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# OBSERVATIONS UPON THE TRANSMISSION OF AMEBIASIS

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Only a few years ago amebic dysentery was considered a problem of the tropics, and the dissemination of the causative organism of practical importance only to those residing or traveling in equatorial regions. In 1933 the Chicago outbreak of amebic dysentery in epidemic form clearly demonstrated that amebiasis is very much a problem of concern to inhabitants of the United States. Of importance was the fact that the epidemic brought to general notice the work of Sistrunk (1911), Giffin (1913), and Sanford (1916), who as early as 1911 had pointed out that *Endamoeba histolytica* infections were existent in highly endemic proportions even in the more northerly parts of the United States. In addition, more general notice was taken of the later surveys by Boeck (1923), Kofoid (1921), Meleney (1930), and many others too numerous to mention here, confirming this earlier work and showing a nation-wide prevalence of the organism. Craig (1934), in order to determine more accurately the general incidence of *E. histolytica*, summarized the results of 50,000 examinations conducted by various workers in almost all parts of the country, and found an average incidence of 11.6 per cent for *E. histolytica*. Most of the rates included in this summary were in the neighborhood of 5 per cent, though some of the southeastern states showed as high as 40 per cent of certain population groups to be infected. Thus, if any benefits may be said to have resulted from the Chicago outbreak of dysentery, one was that the epidemic focused attention on a fact which previously had lacked general recognition, namely, the importance of amebiasis as a public health problem in the United States.

The realization that there were some 10 million carriers, all potential sources of infection, led to a renewed interest in methods of transmission. The main stimulus to this interest was that current theories of transmission generally held when the first Chicago cases appeared sent investigators on a false lead. The first efforts in tracing the source of infection were those attempting to incriminate food handlers; yet as facts were gathered, it became evident that food-handler dissemination had had little if any part in the development of the epidemic.

In 1937 I became interested in the various reports in the literature which followed as an aftermath of the Chicago investigations. In so far as transmission phases were concerned, the main controversy centered on food-handler dissemination. My own observations in this regard had led me to believe that the importance of food handlers as transmitters was being unduly emphasized. At the time, I had been with the Special Service Squadron, a group of naval vessels stationed in the American tropics, for a period of over a year. We had made cruises to almost every country of central and northern South America, a region notorious for high *E. histolytica* indices among the native populations. There were 500 men comprising the crews of these ships. Visits were made to towns of both the seacoast and the interior. An unusual amount of shore leave was granted the men, as the purpose of the cruises was to make friendly contacts with the various population groups. It was soon evident that the sailors were being repeatedly exposed to large numbers of infected food handlers who were serving both food and drink to the men in eating establishments ashore. Furthermore, the hazards were increased, owing to unsatisfactory sanitary conditions and a lack of appreciation of proper hygiene on the part of the attendants. Here, then, was an ideal situation for food-handler

dissemination, and the fact that the exposures were repeated in various places over a two- or three-year period suggested that these conditions would inevitably lead to many new infections among the sailors thus exposed. Consequently, it was most surprising to discover that following these not a single case of amebic dysentery had appeared.

This observation led me to determine the prevalence of latent *E. histolytica* infections in this group. It seemed possible that even though clinical manifestations of the organism had not appeared, a high carrier rate would be found. With the expert advice and assistance of Dr. Carl M. Johnson, the writer began a series of investigations at the Gorgas Memorial Laboratory in Panama, which extended over a two-year period. With every facility offered by both the navy and the laboratory, we decided to examine the entire group serving with the Special Service Squadron and certain other similarly exposed groups. Three fecal examinations were made on each individual. We employed as a routine the administration of a mild cathartic, since this procedure, judging from the work of Andrews (1931), promised to detect almost all the *E. histolytica* infections. Iron-hematoxylin stains made by the rapid technique devised by Johnson were used to confirm all diagnoses.

It was obvious that in order to determine the number of newly acquired infections incident to the described exposure we would need to know the infection rate of the group prior to its travel. For this purpose the writer surveyed a group of naval recruits at one of the larger naval training stations in the United States. Roughly, *E. histolytica* rates ranging from 8 to 15 per cent were obtained, the higher figure being that for men enlisted from the southern states and the lower for men from other parts of the country. Thus, we felt that, regardless of any exposures experienced in the tropics, a rate falling within this range would be that expected from infections acquired previously and incident to residence in the United States. For greater accuracy the proportions of men originally from the South were ascertained for each of the subsequently examined groups and the expected rate adjusted for the number of men originally resident in the South.

The crews of three different ships were examined. Our results showed 9.6, 9.3, and 10.4 per cent infections of *E. histolytica* for each of these ships, or an average of 9.5 per cent for the combined crews comprising 472 men. These were rates which indicated that new infections had not been acquired. Not only did they fall near the lower estimates of the expected infection range of 8 to 15 per cent, but, taking into consideration the previous United States residence of these men, 11.0 per cent infections were expected, whereas actually there were only 9.5 per cent infections. Similarly, in another group of 251 men attached to submarines on tropical duty 9.6 per cent infections were found, or almost exactly the same as the expected rate, which was 9.0 per cent; or again, evidence that transmission had not occurred.

These investigations, then, strongly suggested that the food handlers had not been a source of amebic infections even under most favorable conditions for such transmission.

Later we obtained further evidence to confirm these findings. We had observed aboard ship that certain individual messing units had been served by cooks and waiters among whom were numerous carriers, and that these food-handler exposures had undoubtedly occurred over a period of many months. Included among these groups were carriers attending messes aboard submarines. These ships were studied with particular interest, as proper hygiene on the part of mess attendants on small undersea craft was obviously difficult to attain and would very easily permit dissemination by food handlers.

We found in each of 11 individual messes from 1 to 4 carriers engaged in

the preparation or serving of food. In all, there were 196 men served by 20 carriers. Despite this, only 8.7 per cent *E. histolytica* infections were found among those being served, whereas in 8 other messes comprising 149 men there were no carriers among the food handlers; yet the rate was 11.4 per cent, or slightly higher than in the groups which had been served by an unusually large number of infected food handlers. Another interesting observation was that, in addition to the evidence that infected food handlers had not transmitted their *E. histolytica* infections, there was also no convincing evidence that any of the other species of amebae or flagellates had been transmitted by food handlers. Nor had cases of clinical dysentery appeared in any of the messes, despite the fact that the carrier situation among the food handlers had existed over a prolonged period.

These observations have led me to agree with those who are not convinced that the food-handler hypothesis is tenable, or at least that its importance as a method of transmission has been greatly overestimated. Certainly the findings in the exposed navy groups ought to arouse suspicion in this matter.

There is, as a matter of fact, little evidence to support the belief that food handlers are a general source of amebic infection. The general acceptance of the food-handler proposition seems to be based mainly on its plausibility. Knowing that there are cysts of *E. histolytica* in feces passed by a carrier, it has seemed logical to assume that contamination from the fingers of a person serving food would be a frequent means of dissemination. This assumption is to be questioned, however, in view of the practical experiments of Spector (1933) and her co-workers, who have shown that the process of drying strictly limits the danger of such contamination. Again, only minute numbers of cysts could be commonly transferred by this means and there is more than a reasonable doubt whether one or a few cysts will suffice to establish a human infection.

Other arguments purporting to support the food-handler hypothesis have also been presented, but again they are most unconvincing. The discovery of amebiasis in persons of higher economic status and those living in excellently sanitated towns has given considerable weight to the food-handler hypothesis. Seemingly, this mode of transmission would appear to be the only logical manner in which these infections could have been acquired, but as a single exposure in a region of less adequate sanitary attainment will suffice to acquire an infection, such infections may be accounted for in this manner without the necessity of incriminating food handlers.

There have been cited isolated examples where it would appear that a cook or other person in like capacity had passed his infection on to those whom he had served. In these cases, however, there has been no proof that the infections were not in fact preëxistent to the food-handler contacts; yet, peculiarly enough, the observers in reporting these so-called demonstrations of transmission by food handlers do not appear to have considered such a possibility. No one can doubt that an exceedingly unclean food handler might, under unusual conditions, convey his infection, but whether this occurs commonly and as a result of minor infractions in hygienic conduct is quite another matter.

One other experience gained in investigations in the American tropics has made me wonder if, in controversies on the relative importance of the various means of transmission, whether by water, food handlers, flies, or other means, we were not overlooking the one fundamental source of infection relative to which all others seem to be of secondary importance. We had the experience of surveying a group of sailors who were passing through the Panama Canal aboard a naval transport en route home after three years of service in the Orient. Our examinations revealed 26.1 per cent *E. histolytica* infections, an

incidence which left no doubt that this group had acquired many infections during their time spent in the Far East. Another finding was that several of the men had contracted clinical dysentery during their stay in the Orient.

What conditions, then, made travel so dangerous in the Orient and relatively innocuous in the American tropics? The explanation appears to rest in one essential difference. In the Far East, often even in the larger cities, there is frequently not only an indiscriminate deposition of human stools in house and yard, but also a collection and storing of fecal material to be sold and used in garden farming. Thus, while one could quite properly incriminate the vegetable supply, the important fact is that had there been proper methods for disposing of human refuse in the first place, this source and other possible means of transmission would have been eliminated. Efforts directed at prohibiting the practice of using human products as fertilizer would help, but these would constitute only an adjuvant and inferior method of control as compared to a correction of the underlying fault. As long as fecal disposal is improperly handled, one form or another of transmission obviously remains possible.

In the American tropics, the places visited by the navy men were those equipped with fairly efficacious methods of handling human excreta, and this would appear to be the most logical explanation of the lesser hazard of infection as compared to that in the Orient. The writer is quite cognizant that dysentery still prevails in tropical America, but it does so principally in regions in which proper sewage disposal has not been achieved. Note Faust's (1931) impressive demonstration in this regard. He found an 8-per cent infection rate in Canal Zone residents favored by an excellent sanitary disposal system, between 15 and 20 per cent in a Panama City hospital caring for many out-of-town natives living in a region with less adequate disposal methods, and over 70 per cent in a Chagres River Indian village where a call of nature is answered, at least by children, immediately and wherever they chance to find themselves.

By virtue of the same principle by which Faust points out that the *E. coli* index of a community may be used as a measure of pollution, similarly the writer believes that the *E. histolytica* index of a stable population group serves to test the efficacy of the community's sewage-disposal system. An indication of this is the fact that in almost every survey with which the writer is familiar, and in which high *E. histolytica* rates have been reported, epidemiological investigations point to the coexistence of defective methods of fecal disposal.

Without losing sight of the basic importance of proper care in handling sewage, the hazard which polluted water presents as a source of infection deserves special emphasis. The highly suggestive observations of Clark (1925) indicate that impounded and filtered water supplies play a major role in lowering the amebiasis rate in communities so favored. This was strikingly demonstrated in Panama City, where, after a protected water supply had been established, Clark noted that a remarkable drop had occurred in the number of cases of amebic dysentery coming to autopsy. Similarly, preventive measures directed along such lines have been successful elsewhere. Certainly, for other reasons as well as for reducing morbidity due to *E. histolytica*, water purification is an important preventive measure. One may question, however, whether a protected water supply will assure complete safety if attention is not also given to the proper disposal of feces. The fact cannot be disregarded that despite the availability of a pure water supply in the home, negligence in the habits and care exercised in disposing of stool passages would still remain a dangerous source of amebic dissemination.

Thus, in turn, one might examine each commonly stressed method by which

*E. histolytica* infections are acquired; but all, with the exception of dissemination by food handlers, postulate that infective fecal material in some manner has been inadequately disposed of. As simple as this proposition is, the tendency has been to disregard it, centering attention on secondary or adjuvant means of transmission.

## Conclusions

1. Both the endemic prevalence and epidemic occurrence of *E. histolytica* infections in the United States emphasize the importance of a carefully planned program of control.

2. Although the degree of importance which should be attached to any one method of transmission may not yet be certain, it seems logical that preventive measures, whenever possible, should be based on the principle that imperfect methods of fecal disposal constitute the fundamental and primary source of amebic infections.

3. Transmission by flies, sewage-contaminated vegetables, water, or within the family unit, are secondary sources dependent on the care and habits exercised in disposing of stool passages.

4. Correction of these adjuvant sources of infection in given cases may play important roles in prevention, but vigilance is required that sewage-disposal methods are not ignored as a source which may again allow dissemination to occur.

5. Food-handler dissemination has been postulated as the important means of transmission in well-sanitated regions. It is a mechanism of infection which is on the whole independent of methods of fecal disposal. The importance to attach to food handlers as transmitters, however, requires further investigation, and the evidence at present indicates that this mechanism of dissemination has been greatly overemphasized. To this may be added that practical control measures to prevent transmission from such sources would be difficult, costly, and frequently impossible to carry out.

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