Evaluation of the Rapid Plasma Reagin Test in Field Operation

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THE rapid plasma reagin (RPR) test for syphilis has been described by Portnoy, Garson, and Smith (*1*) as a method suitable for use in population groups whose rapid movement or concentration presents difficulties in syphilis control. Limited time for testing, diagnosis, and treatment, and difficulty and expense of followup suggest the use of this procedure.

One such mobile group entering the United States annually has been the several hundred thousand braceros, Mexican farmworkers, who pass through the reception centers on the U.S. border. Health examinations performed rapidly and efficiently by the Foreign Quarantine Division of the Public Health Service at the border reception centers have not included routine blood tests for syphilis. Complete serologic screening of all of these migrants has been prohibitive because of the man-hours required for testing and the problems involved in followup, diagnosis, and treatment, as indicated, of positive reactors who had been dispersed to farms before test results were available.

However, previous sample blood tests of these workers have shown the advisability of serologic testing. In 1951 a small group of 11,850 were blood tested for syphilis, and 12.8 percent were reactive. In 1956 a larger sample, 117,776, was tested, and 8,646, or 7.3 percent, were found to be reactive.

The use of the RPR test makes possible rapid diagnosis and treatment while the workers are at the reception centers. Results may be obtained on individual specimens in 18 minutes and made available to the diagnostician within 40 minutes after the specimen is drawn.

Study Group

The test was first used in a large-scale field operation at the El Centro, Calif., Reception Center between April 16 and June 28, 1957. Under the direction of the originators of the test, a field team from the Venereal Disease Experimental Laboratory, Chapel Hill, N.C., tested 47,579 Mexican agricultural workers. Of this number, 3,913 specimens, or 8.2 percent, were reactive and an additional 685, or 1.4 percent, were weakly reactive. Although weakly reactive test results were recorded, only the reactive test results were referred to the diagnostician. This practice of grouping the weakly reactive with the nonreactive results of the RPR test has been continued in the laboratories of the Mexican border reception centers.

During this survey period, diagnoses of syphilis, by stage, based on physical inspection and examination, blood test, and darkfield microscopy, as indicated, included 31 primary and secondary (25 of which were seronegative), 985 early latent, and 2,712 other stages of syphilis. Of the other reactive specimens, 72 were

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RPR testing projects have been established in the five border reception centers at El Paso, Hidalgo, and Eagle Pass, Tex., Nogales, Ariz., and El Centro, Calif., by the Division of Foreign Quarantine to screen all braceros on a routine, year-round basis. The RPR test has also been used successfully in demonstration projects in Cook County Jail in Chicago and with migrant groups in North Carolina and Arizona.

diagnosed as pinta. Eight workers had previously received adequate treatment for syphilis and 130 could not be located.

Those workers for whom treatment was indicated received 2.4 million units of benzathine penicillin G as a single 4-cc. intramuscular injection. All but two in the primary and secondary stage were discovered as lesion suspects by the Foreign Quarantine personnel in their routine health examination, demonstrating the effectiveness of this inspection, and were confirmed as darkfield-positive by the special project physician assigned by the Venereal Disease Branch.

Methods

In order to compare the performance of the RPR test to several other blood-testing procedures, a total of 1,672 blood specimens from braceros previously tested by the RPR test at El Centro were shipped to the Venereal Disease Research Laboratory at Chamblee, Ga., where the VDRL slide, Kolmer cardiolipin complement fixation, Hinton flocculation (*2*), and *Treponema pallidum* complement fixation (*3*) tests were performed. These tests were selected for comparison with the RPR test because they represented a slide flocculation, tube flocculation, and a complement fixation test with cardiolipin antigens and a test using treponemal antigen.

To obtain sufficient reactive specimens for a valid comparison of these tests, approximately one-half the sample was drawn from persons reactive to the rapid plasma reagin test, the other half from those who were nonreactive.

Results

In the total group of 47,579 braceros tested, the RPR test was nonreactive in 90.4 percent, weakly reactive in 1.4 percent, and reactive in 8.2 percent. The corresponding percentages for the sample group of 1,672 specimens were 45.8 percent nonreactive, 6.3 percent weakly reactive, and 47.9 percent reactive (table 1). The ratio of weakly reactive to reactive was 1:5.9 in the total group and 1:7.6 in the sample. Among the other four tests performed on the sample, the VDRL slide test obtained the highest percentage of nonreactive results (55.7); and the TPCF test, the lowest (35.5).

A comparison is made in table 2 of the results of the rapid plasma reagin test with corresponding results of the VDRL, Hinton, Kolmer, and TPCF tests in 1,604 specimens giving definite results to all tests. Among 747 specimens nonreactive to the RPR test, almost parallel nonreactive results are seen with the VDRL slide test (99.5 percent), Hinton (99.1 percent), and Kolmer (98.4 percent). The TPCF test shows least agreement, with only 69.2 percent nonreactive. The 103 specimens weakly reactive to the RPR test were 77.7

Table 1. Total sample of 1,672 specimens from El Centro, Calif., by test result

Test	Nonreactive		Weakly reactive		Reactive		Anticomplementary		Not tested	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
RPR	766	45.8	105	6.3	801	47.9	------	------	------	------
TPCF	593	35.5	271	16.2	758	45.3	30	1.8	20	1.2
Kolmer cardiolipin	809	48.4	29	1.7	813	48.6	11	.7	10	.6
Hinton flocculation	829	49.6	37	2.2	774	46.3	------	------	32	1.9
VDRL	932	55.7	143	8.6	591	35.3	------	------	6	.4

Table 2. Comparison of RPR test with VDRL, Hinton, Kolmer, and TPCF tests in 1,604 specimens from El Centro, Calif., giving definite results to all tests (anticomplementary and not tested excluded)

Result of other tests	VDRL slide		Hinton flocculation		Kolmer cardiolipin		TPCF	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
	747 specimens nonreactive to RPR							
Nonreactive	743	99. 5	740	99. 1	735	98. 4	517	69. 2
Weakly reactive	1	. 1	1	. 1	2	. 3	119	15. 9
Reactive	3	. 4	6	. 8	10	1. 3	111	14. 9
	103 specimens weakly reactive to RPR							
Nonreactive	80	77. 7	54	52. 4	38	36. 9	5	4. 9
Weakly reactive	16	15. 5	11	10. 7	14	13. 6	16	15. 5
Reactive	7	6. 8	38	36. 9	51	49. 5	82	79. 6
	754 specimens reactive to RPR							
Nonreactive	93	12. 3	33	4. 4	25	3. 3	64	8. 5
Weakly reactive	125	16. 6	24	3. 2	12	1. 6	135	17. 9
Reactive	536	71. 1	697	92. 4	717	95. 1	555	73. 6

percent nonreactive to the VDRL, 52.4 percent nonreactive to the Hinton, and 36.9 percent nonreactive to the Kolmer test. Only 4.9 percent of these specimens were nonreactive to the TPCF test.

Of the 754 specimens reactive to the RPR test, the greatest agreement is with the Kolmer test, with 95.1 percent reactive and only 3.3 percent nonreactive; agreement is also close with the Hinton test, in which 92.4 percent of the specimens were reactive and 4.4 percent nonreactive. Oddly enough, the VDRL slide and TPCF tests, at opposite extremes in reactivity in specimens nonreactive and weakly reactive to the RPR test, have approximately the same reactivity rates, 71.1 and 73.6 percent, respectively among specimens reactive to the RPR. When weakly reactive and reactive results are combined for each of the compared tests, total reactivity ranges from 96.7 percent for the Kolmer to 87.7 percent for the VDRL in the group of 754 specimens reactive to the rapid plasma reagin test.

The actual percentage of agreement between the RPR and the other compared tests in these 1,604 specimens is shown in table 3. Complete agreement is defined as both tests nonreactive, both tests weakly reactive, or both tests reac-

Table 3. Percentage of agreement between RPR and other tests in 1,604 specimens from El Centro, Calif., giving definite results to all tests

Other tests	Complete agreement		Partial agreement		Disagreement	
	Number	Percent	Number	Percent	Number	Percent
Kolmer	1, 466	91. 4	63	3. 9	75	4. 7
Hinton flocculation	1, 448	90. 3	62	3. 8	94	5. 9
VDRL slide	1, 295	80. 7	132	8. 2	177	11. 1
TPCF	1, 088	67. 8	217	13. 6	299	18. 6

tive. A reactive result to one test and weakly reactive result to the other is considered partial agreement. The RPR was in complete agreement with the Kolmer test in 91.4 percent of the specimens and with the Hinton in 90.3 percent. Complete agreement is lowest when the RPR is compared with the TPCF test, 67.8 percent. Disagreement with the rapid plasma reagin test ranges from 4.7 percent for the Kolmer to 18.6 percent for the TPCF test.

In order to determine the type of specimens in which the majority of discrepancies occurred, the results of the TPCF test are compared with the results of the RPR and VDRL quantitative slide test (fig. 1). The general pattern of this chart—an increase in percentage of specimens reactive to the TPCF test with increasing reactivity of the RPR and VDRL slide tests—is broken by the second bar which represents specimens which were weakly reactive to the RPR and nonreactive to the VDRL test. In this group, 80 percent were reactive to the TPCF test and only 3.8 percent were nonreactive. Among 743 specimens which were

Figure 1. Result of TPCF test compared with results of RPR and VDRL tests.

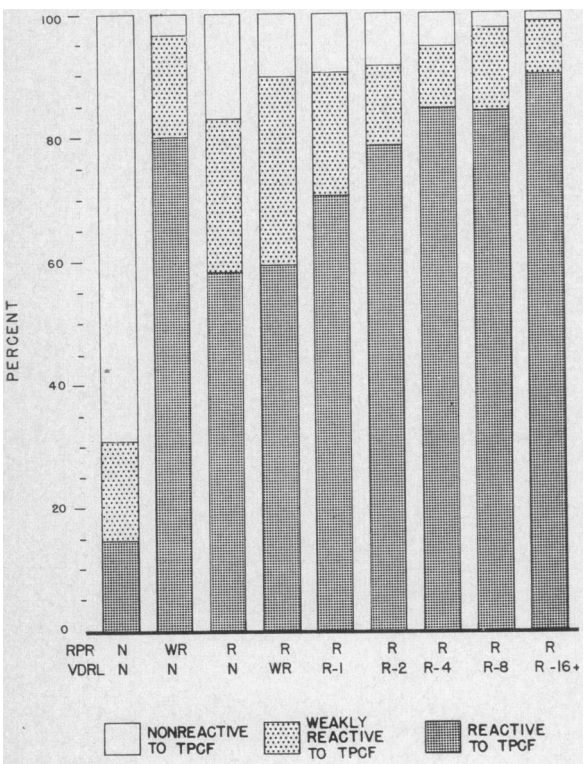
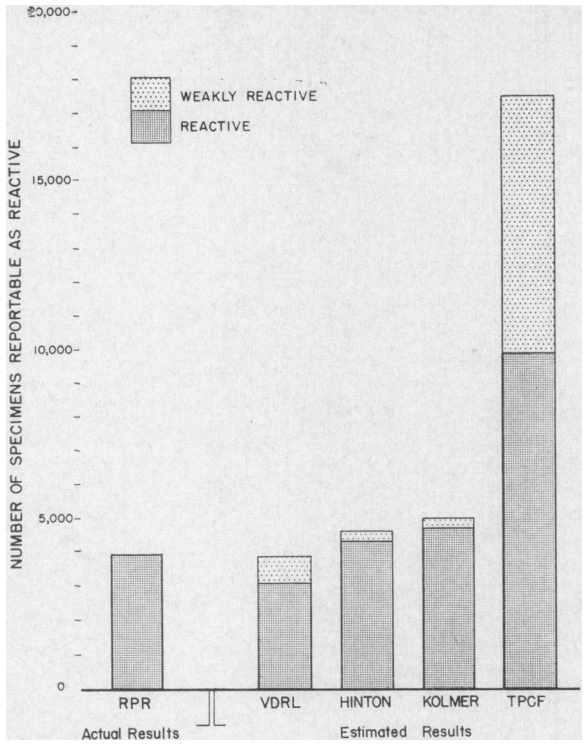


Figure 2. Actual reactivity of RPR test and estimated reactivity of other tests among 47,579 braceros tested in 1957, El Centro, Calif.



nonreactive to both the RPR and VDRL tests, more than 3 out of every 10 specimens showed some reactivity to the TPCF (14.5 percent reactive and 16 percent weakly reactive). Although this latter observation would indicate greater sensitivity of the TPCF test, among specimens reactive to the RPR, the percentage nonreactive to the TPCF ranged from 17.2 percent when the VDRL was nonreactive to 1.3 percent when the VDRL was reactive to 16 or more dils.

On the basis of the results obtained in the sample, estimates have been made of the number of specimens that would have been reportable (reactive or weakly reactive) in the Kolmer, Hinton, VDRL slide, and TPCF tests, had these tests been performed on the total 47,579 specimens. Only the reactive results of the RPR test are reported to the physician at the bracero reception center laboratories, whereas both reactive and weakly reactive results of the other tests are reportable. Therefore, consideration was given to these practices in preparing the estimate for comparison of

these several testing procedures. These estimates are compared with the actual number of specimens that were reactive to the RPR test (fig. 2).

As opposed to the figure of 3,913 specimens (8.2 percent) that were reactive to the RPR test, 3,865, or 8.1 percent, would have been reactive or weakly reactive to the VDRL slide test; 4,547, or 9.6 percent, to the Hinton; 4,948, or 10.4 percent, to the Kolmer; and 17,452, or 36.7 percent, would have been reactive or weakly reactive to the TPCF test. (The TPCF technique employed in this evaluation was found to have a high reactivity and a low specificity in the SERA study (*4*) and has since been modified by the test's authors.) The actual number of specimens reactive to the RPR test most closely approximates the number of reportable reactions for the VDRL slide test.

Discussion

The group of specimens under consideration was highly selective, being taken entirely from Mexican male laborers with an unknown percentage of associated pinta, and selected on the basis of the result of the RPR test (roughly one-half reactive, one-half nonreactive). The results reported here may differ considerably from results obtained in a random sample of the population. In this series, however, the result of the RPR test agreed closely with the results of the Kolmer cardiolipin and Hinton flocculation tests.

Summary

During the period April 16 through June 28, 1957, a total of 47,579 Mexican agricultural workers were tested with the rapid plasma reagin test at El Centro, Calif. Reactive results were obtained in 3,913 and weakly reactive results in 685, a total reactivity rate of 9.7 percent.

In this same period a sample consisting of 1,672 specimens from workers tested by the RPR test was subjected to a battery of tests, including the VDRL slide, Kolmer cardiolipin complement fixation, Hinton flocculation, and TPCF, at the Venereal Disease Research Laboratory.

The Kolmer and the Hinton tests were in closest agreement with the RPR test, the percentage of complete or partial agreement being 95.3 and 94.1, respectively. Least agreement was obtained with the TPCF test, 81.4 percent. The TPCF test showed some reactivity in 3 out of every 10 specimens which were nonreactive to both the RPR and VDRL slide tests.

If one of these other tests had been used in place of the RPR at the El Centro reception center, it is estimated on the basis of the sample that reactive or weakly reactive results would have been obtained by the VDRL slide test in 3,865, by the Hinton in 4,547, by the Kolmer in 4,948, and by the TPCF in 17,452 specimens from the Mexican workers tested.

REFERENCES

(*1*) Portnoy, J., Garson, W., and Smith, C. A.: Rapid plasma reagin test for syphilis. Pub. Health Rep. 72: 761–766, September 1957.

(*2*) U.S. Public Health Service: Manual of serologic tests for syphilis. PHS Pub. No. 411. Washington, D.C., U.S. Government Printing Office, 1955.

(*3*) Portnoy, J., and Magnuson, H. J.: *Treponema pallidum* complement-fixation (TPCF) test for syphilis. Am. J. Clin. Path. 26: 313–322, March 1956.

(*4*) U.S. Public Health Service: Serologic evaluation and research assembly. PHS Pub. No. 650. Washington, D.C., U.S. Government Printing Office. (In press.)