PREVALENCE OF ANEMIA, THALASSEMIA AND SICKLE CELL ANEMIA IN MEDICAL STUDENTS: A THREE YEAR CROSS-SECTIONAL STUDY IN P.D.U. MEDICAL COLLEGE, RAJKOT

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ABSTRACT

BACKGROUND: To study the prevalence of anemia, thalassemia and sickle cell anemia in the medical students of P.D.U. Medical College, Rajkot (Gujarat, India) and to evaluate the usefulness of Naked Eye Single Tube Red Cell Osmotic Fragility Test (NESTROFT) and various discriminative indexes (haemogram indices) in screening of Beta Thalassemia Trait (BTT).

MATERIALS AND METHODS: An analytical cross-sectional study of 400 medical students was conducted at P.D.U. Medical College, Rajkot at various intervals from January 2010 to December 2012. With written informed consent, EDTA anti-coagulated whole blood samples were collected and processed by automated cell counter for Complete Blood Count (CBC), Peripheral smear prepared and stained by Leishman’s stain and NESTROFT and Sickling Test were performed. The diagnosis of BTT was confirmed by High Performance Liquid Chromatography (HPLC).

RESULTS: The overall frequencies of anemia, BTT and sickle cell anemia were 23%, 3.5% and 0.75% respectively. 97.83% of anemia in students was of mild degree. The efficiency of NESTROFT, Mentzer Index, Srivastava Index and Shine & Lal index for diagnosis of BTT were 84.61%, 88.46%, 73.07% and 32.69% respectively.

CONCLUSION: With a 3.5% rate of BTT, studies on national level are needed to know the actual prevalence in premarital people. NESTROFT combined with discriminative haemogram indices can be used as a useful means for screening for BTT in resource limited setting.

KEYWORDS: β-thalassemia trait (BTT), Discriminative indices, Medical students screening, NESTROFT

INTRODUCTION

Nutritional anemia is very much prevalent and largely undiagnosed among students in Professional Institutes. Nutritional anemia though global, is more of concern in the developing countries due to high prevalence. Unfortunately it is not restricted to rural and low socio economic status adolescents but shows increased prevalence in developed affluent societies. The study done by Dr. Yogesh et al on 200 healthy medical students at the Himalayan Institute of Medical Sciences, Dehradun reported that 8% of the students of MBBS were anemic with 17% of the female students having hemoglobin <12 gm%.

Nutrition foundation of India (2009) also found 9.6% of the urban adolescents girls having the hemoglobin <10 gm%. Adolescents being a formative year in life are more prone to major nutritional deficiency. Since adolescence has the lowest rate of mortality among different age groups it has been placed in least priority. Anemia during adolescence severely impairs the physical and mental development; weakens behavioral and cognitive development; reduces physical fitness; decreases the work performance. Although prevalence of anemia is marginally higher in rural areas but recent studies have highlighted the increasing prevalence of anemia among adolescents living in urban settlements. Medical fraternity is among the literate and well informed sector of the society. Considerable changes in the lifestyle & behavior, increased consumption of easily and cheaply available fast foods, inadequate and inappropriate dietary habits & mechanical job profile are likely to increase the prevalence of nutritional disorders including anemia even in the affluent young adults. Since children and young adults are our future, therefore it is important for us to assess their problems at an early stage so that strategic intervention can be planned. This creates

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awareness among them to improve their health status and nutritional requirements and to further guide the society. Thalassemia can easily be prevented by awareness, education, screening, genetic counseling and prenatal diagnosis. There is high need of primary preventive strategies to prevent further births of thalassemia major children. The control programs can reduce birth of child with thalassemia major as in Sardinia have reduced the birth of these children from 1:250 to 1:4000. Prospective prevention strategies, which include population education, mass screening, genetic counseling and prenatal diagnosis, can efficiently reduce new number of thalassemia major patient. The screening of students of high school, colleges for β thalassemia trait (BTT) detection along with education and awareness of disease is important to prevent marriages of thalassemia minors. Screening programs for high school students are currently being used and recommended. The Government of Gujarat had made it mandatory to screen all the students who are getting admission in colleges for BTT. Since in most cases the carrier is thalassemia minor, the genetic trait is ascertained only after the marriage. And by that time, the damage is done. The management of thalassemic child costs about more than 90,000 to 1,00,000 rupees per year for blood transfusions and costly iron chelation therapy which is associated with repeated transfusions. Shocking details have come out from the thalassemia test drive conducted by the Gujarat Technological University (GTU) in August, 2012. 722 students have tested positive for the thalassemia minor in the test. Screening among 420 medical students at University of Indonesia revealed the prevalence of β-thalassemia trait as high as 4.76%. In an analytical cross sectional study, performed from Jan 2010 to May 2010 at Dow Medical College, Dow University of Health Sciences Karachi, Pakistan the overall frequency of β Thalassemia Trait (BTT) observed in students was 5.3%. There is lack of proper awareness and health education regarding disease of this magnitude which results in increasing number of consanguinity and increased disease burden. Similarly another common haemoglobinopathy, Sickle cell anaemia is also much more common in Gujarat State particularly in the Tribal regions of South Gujarat. The Medical students are being selected as subjects because they form an important part of health care system. Appropriate screening of them and their counselling helps not only to attain a healthy state of well being in them but also there is an advantage that they will guide the society to the best out of their experience.

**MATERIALS AND METHODS**

An analytical cross-sectional study of 400 medical students was conducted at P.D.U. Medical College, Rajkot at various intervals from January 2010 to December 2012. With written informed consent, EDTA anti-coagulated whole blood samples were collected and processed by automated cell counter Sysmex KX-21 for complete Blood Count (CBC). Peripheral smear prepared and stained by Leishman’s stain and NESTROFT and Sickling Test were performed. The diagnosis of BTT was confirmed by High Performance Liquid Chromatography (HPLC). Subjects with HbA2 levels of 3.5% and above are considered to have BTT. For anaemia, grading is done as severe for Hb <7 g%, moderate for Hb 7-10 g% and mild for Hb >10 g% but less than normal for the gender wise age group. The discriminative indexes used in this study are as under:

<table>
<thead>
<tr>
<th>Discriminative Index</th>
<th>Equation</th>
<th>Cut off values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mentzer Index</td>
<td>MCV/RBC</td>
<td>&lt;13 TM, &gt;13 IDA</td>
</tr>
<tr>
<td>Srivastava Index</td>
<td>MCH/RBC</td>
<td>&lt;4.4 TM, &gt;4.4 IDA</td>
</tr>
<tr>
<td>Shine &amp; Lal Index</td>
<td>(MCV² x MCH)/100</td>
<td>&lt;1530 TM, &gt;1530 IDA</td>
</tr>
</tbody>
</table>

TM = Thalassemia Minor  
IDA = Iron Deficiency Anaemia

**Statistical Formulas used in the study are:**

\[
\text{Sensitivity} \% = \frac{TP}{TP + FN} \times 100
\]

\[
\text{Specificity} \% = \frac{TN}{TN + FP} \times 100
\]

\[
\text{Efficiency} \% = \frac{TP + TN}{TP + TN + FP + FN} \times 100
\]

TP = True Positive  
FP = False Positive  
TN = True Negative  
FN = False Negative

**RESULTS**

The study showed that out of 400 students screened 92(23%) were found to be anaemic, while 14(3.5%) students were positive for BTT and only 3(0.75%) students were positive for sickle cell anaemia.
Table 1: Evaluation of NESTROFT and other discriminative indexes for diagnosis of BTT

<table>
<thead>
<tr>
<th>Test/index</th>
<th>Hb A_{2} &gt;3.5</th>
<th>Hb A_{2} &lt;3.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>NESTROFT Positive</td>
<td>14 (True Positive)</td>
<td>08 (False Positive)</td>
</tr>
<tr>
<td>NESTROFT Negative</td>
<td>30 (True Negative)</td>
<td>00 (False Negative)</td>
</tr>
<tr>
<td>Mentzer Index &lt;13</td>
<td>13 (True Positive)</td>
<td>05 (False Positive)</td>
</tr>
<tr>
<td>Mentzer Index &gt;13</td>
<td>33 (True Negative)</td>
<td>01 (False Negative)</td>
</tr>
<tr>
<td>Srivastava Index &lt;4.4</td>
<td>14(True Positive)</td>
<td>14 (False Positive)</td>
</tr>
<tr>
<td>Srivastava Index &gt;4.4</td>
<td>24 (True Negative)</td>
<td>00 (False Negative)</td>
</tr>
<tr>
<td>Shine &amp; Lal Index &lt;1530</td>
<td>14 (True Positive)</td>
<td>35(False Positive)</td>
</tr>
<tr>
<td>Shine &amp; Lal Index &gt;1530</td>
<td>03(True Negative)</td>
<td>00(False Negative)</td>
</tr>
</tbody>
</table>

Table 2: Sensitivity, Specificity and Efficiency of NESTROFT and other discriminative indexes for the diagnosis of BTT

<table>
<thead>
<tr>
<th>Test/index</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>Efficiency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NESTROFT</td>
<td>100</td>
<td>78.94</td>
<td>84.61</td>
</tr>
<tr>
<td>Mentzer Index</td>
<td>92.85</td>
<td>86.84</td>
<td>88.46</td>
</tr>
<tr>
<td>Srivastava Index</td>
<td>100</td>
<td>63.14</td>
<td>73.07</td>
</tr>
<tr>
<td>Shine &amp; Lal Index</td>
<td>100</td>
<td>7.8</td>
<td>32.69</td>
</tr>
</tbody>
</table>

DISCUSSION

The prevalence of anemia in medical students in our study is quite comparable with study done by M. Divya et al on 558 medical students of Sri Lakshminarayan Institute of Medical science, Puducherry (32.36%), Rubeena et al on 100 medical students of Rohilakhand Medical College and hospital, Bareilly, Uttar Pradesh (32.00%). Our study contradicts with the findings by Yogesh et al on 200 medical students of Himalayan Institute of Medical Science, Dehradun (8.00%). The prevalence of thalassemia in medical students in our study is quite comparable with the study done by Sumera et al on 266 medical students at Dow Medical College, Karachi (5.30%), Wahidiyat et al on 420 medical students of Eijkman Institute, Indonesia (4.76%). Sensitivity, specificity and efficiency of NESTROFT, Mentzer Index, Srivastava Index and Shine & Lal index are comparable with the studies of Nishi Madan et al and Sujata et al; while it contradicts with the findings of Monica et al. Specificity and efficiency of Shine and Lal index contradicts the findings obtained by Monica et al. It could be attributed to differences in the mutation spectrum of the thalassemia disease of the different populations. Rund et al. explained that different MCV values are significantly correlated with different β thalassemia mutations. Rosatelli et al. mentioned the relationship between the hematological phenotype and the type of mutation in β thalassemia minor individuals, which could also explain the inter-population differences.

CONCLUSION

With a 3.5% rate of BTT, studies on national level are needed to know the actual prevalence in premarital people. NESTROFT combined with discriminative haemogram indices can be used as a useful means for screening for BTT in resource limited setting.

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