Treponema pallidum immune adherence test for serodiagnosis of syphilis

2: Comparison with glass plate, TPHA, and FTA–ABS tests

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SUMMARY Using sera from 340 patients with syphilis the Treponema pallidum immune adherence (TPIA) test was compared with the glass plate, T. pallidum haemagglutination (TPHA), and fluorescent treponemal antibody-absorbed (FTA–ABS) tests. The results of the TPIA test agreed with those of the glass plate, TPHA, and FTA–ABS tests in 65%, 82%, and 73% of cases respectively. In the quantitative TPIA test no significant correlation with the other tests was observed, and it is, therefore, concluded that the TPIA test has highly individual characteristics. From gel filtration the particular feature of the test was its high sensitivity to the IgM antibody. The TPIA test thus appears to be suitable for estimating antibody in the early stages of the disease.

Introduction

No work has been done since Olansky et al (1954) investigated the clinical significance of the Treponema pallidum immune adherence (TPIA) test. The reasons for this are that the techniques of the test have not yet been fully established and that there has been a notable development in the use of other tests, such as the fluorescent treponemal antibody-absorbed (FTA–ABS) and Treponema pallidum haemagglutination (TPHA) tests, which use T. pallidum antigen.

In our previous report (Tanaka et al, 1978) we described an improved method for the TPIA test as originally reported by Nelson (1953) and evaluated it in the diagnosis of syphilis. This paper gives the results of a further evaluation of the TPIA test compared with the glass plate (modified Venereal Research Laboratory test), TPHA, and FTA–ABS tests.

Material and methods

SYPHILITIC SERA

The sera were obtained from the dermatological department of the Tokyo Metropolitan Okubo Hospital and the urological department of the Metropolitan Taito Hospital. All sera were inactivated at 56°C for 30 minutes before use.

TPIA TEST

The technique reported previously was used (Tanaka et al, 1978), the results being expressed as IA indices. Indices of 25% or less were positive, those of 50% or more were negative, and those in between were doubtful-positive (qualitative test). The results of the quantitative test were expressed as the maximum dilution which gave IA indices of 25% or less.

SEROLOGICAL TESTS

The TPHA (microtitre method), glass plate (Mizuoka et al, 1973), and FTA–ABS tests were used.

GEL FILTRATION

Two types of Sephadex G-200 column (2.4 × 100 and 1.0 × 45 cm) were used. Veronal buffer (0.07 mol/l; pH 7.3) containing 0.1 mol/l NaCl was used as eluent.

Results

COMPARISON OF TPIA TEST WITH OTHER SEROLOGICAL TESTS

The sera from 340 patients with syphilis were tested by the glass plate, TPHA, and TPIA tests.
Sera from 148 of these patients were also examined by the FTA-ABS test. The results of the TPIA test agreed with the results of the glass plate, TPHA, and FTA-ABS tests in 65%, 81-2%, and 73% of cases respectively (Table 1). It is noteworthy that 15-9% of the sera giving positive results to the TPIA test gave negative results to the glass plate test.

Table 1  Correlation of the results of the TPIA test with those of the glass plate, TPHA, and FTA-ABS tests

<table>
<thead>
<tr>
<th>Tests</th>
<th>Positive No.</th>
<th>Positive %</th>
<th>Doubtful-positive No.</th>
<th>Doubtful-positive %</th>
<th>Negative No.</th>
<th>Negative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glass plate</td>
<td>210</td>
<td>61.8</td>
<td>28</td>
<td>8.2</td>
<td>23</td>
<td>6.8</td>
</tr>
<tr>
<td>TPHA</td>
<td>258</td>
<td>75.9</td>
<td>31</td>
<td>9.1</td>
<td>16</td>
<td>4.7</td>
</tr>
<tr>
<td>FTA-ABS</td>
<td>104</td>
<td>70.3</td>
<td>27</td>
<td>18.2</td>
<td>9</td>
<td>6.1</td>
</tr>
</tbody>
</table>

Figures 1 and 2 show the results of the qualitative and quantitative TPIA tests respectively compared with those of the other serological tests. Compared with the TPHA test, which showed the highest correlation with the qualitative TPIA test, titres in the quantitative TPIA test showed a wide range even in the groups of sera with the same TPHA titres; thus it was assumed that the correlation was low (Figure 2). The same trends were also observed between the results of the TPIA test and those of the glass plate and FTA-ABS tests. Many sera which gave strongly positive results to the qualitative TPIA test showed low titres in the glass plate test, and many sera which gave negative results to the glass plate test had high titres in the quantitative TPIA test (Figures 1 and 2). The differences in the reactivity of the two tests were even more marked. In the quantitative TPIA test the correlation with the FTA-ABS test was low although treponemal antigen was used in both tests. This is because many results in the doubtful-positive (25-50%) range of the TPIA test were clearly positive in the FTA-ABS test (Table 1).
Table 2 shows the results of various tests on sera from untreated patients. Cases 1–8 were diagnosed to be in the primary stage of syphilis and had some clinical symptoms; Cases 9–19 were in the secondary stage; Cases 20–22 had no obvious symptoms; and Cases 23–25 had latent syphilis. The sera from Cases 1 and 5 gave positive results to only the TPIA test and the TPIA and FTA-ABS tests respectively. In Case 22 serum antibodies were initially absent, but after 10 days gave positive results to the glass plate and TPIA tests. Since sera from Cases 20 and 21 initially gave positive results to only the glass plate test these results were suspected of being biological false-positive results. Later, sera from these two cases gave a doubtful-positive result and a positive result respectively in the TPIA test.

**GEL FILTRATION OF SYPHILITIC SERUM**

From the results of the comparisons of the various serological tests it is clear that the TPIA test has its own particular characteristics. The TPIA, TPHA, glass plate, and FTA-ABS tests were carried out on the fractions obtained by gel filtration on Sephadex G-200, and the distribution of antibody activity in the 7S and 19S fractions was investigated. Figure 3 shows the results for patients with syphilis. The TPHA antibody activity presented mainly in the 7S fraction, while the antibody activities in the other tests were distributed in the 7S and 19S fractions. When serum treated with 2 mercaptoethanol (Miller and Metzger, 1965) was subjected to gel filtration almost no change in TPHA activity was observed, but the antibody in the 19S fraction had disappeared in the TPIA test (Figure 4). As the titre of this serum was low in the glass plate test the distribution of antibody in the test could not be determined. When other sera which had higher titres were tested similar results were obtained in the glass plate test. It was, therefore, concluded that in the TPIA and glass plate tests reactivity was predominantly with IgM antibody.

**Discussion**

In the previous paper an improved method of the TPIA test was described (Tanaka et al, 1978).

![Fig. 2 Relationship between quantitative TPIA test and other tests](http://sti.bmj.com/)

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**Note:** The figure in the text is not visible in this text format, but it shows the relationship between quantitative TPIA test and other tests (FTA-ABS).
Fig. 3 Distribution of antibody activity in fractions by gel filtration on Sephadex G-200 in patients with syphilis
\( \times \times \) in glass plate test; \( \odot \odot \) in TPHA test; \( \bullet \bullet \) in TPIA test; \( \triangle \triangle \) in FTA-ABS-IgG test;
\( \blacktriangle \blacktriangle \) in FTA-ABS-IgM test; \( \ldots \ldots \) OD at 280 nm

Fig. 4 Effect of 2-mercaptoethanol treatment for antibody activity in fractions by gel filtration on Sephadex G-200
(a) untreated (b) treated \( \bullet \bullet \) in TPIA test; \( \odot \odot \) in TPHA test; \( \ldots \ldots \) OD at 280 nm
In this study, the correlation between the TPIA test and the glass plate, TPHA, and FTA–ABS tests was investigated. Firstly, in a comparison of the TPIA and glass plate tests the agreement of results was found to be low, and no marked correlation was observed. This is reasonable when it is considered that the glass plate test detects antacirolipin antibody and the TPIA test detects anti-treponemal antibody. The FTA–ABS and TPIA tests both use T. pallidum as antigen, but less correlation than expected was seen. Since the antibody for the FTA–ABS test used in these experiments was anti-Ig the antibody detected in the test was mainly the IgG antibody. In the TPIA test, however, the sensitivity to IgM antibody was much higher than that to IgG antibody, as was apparent from the results of gel filtration (Figure 3). This may be the main reason for the lack of correlation between the two tests.

The results of the qualitative TPIA test showed a high correlation with those of the TPHA test, presumably because treponemal antigen was used. In the quantitative TPIA test, however, there were differences in the distribution of the antibody titre and correlation was low (Figure 2). This may be due to the following reasons:

1. As reported by Robertson et al (1975) it was clear from the gel filtration that antibody detected by the TPHA test was mainly in the IgG fraction but antibodies detected by the TPIA test were IgM;

2. Unlike the TPIA test the TPIA test requires complement.

In conclusion, the TPIA test differs considerably from the glass plate, TPHA, and FTA–ABS–IgG tests, especially in its reactivity in the IgM fraction. From the results of the tests using the sera of untreated patients it was clear that the TPIA test had a high sensitivity to the antibody, which appeared soon after infection. In the instance of Cases 1 and 5, only the TPIA test and TPIA and FTA–ABS tests respectively gave positive results (Table 2). Case 22 was examined just before symptoms occurred when serum antibodies were absent, but after 10 days the glass plate and TPIA tests gave positive results. At the end of the first month of treatment the index decreased to the range of doubtful-positive, and the glass plate test gave negative results. The results of the TPHA test remained negative. Since sera from Cases 20 and 21 showed positive results only to the glass plate test, these were considered to be biological false-positive results. Sera from Cases 20 and 21, however, were retested after nine and 14 days respectively and showed doubtful-positive and positive results in the TPIA and FTA–ABS tests respectively. These cases were considered to be at the seronegative stage. From the above results it can also be assumed that the TPIA and other serological tests differ considerably even though they both depend on reactions using treponemal antigen.

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References


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