 23.32-25.00%, and mild anemia level with a hemoglobin value 8.00-8.50g/dl and PCV 25.00-27.00% and moderate anemia level with a hemoglobin value 8.50-9.30g/dl and PCV 27.00-29.00%, compared to a mean of normal hemoglobin value ranged between 12.97-13.39g/dl and PCV 38.25-39.42%. this was explained by low health education of the parents and their knowledge about the disease, is very limited and transfusion used only when the patient showed clinical symptoms cuased by sever anaemia and simply to sustain life (1,18). These results were agreed with the results obtained by Sarya *et al.* (12) and Moayad M. (13). From Table (3), the preferred life for the Beta-thalassaemia major was in the age 6-12yrs old group. In this life period the patients has higher hemoglobin value, hemoglobin ratio, PCV. (8.24g/dl, 1.04 and 26.71% respectively).

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دراسة بعض القيم الدموية عند مرضى البيتا – ثلاسيميا في مدينة الموصل

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الملخص:

تم جمع خمسة وتسعون عينة من مرضى الثلاسيميا بمركز الموصل للثلاسيميا للفترة بين ٢٠٠١-٢٠٠٢، كانت العينات موزعة بواقع ٥٢ عينة (بنسبة ٥٤%) ذكور و٤٥ عينة (بنسبة ٤٦%) اناث للاعمار من ٣,٥ الى ٢٤ سنة، و٨٧ عينة دم مثلث مجموعة السيطرة جمعت من متطوعين أصحاء موزعة بواقع ٥٦ عينة (بنسبة ٦٥%) ذكور و٣١ عينة (بنسبة ٣٥%) اناث للاعمار من ٥و٣ – ٢٤جمعت من مستشفى ابن الاثير. تم تقدير قيم الهيموكلوبين وحجم مضغوط كريات الدم ومجاميع الدم بالاضافة لمعلومات جمعت عن العمروالجنس.

بين تحليل التباين بأنه لا توجد فروقات جوهرية عند مستوى احتمالية ($p<0.05$)بين متوسطات قيم العمر والجنس ومجاميع الدم مع قيم الهيموكلوبين عند مرضى الثلاسيميا مقارنة مع السيطرة . ولكن هناك فروقات ($p<0.05$) بين متوسطات وحجم مضغوط كريات الدم مع قيم الهيموكلوبين لمرضى الثلاسيميا مقارنة مع مجاميع السيطرة. وان قيمة دليل الثلاسيميا (قيمة الهيموكلوبين عند مرضى الثلاسيميا مقسوما على قيم الهيموكلوبين الطبيعية عند العمر المماثل) هو أقل من ٠,٧٠ % ، ان هذا الدليل يعادل قيمة هيموكلوبين ٨,٤٥ ملغم/ديسيمتر عند مرضى الثلاسيميا مقارنة بقيم هيموكلوبين طبيعية ١٢,٠٧ ملغم/ديسيمتر ، وتبعا لهذه القيمة تم تصنيف شدة البيتا–ثلاسيميا وللمرة الاولى الى :ثلاسيميا شديدة جداً ، وثلاسيميا شديدة، وثلاسيميا معتدلة الشدة، وثلاسيميا خفيفة او بسيطة، لها قيم هيموكلوبين اقل من ٧,٥٦ ، ٧,٥٦–٨,٠٠ ، ٨,٠٠–٨,٥٠ ، ٨,٥٠–٩,٣٠، ملغم هيموكلوبين/ديسيليترعلى التوالي وجد نتيجة لتوزيع البيتا–ثلاسيميا على مجاميع الدم، بانه يمكن توزيعها من الاعلى والاكثر نسبة اصابة وكما يلي: O^+, A^+, B^+, O^-و AB^+والادنى هو A^- بنسب اصابة وانتشار هي: ٤٨,٦١ و ٢٣,٦١ و ٢٢,٢٢ و ٢,٢٨ و ١,٣٩ واخيرا" ١,٣٩ % على التوالي. كما وجد أن افضل عمر لدى مرضى الثلاسيميا هو ٦–١٢ سنة حيث احتوى دمهم على أعلى قيمة هيموكلوبين ونسبة هيموكلوبين وحجم مضغوط كريات الدم.