Research Article

Efficacy of Hematological Indices for β Thalassemia Trait Screening in Pregnant Women

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Abstract: Background: ß thalassemia is one of commonest inherited disorder in Pakistan having a carrier rate of 5%. Pregnant women having ß thalassemia trait can have offspring having ß thalassemia major which is lifelong blood transfusion dependent state. Different screening programmes are being carried out in various parts of the world so that the birth of children having ß thalassemia major can be effectively reduced.

Objective: To determine the diagnostic accuracy of hematological parameters in identifying β thalassemia trait in pregnant women keeping measurement of HgbA2 as gold standard.

Methods: 108 pregnant women were enrolled during one year of the study period. Blood sample was taken and blood complete picture was obtained. By using variables of CP card Green & King index, Shine & Lal index and RDWI were calculated keeping hemoglobin electrophoresis as gold standard.

Results: The age of patients ranged from 17 to 37 years with mean age of 24.65. Out of 108 pregnant women enrolled in study 40 were found to have ß thalassemia trait based on results of hemoglobin electrophoresis. Shine & Lal index showed 100% sensitivity, 0% specificity, 35% PPV and 0% NPV. Green & Kings index had sensitivity of 32%, specificity 100%, PPV of 100% and NPV of 71% while RDWI showed 50% sensitivity, 100% specificity, PPV of 100% and NPV of 77% in diagnosing ß thalassemia trait in pregnant women.

Conclusion: Automated cell counters based formula including Green & King index, Shine &Lal index and RDWI provide rapid, reliable and cost effective method for screening of ß thalassemia trait especially in third world countries like Pakistan. However none of them have 100% sensitivity and specificity. So they should be collectively looked at in screening programmes.

Keywords: ß Thalassemia trait, Hemoglobin electrophoresis, Red cell indices, Microcytic anemia, Iron deficiency .

INTRODUCTION

Anemia in pregnancy is a global health problem which is affecting nearly 51% of pregnant women worldwide. It has multifactorial etiology and may be microcytic, macrocytic or normocytic normochromic. Among microcytic anemia, iron deficiency anemia is the commonest cause of anemia in pregnancy [1, 2] with a prevalence of 52% [3]. The other important cause of microcytic anemia is ß thalassemia trait having a carrier rate of 5-6% in Pakistani population [4, 5]. It is important to differentiate between the two as an early diagnosis of iron deficiency anemia can result in significant reduction in maternal and infant mortality and morbidity. While pregnant women having ß thalassemia trait can be prevented from receiving unnecessary iron therapy. Also, they can be given early and appropriate family counseling [6, 7]. Because if both husband and wife are cases of ß thalassemia trait, they have one in four chance of having a ß thalassemia major child. So antenatal screening and diagnosis is a promising strategy for reduction of mortality and morbidity from thalassemia [5]. Gold standard for diagnosis of iron deficiency is based on low serum ferritin levels [8] while elevated HbA2 levels serve as gold standard for diagnosis of ß thalassemia trait [5]. Some other simple and cost effective formulas have been defined to quickly discriminate these diseases based on erythrocyte indices obtained from automated blood cell analyzers.

MATERIALS AND METHODS

It was a cross-sectional (validation study) conducted at department of pathology, Benazir Bhutto Hospital

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Rawalpindi. It is a tertiary care hospital. Its catchments area includes northern part of Punjab, North West Frontier Province, Azad Jammu Kashmir. It is teaching unit of Rawalpindi Medical College. Duration of study was 1 year conducted on 108 pregnant women having hypochromic microcytic anemia (Hgb <11g/dl, MCV<76, MCH<27). Blood of patients was collected in EDTA and then processed on Sysmex -KX-21. A peripheral blood examination was done to confirm hypochromic microcytic picture. Hemoglobin electrophoresis was performed for hemoglobin A2 estimation. Based on findings of blood CP card RDW index, green & king formula, Shine & Lal formula were calculated (Table **1**). Analysis of data was carried out using statistical package for social sciences (SPSS VERSION 16).

Table 1. Red Cell Counter Based Indices to Identify.

Index	Formula	BTT
Green & King	MCVXMCVXRDW/(Hbx100)	<65
Shine & Lal	MCVXMCVXMCH/100	<1530
RDWI	MCVXRDW/RBC	<220

RESULTS

Out of 108 pregnant females 40 were found to have β thalassemia trait on the basis of results of hemoglobin electrophoresis (Table **2**). Diagnostic accuracy of Green & Kings index (Table **3**), Shine & Lal index (Table **4**) and RDWI (Table **5**) in identifying β thalassemia trait was calculated, keeping the results of hemoglobin electrophoresis as gold standard.

Table 2. Females Identified as Having BTT on Haemoglobin Electrophoresis.

Total No Pregnant Females	Females Having B Thalassaemia Trait On Hgb Electrophoresis Result (HgbA2>3.5%)	Mean	Standard Deviation
108	40	3.1279	1.21947

Table 3. Diagnostic Accuracy of Green & King Index in Identifying BTT.

	HaemoglobinA2>3.5% +ive	-ive	Mean	Standard Deviation
<65	13	0	1.9788	97.584
Green & king index				
>65	27	68		

Table 4. Diagnostic Accuracy of Shine & Lal Index in Identifying BTT.

	HaemoglobinA2>3.5% +ive	-ive	Mean	Standard Deviation
< 1530	38	60	8.8619	290.732
Shine & LalIndex				
> 1530	2	0		

Table 5. Diagnostic Accuracy of RDWI in Identifying BTT.

	Hemoglobin A2 >3.5% +ive	-ive	Mean	Standard Deviation
<220	20	0	5.8422	295.971
RDWI				
>220	20	68		

DISCUSSION

ß thalassemia has a recessive mode of inheritance. It is one of most common inherited single gene disorder [9, 10]. Different ß thalassemia carrier screening programmes are being conducted throughout the world, as this is the only effective way of reducing the incidence of thalassemia major births [11-14]. In Pakistan ß thalassemia has a carrier rate of 5%. Good and effective screening programme is the need of hour in developing country like Pakistan [15-17]. Definitive diagnosis of ß thalassemia is by hemoglobin electrophoresis [18-20]. However it is expensive and only available at restricted places [21, 22]. My study aims at the use of different hematological parameters which include Green & King index, Shine & Lal index and RDW index for identifying ß thalassemia trait in pregnant women, so that effective genetic counseling can be provided to parents of affected offspring. My study included 108 pregnant women having ß thalassemia trait diagnosed by hemoglobin electrophoresis. Green & King index, Shine & Lal index & RDW index were calculated by using simple hematological parameters like Hgb, RBC count, MCV, MCH and RDW. According to this study Green & King index has sensitivity of 32% and specificity of 100%. Shine & Lal index has sensitivity and specificity of 95% and 0% respectively. While RDW index has sensitivity of 50% and specificity of 100%, however, hemoglobin electrophoresis is gold standard for diagnosing ß thalassemia trait [23-25]. The results of my study are comparable to many studies done in past. Okan *et al.* conducted a study to examine the accuracy of nine indices in identifying ß thalasemia trait. Indices examined in the study were RBC count, RDW, Mentzer index, Shine & Lal index, England & Fraser index, Srivastava index, Green & King index, RDW index and Ricerca. Similarly in an another study Niazi *et al*. studied the

usefulness of seven indices including Mentzer index, Shine & Lal index, Srivastava index, England & Fraser, Ricerca, Green & King index, RDW index in differentiating microcytic hypochromic anemia. The percentage of correctly identified patients having ß thalassemia trait was highest for RDW index (88.14%), followed by Mentzer index (86.85), Green & King (83.97%), Srivastava (82.37%), Ricerca (80.44%), England & Fraser (78.28%) and Shine & Lal (72.43%) [26]. We have done an effort to do screening of pregnant women having ß thalassemia trait by the use of some simple hematological parameters. Our results are similar to many previous studies with Shine & Lal index having greatest sensitivity [27, 28]. Yeo GS *et al.* conducted a study showing similar results [29]. So if pregnant women are screened by using these simple parameters we can effectively reduce the number of infants having ß thalassemia major which is a lifelong transfusion dependent state.

CONCLUSION

Automated cell counters based formula including Green & King index, Shine & Lal index and RDWI provide rapid, reliable and cost effective method for screening of ß thalassemia traits especially in under resourced countries like Pakistan. However none of them have 100% sensitivity and specificity so it is better to look at them collectively, while hemoglobin electrophoresis remains the Gold standard for identification of ß thalassemia trait.

AUTHORS' CONTRIBUTION

• **Maryam Habib** and **Masooma Shaheen** designed the study and performed literature analysis.
• **Wardah Aslam** collected the data and performed critical revision of the manuscript.

CONFLICT OF INTEREST

Declared None.

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