Incidence of G6PD Deficiency in Patients of Three Different Ethnic Groups Suffering from Pulmonary Tuberculosis

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There is now considerable evidence that susceptibility to certain diseases is influenced by genetic characteristics. Saha and Banerjee (1968) found that in Chinese, but not in Indians and Malays, people with blood group 0 were found less frequently among patients with pulmonary tuberculosis than among controls. In order to explore further the association between disease and genotype, an investigation was made of G6PD deficiency in the erythrocytes of tuberculous patients and healthy subjects.

Subjects and Methods

Patients. There were 1758 males, comprising 1599 Chinese, 96 Malays, and 63 Indians. All were being treated as out-patients at the Singapore Anti-tuberculosis Association (SATA) clinic. The diagnosis of pulmonary tuberculosis was made on clinical and radiological evidence and bacteriological examination of sputum.

Controls. There were 1171 males, comprising 577 Chinese, 232 Malays, and 362 Indians, who were attending regularly the SATA clinic for clinical and radiological examinations, and in whom no evidence of tuberculosis or other disease was found.

Venous blood was collected after the subject had fasted overnight, and 2 ml. was added to a bottle containing 0·5 ml. of acid citrate dextrose solution (Miller, 1960). The sample was then placed immediately into a vacuum flask containing ice. Tests for G6PD deficiency were made in nearly all instances within 6 hours of collection of blood. Otherwise the sample was stored at 4°C. until the test was performed next morning. Each time a G6PD deficient blood was encountered, another sample was taken at a later date and retested to confirm the result. In no instance was the second result different from that of the first.

Separate tests on 31 patients showed that treatment with antituberculosis drugs had no demonstrable effect on the G6PD screening test.

Deficiency of G6PD was assessed by the method of Motulsky and Campbell-Kraut (1961). After mixing thoroughly, 0-02 ml. blood was transferred to a test tube containing 1 ml. distilled water in a constant-temperature waterbath at 37°C. 0·1 ml. of disodium glucose-6-phosphate (825 mg./100 ml.), 0·1 ml. sodium nicotinamide adenine dinucleotide phosphate solution (50 mg./100 ml.), 0·25 ml. brilliant cresyl blue (32 mg./100 ml.), and 0·2 ml. Tris buffer (pH 9·5) were added in rapid succession. The tube was mixed by rolling between the palms. A small amount of liquid paraffin was added to prevent contact of the test solution with the air. Any sample which did not decolorize within 120 minutes was taken as G6PD deficient. Each sample showing G6PD deficiency was checked for packed-cell volume. If the packed-cell volume was less than 40%, the test was repeated because of the possibility that the red cells were too few in number to supply an adequate amount of the enzyme. In the repeat test a larger volume of blood was used.

Results

The results of all the tests are given in the Table. The difference in frequency of G6PD deficiency between control and patient groups was not statistically significant for any of the races ($\chi^2 < 0·67$).

Discussion

The relatively infrequent occurrence of G6PD deficiency among Indians in the present inquiry is consistent with the observations of Luan Eng and Tiit (1964). However, Vella (1961) observed a higher incidence of G6PD deficiency, but the number of subjects investigated by him was very few.

Most of the subjects investigated were Chinese, and among them the proportion of the patients with G6PD deficiency was about the same as that in the controls. The number of Malay and Indian patients was relatively small, so that firm conclusions cannot be made on the results of the tests on these
TABLE
DISTRIBUTION OF G6PD DEFICIENCY IN PULMONARY TUBERCULOSIS

<table>
<thead>
<tr>
<th>Ethnic Origin</th>
<th>Control</th>
<th>Pulmonary Tuberculosis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total No. of Subjects Investigated</td>
<td>Normal</td>
</tr>
<tr>
<td>Chinese</td>
<td>577</td>
<td>556</td>
</tr>
<tr>
<td>Malays</td>
<td>232</td>
<td>224</td>
</tr>
<tr>
<td>Indians</td>
<td>362</td>
<td>356</td>
</tr>
<tr>
<td>Total</td>
<td>1171</td>
<td>1136</td>
</tr>
</tbody>
</table>

Indian and Chinese, \( x^2 = 3.13 \), with one degree of freedom.
Indian and Malay, \( x^2 = 1.97 \), with one degree of freedom.

subjects. However, the over-all results again provide no evidence for an association between G6PD deficiency and the occurrence of pulmonary tuberculosis. The present observations support those of Halber and Hirszfeld (1926) who, on the basis of ABO blood group determinations, concluded that there was no genetic component in the aetiology of pulmonary tuberculosis. This is also compatible with the results obtained by Campbell (1956) and Lewis (1961).

In the literature there are conflicting reports about the association of blood groups and pulmonary tuberculosis. Our previous report (Saha and Banerjee, 1968) was also inconclusive, as resistance to pulmonary tuberculosis by those belonging to blood group O was not established in the case of Malay and Indian patients. The accumulated evidence suggests that susceptibility to pulmonary tuberculosis may be influenced by genetic, ethnic, environmental, and other factors. Unless all the possible influences are investigated simultaneously, firm conclusions about the relative importance of each in the aetiology and prognosis of the disease may not be possible.

Summary and Conclusion

Investigations were made for the presence of G6PD deficiency on 1171 male healthy subjects and 1758 patients suffering from pulmonary tuberculosis of different ethnic origin. There was no significant difference in the incidence of this genetic abnormality in pulmonary tuberculosis in any of the ethnic groups when compared with the controls, which suggests that the susceptibility to pulmonary tuberculosis is not influenced by this genetic X-linked mutant. Indians of this series have exhibited the lowest incidence of G6PD deficiency compared with the Chinese and Malays.

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REFERENCES