Unusual Type of Hypochromic Anemia Complicating Billroth II Type Gastrectomy

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The most common type of iron deficiency complicating gastrointestinal disease is that associated with chronic blood loss. Occasionally, malabsorptive defect, whether selective for iron or combined with other nutrients, may cause hypoferremic, hypochromic anemia (1). Subtotal or total gastrectomy is also complicated by iron deficiency, which is prevented if medicinal iron is also taken with food. In all these conditions, response to oral or intramuscular iron therapy is good (2, 3).

We have had the opportunity to study a patient who, 13 years after Billroth II subtotal gastrectomy (proximal duodenum acts as a blind loop), had a severe hypoferremic hypochromic anemia which did not respond to oral or intramuscular iron therapy. The major defect seems to be related to defective iron re-utilization, which was corrected after a Henley procedure (4)—jejunal interposition, with restoration of GI continuity through the duodenum.

The purpose of this paper is to report the results of studies in this patient, and the implications of the findings. This case was reported as part of a larger study (5); to our knowledge, no similar case has been reported in the literature.

METHODS

Serum iron was measured by a modification of Peterson's method (6). The normal range is 60–150 μg/100 ml. The blood volume and the red blood cell survival were determined by the ⁵¹Cr tagged red blood cell method (7). The normal half life of the red blood cell is 28–30 days. The plasma ⁵⁹Fe half clearance rate, and the red cell utilization of iron were measured according to the method of Huff (8). The radioiron, as ferrous citrate (⁵⁹Fe) or ferric chloride (⁵⁵Fe), was diluted with saline and injected intravenously. The normal value of the red blood cell utilization of iron is 75% or more. Details of the methods used have been published previously (9).

Iron absorption was measured by orally giving approximately 20 μc ⁵⁹Fe diluted with 1.02 mg inert iron to the patient, who had been fasting. Blood samples were collected on the seventh and fourteenth day, and blood volume was determined on the last day of collection. Iron absorption was expressed as the amount of total radioactive iron which appeared in circulating red cells—ie, the percentage of the total iron radioactivity present in the oral dose. In 10 normal women, the range is between 10.9 and 37.2%, with a mean of 22.9% (3).

Iron re-utilization was measured by intravenously administering ⁵⁵Fe-labeled he-
moglobin solution. The radioactive hemoglobin solution was prepared from the blood of a patient with polycythemia vera, who received a large dose of $^{55}$Fe a few months before as part of a therapeutic radiation course. Blood samples were collected from the patient on the seventh, fourteenth and twenty-first day. The blood samples, including the standard, were digested, electroplated and counted in a liquid scintillation, according to the method of Dern and Hart (10). Iron utilization by red blood cells was expressed as a percent of the administered dose. The normal range is 57-73%. Details of the methods have been published elsewhere (11, 12).

Fat absorption was estimated by measuring 3-day fecal fat excretion after a normal fat diet (approximately 70 g/day) (13); the normal value is less than 5 g fat/day. The d-xylose test was performed according to a modification of the method cited (14). The normal value is more than 5 g. For quantitative bacterial count, material from the afferent loop was obtained through a tube which was placed at the site under fluoroscopic guidance (15). The Schilling test was performed as described previously (16). The normal values range from 6.4 to 25.4%, with a mean of 15.5% in individuals without pernicious anemia or malabsorption.

**CASE REPORT**

RO, a 38-year-old white woman, was admitted to the Thomas Jefferson University Hospital on Feb 9, 1963, with symptoms of refractory anemia of 6 months' duration. She complained of weakness, exertional dyspnea and a retrosternal pain which she felt when climbing stairs. She experienced epigastric fullness, rapid pulse rate, and sweating after meals, which were relieved best by lying down. Although her appetite was voracious, her bowel movements regular and her stools formed, she failed to gain weight.

In 1950, a subtotal gastrectomy and gastrojejunostomy (Billroth II) were performed because of a bleeding duodenal ulcer, and during the ensuing 5 years, she was discovered to be mildly anemic on several occasions. During her third pregnancy, in 1955, she became more anemic, and was treated with weekly intravenous infusions of iron. After her pregnancy, she continued to take iron orally for the next 3 years, and occasionally she was also given parenteral iron therapy. One year prior to the present admission, menorrhagia developed and persisted for 6 months. Anemia became progressively more severe during this period, and she lost weight and developed symptoms of dumping. Treatment with vitamin $B_{12}$, folic acid and iron (oral and intramuscular) failed to correct the anemia.

Physical examination revealed a pale Caucasian woman with normal vital signs. The mucous membranes were pale and the tongue smooth. A few shotty cervical lymph nodes were palpable, and there was a soft, blowing Grade 2 apical systolic murmur.

Laboratory studies revealed the following: hemoglobin 5.5 g/100 ml, erythrocyte count 3.52 millions/cumm, reticulocyte count 0.2%, leukocyte count normal and platelet count normal. Erythrocyte indices were: mean corpuscular volume 74 cu#, mean corpuscular hemoglobin 15.2 $\mu g$, and mean corpuscular hemoglobin concentration 21.2%. Bone marrow aspiration from the sternum showed normal cellularity, with an erythrocytoid to myeloid ratio of 1:3, and the iron stain showed an absence of iron. Hemoglobin paper electrophoresis, alkali denaturation, and $A_{2}$ hemoglobin component were normal. Serum iron was 18 $\mu g$/100 ml, and total iron binding capacity was 468 $\mu g$/100 ml. Serum cholesterol was 100 mg/100 ml with 75% esterified, serum albumin was 3.9 g/100 ml, and serum globulins were normal. Serum carotene was 0.038 mg/100 ml.

Urinary excretion of d-xylose after a 25 g oral dose was 0.03 g in 5 hours, and the 24-hour fecal fat excretion was 13.7 g, while the patient was receiving a diet containing approximately 70 g of fat daily. A quantitative culture was made from the afferent loop of the gastroenterostomy, and it revealed 20 million colonies of $E$ coli and 12,000 colonies of alpha hemolytic streptococci/ml. The Schilling test revealed 0.59% excretion, an abnormality which was not corrected by intrinsic factor. Gastric analysis after maximal histamine stimulation disclosed no free acid. Absorption of an oral iron dose of $^{55}$Fe was 1.1%, while the maximal red blood cell utilization of $^{55}$Fe, given intravenously and measured simultaneously, was 98.9%. The $^{51}$Cr half life survival time of the red blood cells was 25 days. At the time the ferrokinetic studies were performed,