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Abstract

Non-hemin iron content in gastric juice was examined in 46 patients with various blood diseases, especially idiopathic hypochromic anemia and in 26 healthy controls. 1. The iron content in gastric juice was found to be 290 $\mu\text{g}/\text{dl}$ in healthy controls, a lower value of 110 $\mu\text{g}/\text{dl}$ in idiopathic hypochromic anemia and a higher value of 550 $\mu\text{g}/\text{dl}$ in aplastic anemia. These values were in a close correlation with serum iron or sideroblasts. 2. In idiopathic hypochromic anemia there was also a close correlation between the iron content in gastric juice and hemoglobin. In the course of treating idiopathic hypochromic anemia (stage of recovery of anemia) the iron content in gastric juice showed a marked increase over the value in healthy controls as well as a transient increase after an intravenous iron tolerance test. This condition may be interpreted as an "iron-losing anemia". Iron excretion of gastric mucosa in various blood diseases and its changes in the course of treating idiopathic hypochromic anemia in relation to the cause of this anemia were discussed.

THE IRON CONTENT OF GASTRIC JUICE : IN RELATION TO THE CAUSE OF IDIOPATHIC HYPOCHROMIC ANEMIA

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During the last three decade extensive studies on the iron metabolism have been made by various authors revealing that the iron is mainly absorbed through the duodenal mucosa. And in 1963 CROSBY and associates¹ reported that the intestinal mucosa is also responsible for the excretion of iron.

Keeping this in mind the authors² observed the iron contents of the duodenal mucosa of biopsy specimens obtained from the anemic patients, and it has been demonstrated that there is a close relation between the contents of non-hemin iron of the duodenal mucosa and the general iron metabolism, i. e. the iron contents of the mucosa reflected well the serum iron level. Histochemical observation of the mucosa suggested that besides the iron in epithelium the iron in the lamina propria, probably being carried by histiocytic cells, will be somehow correlated to the iron absorption or excretion of the duodenum. The iron contents of the mucosa increased after the intravenous administration of iron and the iron is mainly deposited in the lamina propria as revealed by histochemical observations. This suggests that the increased iron in the mucosa after the parenteral administration is correlated to the excretion of iron as well as the storage of iron to some extent.

For the purpose of settling the problem whether or not the gastroduodenal mucosa is actually involved in the iron excretion the authors observed the iron contents of gastric juice before and after parenteral administration of iron.

In this paper it is reported that the iron contents of gastric juice of anemic patients of iron deficiency are generally lower than that of non-anemic individuals, but after the treatment of intravenous or oral iron administration, a fairly large amount of iron is excreted from the gastric mucosa of the anemic patients, continuing even in the period where hemoglobin level has recovered to the normal. The data suggested a possibility of an excess iron excretion being responsible for the development of the idiopathic iron deficiency anemia.

The abstract of the present paper was presented at the General Meeting of the Japan Hematological Society in 1966.

MATERIALS AND METHODS

The subjects of the study were consisted of 26 healthy controls and 46 patients with various blood diseases (22 of idiopathic hypochromic anemia, 15 aplastic anemia and 9 of leukemia), totaling 72 cases.

Gastric juice was taken on early morning, and the fluid contaminated with bile or food was not used. Exfoliated cells in the fluid were removed by centrifugation. Non-hemin iron content of gastric juice was measured by Brückmann-Zondek's method³. Barkan's method⁴ was used for serum iron and Kaplan's method⁵ for sideroblasts, the iron containing erythroblasts in the bone marrow.

Forty mg of iron as saccharated ferric oxide were employed for the intravenous iron tolerance test.

RESULTS

Iron content of gastric juice in various blood diseases (Figs. 1, 2):

In healthy controls non-hemin iron content of gastric juice was considerably variable with an average of 290 $\mu\text{g}/\text{dl}$. Idiopathic hypochromic anemia showed a decrease in non-hemin iron content of gastric juice with an average value of 110 $\mu\text{g}/\text{dl}$. The value was higher in cases of aplastic anemia than in healthy controls, showing the value of 550 $\mu\text{g}/\text{dl}$. The majority of leukemia cases was in the range of healthy controls.

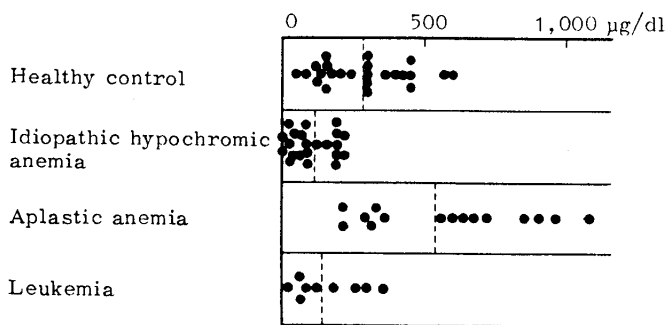


Fig. 1 Iron content in gastric juice

The contents of non-hemin iron of gastric juice were in a comparatively close correlation with those of serum iron in the same individual as in intestinal mucosa. The percentage of sideroblasts showed a close correlation with the iron content of gastric juice, suggesting a parallel linkage between the iron metabolism in the bone marrow and iron excretion of gastric mucosa. The iron content of gastric juice also showed a close correlation with hemoglobin content in cases of idiopathic hypochromic anemia, and an inverse correlation in aplastic anemia,

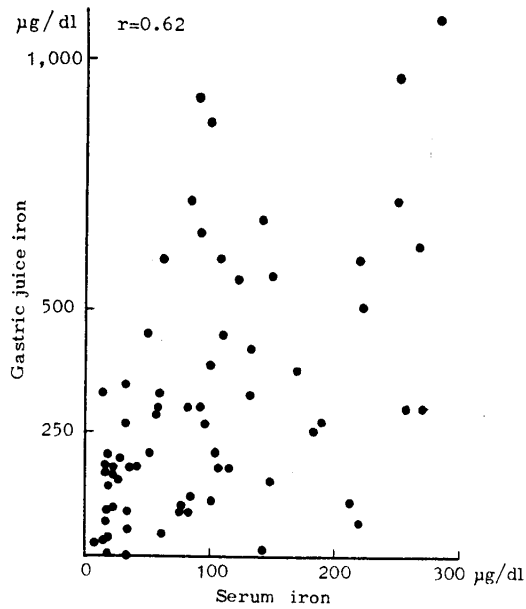


Fig. 2 Relationship between gastric juice iron and serum iron

although variable in healthy controls. In addition, there could be observed no relationship between the iron content and the acidity of gastric juice.

Iron content of gastric juice in the therapeutic course of idiopathic hypochromic anemia (Figs. 3, 4, 5): The iron content of gastric juice in cases

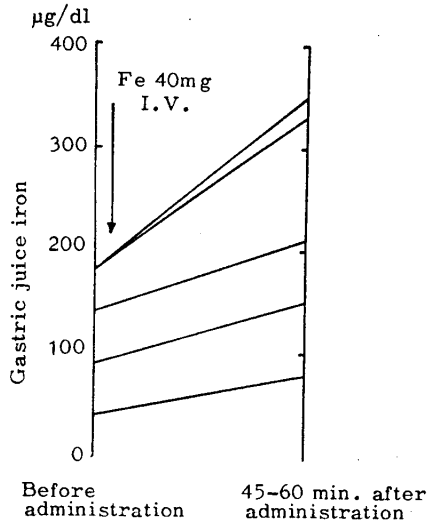


Fig. 3 Change of gastric juice iron after intravenous iron tolerance test in idiopathic hypochromic anemia

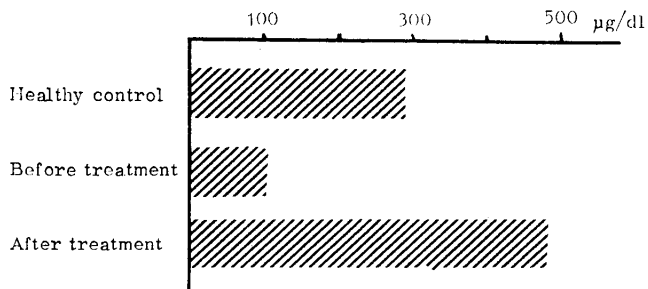


Fig. 4 Change of gastric juice iron by iron therapy in idiopathic hypochromic anemia

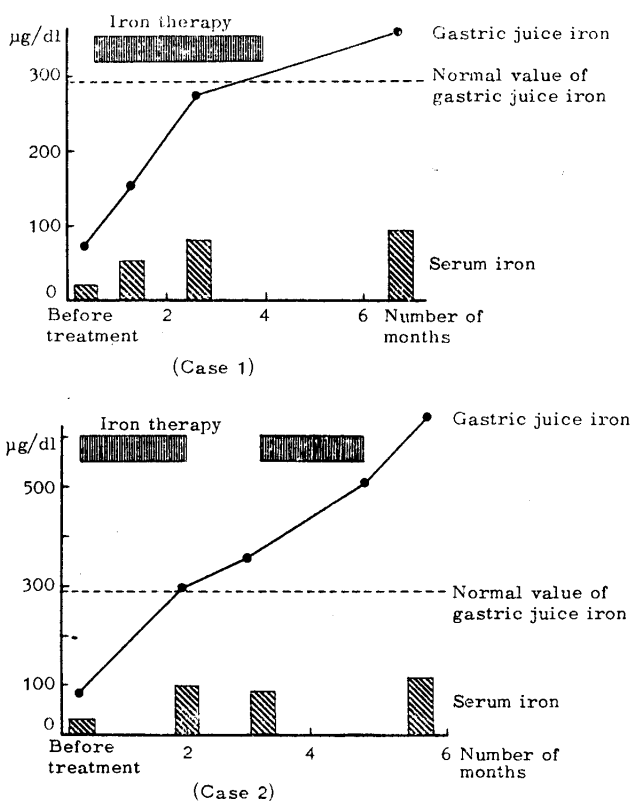


Fig. 5 Change of gastric juice iron during the course of iron therapy in idiopathic hypochromic anemia

of idiopathic hypochromic anemia showed a lower value, 110 $\mu\text{g}/\text{dl}$, on the average than healthy controls, but on the other hand, a correlation between the iron content and hemoglobin was seen, and this iron content was relatively high when anemia was mild. Iron content of gastric juice of idiopathic hypochromic

anemia was measured at various time intervals after intravenous injection of iron in early morning hours. Subsequently, iron contents of gastric juice clearly increased by the intravenous iron administration. It is very interesting to note that non-hemin iron of gastric juice at the stage of recovery after iron treatment in idiopathic hypochromic anemia showed a higher value than in the healthy control. Namely, an increase of iron excretion in gastric juice was undoubtedly observed on the recovery of anemia after treatment.

DISCUSSION

It is generally believed that iron in the body is reutilized effectively and only a small physiological loss of iron can be supplemented by the daily absorption, about 1—2 mg Fe per day, and the organism has no specific mechanism to excrete iron. It was demonstrated that the iron excretion exerted no influence on the general iron metabolism since iron contents of urine,^{6,7,8} bile⁹ and sweat¹⁰ were very small. Consequently, main emphasis is now being placed on the absorption or storage of iron in the study of iron metabolism. Also with respect to the iron metabolism in gastrointestinal mucosa iron excretion is neglected, although iron absorption has been intensively studied. Recently CONRAD and CROSBY¹ have reported that the iron content of the intestinal epithelial cell and the iron loss by its desquamation play an important role in the regulatory mechanism of iron absorption. In an effort to solve the mechanism of iron absorption, we placed a special emphasis on the storage iron content of intestinal mucosa, and as it is believed that the storage iron content of intestinal mucosa affects the iron absorption and by the reason just described, our attention was also directed to the iron excretion in gastrointestinal mucosa. It is noteworthy that the amount of iron contained in gastric juice is considerably high in healthy controls, and this gastric juice iron level is in a close correlation with serum iron level, percentage of sideroblasts and intestinal tissue iron. As far as the iron metabolism of idiopathic hypochromic anemia is concerned, exhaustive studies have been made only in its advanced stage but not in the course of its recovery or reappearance, and also no observation has been reported, concerning the changes in the iron contents of gastric juice. Our results, however, indicate that the iron content of gastric juice transiently increases after intravenous iron administration and keeps the elevated level for some period after withdrawal of iron therapy. The data suggest that there is an abundant and continuous iron excretion in idiopathic hypochromic anemia in the condition where iron level is kept within normal and this increased iron excretion in gastrointestinal mucosa may be the cause of idiopathic hypochromic anemia suggesting "iron-losing disease". The use of Fe⁵⁹ is to be recommended to obtain better results in the detection of iron excretion from body in idiopathic hypochromic anemia. BARER⁶

found that the iron content is somewhat increased in urine in some cases of idiopathic hypochromic anemia, and this is very interesting in relation to our study.

CONCLUSION

Non-hemin iron content in gastric juice was examined in 46 patients with various blood diseases, especially idiopathic hypochromic anemia and in 26 healthy controls.

1. The iron content in gastric juice was found to be 290 $\mu\text{g}/\text{dl}$ in healthy controls, a lower value of 110 $\mu\text{g}/\text{dl}$ in idiopathic hypochromic anemia and a higher value of 550 $\mu\text{g}/\text{dl}$ in aplastic anemia. These values were in a close correlation with serum iron or sideroblasts.

2. In idiopathic hypochromic anemia there was also a close correlation between the iron content in gastric juice and hemoglobin. In the course of treating idiopathic hypochromic anemia (stage of recovery of anemia) the iron content in gastric juice showed a marked increase over the value in healthy controls as well as a transient increase after an intravenous iron tolerance test. This condition may be interpreted as an "iron-losing anemia".

Iron excretion of gastric mucosa in various blood diseases and its changes in the course of treating idiopathic hypochromic anemia in relation to the cause of this anemia were discussed.

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