Urinary xylose excretion in steatorrhoea

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EDITORIAL SYNOPSIS The urinary xylose excretion is low in patients with untreated idiopathic steatorrhoea but subsequent improvement in excretion was noted after treatment in six out of nine patients. This did not coincide with histological improvement. With Crohn's disease low values were found when the jejunum but not the ileum was involved.

The numerous articles on xylose excretion published in recent years seem to testify to the reliability of this test (Benson, Culver, Ragland, Jones, Drummey, and Bougas, 1957; Turner, 1950; Brien, Turner, Watson, and Geddes, 1952) and its diagnostic value in certain types of steatorrhoea, and it is generally agreed that as an index of carbohydrate absorption the xylose excretion test is superior to the glucose tolerance test (Butterworth, Perez-Santiago, Martinez de Jesus, and Santini, 1959; Christiansen, Kirsner, and Ablaza, 1959; Finlay and Wightman, 1958). We have therefore studied the xylose excretion in a group of 49 subjects in whom other clinical and biochemical tests were carried out at the same time and who were also subjected, in the majority of cases, to peroral small intestinal biopsy (Shiner, 1956). These subjects consist of controls as well as patients without steatorrhoea, and patients with idiopathic steatorrhoea, regional enteritis, and post-gastrectomy steatorrhoea. We are also presenting our observations on repeat xylose, faecal fat, and biopsy tests in some of the patients with idiopathic steatorrhoea, performed a variable time after starting them on a gluten-free diet.

METHOD AND MATERIAL

The xylose excretion test was carried out in the following way. The patient was fasted for at least eight hours before the test. The bladder was completely emptied and the urine saved. An oral dose of 25 g. D(+) xylose dissolved in 500 ml. of water was then given. All urine passed during and at the end of the next five hours was collected and pooled. The xylose content of the five-hour and the fasting urine was measured by the colorimetric method of Roe and Rice (1948) which is specific for pentose determinations. Faecal fat estimations (Anderson, French, Sammons, Frazer, Gerrard, and Smellie, 1952) were the average of a three-day collection in all except one patient.

The 49 subjects studied consisted of 17 controls and of 16 patients with idiopathic steatorrhoea, 11 with regional enteritis, and five with post-gastrectomy steatorrhoea (Table I). The average age of the 17 control subjects was 44.4 years, 10 being below the age of 50 (average age 33.9 years) and seven above (average age 59.4 years). Seven of the 17 subjects were chosen from amongst our staff and no further tests were carried out. A further six presented with anaemia (two patients) and diarrhoea of unknown cause (four patients). In all of these faecal fat estimations were found to be within normal limits (below 5 g. in 24 hours) and in the five patients subjected to peroral biopsy the mucosal appearances of the jejunum were normal. Since most of the control subjects were under the age of 50 a further four patients above the age of 50 suffering from haematemesis (two patients), minor abdominal pain of unknown origin (one patient), and cholelithiasis (one patient) were included in this group.

The 16 patients with idiopathic steatorrhoea had an average age of 54.8 years. All were subjected to faecal fat determinations, small bowel radiographs, and mucosal biopsies as part of a diagnostic confirmation. No treatment had been given before their investigation. Repeat xylose excretion tests and faecal fat estimations were carried out in nine of the 16 patients after treatment with a gluten-free diet. At the same time six of the nine patients were subjected to repeat peroral biopsies.

Of the patients with active regional enteritis (average age 40.5 years), four had involvement of the jejunum and seven of the ileum. This was determined either by radiology of the small intestine or at laparotomy (Table I). Three of the four patients with jejunal involvement were found to have steatorrhoea but only one of the seven patients with ileal disease excreted more fat than normal. Jejunal mucosal biopsies were obtained in three of four patients and were normal in two and abnormal in one with jejunal disease. Of the seven patients with ileal disease, mucosal biopsies were obtained in five and were found to be normal in four and only slightly abnormal in one of these.

In the five patients presenting with post-gastrectomy diarrhoea, a Polya partial gastrectomy had been performed in four and a total gastrectomy in the fifth patient.

TABLE I

PATIENTS STUDIED IN PRESENT SERIES

Group	Sex	Age	Urinary D(+) Xylose Excretion (g./5 hours)	Faecal Fats (g./24hr.)	Result of Barium Meal and Follow Through	Small Intestinal Biopsy	Comments	
Controls								
1	R.P.	M	30	5.8	—	—	Staff	
2	A.C.	M	33	7.4	—	—	Staff	
3	P.W.	F	27	7.9	—	—	Staff	
4	M.S.	F	37	8.0	—	—	Staff	
5	E.C.	F	54	5.1	—	—	Staff	
6	H.W.	F	41	4.7	—	—	Staff	
7	O.D.	F	51	6.7	—	—	Staff	
8	M.M.	F	38	5.7	3.2	Normal	Pernicious anaemia	
9	J.H.	M	75	6.4	3.5	Normal	Anaemia	
10	T.M.	F	29	8.9	3.7	Normal	Diarrhoea	
11	M.D.	M	34	6.4	4.6	? Mild steatorrhoea pattern	Diarrhoea	
12	M.R.	M	44	8.7	2.3	Normal	Diarrhoea, anxiety state	
13	H.G.	M	26	8.5	4.0	Normal	Recurrent diarrhoea	
14	H.T.	M	59	7.1	—	Normal	Haematemesis	
15	E.D.	F	62	6.5	2.7	—	Cholelithiasis	
16	B.B.	M	59	6.3	—	Deformed duodenal cap, small duodenal ulcer	Haematemesis	
17	S.B.	M	56	7.8	—	Normal	Abdominal pain due to musculo-skeletal causes	
Idiopathic Steatorrhoea								
1	M.W.	F	65	5.0	24.4	Deficiency pattern	Subtotal villous atrophy	
2	M.F.	M	48	5.7	9.3	Deficiency pattern	Subtotal villous atrophy	
3	M.W.	F	59	1.1	25.8	Deficiency pattern	Complete villous atrophy	
4	G.H.	M	67	1.3	21.5	Deficiency pattern	Subtotal villous atrophy	
5	C.F.	M	55	3.6	11.7	Deficiency pattern	Partial villous atrophy	
6	M.J.	F	58	0.6	33.2	Deficiency pattern	Subtotal villous atrophy	
7	J.J.	M	65	2.4	17.2	Deficiency pattern	Subtotal villous atrophy	
8	E.A.	F	75	0.9	20.7	Deficiency pattern	Subtotal villous atrophy	
9	G.W.	M	61	3.2	13.0	Deficiency pattern	Subtotal villous atrophy	
10	F.D.	M	62	4.0	15.5	Dilatation and fluid levels	Partial villous atrophy	
11	G.M.	F	35	3.4	15.3	Normal	Subtotal villous atrophy	
12	R.D.	M	47	2.9	9.8	Deficiency pattern	Subtotal villous atrophy	
13	G.N.	F	45	2.6	12.8	Deficiency pattern	Subtotal villous atrophy	
14	W.S.	M	45	2.9	11.6	Normal	Subtotal villous atrophy	
15	M.C.	F	29	1.4	19.0	Deficiency pattern	Subtotal villous atrophy	
16	A.C.	M	61	0.8	7.4	Deficiency pattern	Subtotal villous atrophy	
Enteritis Jejunitis								
1	E.P.	M	50	4.6	27.0	Strictures of duodenum and jejunum	Laparotomy biopsy of jejunum showed subtotal villous atrophy	Diagnosis confirmed at operation
2	G.W.	M	60	3.1	13.0	Small intestinal obstruction	Partial villous atrophy	Diagnosis confirmed at operation
3	M.H.	M	38	3.0	25.3	Small intestinal obstruction	Normal	Diagnosis confirmed at operation
4	I.L.	F	29	5.2	3.5	Crohn's disease of jejunum	Normal	Diagnosis confirmed at operation
Ileitis								
1	D.G.	F	53	6.5	10.8	Crohn's disease of ileum	—	No laparotomy
2	L.P.	M	25	6.8	6.5	Terminal ileitis	Normal	Diagnosis confirmed at operation
3	G.T.	F	38	5.9	2.3	Terminal ileitis	Normal—partial villous atrophy	Diagnosis confirmed at operation
4	A.J.	F	29	6.9	3.1	Terminal ileitis	Normal	Diagnosis confirmed at operation
5	P.D.	M	56	3.4	4.6	Normal	Normal	Diagnosis confirmed at operation
6	R.V.	F	42	7.6	3.5	Dilatation of ileal loops	Normal	Diagnosis confirmed at operation
7	V.C.	F	26	6.4	4.6	Narrowing of terminal ileum	—	Diagnosis confirmed at operation
Post-gastrectomy Steatorrhoea								
1	L.H.	F	67	5.7	11.7	Normal	Normal	Partial gastrectomy
2	E.W.	M	55	6.2	9.9	Normal	Normal	Total gastrectomy
3	G.M.	M	24	5.7	5.3	Normal	—	Partial gastrectomy
4	N.G.	M	61	7.3	32.0	Normal	Normal	Partial gastrectomy
5	A.R.	M	0	6.4	13.2	Delayed emptying of stomach	—	Partial gastrectomy

Steatorrhoea was confirmed in all cases. The barium meal and follow-through in all cases showed a normal jejunum. In three of the five patients subjected to peroral biopsy a normal mucosa was found. The average age in this group was 51.4 years.

RESULTS

The average urinary xylose excretion in the 17 control subjects was 6.94 g. in five hours (Table II). For

the 10 cases under the age of 50 the average was 7.20 g. and for those over 50 it was 6.56 g. Only one patient (aged 44) excreted less than 5 g. in five hours. In the idiopathic steatorrhoea group (16 patients) the xylose excretion ranged from 0.6 to 5.7 g., with an average of 2.61 g. Only one patient excreted above 5 g. of xylose. The average xylose excretion for the entire group with Crohn's disease (11 patients) was 5.40 g. These results were then graded according to jejunal and ileal involvement. In the four patients

TABLE II
AVERAGE URINARY XYLOSE EXCRETION

Group	No. of Patients	Average Age (yr.)	D (+) Xylose Urinary Mean (g./5 hours)	Range
Controls	17	44.4	6.94	4.7-8.9 Standard deviation 1.18
Under 50	10	33.9	7.20	4.7-8.9
Over 50	7	59.4	6.56	5.1-7.8
Idiopathic steatorrhoea	16	54.8	2.61	0.6-5.7 Standard deviation 1.49
Enteritis	11	40.5	5.40	3.0-7.6
Jejunitis	4	44.3	3.98	3.0-5.2
Ileitis	7	38.4	6.21	3.4-7.6
Post-gastrectomy steatorrhoea	5	51.4	6.26	5.7-7.3
Repeat investigation on idiopathic steatorrhoea after gluten-free diet	9	53.1	4.60	1.0-7.2

TABLE III
URINARY XYLOSE AND FAECAL FAT EXCRETION AND BIOPSY RESULTS AFTER TREATMENT

Case No.	Period of Study in Months	Therapy	Urinary Xylose Excretion (g./5 hours)	Faecal Fat Excretion (g./24 hours)	Result of Small Intestinal Biopsy
1 M.W.	Initial	—	5.0	24.4	Subtotal villous atrophy
	1	Gluten-free diet	6.7	7.6	—
	8	Gluten-free diet	7.2	4.7	Partial villous atrophy
2 C.F.	Initial	—	3.6	11.7	Partial villous atrophy
	1	Gluten-free diet	6.9	3.6	Partial villous atrophy
3 J.J.	Initial	—	2.4	17.2	Subtotal villous atrophy
	1	Gluten-free diet	1.6	—	Subtotal villous atrophy
	5	Gluten-free diet	3.2	15.5	—
	8	Gluten-free diet	1.9	5.8	—
4 E.A.	Initial	—	0.9	20.7	Subtotal villous atrophy
	1	Gluten-free diet	1.1	19.0	—
	8	Gluten-free diet	1.0	22.7	Subtotal villous atrophy
5 F.D.	Initial	—	4.0	15.5	Partial villous atrophy
	6	Gluten-free diet	4.2	7.7	—
6 G.M.	Initial	—	3.4	15.3	Subtotal villous atrophy
	9	Gluten-free diet	5.3	3.1	Subtotal villous atrophy
7 R.D.	Initial	—	2.9	9.8	Subtotal villous atrophy
	10	Gluten-free diet	4.7	8.1	—
8 W.S.	Initial	—	2.9	11.6	Subtotal villous atrophy
	4	Gluten-free diet	6.6	1.9	Subtotal villous atrophy
9 M.C.	Initial	—	1.4	19.0	Subtotal villous atrophy
	6	Gluten-free diet	3.6	7.7	Subtotal villous atrophy

with jejunal disease the average xylose excretion was 3.98 g. whereas in the seven patients with ileal disease it was 6.21 g. In all five patients with post-gastrectomy steatorrhoea the xylose excretion was normal and the average was 6.26 g.

In nine of the 16 patients with idiopathic steatorrhoea repeat investigations were carried out from one to 10 months after they started on a gluten-free diet, and faecal fat estimations as well as peroral small intestinal biopsy were carried out at the same time wherever possible (Table III). Their average xylose excretion was 2.61 g. before treatment and was raised to 4.60 g. after the gluten-free diet. In four patients the repeat xylose estimations rose to normal limits. In five patients (J.J., F.D., E.A., R.D., and M.C.) the urinary xylose excretion remained below 5 g. Three of these five patients (F.D., R.D., and M.C.) responded well clinically to the gluten-free diet but only two showed a definite though subnormal improvement in xylose excretion. Repeat faecal fat estimations in these three patients likewise showed improvement in the steatorrhoea although again normal values were not obtained. Only one of these three patients (M.C.) was subjected to repeat biopsy and no improvement was evident histologically. Of the two patients not responding to the gluten-free diet (J.J. and E.A.) one showed a reduction in stool fat to near normal level but the other showed no reduction. Repeat biopsies in both patients showed no improvement.

The four patients with idiopathic steatorrhoea in whom normal xylose values were obtained after treatment showed a good clinical response to the gluten-free diet, and faecal fat estimations declined to within normal limits. All four patients were subjected to repeat biopsy. In one patient there was a definite histological improvement and the mucosal appearance was one of partial villous atrophy where previously a subtotal villous atrophy was present. The other three patients showed no histopathological change from the original biopsy.

DISCUSSION

The urinary xylose excretion values in the control group agree well with those of other authors (Brien *et al.*, 1952; Fourman, 1948; Christiansen *et al.*, 1959; Shamma'a and Ghazanfar, 1960). They are said to decline with advancing age (Fowler and Cooke, 1960; Finlay and Wightman, 1958). In our control subjects there was also a slight decrease noted in those over 50 but in no case was the level below 5 g. Moreover, the average value in the older control group was still nearly two and a half times greater than in patients in the idiopathic steatorrhoea group whose average age was over 50.

Other authors (Christiansen *et al.*, 1959; Roberts, Beck, Kallos, and Kahn, 1960) have shown that improvement in xylose absorption and excretion occurred in patients with idiopathic steatorrhoea on a gluten-free diet. Our nine patients in whom repeat tests were carried out showed a rise from an average of 2.61 to 4.60 g. in the five-hour urinary xylose excretion. However, on close analysis it became evident that not all patients showed such improvement. We usually, but not invariably, found an increase in xylose excretion in patients in whom a good clinical response was obtained with a gluten-free diet. This usually paralleled an improvement in fat absorption but showed no correlation with biopsy appearances which, with the exception of one case, remained unchanged.

In the group of patients with regional enteritis intermediate values for xylose excretion between the normal and idiopathic steatorrhoea have been reported by some authors (Christiansen *et al.*, 1959). Others (Fowler and Cooke, 1960) have found normal xylose excretion in this group. Our results seem to indicate a decrease in xylose excretion values with the jejunal type and a normal excretion with the ileal type of regional enteritis. Along with a decrease in xylose excretion can usually be demonstrated a malabsorption of fat and of folic acid in the jejunal type of disease (Shiner and Drury, 1962). In those with ileal involvement (seven patients) only one showed an excess of faecal fat in spite of a normal xylose excretion. Conversely, the only patient to show a subnormal xylose excretion had normal faecal fat values.

That steatorrhoea *per se* can occur independently of malabsorption of sugars can best be demonstrated in our group of five patients with steatorrhoea after gastrectomy, all of whom showed normal xylose excretion levels, and, incidentally, normal peroral mucosal biopsies. Our results in this group of patients correlate well with those of other authors (Fowler and Cooke, 1960).

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