VALUE OF SINGLE WIDAL TEST IN THE DIAGNOSIS OF TYPHOID FEVER

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ABSTRACT

The usefulness of single Widal test in the diagnosis of typhoid fever was investigated. The test was done on 50 normal children, 50 children with non typhoidal fevers and 30 culture proved typhoid cases. Twenty one (70%) and nine (30%) of thirty typhoid fever cases had 'O' and 'H' agglutinin liter levels of more than or equal to 1:160, respectively as compared to only 3 (3%) and to 1 (1%) among controls. These differences were significant (p <0.001). Twenty two (73.3%) out of thirty typhoid fever cases had either an 'O' or 'H' agglutinin liter of more than or equal to 1:160 as compared to only 3 (3%) among controls. An 'O' agglutinin titer of1:160 had a specificity of 97%, a sensitivity of 70% and an accuracy of 90%. An 'H' agglutinin in liter of 1:160 was had a specificity' of 97%, a sensitivity of 30% and an accuracy of 83.1%. Based on the above analysis, 'O' or 'H' liters of 1:160 or more were indicative of typhoid fever. Similarly, when the 2 liters were considered together, either 'O' or 'H' liters of1:160 or more were suggestive.

Key words: *Agglutination test; Typhoid, Widal test.*

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The definitive diagnosis of typhoid fever requires the isolation of *Salmonella typhi* from the blood, feces, urine or other body fluids. In developing countries, facilities for isolation and culture are often not available especially in smaller hospitals, and diagnosis relies upon the clinical features of the disease and the detection of agglutinating antibodies to *S. typhi* by the Widal test.

The Widal test has been used very extensively in the serodiagnosis of typhoid fever and, in developing countries, remains the only practical test available. Many studies(l-5), however, have produced data which have cast serious doubts on the value of the Widal test. Classically, a four fold rise of antibody in paired sera is considered diagnostic of typhoid fever(6). However, paired sera are often difficult to obtain and specific chemotherapy has to be instituted on the basis of a single Widal test.

In view of the doubts expressed on the value of the Widal test, we thought it worthwhile to reassess the utility of a single Widal test in the diagnosis of typhoid fever.

Material and Methods

The study was conducted at the Department of Pediatrics J.J.M. Medical College, Davangere. The children included in the study were either in-patients or out-patients at one of the 3 hospitals, affiliated to J.J.M. Medical College.

Serum samples for the Widal test were collected from patients and controls, who formed three groups. The study group comprised 30 children with a definitive diagnosis of typhoid fever as indicated by the isolation of *S. typhi* from the blood. The control group was comprised of 2 subgroups. There were 50 children with non-typhoidal

fevers including patients with tuberculous meningitis (n=5), consolidation (n=7), pulmonary tuberculosis (n=3), enterococcal infection (n=2), pyoderma (n=6), pleural effusion (n=2), empyema (n=l), pyopneumothorax (n=l), pharyngitis (n=5), chronic suppurative otitis media (n=7), urinary tract infection (n=7) and pyrexia of unknown origin (n=4). The diagnosis in each of these cases was made on the basis of the clinical evaluation and supportive laboratory investigations. There were 50 more children in the control group who were attending the out patient department for minor complaints not associated with fever.

The Widal tube agglutination test was done on all sera by the conventional agglutination method(7) using commercially available antigens (SPAN Diagnostic Private Limited). 0.4 ml of two fold serially diluted patients sera (dilution from 1:20 to 1:320) in 0.9% normal saline were tested by adding an equal volume of antigen. A negative saline control was included in each batch of the test.

Results

'O' and 'H' agglutinin titer levels were assessed in a total of 130 cases comprising 30 children with typhoid fever, 50 children with non-typhoidal fevers and 50 healthy children.

It is seen from *Table I* that 21 (70%) out of 30 typhoid fever cases had an '0' agglutinin titer level of more than or equal to 1:160 as compared to only 3 (3%) among controls. This difference was significant ($p < 0.001$).

Similarly, 9 (30%) out of 30 typhoid fever cases had an 'H' agglutinin titer level of more than or equal to 1:160 as compared to only 1 (1%) among controls *(Table II,* $p < 0.001$).

On considering 'O' and 'H' agglutinins in isolation, a titer of more than or equal to 1:160 was present in a significant number of typhoid cases as compared to controls. Hence, a significance table was constructed *(Table III)* considering 'O' and 'H' titers together and taking as significant either 'O' or 'H' titer of more than or equal to 1:160. It is evident that only 3 (3%) of the controls showed significant titers as compared to 22 (73.39?)) of cases with typhoid fever.

In order to assess the overall accuracy of the Widal test in predicting the presence or absence of typhoid fever 5 test parameters viz., sensitivity, specificity, positive predictive value, negative predictive value and ac-

TABLE I–*'O' Agglutinins in Normal Children, Children with Non-Typhoid Fevers and Typhoid Fever*

Group	No. of cases	<1:20	1:20	1:40	1:80	1:160	1:320
Normal children	50	26 (52)	17 (34)	5 (10)	2 (4)	0	0
Non-typhoidal fever	50	22 (44)	9 (18)	11 (22)	5 (10)	3 (6)	0
Typhoid fever	30	0	1 (3.3)	6 (20)	2 (6.7)	3 (10)	18 (60)

Figures in parantheses indicate percentages.

TABLE II– *'H' Agglutinins in Normal Children, Children with Non-Typhoid Fevers and Typhoid Fever*

Group	No. of cases	<1:20	1:20	1:40	1:80	1:160	1:320
Normal Children	50	45 (90)	5 (10)	0	0	0	0
Non-typhoidal fever	50	36 (72)	8 (16)	4 (8)	1 (2)	0	1 (2)
Typhoid fever	30	5 (16.7)	5 (16.7)	9 (30)	2 (6.6)	3 (10)	6 (20)

Figures in parantheses indicate percentages.

TABLE III– *'O' and 'H' Agglutinin Titers in Normal Children, Children with Non-Typhoid Fevers and With Typhoid Fever*

Group	No. of cases	Significant 'O' or 'H' (≥1:160)		Non-significant 'O' and 'H' (<1:160)	
Normal children	50	0	(0)	50	(100)
Non-typhoidal fevers	50	3	(6)	47	(94)
Typhoid fever	30	22	(73.3)	8	(26.7)

Figures in parantheses indicate percentages.

curacy were calculated at each titer level(8). An 'O' agglutinin titer of 1:160 had a sensitivity of 70%, a specificity of 97%, a positive predictive value of 87.5%, a negative predictive value of 91.5% and the highest overall accuracy of 90.8% *(Table IV)*. An 'H' agglutinin titer of 1:160 had a sensitivity of 30%, a specificity of 97%, a positive predictive value of 90%, a negative predictive value of 82.5% and an accuracy of 83.1% *(Table V)*. This titer had a negligibly lower specificity and accuracy when compared with a titer of 1:80, and it had a higher positive predictive value (90% as compared to 84%). Hence, although a 'H' agglutinin titer of 1:80 is suggestive, a titer of 1:160 was considered to be of greater significance.

Based on the above analysis, an 'O' titer in isolation, an 'H' titer in isolation and 'O' or 'H' titers when considered together of greater than or equal to 1:160 were indicative of typhoid fever.

Discussion

The serum of a proportion of the population in any region contains antibodies capable of reacting to a variable titer in the Widal test. In the absence of previous inoculation with typhoid or TAB vaccine, the frequencey of 'H' agglutinins in a popula-

TABLE IV– *Sensitivity, Specificity, Positive Predictive Value, Negative Predictive Value and Accuracy for 'O' Antibody at Different Titer Levels*

Parameter	<1:20	1:40	1:80	1:160	1:320
Sensitivity	100	96.7	76.7	70	60
Specificity	48	74	90	97	100
Positive predictive value	36.6	52.7	69.7	87.5	100
Negative predictive value	100	98.7	92.1	91.5	100
Accuracy	60	79.2	86.9	90.8	90.8

TABLE V–*Sensitivity, Specificity, Positive Predictive Value, Negative Predictive Value and Accuracy for 'H' Antibody at Different Titer Levels*

Parameter	≤1:20	1:40	1:80	1:160	1:320
Sensitivity	83.3	66.7	36.7	30.0	20.0
Specificity	81.0	94.0	98.0	97.0	99.0
Positive predictive value	56.8	76.9	84.0	90.0	85.7
Negative predictive value	94.2	90.4	83.7	82.5	80.5
Accuracy	81.5	87.7			

tion reflects its experience of Salmonellae with the corresponding antigens-either in the form of enteric fever or of latent infection-and therefore varies widely from country to country and from region to region. The frequency and concentration of 'O' agglutinins on the other hand, vary much less in different parts of the world. Hence, baseline surveys of the seroprevalence of *S. typhi* 'O' and 'H' antibodies in the general population must be carried out as a guideline for the interpretation of the Widal test.

Numerous studies have produced data which have cast serious doubts on the value of the Widal test in the diagnosis of typhoid fever. Several factors have contributed to this uncertainty. These include poorly standardized antigens, the sharing of antigenic determinants with other Salmonellae and the effects of treatment with antibiotics and previous immunization with TAB vaccine. Another major problem relates to the difficulty of interpreting Widal test results in areas where *S. typhi* is endemic and where the antibody tilers of the normal population are often not known. Furthermore, in areas where fever due to infectious causes is a common occurrence, the possibility exists that false positive reactions may occur as a result of non-typhoidal fevers(l-5).

The present study reveals that a single Widal test is still a useful diagnostic tool in typhoid fever. An '0' titer in isolation, an 'H' titer in isolation and an 'O' or 'H' titer when considered together, or more than or

equal to 1:160, with relevant clinical findings was found to be highly suggestive of typhoid fever. This is similar to the observations made by others(9,10). At a titer more than or equal to 1:160, the sensitivity of the 'O' titer (70%) was greater than that of the 'H' titer (30%), and the overall accuracy of the 'O' titer was greater (90.8% compared to 83.1%). Hence, the 'O' titer was considered to be of greater diagnostic significance. Similar observations are reported earlier(l,6,11).

It is concluded, that even today, the Widal test remains one of the best, easily accessible, cheap and simple method for the diagnosis of typhoid fever.

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