Prevalence of heterozygous β-thalassemia in the families of β-thalassemia major patients of North Maharashtra

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ABSTRACT

Beta-thalassemia continues to be a major health problem particularly in the poorer developing countries. The aim of this study was to detect and analyze the percentage prevalence of heterozygous β-thalassemia in the families of β-thalassemia major patients. This study follows the retrospective strategies; we have selected 129 family members from various parts of the districts for diagnosis and counseling during 2 months (Feb to Mar 2012) of time. The standard hematological parameters MCV (<80fl) and MCH (<27pg), peripheral blood morphology and Hb electrophoresis (cellulose acetate electrophoresis) were performed in all participants. Among all 129 participants 41 were found to be the heterozygotes 19 (46.34%) were males and 22 (53.66%) were females. One female participant was found to be homozygous β-thalassemia. The percentage prevalence of heterozygotes was very high and the main reason behind this was consanguineous marriages and ignorance regarding thalassemia in these families.

Keywords: Heterozygous β-thalassemia, β-thalassemia major, prevalence, North Maharashtra, Hb electrophoresis

1. INTRODUCTION

Hemoglobinopathies are major health problem in many areas of the world. Two of the most prevalent hemoglobinopathies are sickle hemoglobin (HbS) and β-thalassemia (Weatherall and Clegg, 2001, Wethers et al., 1989). WHO stated that about 370,000 severely affected homozygotes or compound heterozygotes of thalassemia are born every year. Thalassemias are the most common single gene heritable disorder across the world (Quek and Thein, 2007, Pan et al., 2007, Cooley and Lee, 1925). The frequency of thalassemia is high from the Mediterranean basin to the Middle East, Indian sub continent and South East Asia (Kulozik et al., 1988, Verma et al., 2007, Derakhshande-Peykar et al., 2007). It is a group of hereditary anemias caused by absent or decreased production of globin chains. There are about 240 million carriers of beta-thalassemia worldwide & in India the prevalence of carriers is about 3.3% (30 million) and every year more than 9,000 infants are born with beta-thalassemia (Verma et al., 1992). The carrier rate of β-thalassemia varies from 1 to 3% in Southern India and 3 to 15% in Northern India (Verma et al., 1992, Manglani et al., 1997, Ostrowsky et al., 1985, WHO, 1983). Certain communities in India have higher carrier rate such as Sindhis and Punjabis from Northern India, Bhanushalis, Kutchis, and Lohanas from Gujarat, Mahars, Neobuddhists, Kolis and Abris from Maharashtra and Gowdas and Lingayats from Karnataka (Verma et al., 1992, Manglani et al., 1997). A number of studies from different parts of the country provide the data of distribution of various hemoglobinopathies (Ambekar et al., 2001, Sukumaran, 1974) but there are limited data from Northern Maharashtra. The North Maharshtra region especially Dhule, Nandurbar and Jalgaon districts are tribal belts where sickle cell & β-thalassemia are prevalent. These hemoglobinopathies can cause life threatening situation & chronic ill health. Hence the population needs to be screened for hemoglobin disorders, so that appropriate measures for treatment & prevention can be taken.

2. MATERIALS AND METHODS

A total of 10 families of known β-thalassemia major children were selected and they are basically from Dhule District. The study followed the retrospective strategies. Detailed family histories collected from the Govt. Civil Hospital, Dhule as well as patient’s guardian regarding age, sex, ethnic origin (caste/tribe), income, any hereditary disease rather than thalassemia and consanguinity in marriages. Total 129 family members were selected of all age groups and written informed consent was also taken from them.

3. LABORATORY FINDINGS

Venous blood samples were collected into EDTA containing tubes.
Table 1 showing the mean values of various hematological parameters of all 41 heterozygous β-thalassemia with standard deviation

<table>
<thead>
<tr>
<th>Age Groups</th>
<th>Participants</th>
<th>Hb g/dl</th>
<th>Hct %</th>
<th>RBCs</th>
<th>MCV (fl)</th>
<th>MCH (pg)</th>
<th>MCHC (g/dl)</th>
<th>HbA2 %</th>
<th>HbF %</th>
<th>HbA %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-15 years</td>
<td>Female-3</td>
<td>10.63</td>
<td>35.28</td>
<td>5.28</td>
<td>66.65</td>
<td>21.55</td>
<td>32.45</td>
<td>4.7</td>
<td>0.32</td>
<td>94.02</td>
</tr>
<tr>
<td>Male-1</td>
<td>9.40</td>
<td>0.75</td>
<td>0.31</td>
<td>2.89</td>
<td>1.58</td>
<td>0.69</td>
<td>0.93</td>
<td>1.28</td>
<td>0.26</td>
<td></td>
</tr>
<tr>
<td>16-30 years</td>
<td>Female-8</td>
<td>12.16</td>
<td>36.58</td>
<td>5.83</td>
<td>78.52</td>
<td>23.67</td>
<td>30.62</td>
<td>5.44</td>
<td>1.16</td>
<td>93.4</td>
</tr>
<tr>
<td>Male-2</td>
<td>1.07</td>
<td>1.8</td>
<td>0.32</td>
<td>1.33</td>
<td>2.73</td>
<td>1.02</td>
<td>0.40</td>
<td>0.26</td>
<td>0.38</td>
<td></td>
</tr>
<tr>
<td>31-45 years</td>
<td>Female-5</td>
<td>12.31</td>
<td>37.81</td>
<td>5.13</td>
<td>72.00</td>
<td>22.54</td>
<td>21.14</td>
<td>4.89</td>
<td>0.92</td>
<td>94.06</td>
</tr>
<tr>
<td>Male-9</td>
<td>1.05</td>
<td>1.58</td>
<td>0.54</td>
<td>5.68</td>
<td>3.39</td>
<td>1.37</td>
<td>0.37</td>
<td>0.11</td>
<td>0.33</td>
<td></td>
</tr>
<tr>
<td>45 years and above</td>
<td>Female-6</td>
<td>11.64</td>
<td>38.79</td>
<td>5.99</td>
<td>69.08</td>
<td>23.99</td>
<td>23.65</td>
<td>4.95</td>
<td>0.85</td>
<td>94.39</td>
</tr>
<tr>
<td>Male-7</td>
<td>3.22</td>
<td>1.14</td>
<td>1.31</td>
<td>19.45</td>
<td>2.66</td>
<td>1.90</td>
<td>1.34</td>
<td>0.17</td>
<td>0.37</td>
<td></td>
</tr>
</tbody>
</table>

Figure 1
Age wise prevalence of heterozygotes

4. RESULTS
A total of 129 participants were screened, out of these total male participants were 65 (50.39%) and females were 64 (49.61%). Among all 129 participants 87 (67.44%) showed relatively normal hematological parameters including MCV, MCH and blood morphology. Further Hb analysis showed no β-thalassemia or HbF carriers. The values of HbA2 and HbF were in the normal level. Out of 129 participants 41 (31.78%) were found to be heterozygotes with raised HbA2 levels (4.60%-5.90%) with reduced hematological picture, among 41 participants, 17 (13.17%) showed microcytosis, hypochromia and borderline values (78.60% to 80.00%, 29.30pg to 27.10pg) respectively while 24 (18.60%) participants showed reduced erythrocyte indices including MCV (58.20fl-67.50fl) and MCHC (19.9pg-23.30pg). Table-1 shows the laboratory findings of all 41 participants. Remaining 1 (0.77%) case was a 2 years female child diagnosed as β-thalassemia major. The hematological parameters showed reduced MCV (66.20fl) and MCH (21.55pg). Hb analysis showed elevated HbF level (14.70%) and reduced HbA2 level (2.80%). The percentage wise data showed that normal males and females were 46 (35.65%) and 41 (31%) respectively. Whereas 22 females (17.05%) and 19 males (14.73%) were found to be as heterozygous β-thalassemia.

5. DISCUSSION
It was a pilot study carried out in the Dhule district a high prevalence area of Maharashtra, India. To the best of our knowledge, it is the first of its kind reported from North Maharashtra & there is limited data available from this region. The screening protocol of the present study usually relies on using a complete blood count obtained by an automated blood cell counter (The thalassemia working party, 1994, A thalassemia working party, 1998). Individuals with low MCV (<80fl) and MCH (<27pg) usually have further investigation using electrophoresis to identify the carriers. The incidence of heterozygous β-thalassemia were high (21.95%) out of total 41 heterozygous β-thalassemia cases in males aged between 31-45 years followed by (19.51%) in females (16-30 years), (17.07%) in males (16-30 years), (14.63%) in females (above 46 years), (12.20%) in females (31-45 years), (7.31%) in females (1-15 years), (4.88%) in (16-30 years) and (2.44%) in (1-15 years) in males. Graph showing the age wise distribution of heterozygotes (Figure 1).

Some European countries like Cyprus and Sardinia have been successfully introduced the screening programme of adolescent & school children (Angastiniotis et al., 1995, Cao et al., 1998). Screening of relatives, family members and informed them about the risks by thalassemia major patients & carriers, has strengthened the efficacy of the screening programme (Cao et al., 1998). Consanguineous mating is very common in this region and is known to play an important role in hereditary diseases. Since closely related individuals have a higher chance of carrying the same alleles than less closely related individuals, the children from consanguineous marriages are more frequently homozygous for various alleles than children from non-consanguineous marriages (Stern, 1960).

The primary objective of this study was to determine the percentage prevalence of heterozygous β-thalassemia cases in the families of β-thalassemia major patients. It has been reported that 58% thalassemia trait was found in siblings of β-thalassemia major patients with a male to female ratio 0.9:1 (Khan et al., 1995). Similar study conducted by Khatkar et al., 2006 showed 69.2% heterozygous β-thalassemia was detected in their study. It was observed that β-thalassemia is probably the commonest inherited hemoglobin disorder in the Indian subcontinent (Sukumaran and Master, 1973). The prevalence of β-thalassemia carriers varies between 1 to 17% in different region in India with mean prevalence of 3.3%. The highest frequency of β-thalassemia trait is reported in Gujarat (10-15%) followed by Sindh (10%), Punjab (6.5%), Tamil Nadu and Maharashtra (Ambekar et al., 2001, Bagi, 1996, 2000, 2002, Varawalla, 1991, Venma, 1997, Dastidar, 1994). Homozygous state causes a serious physical, psychological and financial burden on the family, society and health care systems. Therefore prevention of the disease by carrier detection as an alternative means to prevent the birth of thalassemic children seems to be more practical and effective in developing countries (Ghanei, 1997). Approximately 90% of the family members were lived below poverty level. Illiteracy and unawareness regarding this hereditary disorder was found in most of these families. Low income status, illiteracy and lack of awareness are also contributing in increasing the frequency of this disease (Shami and Tariq, 1999, Sengupta, 2008).
6. CONCLUSION
The present study extends the observations of previous workers & provides information on the prevalence of heterozygous β-thalassemia in the affected families. This type of study has strengthened the efficacy of screening programme. It is concluded that the percentage of heterozygotes were high in the affected families and it suggests the need to establish a programme for genetic counselling and screening of population and affected families as well. Such activities would eventually reduce the burden of this dreaded disease in the state and lead to its control.

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