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Comparison of various hematological indices in patients of β Thalassemia trait of Jharkhand ,Ranchi, India:A study conducted on 50 patients over 3 years duration

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ABSTRACT The two most frequent types of microcytic anemia are beta thalassemia trait (β-TT) and iron deficiency anemia (IDA). We retrospectively evaluated the reliability of various indices for differential diagnosis of microcytosis and β-TT in the same patient groups.

Methods. A total of 50 carefully selected patients with no age restriction were evaluated. We calculated 7 discrimination indices in all patients with hemoglobin (Hb) values of 5.1 to11.6 g/dL. The patient groups were evaluated according to red blood cell (RBC) count; red blood distribution width index, Mentzer, Shine and Lal, England and Fraser, Srivastava, Green and King and Ricerca indices

Results: Most sensitive index was Shine and Lal, followed by Mentzer index.

KEYWORDS : Hematological indices, β Thalassemia trait, Iron deficiency anemia.

Introduction

The two most common causes of Microcytic anemia are iron deficiency anemia and β-thalassemia. Microcytic anemia in a case of thalassemia results from impaired globin chain synthesis and decreased hemoglobin (Hb) synthesis, resulting in microcytosis and hypochromia[1]. Individuals with the beta thalassemia trait (β-TT) are usually asymptomatic and may be unaware of their carrier status unless diagnosed by testing. β-TT is the most common type of hemoglobinopathy transmitted by heredity. It is estimated that about 50% of the world's population with β-TT are in Southeast Asia[2].

A definitive differential diagnosis between β-TT and IDA is based on the result of HbA_2 electrophoresis, serum iron levels, and a ferritin calculation[3]. But all these investigations are quite expensive, especially in developing country like ours. Electronic cell counters have been used to determine red cell indices as a first indicator of β-TT. The purpose of using indices to discriminate anemia is to detect subjects who have a high probability of requiring appropriate follow-up and to reduce unnecessary investigative costs. Since 1970, a number of complete blood count indices have been proposed as simple and inexpensive tools to determine whether a blood sample is more suggestive of β-TT or IDA[4-12]. The need of a sensitive index for screening of the patients has led to the commencement of this study. Here, we have compared the ability of 7 different Indices in patients of β thalassemia trait and calculated their sensitivity for the disease.

Materials and Methods:

A total of 50 patients with β thalassemia trait were included in the study. Patients were otherwise medically fit and no clinical symptoms of acute or chronic inflammation or infectious diseases was present in them. None of them had received a transfusion or had an acute bleeding episode in the previous month. The samples were obtained during the course of routine analysis and collected in EDTA anticoagulant tubes. Red blood cell (RBC) count and red blood cell distribution width (RDW) were assessed on a Sysmex XT 2000i Hematology Analyzer.HbA_2 was detected by high-performance liquid chromatography (Bio-Rad Variant II, California, USA) which confirmed the cases to be of β thalassemia trait. 7 indices were taken in consideration and sensitivity was calculated for each of them to determine which index has highest sensitivity in the subpopulation of Jharkhand Different RBC indices and mathematical formulas used to differentiate between β-TT and IDA is shown in table 1.Complete hemogram of 50 patients and Indices value are shown in table 2.

Hematological index	Formula	Cut off value for β-TT
Mentzer index (MI) (1973)	MCV/RBC	<13
Srivastava (1973)	MCH/RBC	<3.8
England & Fraser(E and F) (1973)	MCV – (5 × Hb) – RBC – 3.4	<0
Shine and Lal (S and L) (1977)	MCV × MCV × MCH/100	<1530
Green & King (G and K) (1989)	MCV × MCV × RDW/Hb × 100	<72
Ricerca (1987)	RDW/RBC	<3.3
RDWI (1987)	MCV × RDW/RBC	<220

Table1- Different RBC indices and mathematical formulas used to differentiate between β-TT and IDA

Results and Analysis:

Data were analyzed with computerized Medcalc software version 9.6.4.0. The differential values for each discrimination index were applied as defined in the original published reports: red blood distribution width index (RDWI), Mentzer index [4], the Shine and Lal index[5], the England and Fraser index[6], the Srivastava[7], the Green and King index[8], the Ricerca et al. index[9].

The following results were obtained-Range of hemoglobin values lie between 5.1 and 11.6gm%.

S.No	RBC	Hb	PCV	MCV	MCH	MCHC	RDW-CV	PLT	MI	SHRI.	E & F	S & L	G & K	RICERCA	RDWI
1	6.45	10.3	31.2	76	16	33	30.8	162	11.78	2.48	1	57.60	172.72	4.78	362.91
2	5.52	10.2	33	63.8	18.5	29	22	122	11.56	3.35	7.28	40.52	87.79	3.99	254.28
3	6.11	10.9	35	55.5	17.8	32.2	23	275	9.08	2.91	-5.11	30.62	65.00	3.76	208.92
4	6.2	10.9	33.7	58.4	17.6	30.1	22	469	9.42	2.84	-2.3	33.93	68.84	3.55	207.23
5	5.6	10	39	69.5	17.9	25.7	15.9	345	12.41	3.20	13.9	48.12	76.80	2.84	197.33
6	6.16	10.2	43.9	71.3	19.8	27.8	17.9	186	11.57	3.21	14.14	50.64	89.21	2.91	207.19
7	6.46	11.5	3.87	59.9	18.3	30.5	17.2	234	9.27	2.83	-4.06	35.70	53.66	2.66	159.49
8	5.69	10.8	35	61.5	19	30.9	17.4	314	10.81	3.34	1.81	37.63	60.94	3.06	188.07
9	6.54	11.5	45.7	69.9	23.4	33.5	15.8	180	10.69	3.58	5.86	48.63	67.13	2.42	168.87
10	3.39	5.6	20.7	61.1	16.5	27.1	20.9	239	18.02	4.87	29.71	37.17	139.33	6.17	376.69
11	6.39	10.4	40.9	64	19.7	30.8	18.4	93	10.02	3.08	5.61	40.76	72.47	2.88	184.29
12	1.9	5.4	20.3	20.7	28.4	26.6	17.4	97	10.88	14.95	-8.23	3.99	13.77	9.16	189.32
13	6.42	10.6	40.9	63.7	19.9	31.3	18	241	9.92	3.10	4.28	40.38	68.90	2.80	178.60
14	3.29	6.3	21.8	66.3	19.1	28.9	27.5	137	20.15	5.81	31.51	43.77	191.88	8.36	554.18
15	5.42	11.1	34.9	64.4	20.5	31.8	14.9	225	11.88	3.78	3.48	41.27	55.67	2.75	177.04
16	2.77	6.3	20.1	72.6	22.7	31.3	18.2	68	26.21	8.19	38.33	52.48	152.27	6.57	477.01
17	2.6	7.2	23.6	90.8	27.7	30.5	21.1	261	34.92	10.65	52.2	82.17	241.61	8.12	736.88
18	3.08	5.6	20.8	67.5	18.2	26.9	16.1	42	21.92	5.91	36.42	45.38	130.99	5.23	352.84
19	5.03	11.2	35.6	70.8	22.3	31.5	16.7	162	14.08	4.43	9.77	49.90	74.74	3.32	235.06
20	4.49	11.4	35.6	79.3	25.4	32	12.8	492	17.66	5.66	17.81	62.63	70.61	2.85	226.07
21	5.83	11.3	37.8	64.8	21.1	32.5	19.4	132	11.11	3.62	2.47	41.78	72.09	3.33	215.63
22	4.2	7.4	25.1	59.8	17.6	29.5	21.6	116	14.24	4.19	18.6	35.58	104.38	5.14	307.54
23	6.23	11.6	42.9	68.9	20.2	29.4	18.3	122	11.06	3.24	4.67	47.27	74.89	2.94	202.39
24	5.68	10.4	40.5	71.3	21.8	30.6	16.8	75	12.55	3.84	13.62	50.62	82.12	2.96	210.89
25	8.36	10.9	58.1	69.5	20.2	29.1	20.5	231	8.31	2.42	6.64	48.10	90.84	2.45	170.42
26	3.89	10	37	95.1	30.8	32.4	16.8	286	24.45	7.92	41.21	90.13	151.94	4.32	410.71
27	6.38	11.6	45.6	71.5	22.9	32	20.1	298	11.21	3.59	7.12	50.89	88.58	3.15	225.26
28	5.32	10.3	34.8	65.4	19.4	29.6	16.9	129	12.29	3.65	8.58	42.58	70.18	3.18	207.76
29	5.31	9	27.5	51.8	16.9	32.7	18.2	383	9.76	3.18	1.49	26.66	54.26	3.43	177.54
30	5.58	11.5	38.9	69.7	22.4	32.1	14.7	58	12.49	4.01	6.62	48.36	62.10	2.63	183.62
31	4.97	10.7	33.9	68.2	21.5	31.6	15	145	13.72	4.33	9.73	46.30	65.20	3.02	205.84
32	6.72	9.3	41.6	61.6	19.8	32.1	19.6	394	9.17	2.95	8.38	37.75	79.97	2.92	179.67
33	3.89	8.4	27.1	69.7	21.6	31	17.9	366	17.92	5.55	23.81	48.36	103.52	4.60	320.73
34	5.13	11.5	40	78.9	22.8	28.8	17.2	141	15.38	4.44	16.27	62.02	93.11	3.35	264.54
35	2.17	5.1	20	77.4	23.5	30.4	17.8	130	35.67	10.83	49.73	59.67	209.09	8.20	634.89
36	6.42	10.8	40.9	63.7	19.9	31.3	18	241	9.92	3.10	3.28	40.38	67.63	2.80	178.60
37	3.9	5.4	20.3	65.6	28.4	26.6	16	97	16.82	7.28	34.7	42.75	127.51	4.10	269.13
38	5.9	10.6	34.2	58	98	31	16.1	46	9.83	16.61	-0.9	32.66	51.09	2.73	158.27
39	6.39	10.6	40.9	64	19.7	30.8	25	93	10.02	3.08	4.61	40.76	96.60	3.91	250.39
40	3.39	5.6	20.7	61.1	16.5	27.1	27	239	18.02	4.87	29.71	37.17	179.99	7.96	486.64
41	5.92	9	31.7	70.9	20.5	28.6	18.7	241	11.98	3.46	19.98	50.06	104.45	3.16	223.96
42	5.18	11.1	31.7	77.4	21.4	27.7	17.2	242	14.94	4.13	16.72	59.69	92.83	3.32	257.00
43	4.35	10.9	13.2	84.1	25.1	29.8	16.2	362	19.33	5.77	25.25	70.48	105.12	3.72	313.20
44	5.53	11.5	38	68.9	20.8	30.2	18.1	255	12.46	3.76	5.87	47.26	74.72	3.27	225.51
45	5.86	9.3	40	72.4	21.8	29	19.3	115	12.35	3.72	20.04	52.20	108.78	3.29	238.45
46	5	11.6	26.4	68	21	32.1	15.1	262	13.60	4.20	5	46.03	60.19	3.02	205.36
47	7.11	10.9		61.3	19.5	31.9	19.1	364	8.62	2.74	-0.31	37.38	65.85	2.69	164.67
48	4.79	9	29.3	61.2	18.8	30.7	16.4	235	12.78	3.92	11.41	37.27	68.25	3.42	209.54
49	6.02	10.8	34.4	57.1	17.9	31.4	19.5	1.5	9.49	2.97	-2.92	32.43	58.87	3.24	184.96
50	5.19	10.9	34.3	66.1	21	31.8	16.3	1.7	12.74	4.05	6.41	43.48	65.34	3.14	207.60

Table 2-Complete hemogram and indices value of 50 patients.

Sensitivity is calculated as- $\frac{\text{True positive}}{\text{True positive + False negative}} \times 100$

Sensitivity obtained for different indices were- Mentzer index-64%,Shine and Lal index-90%, England and Fraser index -14%, Srivastava index-52%, the Green and King index-40%, the Ricerca index-52% and Red blood distribution width index (RDWI)-56%.While England and Fraser index showed least sensitivity, Shine and Lal proved to be most sensitive(90%), followed by Mentzer Index(64%).

Discussion

β-TT and IDA are among the most common types of microcytic anemia. Distinguishing β-TT from IDA has important clinical implications because each disease has an entirely different cause, prognosis, and treatment. Thalassemia is endemic in Jharkhand. Up to now, many investigators have used different hematological indices to distinguish β-TT from IDA using only a complete blood count. This process helps to select appropriate individuals for a more detailed examination; however, no study has found 100% specificity or sensitivity for any of these RBC indices. RBC count has been considered a valuable index[13], but RBC alone is not a reliable tool for distinguishing β-TT from IDA. Different studies have shown different reliable results. In a 2010 study, Ferrara et al. demonstrated that RDWI had the highest sensitivity (78.9%)[14].In 2007, Ntaios et al. reported that the Green and King index was the most reliable index, as it had the highest sensitivity (75.06%)[15]. Our study here shows that Shine and Lal

is the most sensitive index. Mentzer index can also be used, as it is very simple to calculate with moderate degree of sensitivity.

Conclusion

In conclusion, the cell-count-based indices, particularly the Mentzer index, and Shine and lal index are easily available and reliable methods for detecting β-TT. According to our results, the percentage of correctly diagnosed patients was the highest with the Shine and Lal index (90%) followed by the Mentzer index (64%),and they can be readily applied in patients in Jharkhand subpopulation.

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