



Case Report

Food-Intake-Related Hypocupremia Decreased the Number of White Blood Cells and Increased the Concentration of Cholesterol in Serum in Elderly Female

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SUMMARY

Copper (Cu) is one of the essential metal elements necessary for homeostasis maintenance. Cu is present in most foods and thus, hypocupremia is rare even when the food intake is minimal. Elderly people, however, especially those with dementia, sometimes have decreased oral food intake. In this paper, we describe the case of a female patient in her 80s taking very low Cu supportive meals and suffering from hypocupremia. This patient stayed in our hospital from 201X-6 because of dementia. We observed her general condition (blood cell count, biochemical data) once every 2-3 months. She showed decreased appetite and could eat only very low Cu supportive meals from August 201X+1 and suffered from hypocupremia (serum Cu concentration significantly decreased and reached a minimum of 4 ng/dl in October 201X+1). The number of white blood cells decreased and the concentration of total cholesterol in serum increased. They immediately returned to normal levels after she started eating regular food from October 201X+1. Food-intake-related hypocupremia can easily induce immunodeficiency and hypercholesterolemia, but can be easily treated by simply eating regular food.

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1. Introduction

Copper (Cu) is one of the essential metal elements because it acts as a critical cofactor of specific cuproenzymes, which catalyze electron transfer reactions required for cellular respiration, iron oxidation, pigment formation, neurotransmitter biosynthesis, anti-oxidation, defensin synthesis, peptide amination, and connective tissue formation.¹ However, Cu deficiency in humans is rare because Cu is widely distributed in various food sources. Acquired Cu deficiency has been reported in the case of hospitalized patients treated with long-term total parenteral or enteral nutrition lacking Cu supplementation.^{2–8}

In this paper, we report the case of a female patient in her 80s who suffered from hypocupremia owing to decreased oral food intake. She showed a decrease in the number of white blood cells (WBCs) and an increase in total cholesterol (T-cho) concentration. These changes were significantly and immediately reversed by oral intake of Cu in regular food (not by Cu supplement intake).

2. Case Report

The female in her 80s was an in-patient from 201X-6 because of schizophrenia with a strong suspicion of dementia. She was disabled and usually stayed in bed or used a wheelchair. Because of her mental disorders, she frequently rejected food. She also frequently suffered from constipation and subileus condition. These clinical conditions led to her poor nutritional status over a long time. From

December 201X, she could not eat her usual meals and thus, she mainly ate several kinds of oral supportive diet. However, the total intake decreased and from August 201X+1, she could eat only an oral supportive meal, which was unfortunately of the very low Cu type. With the cooperation of nursing and nutrition supporting teams, she started to eat regular meals from the middle of October 201X+1.

We carried out laboratory tests once every 2–3 months to observe and confirm her general serum condition. We determined the numbers of red blood cells (RBCs), WBCs, and platelets (Plt), and the concentrations of hemoglobin (Hb), total protein (TP), albumin (Alb), sodium (Na), potassium (K), chloride (Cl), and T-cho (Table 1). We also sometimes checked the concentrations of high- and low-density lipoprotein cholesterol (HDL and LDL, respectively), and triglycerides (Tg). Body weight was measured every month.

As shown in Fig. 1 and Table 1, the concentration of serum Cu was significantly decreased from December 201X owing to her low Cu intake. During this period of decreased serum Cu concentration, the concentration of T-cho gradually increased and the number of WBCs decreased. On the other hand, BW slightly increased, except in the period when her food intake decreased. The LDL/HDL ratio increased from 2.1 in February 201X+1 to 3.6 in October 201X+1, which was a 74% increase.

Two months after she started eating regular food again, the concentration of serum Cu increased, and the number of WBCs also increased. On the other hand, the concentration of T-cho decreased (interestingly, BW also decreased). The LDL/HDL ratio also returned to normal values (LDL/HDL = 2.5). As shown in Table 1, the concentration of TG also decreased during these two months.

In summary, the concentration of serum Cu was significantly increased by Cu intake and the number of WBCs increased and the

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Table 1
Laboratory data from the case patient

	201X, Dec.	201X+1, Feb.	201X+1, Aug.	201X+1, Oct.	201X+1, Dec.	201X+2, Jan.
Cu ($\mu\text{g}/\text{dl}$)	65	30	4	5	133	132
BW (kg)	39	42.5	44.8	44.5	42.8	42.1
BMI (kg/m^2)	19.3	21	22.2	22	21.2	20.8
RBCs (10^4 cell/ μl)	421	409	431	422	465	469
WBCs (cell/ μl)	8020	6870	5600	4690	7310	7080
Hb (g/dl)	13	12.7	13.3	12.9	14	14
Plt (10^4 / μl)	41.7	42.1	40.8	40.3	40.4	46.7
TP (g/dl)	7.2	n.d.	7.7	6.9	7.4	7.3
Alb (g/dl)	3.4	n.d.	3.6	3.2	3.6	3.6
Na (mEq/l)	131	137	138	140	139	139
K (mEq/l)	4.2	4.4	4.6	5	4.8	4.8
Cl (mEq/l)	96	99	99	101	101	100
T-cho (mg/dl)	284	274	316	310	272	252
HDL (mg/dl)	n.d.	87	n.d.	65	86	78
LDL (mg/dl)	n.d.	180	n.d.	234	167	158
TG (mg/dl)	n.d.	n.d.	n.d.	134	101	83

Cu, copper; BW, body weight; BMI, body-mass index; RBCs, red blood cells; WBCs, white blood cells; Hb, hemoglobin; Plt, platelets; TP, total protein; Alb, albumin; Na, sodium; K, potassium; Cl, chloride; T-cho, total cholesterol; HDL, high density lipoprotein; LDL, low density lipoprotein; TG, triglyceride.

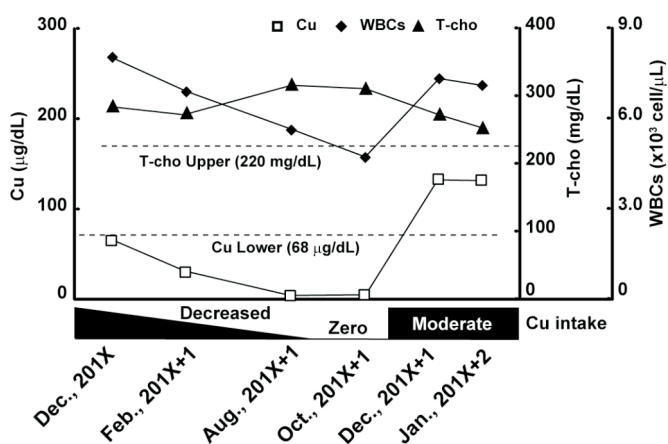


Fig. 1. The decrease in the concentration of serum copper (Cu; \square) induced the increase in the concentration of total cholesterol (T-cho; \blacktriangle) and the decrease in the number of white blood cells (WBCs; \blacklozenge) in serum. Low intake of Cu in food induced the decrease in the concentration of Cu in serum, increased the concentration of T-cho and decreased the number of WBCs in serum. After sufficient intake of Cu by eating regular food, they returned to normal levels.

concentration of T-cho decreased in this patient. Hypocupremia decreased the number of WBCs and disturbed cholesterol metabolism. Note that the poor serum condition in this patient was immediately reversed by oral intake of Cu in regular meals.

3. Discussion

As mentioned in Introduction, Cu is present in most foods, especially in liver, nuts, legumes, and shellfish, which include high amounts of Cu per unit;⁹ thus, hypocupremia is rare. However, in cases of poor nutritional condition, such as total parenteral or enteral nutrition, hypocupremia may be induced. As shown in this report, a very unusual nutritional condition (very low Cu supportive meal intake for several months) potentially induces hypocupremia, which decreases the number of WBCs, predisposing affected patients to infection, and increases T-cho concentration, which potentially induces cardiovascular disease. Anemia is one of the common disorders induced by hypocupremia.^{3,5,10,11} However, in our patient, anemia was not induced by hypocupremia even when other factors were also affected (Table 1). We consider that not only anemia but also other diseases such as infection and cardiovascular

disease can be induced by hypocupremia.

It was reported that low-Cu nutrition induces an increase in cholesterol concentration.¹² It was also reported that Cu replenishment restores the cholesterol concentration to normal levels. However, Cu concentration and lipid conditions are still controversial issues.^{13–15} In our patient, the concentration of T-cho and the LDL/HDL ratio increased owing to hypocupremia, which returned to normal levels after Cu intake. Note that the very low Cu supportive meals that we fed the patient contained high lipid concentrations to increase the total calories. This dietary condition potentially induced the high T-cho concentration during the period of very low Cu supportive meal intake, as shown in Fig. 1. This also explains previous controversial findings (i.e., both low and high concentrations of Cu induce high T-cho concentrations). Since the increase in LDL/HDL ratio potentially induces cardiovascular disease, although further study is needed, the concentration of Cu in serum may be considered as a risk factor for cardiovascular disease.

Note that hypocupremia and the changes it can potentially induce can be easily reversed by food intake (Fig. 1). Elderly people, especially those who suffer from dementia, frequently lose their appetite, resulting in a decrease in their food intake. However, sometimes they can be induced to eat again by considering psychological factors (e.g., use of a different form of nutrition, consideration of their food preferences). This approach is usually more advantageous to implement than drug medication.

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Conflict of Interest

The authors declare no conflict of interest.

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