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"Myelodysplasia" from copper deficiency

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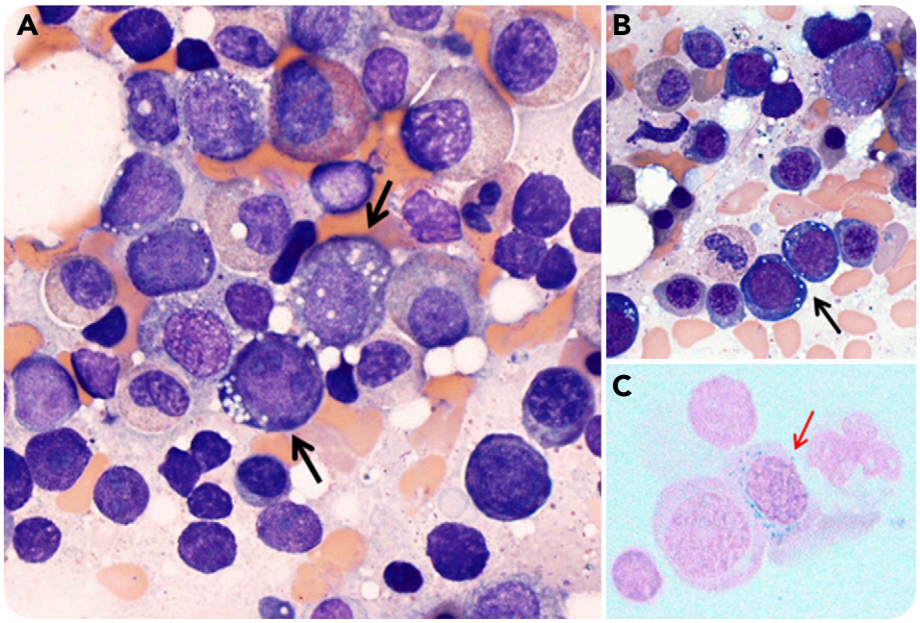

A 45-year-old woman presented with pancytopenia (hemoglobin, 4.8 g/dL; mean corpuscular volume, 96; leukocytes, 0.9 × 10^9/L; platelets, 157 × 10^9/L; absolute reticulocytes, 34 × 10^9/L). Staining of the bone marrow aspirate showed rare ringed sideroblasts (panel C, red arrow; Prussian blue stain, original magnification ×1000), mild dyserythropoiesis with nuclear to cytoplasmic dyssynchrony, and prominent cytoplasmic vacuolization (panels A-B, black arrows; Wright-Giemsa stain, original magnification ×1000). Cytogenetics and sequencing for 97 myeloid genes were unrevealing. Laboratory studies documented a low serum copper (4 μg/dL) (normal, 75-175 μg/dL) and an elevated serum zinc (191 μg/dL; normal, 60-130 μg/dL). Additional history revealed frequent use of a zinc-containing denture adhesive. After 1 month without further zinc exposure and daily oral copper supplementation, serum levels normalized and pancytopenia resolved.

Zinc and copper normally exist in a dynamic equilibrium. Excess zinc, however, induces metal-binding metallothioneins in intestinal enterocytes, which bind copper; the bound copper is then lost by enterocyte shedding. Hypocupremia is also associated with gastric surgery, malabsorption, and excess copper chelation. The resulting hypocupremia impairs iron absorption and insertion into the protoporphyrin ring, causing iron accumulation with ringed sideroblasts, dysplastic changes, and vacuolization. Similar to cobalamin deficiency, an irreversible myeloneuropathy has also been reported with hypocupremia. Copper deficiency is a rare nutritional cause of reversible pancytopenia with dysplastic changes and should be considered in the differential diagnosis of pancytopenia.

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