ABSORPTION STUDIES IN CHILDREN WITH GIARDIA LAMBLIA INFECTION

A Preliminary Report

BY

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Infection of children with the flagellate giardia lamblia often causes abdominal symptoms, anaemia and defective development. It is not known how these symptoms originate. Abdominal pains are most probably connected with the mechanical action of the protozoa. Anaemia may be due to the fact that the parasites inhabit and thus damage a part of the body which plays an important part in haematopoiesis. No satisfactory explanation has been offered for the interference with development, since the small amount of foodstuffs withdrawn by the parasites cannot be sufficiently great to cause severe loss. This circumstance led me to examine the conditions of absorption in children infected with giardia lamblia.

Particular attention was paid to fat absorption. cursory examinations had already revealed abnormalities in this function, and Miller (1926) had observed that typical steatorrhea was a common condition in the giardia epidemics in the Great War. Concentration of urinary pigments was also estimated. The value of this latter is not always characteristic of intestinal absorption, neither are the changes proportional. But if absorption in the bowel is hindered by some cause a high proportion of the biliary pigments will be excreted in the faeces and the amount of pigments in the urine thus lessened.

The determinations were made in seventeen children selected from one hundred and eighty-eight giardia-infected patients. Their ages varied from two to fourteen years. The following data are twenty-four-hour averages of experiments lasting forty-eight or seventy-two hours. Fat determinations were made by the method of F. Müller (1887) and the estimation of urinary pigments by that of Veil (1927) and Heilmeyer (1927).

Absorption of fat

About 90 to 97 per cent. of the fatty substances taken by mouth are absorbed in a healthy organism under normal conditions when a normal diet is given ;

the fat excreted amounts to about 10 to 15 per cent. of dried faeces. Fat absorption was examined in fourteen children. The data of importance are given in table 1. Similar cases were put in one group; the values given are averages from the single instances.

TABLE 1
INTAKE AND EXCRETION OF FAT

NUMBER OF CASE	FAT INTAKE IN GM.	FAT EXCRETED IN FAECES		FATTY ACIDS IN PER- CENTAGE OF EXCRETED FAT		pH
		IN PER- CENTAGE OF FAT INTAKE	IN PER- CENTAGE OF DRY SUBSTANCE	FREE	SAPONIFIED	
3, 7, 9, 12	48.05	4.41	9.07	20.0	45.5	6.9
4, 10, 13	49.04	24.83	35.47	47.0	29.2	5.0
5, 11, 17	82.30	47.57	41.53	41.0	37.6	4.6
1, 2, 15, 16	40.44	77.68	51.83	58.9	15.9	3.8
1, 2, 15, 16	12.53	79.20	26.87	62.2	12.2	3.8

As can be seen, only the four children of the first group show normal absorption, while those of the second, third and fourth groups all reveal abnormal absorption. Members of the fourth group do not retain more than a fifth of the consumed fat and more than the half of the dry substance of their faeces consists of fat, but not as if the fat content of the food were excessive. The patients of the fourth group were examined after reducing the fat in their original diet to a third. The last line of table 1 shows the results. It is clear that the absorptive capacity has not improved after the reduction of fats, the only difference being that a smaller part of the dry substance is formed of fats. After such a dietetic measure the condition of the patients, if judged by the appearance of their stools, seems to be improved, although the absorptive capacity is invariably imperfect.

Interference with absorption of such severity is usually due to pancreatic inactivity. This cause could be excluded in the present cases by determining the fermentative processes. Determination of the lipolytic activity of the faeces was made in every instance, with the stalagmometric method of Rona and Michaelis (1911). The values resulting were over 90 per cent. in nine cases, between 80 and 90 per cent. in two, and between 75 and 80 per cent. in three patients. The lowest value obtained, 76 per cent., must still be regarded as normal. Thus the impaired absorptive capacity is not the consequence of a lack in some ferment. Analyses of the excreted fat demonstrate this too. (See the fifth and sixth columns of table 1.) Apart from the first group, the proportion of free fatty acids exceeds that of the saponified ones. In other words the consumed fat, though split in the intestine, cannot be absorbed. The excessive amount of free fatty acids leads to the acidifying of the intestinal contents. (See the pH values in the last column of table 1.) This circumstance, together

with the fact that the absorption of other materials and of water is similarly impaired, explains the continuous diarrhoea of these patients and the unusually large quantity of stools passed.

The fats are, accordingly, digested but not absorbed. Only two conditions can cause this if the fermentative activities are normal. One is the lack of the adrenocortical hormone regulating the synthesis of fats. Such a condition would, apart from the abnormality of absorption, show itself by several other symptoms, none of which was detectable in the patients in question. Thus it has to be assumed that there is a mechanical obstacle to absorption, in the present cases the impermeable layer of parasites covering the surface of the bowels.

Urinary pigments

According to Veil and Heilmeyer the concentration of pigments in the urine of normal individuals is about $F_0=1.80$, and the total amount of pigments excreted during twenty-four hours, $F \times M$ = between 9.0 and 11.0. In healthy children the F_0 value is commonly over 1.0, and the value of $F \times M$ between 8.0 and 9.0. Determinations were made in thirteen out of the seventeen children. Two of them, having affections of the liver demonstrable also by other means, gave pathologically high values, while normal ones were found in three children. The values of all the remaining eight patients were much below the normal. Two showed F_0 values under 0.1 and $F \times M$ under 1.1; in four others the F_0 was found between 0.1 and 0.2, $F \times M$ between 1.20 and 2.10.

No condition has been known up to now in which the amount of urinary pigments would be lessened. F_0 values may be low in polyuria, but no such symptom could be seen in these patients, and the $F \times M$ values show that not only the concentration of the pigments has decreased but their absolute amount is reduced also. There is only one explanation of this circumstance: the intestinal wall has, owing to some cause or other, become impermeable so that not even the readily absorbable bile can be absorbed.

Treated cases

The above-mentioned experiments have shown that absorption is hindered in these patients and that the hindrance is of a mechanical character. It has been assumed that the obstacle is a layer of parasites adhering to the wall of the intestine. If this assumption is correct, after the expulsion of the protozoa the absorptive capacity should become normal again.

Eight of the seventeen children were treated with arsenic and acridine compounds. No other medicines were given and no dietetic measures taken. The parasites disappeared in every instance, the longest duration being seven weeks. The abnormality of absorption began to improve at once in every case when treatment was started and conditions became perfectly normal in ten to twelve weeks. Table 2 shows the values before and after treatment of the three severest cases which figured in the fourth group of the first table.

TABLE 2
FAT ABSORPTION AND URINARY PIGMENT VALUES BEFORE
AND AFTER TREATMENT

NUMBER OF CASE	TREATMENT	FAT EXCRETED IN FAECES		URINARY PIGMENT	
		IN PERCENTAGE OF FAT INTAKE	IN PERCENTAGE OF DRY SUBSTANCE	F ₀	F × M
2	Before	77.90	58.0	0.095	0.99
2	After	5.60	7.7	1.79	8.0
15	Before	77.40	42.0	0.09	0.82
15	After	5.20	12.1	1.93	8.75
16	Before	73.60	60.5	0.17	1.52
16	After	7.10	9.3	1.44	9.32

It can be seen that the absorption of fats became normal after treatment. The fat in the faeces does not amount to more than one-tenth of the dry substance. The concentration and total amount of pigments in the urine show normal values. Anaemia and the great retardation of development have also shown a parallel improvement.

These experiments prove the pathogenicity of giardia lamblia, which is still doubted by some authors, and partly explain the mode of origin of the symptoms caused by the flagellate. Apart from the lesion of organs playing a part in haematopoiesis, the impaired absorption may have a rôle in the origin of anaemia, and it is this which possibly causes the retardation of development so often seen in giardia-infected children.

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