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Abstract

An intestinal absorption test with the use of D-xylose has been performed on 19 patients including 3 of acute hepatitis, 7 of chronic hepatitis and 9 of liver cirrhosis, and the following results were obtained. 1) The 5 hr urinary excretion and 2 hr blood level of D-xylose tend to increase in patients of acute and chronic hepatitis with severer disorder of liver functions. 2) The standard deviations of the 5 hr urinary excretion and 2 hr blood level of D-xylose are larger in liver cirrhosis than in the other liver diseases. Those cases having severe disorder of liver functions are found to be diminished in 5 hr urinary excretion and 2 hr blood level of D-xylose. 3) A decrease in the absorption of D-xylose from the small intestine of liver cirrhosis might be caused by the diminished surface area of villi of the small intestine.

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INTESTINAL ABSORPTION TEST WITH THE USE OF D-XYLOSE II. ITS APPLICATION ON PATIENTS WITH VARIOUS LIVER DISEASES

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The most fundamental treatment of parenchymatous liver diseases is dietary management which can be properly provided by various intestinal absorption studies. There have been many reports on intestinal absorption of protein and fat in various states of liver diseases, but few reports about the intestinal absorption of carbohydrates. [1-5]

It was described by the author in an earlier communication that the results of D-xylose test performed on normal subjects had been considered to be clinically available as an intestinal absorption test for carbohydrate because of its constant metabolic rate *in vivo* together with its technical simplicity. Its absorption was said to be influenced to some extent by various metabolic processes[6-9], however, it was again found to be negligible in clinical chemistry.

This report is concerned with clinical observations made on the use of this test in patients with acute and chronic hepatitis and liver cirrhosis.

MATERIALS AND METHODS

Three patients of acute hepatitis, seven of chronic hepatitis and nine of liver cirrhosis were examined in this study. They were diagnosed on the basis of history, physical findings, liver function profile, and liver biopsy under the direct vision with peritoneoscopy. All cases of liver cirrhosis were at the stage of compensation. Patients with impaired renal functions were excluded from the materials in this study because of the influence of renal function on its urinary excretion. [10]

The test was carried out according to the method described by BRIEN. [11] Foods and fluids were withheld for at least 12 hours from the subjects, and immediately after sampling urine and the oxalated venous blood, 25 g of D-xylose dissolved in 500 ml of distilled water were given orally. After the admininstration the urine samples were collected at hourly intervals for five hours, and the oxalated venous blood sample was taken once after 2 hours. The patients were kept

at rest and fasting during the test.

The pentose contents in oxalated venous blood samples (1: 10 Somogyi filtrates[12]) and in the urine (diluted 1: 100 or 1: 200 with distilled water) were determined by the colorimetric method of ROE and RICE.[13]

RESULTS

Values for the 5 hr urinary excretion and the 2 hr blood level of xylose in normal subjects which were reported in the earlier communication, and those in acute and chronic hepatitis and liver cirrhosis are summarized in Table 1. As seen in Fig. 1 showing comparative distribution of values in each group, increase in both urinary excretion and blood level occurred in all 3 acute hepatitis, 3 of 7 chronic hepatitis and 4 of 9 liver cirrhosis. On the other hand, reduction in both values were observed in 2 cases with liver cirrhosis. Accordingly, the values in liver cirrhosis were widely distributed with a large standard deviation, and this trend was more predominant with values of the urinary excretion than those of the blood level.

Values of the 5 hr urinary excretion were compared with the results of various liver function tests including BSP, SGOT, serum colloidal reactions and serum bilirubin.

Cases of acute and chronic hepatitis having abnormally high values of the 5 hr urinary excretion tended to show the results predominant with BSP reten-

Table 1 Results of D-xylose absorption tests in normal subjects, acute and chronic hepatitis and liver cirrhosis

1) 5 hr urinary excretion

	no. patients	range	mean	S. D.	S. E.
normal	12	4.7—10.5	8.07	0.36	0.11
acute hepatitis	3	10.3—12.5	11.20	1.15	0.67
chronic hepatitis	7	8.1—12.4	9.46	1.66	0.63
liver cirrhosis	9	5.4—10.9	8.70	2.03	0.68

2) 2 hr blood level

	no. patients	range	mean	S. D.	S. E.
normal	11	24.8—57.6	47.7	9.8	3.0
acute hepatitis	3	44.4—64.8	56.3	10.6	6.0
chronic hepatitis	6	42.1—59.3	52.8	8.9	3.6
liver cirrhosis	8	39.1—67.2	48.1	9.1	3.3

(S. D.: standard deviation, S. E.: standard error of mean)

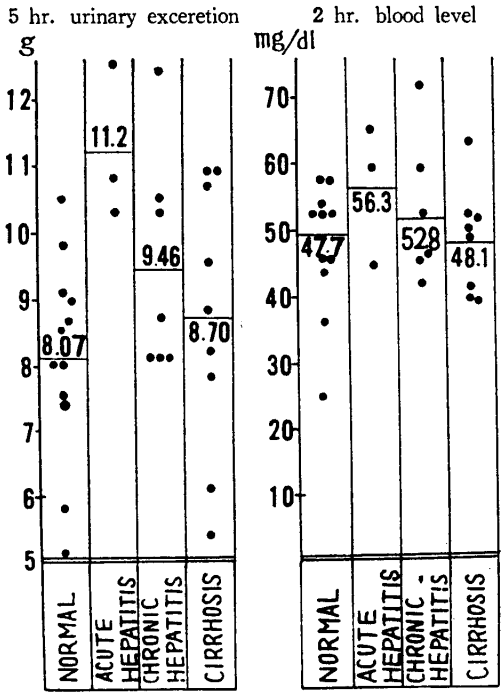
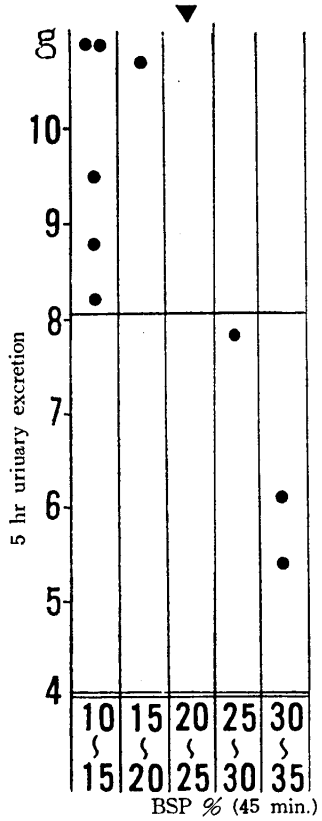


Fig. 1 Comparative distribution of values for the 5 hr urinary excretion and 2 hr blood level of xylose



← Fig. 2 Relation between values of 5 hr urinary excretion and BSP retention in liver cirrhosis

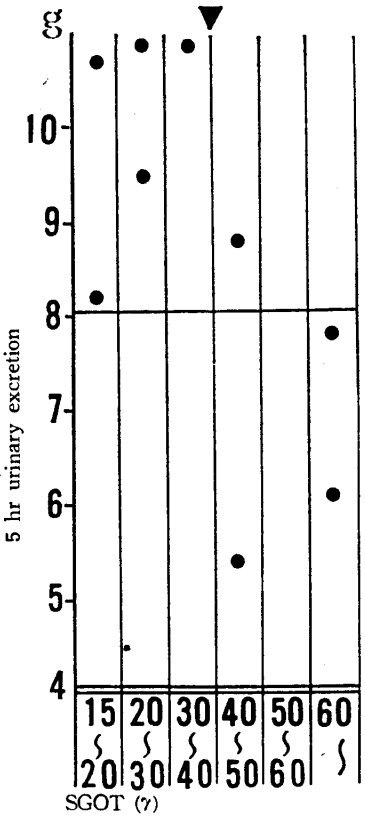


Fig. 3 Relation→ between values of 5 hr urinary excretion and SGOT activities in liver cirrhosis

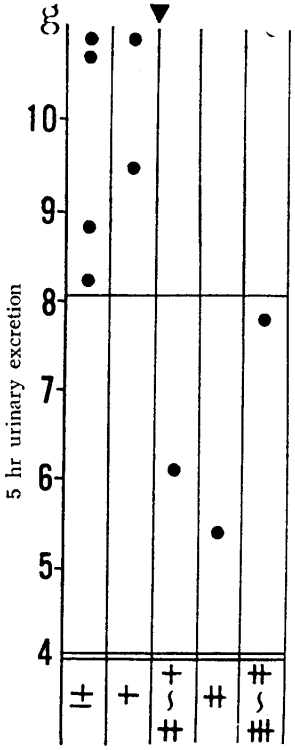


Fig. 4 Relation between values of 5 hr urinary excretion and results of serum colloidal reactions in liver cirrhosis

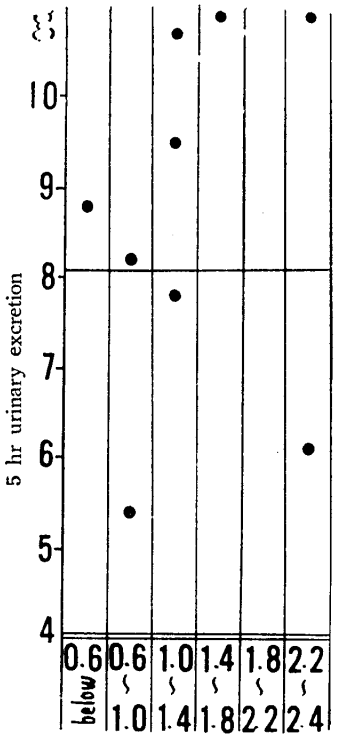


Fig. 5 Relation between values of 5 hr urinary excretion and total serum bilirubin leveles in liver cirrhosis

tion, increased SGOT activities and positive colloidal reactions. Other cases in these disease, however, showed apparently no correlation between values of the urinary excretion and those of various liver function tests.

Values of the urinary excretion in cases of liver cirrhosis could be divided into two groups; one showing increase and the other decrease as compared with the mean in normal subjects. These values were compared with the results of various liver function tests.

Relation between the 5 hr urinary excretion and BSP test is shown in Fig. 2. Cases having diminished values of the urinary excretion tended to show a greater impairement of BSP retention.

Relation between the 5 hr urinary excretion and SGOT is shown in Fig. 3. Cases having diminished values of the urinary excretion also tended to show increased SGOT activities, but this relationship was apparently not so close as

that between urinary excretion and BSP test.

The abnormal colloidal reactions of serum were shown to correlate most closely with diminished values of the urinary excretion as seen in Fig. 4. There was no correlation between values of the 5 hr urinary excretion and total serum bilirubin level as indicated in Fig. 5.

DISCUSSION

CHRISTIANSEN[8] has described the cases of liver diseases with jaundice having an increase in the 5 hr urinary excretion of D-xylose, however, he also mentions the cases of uncomplicated chronic hepatitis without an increase in the 5 hr urinary excretion. In the author's study all cases with acute hepatitis showed increased values in the 5 hr urinary excretion beyond the upper limit of the values in normal subjects. In addition, all subjects with chronic hepatitis also showed an increase in the values of the 5 hr urinary excretion distributing beyond the mean value of normal subjects, but the mean in chronic hepatitis was lower than that in acute hepatitis. It was found in these cases that cases having increased values in the urinary excretion showed severe liver function damages, though there was no correlation between the urinary excretion and serum bilirubin levels.

WYNGAARDEN *et al*[6,-8] and HIATT[9] have demonstrated that D-xylose, at least a part of it, joins the pentose phosphate pathway via D-xylulose-5-P and it is further catabolized to CO_2[7,8], or, on the other way, is synthesized to glycogen.[9] As described by the author in the earlier communication, when 25 g of D-xylose were administered intravenously, the urinary excretion rate of D-xylose within five hours was 41 per cent. BUTTERWORTH[4] had also reported its rate to be 42 per cent by the same condition as author's, and he further collected urine throughout 24 hours, and found that the urinary recovery of xylose was approximately 44 per cent indicating only slight increase compared with the amount excreted within five hours. WYNGAARDEN has also reported the rate of the urinary excretion to be 43 per cent within 24 hours when 10 to 20 g of D-xylose are administered intravenously. From these reports, it is reasonably to presume that the rate, at which D-xylose is metabolized in the body and can not be recovered in urine, is about 60 per cent of the given dose when 10 to 25 g of D-xylose are administered intravenously. It is possibly to consider that blocking in some parts of the metabolic pathways of the given D-xylose in cases with liver function disorders causes an increase in its urinary excretion and blood level.

BUTTERWORTH[4], SHAMMA'A[2], FINLAY[5] and BARANOA[1] have shown diminished urinary excretion in patients with cirrhosis of the liver. SHAMA'A reports of a broad distribution having a large standard deviation of the 5 hr urinary ex-

cretion in liver cirrhosis. Of the results obtained by the author, also the diminished urinary excretion and blood levels were found in cases of liver cirrhosis having severer hepatic function damages, while the means of the both values in these cases were higher than that in normal subjects. On the other hand, WYNGAARDEN has demonstrated that the 24 hr urinary recovery of the D-xylose is approximately 45 to 47 per cent in liver cirrhosis when 10 to 20g of D-xylose are administered intravenously whereas in normal subjects the recovery is 43 per cent. BARANOA *et al.* have also reported that when 25 g D-xylose are injected intravenously in patients with liver cirrhosis in whom the diminished 5 hr urinary excretion is obtained, the 5 hr urinary excretion rather increases, involving a case with the highly increased urinary excretion reaching the amount of 17 g.

It is concluded from these results, that in the patients with liver cirrhosis having severer disordered liver functions the D-xylose absorption from the intestine is rather diminished.

SHAMMA'A has found in his study with the D-xylose absorption test performed on liver cirrhosis a correlation between its urinary excretion rates and serum albumin levels. From these results he suggests that edema in the small intestine may cause diminished absorptin rates of D-xylose. BROITMAN[14] has demonstrated that the urinary excretion rate is not influenced by hypalbuminemia. Likewise, in the results of the author's study there is no correlation between the serum albumin and the 5 hr urinary excretion. KIHARA[15] has investigated histometrically the mucous membrane of middle portion of the duodenum which is obtained by suction biopsy, and demonstrated that surface area of the villi decreasesd in subjects with liver cirrhosis as compared with that of normal subjects and patients with acute and chronic hepatitis.

It is thought that D-xylose is not absorbed against a concentration gradient but absorbed by passive diffusion[16], although it is phosphorylated in the intestinal mucosa during its absorption.[17–19] It is considered, therefore, that a decrease in surface area of the villi may cause a diminished absorption of D-xylose.

CONCLUSIONS

An intestinal absorption test with the use of D-xylose has been performed on 19 patients including 3 of acute hepatitis, 7 of chronic hepatitis and 9 of liver cirrhosis, and the following results were obtained.

1) The 5 hr urinary excretion and 2 hr blood level of D-xylose tend to increase in patients of acute and chronic hepatitis with severer disorder of liver functions.

2) The standard deviations of the 5 hr urinary excretion and 2 hr blood

level of D-xylose are larger in liver cirrhosis than in the other liver diseases. Those cases having severe disorder of liver functions are found to be diminished in 5 hr urinary excretion and 2 hr blood level of D-xylose.

3) A decrease in the absorption of D-xylose from the small intestine of liver cirrhosis might be caused by the diminished surface area of villi of the small intestine.

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