Comparative Efficiency of Rectal Swabs and Fecal Specimens in Detecting Typhoid and Salmonella Cases and Carriers*

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IN bacillary dysentery the causative organisms are known to be confined chiefly to the lumen and especially to the superficial ulcerations of the large intestine. The ideal method, therefore, for collecting material from cases or carriers of bacillary dysentery for bacteriologic examination would seem to be the application of a swab to the ulcers or inflamed intestinal mucosa while they are being visualized through the sigmoidoscope. This procedure is time consuming and requires the services of a specially trained physician. The development of the " blind " rectal swab technique in which a swab is passed into the rectum either directly [1] or through a lubricated rubber tube [2] has made it possible to collect large numbers of specimens rapidly and to permit the inoculation of culture media without any delay. The superiority of the rectal swab specimen over the passed specimen in the laboratory diagnosis of bacillary dysentery has been demonstrated or indicated by several groups of investigators.[3-8] In this laboratory the use of the rectal swab has become routine in the investigation of dysentery outbreaks.

Because of the rapidity and simplicity with which the rectal swab procedure can be employed, it would be desirable if it could be adapted to surveys made for the purpose of finding cases or carriers of typhoid or *Salmonella* infections. However, it is well known that the excretion of these organisms is from the small intestine and adnexa and not from the lower bowel. There are usually no ulcerations or other lesions of the lower bowel in which the bacilli are harbored and from which they can be cultured. The investigation reported here was, therefore, undertaken to compare the efficiency of the usual type of passed fecal specimen with the rectal swab in the laboratory diagnosis of typhoid and *Salmonella* infections.

The large group of typhoid carriers confined in special wards at the Manteno State Hospital, Manteno, Illinois, provided excellent material for the study. Through the coöperation of the hospital authorities 43 patients, with histories of a typhoid or *Salmonella* carrier state, were made available for the study. The patients were selected, on the basis of previous information, so that persistent intermittent and infrequent shedders were all represented in the group studied. Pre-cathartic rectal swabs and

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TABLE 1

Sequence of Laboratory Findings by Patient

	Pre-Cathartic			*Post-Cathartic*		
	Passed			*Passed*		
Patient	** Manteno*	** Chicago*	*R. Swab*	** Manteno*	** Chicago*	*R. Swab*
1	TTTT–T	TTT —	——TT–	TTT–TT	TTTTTT	——T–
2	———	—— —	—— —	———	T———	———
3	——	— —	———	——	–T——	———
4	T TTTT	T T TT	TTTTTT	TTTTTT	TTTTTT	TTTTTT
5	—— —	—— —	———	———	–T——	———
6	TTTTT–	TTT T	T––TT–	TTTTTT	TTTTTT	TTTTTT
7			——T–	–	–	———
8	TTT–T	TT –T	TTTTT	T–TTTT	TTTT–T	T–TTTT
9	– —	TT TT	———	–TT——	———	——T–
10	T T	T	–T–TT	TTTTT	TTTTT	TTTTTT
11	TTTTT	TT TT	T–TTT	TTTTTT	TTTTTT	TTTTTT
12	——T	—— —	———	———	———	———
13			TT––TT	TTTT T	TTTT –	TTT–T–
14			———	—	—	———
15	———	— —	———	———	—T—	———
16	T TTT	– TT	–T–TTT	TTTTTT	TTTTTT	TTTTTT
17			———	– –	– –	———
18	———	—— —	———	—T—	—T—	———
19	——	— —	——	———	———	———
20	——	— –	——	———	———	———
21	———	—— —	———	———	———	———
22	———	— —	———	– ——	– ——	———
23			———	—T—	—T—	———
24	–		———	—T	–T—	———
25	–	– –	—— –	–T —T	–T ——	–T–T—
26	——	–T –	——	— T—	— T—	–T–T—
27	T——	—— —	—T—	S———	———	——T
28	———	—— —	———	———	———	–T——
29	– —	– –	——	———	———	———
30			———	S S —	S S —	———
31	T —	S SS	–	SS SS	SS SS	T SS TS
32	TTTT	T TT	TTTT	TTTTTT	TTTTTT	TTTTTT
33	TTTTTT	TTT TT	TTTTTT	TTTTTT	TTTTTT	S TTTTTT
34	T—— –	—— –	———	—— –	—— –	—— –
35	———	—— —	———	———	———	———
36	———	–T– —	———	—S——	———	———
37	—SS—	S–S SS	S–SSSS	SS–SSS	SS SSS	SSSSS–
38	——	—— —	——	———	———	———
39	——	—— —	–T——	———	–T——	———
40	T TT	– TT	–TTTTT	TT TT	TT TT	–TTTTT
41	T TT	T –T	TTT	TTTT	TTTT	TTTT
42	TTT	TT	–TTTT	TTTTT	TTTTT	TTTTT
43	T		TT	T	T	–T

T = specimen yielded *E. typhosa*
S = specimen yielded *Salmonella*
— = negative findings
* indicates whether examined in Manteno or Chicago laboratories

passed specimens were collected from each patient on the same day. In the evening of the same day the patients were given bile salts and on the following day a saline cathartic was administered. Two rectal swabs and a passed specimen were collected from each patient after the first bowel movement had occurred. An attempt was made to collect six series of pre-cathartic and post-cathartic specimens from each patient. This was not always possible. It was especially difficult to obtain the desired number of pre-cathartic passed specimens from this group of psychotic patients.

Preliminary studies had shown that the best results could be obtained by culturing the rectal swabs in accordance with the following technique: As soon as the swabs were collected, one swab from each patient was plated on Hajna-Perry agar and the other inoculated into a tube containing 2–3 ml. selenite enrichment medium. On the following morning the growth from the latter was streaked on to S. S. medium. In one series the first swab collected was plated directly and the second placed in enrichment medium. This procedure was reversed in alternate series.

The passed fecal specimens were handled according to the following technique: The specimens were collected in paper containers; as soon as specimens were delivered to the laboratory (all were received and plated within 2 hours after collection except a series delivered to our Chicago laboratory for comparative purposes), they were streaked on Hajna-Perry agar and a heavy seeding made into a 12–15 ml. tube of selenite enrichment. On the following morning material from the enrichment media was streaked on to S. S. medium.

Any plate showing suspicious colonies was set aside for further examination. When suspicious colonies were seen on a plate, two or three were picked for further study. Isolated cultures were subjected to extensive biochemical tests and were tested against high titer specific agglutinating sera. All salmonellas isolated were typed.

It should be emphasized that the work was handled in a volume and under the conditions that would be encountered in a survey done in connection with an actual outbreak. Plates were picked without knowledge of the patient's name or what the parallel series of plates revealed. All plates were compared after the picking was completed.

The complete findings are shown in Table 1. From a mere inspection in this table it is apparent that none of the methods is markedly superior when specimens from heavy shedders are examined. However, when the specimens apparently contained few organisms as in those from patients 2, 3, 5, 15, 18, 23, 24, 25, 26, 27, 28 and 39, the efficiency of the passed specimen appears to be greater than the rectal swab. In these instances, also, it appears that the post-cathartic passed specimen yields a higher

TABLE 2

Media Summary — Pre-Cathartic Rectal (234 Specimens)

	No.	*Selenite F-SS Only*	*Selenite F-SS and Hajna-Perry Agar*	*Hajna-Perry Only*
Positive Typhoid	55	12	33	10
Positive Salmonella	5	3	2	..
Positive Typh-Salm	1	..	..	..

TABLE 3

Media Summary—Post-Cathartic Rectal (248 Specimens)

	No.	*Selenite F-SS Only*	*Selenite F-SS and Haina-Perry Agar*	*Hajna-Perry Only*
Positive Typhoid	70	32	33	5
Positive Salmonella	7	2	5	..
Positive Typh-Salm	2	..	..	..

TABLE 4

Media Summary—Pre-Cathartic Specimens (Passed), Chicago (147 Specimens)

	No.	Selenite F-SS Only	Selenite F-SS and Hajna-Perry Agar	Hajna-Perry Only
Positive Typhoid	38	12	17	9
Positive Salmonella	6	2	3	1

TABLE 5

Media Summary—Post-Cathartic Specimens (Passed), Chicago (222 Specimens)

	No.	Selenite F-SS Only	Selenite F-SS and Hajna-Perry Agar	Hajna-Perry Only
Positive Typhoid	78	17	47	14
Positive Salmonella	12	5	7	0

TABLE 6

Type Specimen	Pos.	Neg.	Total
Pre-Cath. Passed	50	99	149
Post-Cath. Passed	53	96	149

P = 0.88

TABLE 7

Type Specimen	Pos.	Neg.	Total
Pre-Cath. Rectal	58	162	220
Post-Cath. Rectal	68	152	220

P = 0.23

TABLE 8

Type Specimen	Pos.	Neg.	Total
Pre-Cath. Rectal	40	103	143
Pre-Cath. Passed	46	97	143

P = 0.47

TABLE 9

Type Specimen	Pos.	Neg.	Total
Post-Cath. Rectal	68	138	206
Post-Cath. Passed	79	127	206

P = 0.23

TABLE 10

Type Specimen	Pos.	Neg.	Total
Pre-Cath. Rectal	52	119	171
Post-Cath. Passed	72	99	171

P = 0.01

percentage of positives than its pre-cathartic counterpart.

The media analyses presented in Tables 2, 3, 4, and 5 are based on the rectal swab results from the laboratory set up at Manteno and the passed specimen findings from our Chicago laboratory. The Chicago laboratory results were used in the latter series because they more nearly approximate the conditions under which specimens are usually received in a public health laboratory. These findings demonstrate again that no single medium is able to pick up all enteric pathogens. They also demonstrate the value of an enrichment medium such as Selenite F.

Because it was impossible to obtain all of the specimens planned, the crude data shown in Table 1 do not present the best comparison of our findings. In Tables 6 to 10 comparison is made of only those specimens which could be definitely paired. In these tables the results from the tetrathionate enrichment series are omitted. Chi-squares have been calculated on all pairs and p-values are shown under each table. All of the differences point in the same direction, i.e., in favor of the passed specimen and those taken post-cathartic, but only one difference is statistically significant, that between the pre-cathartic rectal swab and the post-cathartic passed specimen. The latter comparison is the one of greatest interest to us because the rectal swab is commonly used on patients who have not been given a cathartic while post-cathartic passed specimens are recommended in this type of survey. The marked superiority of the post-cathartic specimen over the pre-cathartic rectal swab under these conditions is striking.

It may be argued that these results may not be conclusive since they were obtained on known carriers. Several months after this part of the study was completed an opportunity presented itself to make another study under field conditions. A case of typhoid occurred

in an institution for mental diseases at K. and the patient was transferred to the institution hospital. The 189 patients on the ward from which this patient was removed were divided into two approximately equal groups. On August 9, 1946, the patients in group one were examined by the rectal swab technique while post-cathartic passed specimens were collected from those in group two. Three days later rectal swabs were collected from the latter group and post-cathartic passed specimens from those in group one. *Eberthella typhosa* was isolated from 7 individuals. From all patients with negative findings two more post-cathartic specimens were collected, all of which gave negative findings.

Analysis of the findings showed that only 3 of the 7 cases or carriers found in this survey yielded positive rectal swab specimens. One of these positives was obtained on a post-cathartic rectal swab, taken through error. All of the original group of post-cathartic specimens on these 7 patients were positive.

Subsequently, beginning about 12 days after the original specimens were collected, two sets of pre- and post-cathartic passed specimens were collected from each of the 7 typhoid cases or carriers found in the original survey. All of the post-cathartic specimens except 1 were found to be positive while 4 of the pre-cathartic specimens were negative. It was noted that the findings were usually positive on all three media combinations employed (S. S., Selinite-S. S. and Hajna-Perry) when post-cathartic specimens were examined, whereas with pre-cathartic specimens positive results were more often obtained, if at all, on a single medium.

DISCUSSION

It is apparent from the results shown above that the post-cathartic passed specimen of feces is a much more satisfactory source of material for bacteriologic examination for typhoid bacilli and salmonellas than the rectal swab although the latter is apparently better as a source of shigellas. This difference might have been predicted from the fact that shigellas are believed to flourish on and in the upper layers of the mucosa of the lower bowel where they can be easily collected by the rectal swab while, on the other hand, *E. typhosa* and the salmonellas are thought to be excreted largely from the small intestine and gall bladder.

By the time typhoid bacilli or salmonellas reach the area which can be reached by the rectal swab they are probably well distributed in the fecal mass. Thus, the rectal swab picks up only a few of these pathogens unless the case or carrier is a very heavy shedder. Enrichment does not aid greatly because the amount of fecal material on the swab is not large in comparison with the amounts of the passed fecal specimen usually employed in seeding the enrichment media.

The effectiveness of both rectal swab and passed specimen was increased in this series if the patient had had a cholegogue and saline cathartic before they were collected. However, in the Manteno study the number of carriers found in the pre- and post-cathartic rectal swab series was identical because carriers found in the pre-cathartic series with the rectal swab technique were missed in the post-cathartic rectal swab series and *vice versa*. However, 11 more carriers were found in the Manteno post-cathartic passed specimen series than in the pre-cathartic group collected by the same technique. On the other hand, 3 of the pre-cathartic passed specimens yielded positives not found in the post-cathartic passed specimen series, so there was a net balance of 8 carriers in favor of the post-cathartic passed specimen series over the similarly collected pre-cathartic series. This was due in large part to the greater number of post-

cathartic specimens that were obtained.

The advantage of the post-cathartic passed specimen over its pre-cathartic counterpart was not significant when paired specimens were studied. In the examination of paired specimens collected during the K. outbreak studied by us, there was again found to be a slight balance in favor of the post-cathartic over the pre-cathartic passed specimen in the ratio of 13 to 10. The difference is again greater than suggested by the figures because inspection of the data shows that the positive findings in the pre-cathartic series were usually found on fewer media combinations, often only one, than in the post-cathartic series.

While the post-cathartic rectal swab yielded much better results than the swab employed without prior administration of a cathartic, we do not believe from our experience that the post-cathartic rectal swab is practicable for general use, especially in psychotic patients. The employment of this procedure in persons who have had a cathartic is disagreeable and, in our opinion, dangerous to the collector of the swab.

The post-cathartic passed specimen has one further advantage over the rectal swab in the laboratory diagnosis of typhoid and salmonellosis. The rectal swab must be cultured immediately after collection in order to prevent drying and, therefore, cannot be used to transport specimens to a distant laboratory by the usual modes of transportation. The post-cathartic passed specimen can, however, be cultured after a considerable delay without loss of efficiency. For example, 205 paired specimens of this type were examined at Manteno State Hospital by one of us (F. F.), and at our Chicago laboratory by another (A. S.) after shipment by Railway Express. The fresh specimens yielded 78 positives while the shipped specimens gave 80 positives. This difference is, of course, ascribable to chance since it would not be expected that the delay would improve the specimens.

The rectal swab can, we believe, be used successfully for one purpose in typhoid and salmonella laboratory work. As indicated above, it was about as effective as the passed specimen in finding heavy shedders of these pathogens. It appears to us that, because of the simplicity and rapidity of the rectal swab procedure, it might well be used as a preliminary to other methods in any large-scale surveys designed to find carriers of enteric pathogens. Used in this way the rectal swab may make it possible to find quickly and easily almost all of the heavy shedders of *E. typhosa* or *Salmonella*. Additional post-cathartic passed specimens can be used to detect the infrequent or light shedder of these organisms. This plan has been adopted by the Illinois Department of Public Health for routine and emergency surveys of institutionalized populations.

SUMMARY AND CONCLUSIONS

Post-cathartic passed specimens are more efficient than rectal swabs as a source of material for the laboratory diagnosis of typhoid and salmonellosis or of the carrier state in these diseases.

The rectal swab is, however, effective in the detection of heavy fecal shedders of *E. typhosa* and *Salmonella* and may be of great value in rapid screening of large population groups if combined with subsequent examinations of post-cathartic passed specimens.

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