THE FLAGELLATED PROTOZOA OF THE INTESTINE

A SPECIFIC ANALYSIS OF THE CONDITIONS RELATED TO THEIR PRESENCE[1]

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In a previous paper (1) I have reported on an analysis of 1040 cases of chronic disease, making comparisons between the two groups in the series, divided on the basis of the presence or absence of flagellated Protozoa in the stools. The subjects of the study were residents of the northern part of Texas.

In this series the species incidence was as follows: *Trichomonas hominis* 12.5 per cent, *Chilomastix mesnili* 7.5 per cent, *Giardia intestinalis* [*G. lamblia*] 2.3 per cent, *Tricercomonas* 1.5 per cent, unidentified flagellates 1.7 per cent. The total case incidence was 23 per cent. It was recognized that these figures are probably lower than the actual incidence, since usually only one stool from each person was examined.

The relative incidence of the Protozoa in this study furnishes an interesting comparison with other reports. Craig (2) states that *Giardia intestinalis* is the most common flagellate occurring in the intestine of man, while *Chilomastix mesnili* is the next in frequency and *Trichomonas hominis* is less common than either, it being a comparatively rare species in most localities.

Quoting from several studies by Kofoid, Kornhauser and Plate in this country, Mathews and Smith and Jepps in England, and Faust in China, Craig thinks it is evident that in temperate regions *Trichomonas hominis* occurs in from 0.5 to 1 per cent of the inhabitants. The 11.9 per cent incidence in Asiatics in the Federated Malay States found by Fletcher and Jepps is the only figure recorded by him which is near that of the present study.

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Hegner (3) notes the remarkable difference in figures of incidence of the different species of flagellates in various reports. He examined one specimen of stool each from 286 patients of hospitals in Central America and found *Trichomonas hominis* in 20.6 per cent, *Chilomastix mesnili* in 7.7 per cent, and *Giardia lamblia* in 2.1 per cent, the figure for *Trichomonas hominis* being considerably higher than mine (as I would anticipate), while those for Chilomastix and Giardia are practically identical. Compiling the results of a number of reports published by English, American and French investigators from 1916 to 1919, Hegner and Payne (4) arrive at an average incidence in twenty thousand reported cases of 12 per cent for *Giardia lamblia*, 4 per cent for *Chilomastix mesnili*, and 3 per cent for *Trichomonas hominis*.

Boeck and Stiles (5) give an incidence in 8029 persons examined by them of 0.007 per cent for Trichomonas, 3.2 per cent for Chilomastix, and 6.5 per cent for Giardia. However the conditions of their examinations did not favor trophozoites and probably numerous instances of Chilomastix and, particularly, Trichomonas infestation in this study failed to come to light, while the inclusion of a number of children offers a reason for the comparatively high incidence of Giardia.

Jepps (6) found widely different incidences in 674 Tamils and 350 Chinese in the same hospital, the Tamils showing 5 per cent Giardia, 3.6 per cent Chilomastix and 16.5 per cent Trichomonas, while the Chinese had but 2.5 per cent Giardia, 0.6 per cent Chilomastix and 2.2 per cent Trichomonas. Hegner (3) would explain this difference on the basis of meat in the diet of the Chinese and not in that of the Tamil.

Barrow (7), in reporting upon 725 persons harboring some type of protozoon records the remarkable proportion of 535 instances of Chilomastix to about 13 of Trichomonas and 10 of Giardia. He also records a 100 per cent incidence of intestinal Protozoa (94 per cent Chilomastix, 8.3 per cent Trichomonas, 2.8 per cent Giardia) in 79 (11 per cent of 725) cases of arthritis deformans, and believes that intestinal Protozoa are etiological factors in this disease. His figures of incidence, however, seem to be an

indictment of *Chilomastix mesnili* only, since the others are not remarkably different from those in this and in other studies.

Smithies (8), in reporting on 3780 patients having some gastro-intestinal disturbance, records the presence of some protozoon in 265, or about 7 per cent. He records the presence of flagellates in 185, or 4.8 per cent, Trichomonas in 78, or 2 per cent, *Chilomastix mesnili* and *"Cercomonas intestinalis hominis"* in 93, or 2.6 per cent, and Giardia in 14, or 0.3 per cent. These figures seem to be the lowest available in recent literature, where conditions warranted the expectation of finding trophozoites, and this is surprising, in view of the class of diseases included in the study.

Thomas and Baumgartner (9), reporting on a study of 1122 inmates of a New York state school for feebleminded women, record a positive finding in 266 cases, or about 23 per cent, practically the same as in my study. However, there is a difference in the proportion of the different organisms, they giving 21 per cent of *Chilomastix mesnili* and 0.26 per cent of *Trichomonas hominis*, while their incidence of Giardia is practically the same as mine, 2.4 per cent. They found that, while a slightly higher percentage occurred in the summer, the seasonal variation was inconsiderable. This may, perhaps, be expected in institutional spread as seems to have been the case there, for there is an increase from an entrance or early institutional incidence of 20 per cent to a steady residential incidence of 40 to 50 per cent after about the third month.

PLACE OF RESIDENCE

Of the whole of my series 71 per cent of the flagellate-carrying cases and 70 per cent of the flagellate-free lived in the city. In an analysis of the species, however, they are not equally proportioned, as 56 per cent of those having Trichomonas lived in the city, while 80 per cent of those with Chilomastix and 91 per cent of those with Giardia were city dwellers. These figures seem to indicate that Trichomonas is relatively more effective in transmission in the rural districts, implying in the region where this study was made a relative lack of sanitary facilities, while

Chilomastix and Giardia are as effectively distributed, or even more so, under metropolitan conditions. This, perhaps, has some explanatory bearing on the higher incidence of Chilomastix and the lower incidence of Trichomonas in other studies, particularly institutional. That modern sanitary facilities do not prevent the spread of intestinal Protozoa, particularly the encysting species, is also shown by Thomas and Baumgartner.

It becomes appreciable in analyzing the studies of different kinds that the non-encysting Trichomonas is more at home in warmer climates and under rural conditions while the resistant

TABLE 1

Relation to age, sex, residence and pathologic state

	TRICHOMONAS	CHILOMASTIX	GIARDIA	FLAGELLATE-FREE
	per cent	*per cent*	*per cent*	*per cent*
City residence	56	80	91	70
Males	41	51	54	40
Below 20 years of age			45	
Below 30 years of age			63	
Below 40 years of age	53	11	81	53
Below 50 years of age	78	55	91	83
Achlorhydria	23	40		19
Hyperchlorhydria	14	10		25
Peptic ulcer	0	0	0	10
Diarrhea	6	7	27	8
Constipation	50	74	40	55
Chronic cholecystitis	44	37		22

phase of the others render them more indifferent to colder temperatures and to ordinary sanitary precautions and so more prevalent, actually or relatively, under conditions of close association of people.

SEX

Forty-seven per cent of the flagellate-infested and 40 per cent of the free were males; in other words in a clientele composed of 60 females to 40 males practically one-half of the flagellate carriers were males. In comparison by species the difference lies with the encysting flagellates, 41 per cent of those having Tri-

chomonas and 51 and 54 per cent of those harboring Chilomastix and Gardia, respectively, being males.

RELATION OF AGE TO INCIDENCE

Of those in this study harboring *Giardia intestinalis* 45 per cent were below twenty years of age, 63 per cent were below thirty, 81 per cent were below forty, and 91 per cent were below fifty. Of those harboring *Trichomonas hominis* 53 per cent were below forty and 78 per cent below fifty. In the case of *Chilomastix mesnili* carriers, however, only 11 per cent were below forty and 55 per cent below fifty. Of the flagellate-free, 53 per cent were below forty and 83 per cent below fifty. The youngest person showing Trichomonas was ten years of age, the youngest showing Chilomastix was six years of age, and the youngest of the Giardia carriers was five. The oldest persons in each case were seventy-nine, seventy-nine, and fifty-seven, respectively. The young and the old are represented with all three. The occurrence of Trichomonas seems to have no relation to age, while Giardia is strikingly represented in the young (nearly 50 per cent before twenty years), and Chilomastix in the older (nearly 50 per cent after fifty years). Thomas and Baumgartner found that "there is a slight but steady increase in the percentage of *Chilomastix mesnili* as the age increases." "There is a sharp drop in Giardia after the first decade."

RELATION TO GASTRIC ACIDITY

Nineteen per cent of the flagellate free group showed a condition of gastric anacidity while 23 per cent of those harboring Trichomonas and 40 per cent of those with Chilomastix showed this condition. On the other hand 25 per cent of the flagellate-free were found to have a gastric hyperacidity while but 14 per cent of the Trichomonas carriers and 10 per cent of those with Chilomastix had this condition. An accompanying finding, perhaps related, is the clinical diagnosis of gastric or duodenal ulcer in 10 per cent of the flagellate-free and none in the flagellate-infested group. One might reasonably have anticipated the reverse of the effect of gastric anacidity upon the presence of

Chilomastix and Trichomonas, assuming that the latter in passing the stomach in its unprotected condition should be more favored by the lowering of the acid barrier than should be the former in its, presumably, better protected encysted phase.

DIARRHEA AND CONSTIPATION

There was diarrhea or history of diarrhoea in 8 per cent of the flagellate-free, 6 per cent of the Trichomonas carriers, 7 per cent of those with Chilomastix, and 27 per cent of those harboring Giardia. All of the Giardia carriers with diarrhea were children, but the case was not similar with the other two parasites. On the other hand 55 per cent of the flagellate-free were habitually constipated while this was the case with 50 per cent of the Trichomonas carriers, 74 per cent of those with Chilomastix, and 40 per cent of those harboring Giardia, these last all adults and too small in number to be of significance. Constipation, then, was conspicuous in the Chilomastix carriers, was present in practically all of the adults with Giardia, and was of similar ratio in the flagellate-free and in the carriers of Trichomonas. Diarrhoea, the condition longest and most frequently attributed to flagellated intestinal Protozoa, appears to bear no statistical relation to the presence of Trichomonas or Chilomastix or Giardia in adults. This study is insufficiently controlled in the matter of the seeming relation of Giardia to diarrhoea in children to allow any conclusion to be drawn.

CHOLECYSTITIS

There was a clinical diagnosis of chronic cholecystitis in 22 per cent of the flagellate-free group, in 37 per cent of those carrying Chilomastix, and in 44 per cent of those with Trichomonas. Except to record and comment on this feature it would seem unwise to attempt to attach any significance to it beyond what the observation itself possesses. It should be recalled, however, that this is one of the clinical states in which some suspicion has been cast on the intestinal Protozoa in recent years. It is the only condition included in this study in which carriers of Trichomonas differ materially from the free group. In the case of

Chilomastix, its relation to the later years of life, to lowering of the acid barrier in the stomach, and to constipation, in other words to conditions themselves related to the clinical state of chronic cholecystitis, makes any scientific deduction impossible. Even the clinical diagnosis of chronic cholecystitis would have little or no scientific standing.

SUMMARY

From the material of this study it appears that in a cross section of a medical practice, including people complaining mainly of chronic alimentary tract disorders, the majority being adults, there are certain statistical data which may be of use in the problem of the relation of the flagellated Protozoa to disease.

1. There was no evidence that diarrhea was related in any way to the presence of *Trichomonas hominis* or *Chilomastix mesnili*.

2. There was no evidence that constipation was related to the presence of Trichomonas but constipation was a common habit of those harboring Chilomastix.

3. Among 240 unwell persons harboring intestinal flagellates there was no case of arthritis deformans.

4. The presence of *Trichomonas hominis* appears to be more related to rural life and to warm climates, while the presence of *Chilomastix mesnili* appears to be more related to city life but relatively unrelated to climate.

5. Infestation with *Giardia intestinalis* was more frequent in early life; *Chilomastix mesnili*, in later life; while age of the person had apparently no relation to the presence of *Trichomonas hominis*.

6. A state of lowered acidity of the stomach appeared to be favorable to the presence of Chilomastix but of no relation to Trichomonas.

7. The observation is made that a clinical diagnosis of chronic cholecystitis was recorded in about twice as many of the carriers of Trichomonas and Chilomastix as in the flagellate-free.

CONCLUSION

The statistical data of this study offer little or no evidence of disease based on the presence of flagellated Protozoa in the intestine, but rather to the contrary, particularly in the case of *Trichomonas hominis*.

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