THE EFFECT OF VITAMIN C ON THE ABSORPTION OF GLYCINE AND CHLORIDES BY THE INTESTINE

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Vitamins play a direct part in the absorption of foodstuffs by the gastrointestinal tract. Much work has been devoted to the study of the role of vitamins in the regulation of absorption but the problem still remains inadequately solved.

Mottram, Cramer, Drew [5] noted stimulation of glucose and peptone absorption under the influence of the vitamin B complex. Analogous data have been obtained by Verzar [9] and S. R. Perepelkin [3].

Schraeder [7] has observed stimulation of glucose absorption under the influence of vitamin C.

E. I. Kleitman (1938) found that experimentally produced vitamin C deficiency did not affect fat absorption but if the diet were made deficient in vitamins B, A and D there was an adverse effect on absorption of fats and glucose.

Vogel [10] notes that vitamin B, if given in extremely large doses, accelerates glucose absorption.

We have shown in previous long-term investigations [1] on dogs, the conditions necessary for absorption of vitamin C and its effect on the absorption of glucose in the small and large intestine and in the lesser sac of the greater curvature. Part of the data concerning the influence of the vitamin on absorption of glucose in the small intestine was obtained from clinical observations on patients in hospital.

Since the question of the influence of vitamin C on the absorption of glycine and chlorides has not been sufficiently elucidated we undertook to study the role played by vitamin C in the regulation of glycine absorption in the small intestine and of chloride absorption in the colon.

EXPERIMENTAL METHOD

The present communication deals with experimental data obtained in experiments on 3 dogs – Dzhek, Tuz and Geroi – with chronic fistulae of the small and large intestine. Experiments were performed 12-14 hours after feeding. The solution being investigated (8 ml) was introduced into the isolated intestinal loop; after 5 minutes it was allowed to run into a measuring cylinder and the intestinal loop was immediately washed out. The washings were also carefully collected and measured. The amount of the test substance absorbed was determined by the amount of it found in the collected part of the solution and the washings. In experiments on the small intestine 0.75% solution of glycine and 0.05% solution of ascorbic acid were used; in experiments on the large intestine the solutions used were 0.85% sodium chloride and 0.05% ascorbic acid. The dissolved vitamin was added to the solution of the test substance so as to obtain definite ratios by volume such as 4 : 1, 3 : 2, 2 : 2 or 4 parts glycine solution to one part vitamin solution etc. If vitamin C was added in the solid state the ratio of glycine to vitamin was maintained. In control experiments water was added instead of the vitamin in the same proportions by volume. The glycine content of the fluids examined was determined by

formol titration. Chlorides were estimated by potentiometric titration, vitamin C by a simplified version of the Lavrov method.

EXPERIMENTAL RESULTS

Experimental data showed that in the case of the dog Dzhek (Table 1) 0.05% solution of ascorbic acid was absorbed to an average extent of 42% during the 5 minutes that it was present in the intestinal loop; absorption of glycine during the same period of time amounted to 40%.

When vitamin C was added to a solution of glycine in various proportions it was found that the optimal ratio for glycine absorption was 2 : 2 when the absorption of glycine increased by 28% as compared with the control. Addition of vitamin C to a solution of glycine in the ratio of 3 : 2 also increased glycine absorption in the intestine (by 24%). When the ratio was 4 parts of glycine to 1 part of the vitamin no improvement in glycine absorption was noted.

TABLE 1

Influence of Vitamin C on Absorption of Glycine in the Small Intestine in Dogs (Average Values in Percentages)

Dog	Time (in minutes)	Absorption of 0.75% glycine solution	Absorption of 0.75% vitamin C solution	Glycine + vitamin C		
				4 : 1	3 : 2	2 : 2
Dzhek	5	40	42	41	64	68
Tuz	5	56	54	65	82	60

Experiments on the dog Tuz (Table 1) showed that glycine was absorbed from 0.75% solution to the extent of 56% during 5 minutes and vitamin C from 0.05% solution to the extent of 54%. Addition of vitamin C to the glycine solution enhanced the absorption of the latter both when the ratio was 3 : 2 and when the value differed, but the effect was more marked in the former case.

As already mentioned, the vitamin was added to the glycine solution in the form of a solution in some experiments and in the solid state in others when it was calculated to give the same ratios of glycine to vitamin. In both cases the results were similar, i.e., absorption of glycine was increased to the greatest extent when the ratio of glycine solution to vitamin was 3 : 2 in the case of Tuz and 2 : 2 in the case of Dzhek.

In order to confirm that glycine absorption was improved by vitamin C and not simply by dilution of the glycine solution with water, control experiments were staged in which water in the same proportions was added instead of the vitamin (Table 2).

It follows from Table 2 that when the vitamin was replaced by water in the same proportions the absorption of glycine not only did not improve but in some cases showed a decrease.

The next section of the work was devoted to the study of the influence of vitamin C on the absorption of chlorides in the colon.

In work dealing with the absorption of chlorides much attention is usually paid to various factors affecting this process. Blickenstaff and others [4] note that chloride absorption is affected by the pressure within the intestinal lumen. References to the dependence of the rate of chloride absorption on the concentration of the solution being absorbed are encountered in the work of Verzar [10], Starling [9], Wells [12], Rabinovich [6]. According to L. P. Pankova [2] the absorption of chlorides is influenced by the presence in the intestinal lumen of intestinal juice, pancreatic juice and bile.

These references to data available in the literature indicate that no direct investigations have been made into the influence of vitamin C on the absorption of chlorides.

TABLE 2

Absorption on Addition of Vitamin C Solution and of Water (Average Data in Percentages)

Dog	Absorption of 0.75% glycine solution	Volume ratio of 0.75% glycine solution to vitamin solution and to water					
		glycine + vitamin C	glycine + water	glycine + vitamin C	glycine + water	glycine + vitamin C	glycine + water
Dzhek	40	–	–	64	47	68	49
Tuz	56	–	–	82	50	60	37

Data in Table 3 show that sodium chloride in 0.85% solution was absorbed to the extent of 13% during the 5 minutes that it was in the isolated intestinal loop and ascorbic acid in 0.05% solution was absorbed to the extent of 17.8% during the same period of time.

Addition of ascorbic acid in the solid state to the sodium chloride solution in the ratio of 4:1 decreased the absorption by half.

TABLE 3

Influence of Vitamin C on Absorption of 0.85% Sodium Chloride Solution in the Colon in the Dog Geroi During a Period of 5 Minutes (Vitamin C Added in the Solid State)

Solution	Absorption (average values in percentages)
0.85% sodium chloride solution	13.0
0.05% ascorbic acid solution	17.8
4: 1 solution of sodium chloride + ascorbic acid	6.5
3: 2 sodium chloride solution	23.0
2: 2 ascorbic acid	27.0

Increasing the concentration of the vitamin led to increased absorption of chlorides in the colon. For example, with a ratio of sodium chloride and solid vitamin C 3 : 2 the absorption increased to 23%. When solid vitamin C was replaced by its solutions with preservation of the proportion of sodium chloride to the vitamin, a similar picture of absorption was observed: chloride absorption was enhanced to the greatest extent when the ratio was 3 parts sodium chloride to 2 parts vitamin C (48% as against 13% in the control).

Vitamin C in certain doses thus enhances the absorption of glycine in the small intestine and of sodium chloride in the colon.

SUMMARY

The effect of ascorbic acid on the regulation of absorption of glycine was studied in experiments on 3 dogs with chronic fistulae of the intestine and colon. It was established that ascorbic acid, administered in definite doses, improved absorption of glycine in the intestine and of sodium chloride in the colon. 3: 2 and 2 : 2 are the optimal ratios of glycine and sodium chloride to the vitamin. In the presence of the above ratio absorption of glycine in the intestines increases by 24-28%, while absorption of chlorides in the colon increases by 18%.

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