DUODENAL STRING TEST IN TYPHOID FEVER

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ABSTRACT

Twenty five children between 4-12 years of age hospitalized with a clinical diagnosis of enteric fever were studied for evaluating the practicality and sensitivity of duodenal string-capsule culture (DSCC) and compared with conventional cultures from blood (BC), urine (UC) and stool (SC). Duodenal string capsule (DSCC) was successfully inserted in 18 patients (72%). Insertion of DSCC failed in 7 patients (28%) and all of them were below 6 years of age. Salmonella typhi was isolated from DSCC and/or BC in 13 cases (72.2%). DSCC was positive in 11 out of 13 confirmed cases of typhoid fever (84.6%). BC was positive in 8 cases (61.5%). DSCC was successful in isolating the organism in about 30% more cases than BC. Duodenal string test was a simple, non-invasive and a reliable test which when used in combination with BC could identify almost all cases of enteric fever irrespective of duration of fever and prior use of antibiotics.

Key words: *Duodenal string test, Typhoid fever, Salmonella typhi.*

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Diagnosis of enteric fever is usually based on clinical condition of the patient with positive serology or by isolating the organism. Serology is rapid, relatively easier and a cheaper investigation but not very specific. Moreover, bacteriological diagnosis by isolation of causative organism is becoming increasingly important for appropriate antibiotic therapy. Isolation from blood, urine or stool is not always successful. Blood culture (BC) positivity wanes from 90% in the first week of fever to 25% after the third week. Bone marrow culture (BMC), the most sensitive method to recover organisms associated with enteric fever(1,2) is an invasive procedure and, therefore is not suitable for routine use specially in the pediatric age group.

Salmonella can be recovered in the bile of patients with enteric fever and is continuously excreted throughout the period of illness(3). Some investigators(3-6) have used this phenomenon and isolated the organisms by culturing the bile containing duodenal fluid using a string device. Enteric fever being a common problem in children in developing countries with limited investigation facilities, this study was planned to evaluate the practicality and positivity of cultures by duodenal string capsule (DSC) in children hospitalized with a clinical diagnosis of enteric fever.

Material and Methods

Children less than 12 years of age admitted to Pediatric unit of Kalawati Saran Children's Hospital, New Delhi with a clinical diagnosis of enteric fever formed the subjects of this study. Patients who were too young to swallow the capsule or had alteration in sensorium were not enrolled. Informed consent was obtained in all cases.

Procedure for Collecting Duodenal Fluid

Patient was kept fasting for 4-8 hours (midnight or overnight) and then instructed to swallow DSC (pediatric Enterotest, HDC Mountain View, California) with a glass of water. One end of the string was then taped to the cheek of the child. The child was made to lie in the right lateral position and allowed small sips of water. The string was left in place for about 4 hours. During this period the gelatin capsule was digested and the string with the lead weight passed into the duodenum. In children who were hesitant, the capsule was placed on the posterior 1/3 of their tongue and the child made to drink some water. The capsule was washed down with the water. At the end of the 4 hours period the string was removed by gently pulling it out of the child's mouth. The bile stained portion which was yellow and confirmed by the alkaline pH (identified by using the pH stick supplied with the capsule) was cut using a sterile blade. This cut portion was cultured in a selenite enrichment broth as per the recommended procedure(7). Blood, urine and stool cultures were also taken besides blood samples for serology. Three consecutive stool cultures were repeated in all the patients 4 weeks after the completion of successful antibiotic therapy to identify any carriers.

Results

Twenty five children with a clinical diagnosis of enteric fever were studied from April 1991 to February 1992. DSC was successfully inserted in 18 children (72%). Six children brought out the capsule within a few minutes of swallowing despite giving repeated sips of water. All these children were less than 6 years of age. One 4-year-old child could not swallow the capsule. The final analysis was therefore, done in 18 children out of which 13 (72.2%) proved to be cases of typhoid fever after isolating *S. typhi* from BC/ Duodenal String-capsule culture (DSCC).

The male to female ratio of the cases was 1.6 : 1 with age group ranging from 4-12 years (mean age 7.6 years). All the patients with the exception of 1 case (duration of fever <7 days) had received one or the other antibiotic before presenting in the hospital. *Table I* shows the comparison of relative efficacy of cultures of blood, urine, stool and duodenal string singly or in combination in isolating *S. typhi*. The positivity was highest with DSCC (84.6%) followed by BC (61.5%). Widal test and urine culture had a very low positivity rate of 15.4 and 7.7%, respectively. The

TABLE I–*Frequency of Isolation of Salmonella typhi from Various Culture Sites (n = 13)*

Specimen	Positive cases	
	No.	%
Singly		
DSCC	11	84.6
Blood	8	61.5
Urine	1	7.7
Stool	-	-
Sole Isolation		
DSCC	5	38.5
Blood	2	15.4
Urine	-	-
Stool	-	-
*Combination		
DSCC + Blood	5	38.5
DSCC + Urine	1	7.7
DSCC + Stool	-	-
Blood + Urine	-	
Blood + Stool	-	-

*One case had positive DSCC + Widal Test and another case positive BC + Widal test

organism could not be isolated from the stool in any of the patient. *Table II* depicts the positivity of culture from different sites according to the age of the child. Once DSC was successfully inserted, there was no significant difference in the isolation rate of *S. typhi* in different age groups.

In 5 patients *S. typhi* was isolated only from the duodenal string while as 2 cases had BC positive with a negative DSCC. DSCC and/or BC accounted for all the 13 diagnosed cases of enteric fever. The duodenal string seemed equally useful irrespective of the duration of fever (*Table III*).

All investigations were negative in 5 children. Three of these were later diagnosed as cases of malaria, pulmonary tuberculosis and pre-leukemia, respectively. Two other children were treated for enteric fever on a clinical diagnosis and responded to treatment. Repeat stool cultures of all the 15 cases did not grow any organism.

Discussion

Isolation of *Salmonella typhi* has become extremely important for the diagnosis and management of enteric fever particularly because of recent emergence of multidrug resistant organisms and a varied clinical picture(8-10). Even routine sensitivity pattern of the isolated organisms is becoming increasingly important because

TABLE II—*Correlation of Isolation of S. typhi with Age of Total Number of Children Studied (n = 18)*

Age (yrs)	Total No. of patients DSC inserted	Diagnosed as typhoid fever	No. of cases with positive culture			
			DSCC	BC	UC	SC
<5	2	1	1	1	1	-
5-10	13	10	8	6	-	-
>10	3	2	2	1	-	-
	18	13	11	8	1	-

Table III—*Correlation of Isolation of S. typhi by DSCC with Duration of Fever (n = 18)*

ıration lays)	Total No. of cases DSC inserted	Diagnosed as typhoid fever	No. of cases with positive culture			
			DSCC	BC	UC	SC
<7	*1	1	1	-	-	-
'-14	6	6	4	5	-	-
-21	10	6	6	3	1	-
·21	1	-	-	-	-	-
	18	13	11	8	1	-

ıe only patient who had not received any antibiotic prior to hospitalization.

of variable therapeutic responses(8,10,13). Since BMC can not be routinely used for diagnosis of enteric fever, improving the isolation rates by employing some of the non invasive methods can be helpful. This study evaluated the duodenal string test as one such method to increase isolation rates singly or in combination with other routine investigations. Culture from duodenal string is a non invasive procedure which was observed to be quite successful in children between 5-12 years of age in our study.

The string was successfully inserted in 72% of attempts. This compares favourably with two other studies reported in children with success rates ranging between 57.6-86%(3-5). The sensitivity of the test was 85% which is similar to that observed by other workers. However, culture from DSCC has been observed to be as sensitive as BMC if repeatedly subcultured in selenite broth(14). Cultures from DSCC taken on two consecutive days has also been reported to improve the isolation rate to 91%(5). A combination of duodenal string test and blood culture identified 13 out of 15 patients (86.7%) of typhoid fever in our study. Other workers have also obtained similar results. Infact Avendano *et al.*(5) obtained 92% isolation when two blood cultures and one duodenal string test were used which was higher than two blood cultures and one bone marrow culture (84%).

The string test was successful in isolating the organism in about 30% more cases than blood culture. One third of the patients had a positive isolation only with the string device. Only two patients had a positive blood culture without a positive string test. The other significant advantage observed with DSCC was that isolation was unaffected by the duration of illness. This suggests that salmonella are excreted in the bile throughout the period of illness(3). Most of the cases often consume one or the other antibiotic before reporting in a health facility but our results suggest that it is not a limitation for culturing the causative organisms by DSCC. Similar observation has been made by others(3).

There are, however, two drawbacks to this method. The first which is inherent in the method itself is that this test cannot be performed in very young children and those cases with more severe presentation like enteric encephalopathy. The second is that gall bladder carriers of salmonella will test positive irrespective of whether they are suffering from acute enteric fever or otherwise. There is, however, no information available on the incidence of carriers of *Salmonella typhi* in the pediatric age group in India. We followed all the 15 cases and repeated their stool cultures 4 weeks after completion of successful antibiotic therapy. None of the cases was a typhoid carrier. However, despite these drawbacks the duodenal string test has proved to be a simple, non invasive and a reliable test which when used in combination with the blood culture would identify almost all cases of enteric fever irrespective of the age (if insertion is successful), duration of fever and prior use of antibiotics.

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NOTES AND NEWS

THIRD COMMONWEALTH CONFERENCE ON DIARRHEA AND MALNUTRITION

The Third Commonwealth Conference on Diarrhea and Malnutrition is to be held in Shatin, New Territories, Hong Kong from *November 11th–14th, 1994*. This conference is organized jointly by the Department of Pediatrics, The Chinese University of Hong Kong and the Hong Kong Pediatric Society. Participation by over 300 delegates from throughout the Commonwealth is anticipated and, in this special meeting, we will be joined by colleagues from China.

Further details are available from:

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