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Evaluation of Sensitivity and Specificity of Widal Test in Children with Enteric Fever - A study in Tertiary Care Paediatric Hospital in Bangladesh

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Abstract | **Original Research Article**

Enteric fever caused by Salmonella enterica serotype Typhi and Paratyphi A and B, is endemic in the Indian sub-continent including Bangladesh, South-east and Far-east Asia, Africa and South Central America. The disease can occur in all age group with highest incidence among children. Widal test in clinically suspected enteric fever cases aged between 2 and 18 years We conducted a cross-sectional study over a period of 6 (Six) months following approval in the Department of Paediatric of Dhaka Shishu Hospital. The aim of this study is to evaluate the Sensitivity and Specificity of Widal test in Children with Enteric Fever. . Sample was collected from three groups: 1) Children suspected of enteric fever; 2) Febrile children (other than enteric fever) and 3) Non-febrile children. The sample size for this study was 50 children in each group. In all three groups around half of the participants were in the '≤ 5 years' age group. Mean ± SD of age was calculated to be, (5.874±2.943) for group-I, (5.598±3.000) for group-II and for group-III (5.740 ± 2.741). More than half of the participants in all groups were males. Male: Female ratio was about 1.2:1 in group-I, 1.5:1 in group-II and 1.4:1 in group-III. There was no statistical deference in age distribution between the groups (p=0.972) and male-female distribution (p=0.683). In the entire group showed similar pattern of distribution. There was no significant statistical difference in fathers' educational qualification (p=0.601) and job (p=0.0711); as well as mothers educational qualification (p=0. 801) and job (p=0. 079). Mean ± SD of monthly income was (18,240.00 ± 10, 98.616) in group-I, (18,000.00 ± 14,532.160) in group-II and (18,000.00 ± 10,688.540) in group-III. There was no statistically significant difference among the groups (for $\chi 2$, p=0.236 and ANOVA, sig. = 0.059 and 0.710). For both enteric group and non-enteric group fever was present in cent percent (100.0%) participants. For group-I most of the patients (76.0%) had step-ladder pattern of fever; while for group-II intermittent (48.0%) and continued (34.0%) type of fever prevailed. ($\chi 2$ = 67.9, df = 2, p-value = 0.000) For both enteric (Mean ± SD = 12.60 ± 6.295) and non-enteric (Mean ± SD = 12.04 ± 5.918) fever group similar pattern of distribution for duration of fever; both quantitative (t-test = 0.503, df = 49, p = 0.617) and qualitative ($\chi 2$ = 0.792, df = 2, p = 0.673) analysis showed that there was no statistical significant difference in duration of fever. Blood culture was done in all of the 150 participants; out of them negative culture was obtained in 123 individual and the remaining 27 (54.0 %%) were culture positive. Culture yeild that all were S. typhi in group-I and in group-II 9 (18%) children was found with Escherichia coli (5), Klebsiella spp (2), Pseudomonas aeruginosa (1) and Staphylococcus aureus (1). Specificity and Positive predictive value were calculated to be 100.0%. The agglutinin levels against TO and TH antigen of the three groups; for group-I children were either widal positive or culture positive and/or both, for group-II widal positive cases were confirmed by negative blood culture findings. TO was found 1:160 or more in 52.0% in enteric fever patients and 12.0% of non-enteric febrile patient. TH showed ≤1:160 count in 48.0% group-I and 16.0% of group-II children. Single Widal test showed Sensitivity=62.0%, Specificity=92.0%, Positive predictive value= 79.49% and Negative predictive value=82.88%. When double widal test result was considered it was positive in 94.0% of enteric fever cases; the remaining 6.0% of cases and most (89.0%) of the non-enteric children were found to be Widal negative. (Sensitivity = 94.0%, Specificity=89.0% Positive predictive value= 81.03% and Negative predictive value=96.74%) Conclusion- Double widal test shows better sensitivity and specificity in diagnosis of enteric fever than a single test. O & H agglutinin titers of ≥1:160 are of diagnostic significance.

Key words: Enteric fever, endemic, *Salmonella enterica serotype Typhi, widal test*.

INTRODUCTION

Enteric fever, caused by Salmonella enterica serotype typhi and paratyphi A, B and C, occurs in all parts of the world where there is substandard water supply and sanitation. It has almost been eliminated from developed countries because of sewage and water treatment facilities but remains a common disease and a major cause of morbidity and mortality worldwide, causing an estimated 16.6 million new infections and 600,000 deaths each year [1]. It is endemic in the Indian subcontinent including Bangladesh, South-east and Far-east Asia, Africa and South Central America. The disease can occur in all age group with highest incidence among children [2]. The annual incidence of enteric fever has been reported as more than 13 million cases in Asia [3]. Exposure of the individual to contaminated food or water closely correlate with the risk for enteric fever [4,5]. Enteric fever is a febrile illness of prolonged duration marked by step-ladder pattern of fever, diffuse abdominal pain, frontal headache, delirium, splenomegaly, hepatomegaly and many other systemic manifestations due to bacteremia and septicemia. However, with indiscriminate use of antibiotics multidrug resistant strains of Salmonella typhi are emerging with changing clinical pattern posing problem in diagnosis [6]. Widal a serological diagnosis test for enteric fever was founded in 1896 by Georges Fernand Isidore Widal [7]. It is an agglutination reaction demonstrating the presence of lipopolysaccharide (LPS) somatic (O) and flagella (H) agglutinins to Salmonella typhi in the serum of a patient using suspensions of O and H antigens [8]. Commercial kits are available for antigens of Salmonella para-typhi A, B and C. The recommended method of performing the widal test is by the tube agglutination technique were serial two-fold dilutions of the subject's serum from 1:20 to 1:1280 are tested [9]. Now days a rapid slide test is most commonly used technique in local laboratories and hospitals because of its convenience. Widal test is easy, inexpensive and relatively non-invasive The widal test has been used extensively in the serodiagnosis of enteric fever and so remains the only practical test available in most developing countries[10], including Bangladesh.

The definitive diagnosis of enteric fever requires the isolation of Salmonella typhi or paratyphi from the blood, feces, urine or other body fluids. Blood culture is regarded as the gold standard for diagnosis and carry 70-75% diagnostic yield in the first week of illness [11]. In developing countries, facilities for isolation and culture are often not available especially in smaller hospitals and rural areas and diagnosis relies upon the clinical features of the disease and the detection of agglutinating antibodies to S. typhi and S. paratyphi by the Widal test. Bacteria can be isolated from blood in 73-97% of cases before antibiotic use [12]. But in our country bacteria can be isolated from blood is only 40-60% of the cases. The relative low sensitivity of blood culture in diagnosing enteric fever is understandable in the wake of widespread antibiotic use in Bangladesh and the difficulties of obtaining large enough blood volumes for culture from children [13] and the long waiting time for culture results have been identified as reasons for the preference for the widal test [14]. One of the major drawback of widal test is cross-reactivity due to which some other bacteria of same genus often produces false positive results, so the positive results must correlate clinically before prescribing medicine. However, many studies[15-18], have produced data which have casted serious doubts on the value of the Widal Test. Typhidot is another rapid slide test used to ascertain the diagnosis of enteric fever, but not cost effective as widal[19]. So widal test is the choice for diagnosis of enteric fever especially in rural area. Classically, a fourfold rise of antibody in paired sera is considered diagnostic of enteric fever [20]. In enteric fever, however, such a rise is not always demonstrable, even in blood culture-confirmed cases. This situation may occur because the acute-phase sample was obtained late in the natural history of the disease, because of high levels of background antibodies in a region of endemicity, or because in some individuals the antibody response is blunted by the early administration of an antibiotic [21]. So, there is a great need for the people to be aware of difficulties in diagnosis and all the consequences of enteric fever and it is the most important area where the health personnel should take serious measures to create an understanding and awareness among the public regarding diagnosis of enteric fever. Enteric fever is endemic in Bangladesh, where there is a high incidence in children [22]. Enteric fever continues to be a major health problem in Bangladesh. Many children with enteric fever are treated at outpatient department as well as inpatient department of the hospital. The Widal test is one of the most utilized diagnostic tests for typhoid fever in developing countries. The unavailability of microbiologic facilities and the long waiting time for culture results have been identified as reasons for the preference for the Widal test; as it remains the only practical test available. However, many studies have produced data which had cast serious doubts on the value of the Widal test and thus reappraisal of the role of a Widal test is needed. It was mentioned earlier that, a fourfold rise of antibody in paired sera is considered diagnostic of typhoid fever. However, paired sera are often difficult to obtain and specific chemotherapy has to be instituted on the basis of a single Widal test.10 In view of the doubts expressed on the value of the Widal test, it is thought to be worthwhile to reassess the utility of a single Widal test in the diagnosis of typhoid fever. So, there is a great need for the people to be aware of all the consequences of Enteric fever and it is the most important area where the health personnel should take serious measures to create an understanding and awareness among the public regarding typhoid fever and its risk factors. Enteric fever continues to be a

major health problem in Bangladesh. In the topical areas however, it is endemic in many places, due to the low standard of living, unprotected water supply and unhygienic methods in the preparation and handling of food. Many children with Typhoid fever are admitted in the hospital with various complications. few studies have been performed worldwide about these particular topics of Enteric fever. But in Bangladesh such studies are practically absent. If these can be done then probably we will be able to increase the awareness about Enteric fever so they may enjoy a good quality of life

Objectives

General objective

- To evaluate the Sensitivity and Specificity of Widal test in Children with Enteric Fever.

Specific objectives

- To ascertain the seroprevalence of Widal test in children.
- To perform blood culture in children with fever.
- To measure the sensitivity and specificity of different antibody titres

MATERIALS AND METHODS

We conducted this study at the Department of Paediatric Medicine of Dhaka Shishu Hospital, Dhaka, a tertiary care paediatric hospital, having 560 beds, Bangladesh Institute of Child Healh (BICH) is its academic wing, which is affiliated with Bangabandhu Sheikh Mujib Medical University (BSMMU), Bangladesh College of Physicians and Surgeons (BCPS) and Dhaka University (DU). The study was conducted over a period of 6 (six) months from 10th October 2013 to 9th April 2014. Our study subjects were children with or without fever, coming to the Dhaka Shishu Hospital, Dhaka. Employing purposive sampling techniques, we taken 50 children in each group (group-I: enteric fever suspected; group-II: febrile illness other than enteric fever and group-III: afebrile children) as a study subjects, so a total of 150 children were included in this study.

Our Inclusion criteria are (1) Age: 2 to 18 years (2) Both sexes (3) Febrile Children suspected of enteric fever (Group I) (4), Children suffering from febrile illness other than enteric fever. (Group II) (5) Children with no history of fever in the past 3 months prior to collection of specimen. (6) Hospitalized for treatment of diseases other than fever. (Group III) andExclusion criteria are (1) Age <2 year (2) Enteric encephalopathy (3), Febrile convulsion (4) Encephalitis, meningitis (5) Immuno-compromised children (6) Unwillingness to participate in the study

Operational definitions are

- Sensitivity: (also called the true positive rate, or the recall rate in some fields) measures the proportion of actual positives which are correctly identified as such (e.g. the percentage of sick people who are correctly identified as having the condition).
- Specificity: measures the proportion of negatives which are correctly identified as such (e.g. the percentage of healthy people who are correctly identified as not having the condition, sometimes called the true negative rate).
- Positive predictive value: is the probability that subjects with a positive screening test truly have the disease.
- Negative predictive value: is the probability that subjects with a negative screeng test truly don't have the disease.

Prior to data collection a questionnaire was designed for this study by reviewing all the available questionnaire of previous studies including all variables. The questionnaire was finalized following pretesting. After selection of a participant according to the inclusion and exclusion criteria and getting written informed concent from their guardian, they were included in respected group and their demographic and clinical information was gathered from the respondent by asking face-to-face questions. Blood specimens were collected from children of all the groups and sent to the Departments of Microbiology and pathology, Dhaka Shishu Hospital (Bangladesh Institute of Child Health), Dhaka, Bangladesh. Widal test was performed using stained bacterial suspension (Micropath, Omega, UK) containing TO and TH antigen, by slide titration. S. typhi were isolated from blood by the lysis-direct plating centrifugation method described previously by saha et al. All the data were collected and recorded systematically in a questionnaire and were analyzed using computer software SPSS (Statistical Package for Social Sciences). Data were presented in the form tables and graphs. Quantitative data were presented with descriptive statistics and bivariate analysis. The level of significance of 0.05 was used for this study.

RESULTS

Table-1: Demographic characteristics of the respondents (n=240)

Respondents	Group-I (%)	Group-II (%)	Group-III (%)	$\chi 2$	P-value
Gender				3.069	0.07979854
Male	20.8	31.7			
Female	79.2	68.3			
Age groups of the children				4.009(t-test)	0.0001
≤ 5	63.3	80.8			
5-10	26.7	16.7			
10>	10.0	2.5			
Religion				1.709	0.42549589
Muslim	95.0	90.9			
Hindu	5.0	8.3			
Others	0	0			
Educational status of the respondents				48.024	0. 0001
Illiterate	4.2	0.8			
Primary	30.8	7.5			
Secondary	21.7	28.3			
Higher secondary	15.0	51.7			
Graduate	20.0	11.7			
University	8.3	0.0			
Occupation of the respondents				10.676	0.00480547
Job	57.5	65.8			
Business	28.3	32.5			
Others	14.2	1.7			

This study was undertaken with the objective to assess the association between Typhoid fever and age, sex and blood phenotypes ABO and Rh group among children. A total of 240 children, out of whom 120 were suffering from typhoid fever (cases) and 120 were non-typhoid (controls), were included in this study.

The most of the caregiver of the children were female, 79.2% in cases and 68.3% in controls. $\chi 2$ = 3.069, df = 1, p-value = 0.07979854; which means there are no any association between different gender groups. By age distributions of both groups were in the '≤ 5 years' age group; 63.3% of Cases group and 80.8% of Controls group were in the age group. Mean ± SD of age was calculated to be, (5.1042 ± 3.11575) for Cases group and for Controls group (3.5951 ± 2.50218). The p-value was 0.0001 for t-test and 0.01151045 for chi-square, which means there was an association in age distribution between the groups. ($p<0.05$). It is illustrated that more than half of the participants in both Cases group [83 (69.2%)] and Controls group [66 (55.0%)] were Males. Male and Female ratio was about 2.25:1 in cases and 1.2:1 in controls. There might be a positive association between male gender and typhoid fever. Accordingly, the difference in male-female distribution between the groups was statistically significant ($\chi 2 = 4.284$, df = 1; p-value = 0.03847271) ($p<0.05$).

Table-2: Socio-economic and environmental condition of the respondents (n=240)

Respondents	Case (%), n= 120	Control(%), n=120	Statistical Analysis	$\chi 2$	P-value
≤ 10,000	27.5	16.7		0.160	0.87
10,000-20,000	51.7	61.6			
> 20,000	20.8	21.7			
Mean ± SD	5.1042 ± 3.11575	3.5951 ± 2.50218			
Area of Residence					
Urban	89.20	96.70		4.134	0.04
Rural	10.80	3.30			
Water consumption					
Boiled water	61.7	76.7	RR=0.8044; 95% CI: 0.6663-0.9713	5.28	0.02
			OR=0.4894; 95% CI: 0.2647-0.9047		
Tube well	3.3	10.0	RR=0.33; 95% CI: 0.0981-1.11	3.62	0.05
			OR=0.3071; 95% CI: 0.0857-1.1013		
Supply water	35.0	13.3	RR=2.6316; 95% CI: 1.4923-4.6405	12.85	0.0003
			OR=3.5101; 95% CI: 1.7283-7.1291		
Habitat					
Neat	61.7	89.2	RR=3.5463; 95% CI: 1.9158-6.5645	20.41	0.0001
Crowdie	38.3	10.8	OR=5.1269; 95% CI: 2.4237-10.8452		
Sanitation					
Sanitary	95.9	98		4.186	0.04
Hanging	3.3	1			
Open	0.8	1			
Food Habits					
Raw food	18.1	5.8		7.37	0.006
No raw food	89.9	94.2			

Above table shows that low incoming family was more in cases [33 (17.5%)] than controls [20 (16.7%)]. Mean ± SD of monthly income was (17,350.00 ± 8,799.016) in cases and (17,175.00 ± 6,847.268) in controls. There was no association between the groups (t-test = 0.16, p-value = 0.873 and $\chi 2 = 3.523$, df = 2, p-value = 0.17178699). Most of the children were urban dwellers (89.2% cases and 96.7% controls); the difference was statistically significant ($\chi 2 = 4.134$, p = 0.04202989). 35.0% of cases drink supply water in comparison with only 13.3% of controls. There was positive association of drinking supply water with typhoid fever (RR=2.6316 and OR=3.5101 and $\chi 2 = 12.85$; p-value = 0.000337). Crowdie habitat was reported by 38.3% of Cases and 10.8% of Controls. There may be strong association of crowdie condition of habitat with typhoid fever (RR = 3.5463; OR = 5.1269 and $\chi 2 = 20.41$; $p < 0.0001$). Out of total 240 participants 5 cases used non-sanitary latrine ($\chi 2 = 4.186$, p = 0.04075916). 18.3% of cases and 5.8% of controls were found to have the practice of 'Eating raw or under cooked food'.

Table-3: Laboratory findings of all study participants (n=240)

Blood Group	Cases (n=120) Percent	Controls (n=120) Percent	Statistical calculations
O	16.7	27.5	RR=0.6073; 95% CI: 0.3535-1.0433 OR=0.5285; 95% CI: 0.2665-1.0482 $\chi^2 = 3.39$; p-value = 0.065593
A	25.0	25.0	RR=1.0; 95% CI: 0.5272-1.6162 OR=1.0; 95% CI: 0.6187-1.8967 $\chi^2 = 0.0$; p-value = 1.0
B	48.3	33.3	RR=1.4505; 95% CI: 1.0287-2.0452 OR=1.8713; 95% CI: 1.0565-3.3144 $\chi^2 = 4.66$; p-value = 0.030873
AB	10.0	14.2	RR=0.7042; 95% CI: 0.3293-1.5061 OR=0.6714; 95% CI: 0.2837-1.5889 $\chi^2 = 0.83$; p-value = 0.362273

It is illustrates that in a gross calculation, there was no statistically difference in distribution of ABO blood group of the children between cases and controls ($\chi2$ = 6.125 df = 3; p-value = 0.10568457). However, when each group was individually considered, blood group 'B' indicated there may be some positive association with typhoid fever [RR = 1.4505 (95% CI: 1.0287-2.0452) and OR = 1.8713 (95% CI: 1.0565-3.3144)]. The difference was statistically significant $\chi2$ = 4.66, df = 1; p-value = 0.030873. (p< 0.05)

Table-4: Laboratory findings of all study participants (n=240)

Blood group	Cases (n=120) Percent	Controls (n=120) Percent	Statistical calculations
Rh typing of Blood			
Positive	96.7	95.8	RR=0.7857; 95% CI: 0.1909-3.2341
Negative	3.3	4.2	OR=0.7784; 95% CI: 0.1791-3.3828
			χ^2=0.112 df=1; p-value = 0.73787855
Widal Test			
Positive	83.3	0	χ^2 = 18.22 df = 1; p-value =0.0001
Negative	16.7	100	
Blood Culture			
Not done	58.3	100	$\chi2$ = 52.585; df = 2; p-value = 0
Positive	38.3	0	
Negative	3.3	0	

Above Table shows that only 3.3% children in case group and 4.2% in control group had Rh negative blood group. There was no positive association [RR= 0.7857 (95% CI: 0.1909-3.2341) and OR= 0.7784 (95% CI: 0.1791-3.3828. Widal test result was positive in 83.3% of cases; the remaining 16.7% negative in case group and all (100.0%) of the controls were found to be Widal negative in control group. The difference of Widal test result between the groups was statistically significant $\chi2$ = 18.22, df = 1; p-value <.0001. (p< 0.05). Participants were included on the basis of their blood culture and/or Widal test findings; patients who had already done either one or both of the tests were considered for this study. Thus, blood culture was done in 50 (41.7%) participants from the case group; out of them negative culture was obtained in 4 (3.3%) individual and the remaining 46 (38.3%) were culture positive. The difference was statistically significant $\chi2$ = 52.585, df = 2; p-value = 0. (p< 0.05).

DISCUSSION

This study was aimed to evaluate the sensitivity and specificity of widal test in children with enteric fever. A total of 150 children were included in this study. In all three groups around half of the participants were in the '≤ 5 years' age group; 50.0% of group-I, 50.0% of group-II and 56.0% of group-III were in the age group. Mean ± SD of age was calculated to be, (5.874±2.943) for group-I, (5.598±3.000) for group-II and for group-III (5.740 ± 2.741). The p-value was 0.972 for chi-square; ANOVA calculated sig. 0.239 for group-II and 0.188 for group-III; which means there was no statistical deference in age distribution between the groups. Similarly, Alam ABMS, Rupam FA, Chaiti F found that, the mean age of 153 patients (86 with definitive typhoid fever, 17 with suspected typhoid fever and 50 with non-typhoidal febrile illness), was 5.2 ± 2.8 years. 60 Their age ranged from 2 years to 15 years (group-I: 2y 4m - 15y; group-II: 2y - 14y and group-III: 2y - 13y).Another study in Dhaka found participants of younger age as, the youngest and oldest patients were 0.7 and 14 years respectively.60 More than half of the participants in all groups [27 (54.0%)], [30 (60.0%)] and [29 (58.0%)] were Males. Male: Female ratio was about 1.2:1 in group-I, 1.5:1 in group-II and 1.4:1 in group-III. The difference in male-female distribution between the groups was not statistically significant ($\chi2$ = 0.763, df = 2, p-value = 0.683). [Table 3.2] Again, Alam ABMS, Rupam FA, Chaiti F found that, over half (54%) of patients was male with male to female ratio being roughly 1:1.60 In all the group fathers' educational qualification showed similar pattern of distribution. Illiteracy and primary education constituted a smaller proportion; 12.0% in each group. Chi-square calculates: $\chi2$ = 8.29, df = 10, p-value = 0.601; which explains that there was no significant statistical difference in the groups. Low earning job like day labourer, Rickshaw puller, driver, tailor, etc.constituted small portion in the groups (14.0%, 8.0% and 12.0%) in people with lesser education (12.0% in each group) and with higher educational qualification more fathers had got jobs in different sectors (58.0%, 60.0% and 56.0%). There was no significant statistical difference between the groups ($\chi2$ = 2.13, df = 4, p-value = 0.0711). Like their fathers Illiteracy of the mothers was 4.0%, 8.0% and 6.0%. Otherseducational status like madrasa was counted similar to regular level in years of education. Chi-square was calculated as, $\chi2$ = 6.16, df = 10, p-value = 0.801; that means there was no statistically significant difference between the groups. Again, most of the mothers were housewives; only 22.0% mothers in group-I, 12.0% in group-II and 10.0% in group-III had

active role in earning. There was no significant statistical difference between the groups ($\chi2$ = 8.37, df = 2, p-value = 0.079). [Table 3.4] Low incoming family was more in group-II (46.0%)] than group-III (38.0%) or group-I (34.0%). Mean ± SD of monthly income was (18,240.00 ± 10,98.616) in group-I, (18,000.00 ± 14,532.160) in group-II and (18,000.00 ± 10,688.540) in group-III. There was no statistically significant difference among the groups ($\chi2$ = 5.54, df = 4; p-value = 0.236; ANOVA indicated sig. = 0.059 and 0.710).Most of the children were urban resided; rural dwellers were more in group-III (32.0%) compared to group-II (30.0%) and group-I (26.0%). There was no statistically significant difference between the groups ($\chi2$ = 6.72, df = 4, p-value = 0.152).For both enteric group and non-enteric group fever was present in cent percent (100.0%) of participants. For group-I most of the patients (76.0%) had step-ladder pattern of fever; while for group-II intermittent type (48.0%) and continued type of fever (34.0%) prevailed. For both enteric (Mean ± SD = 12.60 ± 6.295) and non-enteric (Mean ± SD = 12.04 ± 5.918) fever group had similar pattern of distribution for duration of fever; both quantitative (t-test = 0.503, df = 49, p = 0.617) and qualitative ($\chi2$ = 0.792, df = 2, p = 0.673) analysis showed that there was no statistical significant difference in duration of fever. A cross-sectional study at Central Hospital Ltd., Dhaka, showed about 17% of patients had a history of suffering between 1 – 5 days, 24.6% between 11 – 15 days and 58.5% between 6 – 10 days. The mean duration of illness was 8.2 ± 3.3 days and the minimum and maximum durations were 1 and 15 days respectively.60 Blood culture was done in all of the 150 participants; out of them negative culture was obtained in 123 individual and the remaining 27 (54.0%%) were culture positive. Culture yeild that all were S. typhi in group-I and in group-II 9 (18%) children was found with Escherichia coli (5), Klebsiella spp (2), Pseudomonas aeruginosa (1) and Staphylococcus aureus (1). Specificity and Positive predictive value were calculated to be 100.0%.[Table 3.8] Africa, Keddy KH, Sooka A, Letsoalo ME, Hoyland G, Chaignat CL, Morrisseye AB and Crump JA found that, thirty-six (39%) blood cultures grew a pathogen; 28 (78%) of these cultures grew Salmonella Typhi. Other pathogens isolated included Salmonella Typhimurium, Streptococcus pneumoniae, Staphylococcus aureus and Mycobacterium tuberculosis (one culture each) and Cryptococcus neoformans (four cultures).62 The agglutinin levels against TO and TH antigen of the three groups; for group-I children were either widal positive or culture positive and/or both, for group-II widal positive cases were confirmed by negative blood culture findings. TO was found 1:160 or more in 52.0% in enteric fever patients and 22.0% of non-enteric febrile patient. TH showed ≥1:160 count in 38.0% group-I and 26.0% of group-II children. A total of 11 children in group-II were found to be widal positive; among them 2 children were diagnosed as Dengue fever (diagnosed by IgM and IgG), in the other 9 children blood culture showed other micro-organisms. Single Widal test showed Sensitivity=62.0%, Specificity=92.0%, Positive predictive value= 79.49% and Negative predictive value=82.88%. When double widal test result was considered it was positive in 94.0% of enteric fever cases; the remaining 6.0% of cases and 89.0% of the non-enteric children were found to be Widal negative.(Sensitivity = 94.0%, Specificity=89.0% Positive predictive value= 81.03% and Negative predictive value=96.74%) [Table 3.9.2 and 3.9.3] Similarly, in anothther study in Bangladesh, It is seen that more than 97% of the definitive typhoid fever and 82.3% of the suspected typhoid fever cases had an 'O' agglutinin titer of 1:160 or > 1:160 as compared to only 2% cases of nontyphoid febrile illness (p <0.001). Similarly, 20.9% of culture-positive and 29.3% of suspected typhoid fever cases had an 'H' agglutinin titer of equal to or more than 1:160 as opposed to only 4% of the non-typhoid febrile illness cases (p = 0.003). However, Noorbakhsh S, Rimaz S, Rahbarimanesh AA and Mamishi S found that, among the bacteriologically proven cases of typhoid fever, there were 26 (44.8%) with TO≤1:40 and TH>1:40. In 4 cases (6.8%) there were TO>1:40 and TH<1:40. There were 14 (25%) cases in which TH and TO antibody was less than 1:40. TO titer >1:320 not detected in this group but TH >1/320 were seen in 12 cases (20.6%). From 58 cases with bacteriologically documented typhoid fever 23 (39.6%) aged 5-10, in which 21 cases had positive titers; but in 17 cases which aged less than 5 years all of them had positive titers. Therefore a false negative result was high in this group. On the basis of this cutoff value, and considering both the agglutinins equally important, sensitivity and specificity of the test were 75.86% and 93.75%, respectively. Similarly, the positive and negative predictive values were 89.79% and 84.26%, respectively.

Limitations of the study

This study was conducted in a tertiary care hospital in Dhaka. So the study findings may not reflect the exact scenario of all around the country regarding enteric fever. The current study was conducted among 150 children, not a large study to draw a definite conclusion. Study of enteric fever in the perspective of the objective of current study is rare in Bangladesh as well as in the blobe. So, difficulty was faced to compare the findings to other research findings.

CONCLUSION AND RECOMMENDATIONS

Double widal test shows better sensitivity and specificity in diagnosis of enteric fever than a single test. O & H agglutinin titers of ≥1:160 are of diagnostic significance. This was a small scale study done at a single centre over a brief period of time. A large scale, multi-centre study over long duration will give a complete picture on enteric fever with various factors. However, widal test is easy, inexpensive and

can be done in remote settings. Although double widal test shows better sensitivity and specificity, it is sometimes difficult to double obtain sample. So, in a country like Bangladesh one has to rely on single widal test. (Sensitivity=62.0%; Specificity=92.0%; Positive predictive value= 79.49% and Negative predictive value=82.88% calculated in this study).

REFERENCES

1. Mrs. RS. Tambulwadkar, "Paediatric nursing" Vora medical publications, 2nd edition, page 108
2. Balentine JR. Typhoid fever. Available in [on line]: http://www.medicinenet.com/typhoid_fever/article.htm
3. Enteric fever. Textbook of Microbiology. Ananthanarayan and Paniker by Orient Blackswan; 7th ed. 295 – 30
4. Introduction of typhoid fever. Available in [on line]: http//www.google.com.
5. Park. "Text book of preventive and social medicine" BanarsidasBhanot. 16th edition. 2000. page 187
6. Crump JA, Luby SP, Mintz ED. The global burden of typhoid fever. Bull World Health Organ. 2004; 82: 346-53
7. Panikar CKJ, Vimala KN. Transferable chloramphenicol resistance in Salmonella typhi. Nature. 1972; 239:109-110
8. Etward J E, Nowesn J. Prevalence of typhoid fever in children; Journal of paediatrics. 2004.
9. Ratner JJ, Thomas VL, Forland M. Relationships between human blood groups, bacterial pathogens, and urinary tract infections. The American journal of the medical sciences. 1986 Aug 1;292(2):87-91.
10. Omoregie R, Ogefere HO, Omokaro EU, Omorogbe E. Distribution of ABO and rhesus blood group and haemoglobin phenotypes among tuberculosis patients in Benin City, Nigeria. J Med Lab Sci. 2002;11(1):68-70.
11. Issit DD and Anstee DJ. Applied blood group Serelogy. 4th Ad. Montgomem Scientific Public. 1996; 218 – 246.
12. Admin. Blood Group and Susceptibility to Diseases. URL: http://www.yourbtdiet.com/blood-type-health/blood-group-and-susceptibility-to-diseases/
13. Preventive aspects of Typhoid fever; Available in [on line] http//www.alldisease.com
14. Anstee DJ. The relationship between blood groups and disease. Blood. 2010 Jun 10;115(23):4635-43.
15. Kalra SP, Naithani N, Mehta SR, Swamy AJ. Current Trends in the Management of Typhoid Fever (Review Article). MJAFI. 2003; 59: 130-135.
16. Mehta SR, Narula HS, Roy SK. Atypical presentation of enteric fever. MJAFI. 1987; 43:58-60.
17. Thomas H, Williams M, Huins H. Typhoid and Paratyphoid Fever. URL: http://www.patient.co.uk/doctor/typhoid-and-paratyphoid-fever
18. Crump JA, Mintz ED. Global trends in typhoid and paratyphoid Fever. Clin Infect Dis. 2010 Jan 15;50(2):241-6
19. Brusch JL. Typhoid Fever, Medscape. Sep 2011
20. Siddiqui FJ, Rabbani F, Hasan R, Nizami SQ, Bhutta ZA. Typhoid fever in children: some epidemiological considerations from Karachi, Pakistan. International Journal of Infectious Diseases. 2006 May 1;10(3):215-22.
21. Sánchez-Vargas FM, Abu-El-Haija MA, Gómez-Duarte OG. Salmonella infections: an update on epidemiology, management, and prevention. Travel medicine and infectious disease. 2011 Nov 1;9(6):263-77.
22. Butler T, Islam A, Kabir I, Jones PK. Patterns of morbidity and mortality in typhoid fever dependent on age and gender: review of 552 hopitalized patients with diarrhea. Reviews of infectious diseases. 1990 Jan 1;13(1):85-90.
23. Herrera P, Valenzuela CY. Study of the Widal test phenotypic expression of blood groups ABO, Rh and MNSs in patients with typhoid fever. Rev Med Chil. 1992 Sep;120 (9):994-7.
24. Valenzuela CY, Herrera P. ABO, Rh, MNSs, sex and typhoid fever. Hum Hered. 1993 Sep-Oct;43(5):301-10
25. Ram PK, Naheed A, Brooks WA, Hossain MA, Mintz ED, Breiman RF and Luby SP. Risk factors for typhoid fever in a slum in Dhaka, Bangladesh. Epidemiol Infect. 2007 April; 135(3): 458–465
26. Dewan AM, Corner R, Hashizume M, Ongee ET. Typhoid Fever and its association with environmental factors in the Dhaka Metropolitan Area of Bangladesh: a spatial and time-series approach. PLoS neglected tropical diseases. 2013 Jan 24;7(1):e1998.