The Cupric Culprit: A Case of Copper Deficiency Myelopathy

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Introduction

Copper deficiency is a rare complication of peptic ulcer or bariatric surgeries, malabsorptive disorders such as celiac disease, and excess zinc ingestion.[2] A mimicker of subacute combined degeneration seen in cobalamin (vitamin B12) deficiency, copper deficiency myelopathy most commonly presents with sensory ataxia, paresthesia, anemia or neutropenia, and dorsal columnar enhancement on contrast imaging.

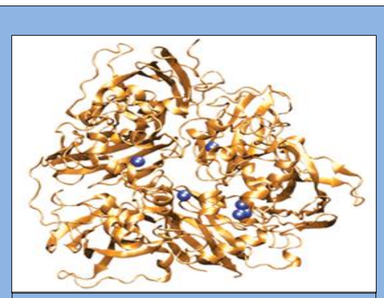


Figure 1: Atomic structure of ceruloplasmin.

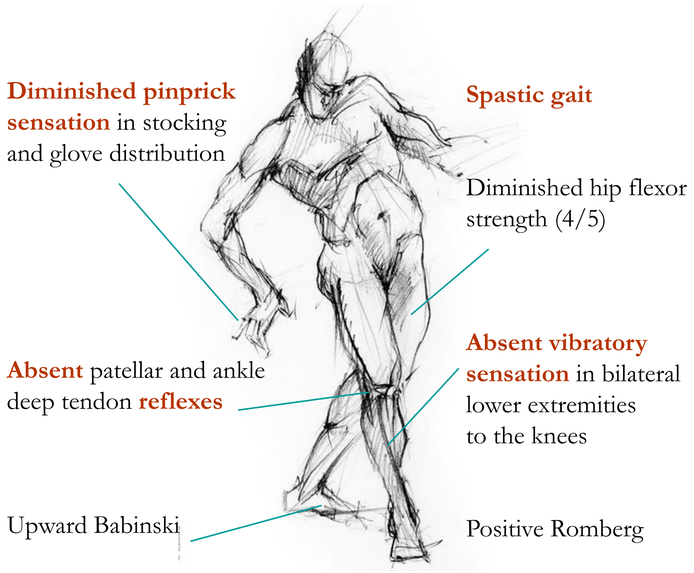
History

A 70 year-old woman with a history of peptic ulcer disease treated with vagotomy and remote Billroth II gastrojejunostomy, diastolic heart failure, anxiety disorder, and obsessive compulsive disorder presents to the emergency room with **six months of gait instability and recurrent falls.**

Clinical Timeline

-6 months from presentation: ***First fall*** thought to be mechanical.
-4 months: *Second fall* occurred while walking down stairs.
-2 months: *Third fall* triggered by vertigo.
-2 weeks: *Fourth fall and ER visit*. CT head and CT C-spine without contrast are unremarkable.
-1 week: *Establishes care with PCP*. Positive orthostatic vitals. Several centrally acting medications are discontinued.
Timepoint 0: *Hospitalization* 3 weeks later for ascending bilateral foot and hand paresthesias and unsteady gait.
+3 days: *Neurology initiates treatment for copper deficiency myelopathy* with IV cupric chloride 8 mg daily for 7 days followed by oral cupric chloride 4 mg twice daily.
+6 weeks: At *PCP follow-up* copper and ceruloplasmin levels normalize (174 ug/ml and 42 ml/dl, resp), *paresthesias and propioceptive sensation improve, distal reflexes and strength recover.*
+12 weeks: Follow-up with PCP demonstrates *persistent vibratory sensation loss and ataxic gait.*

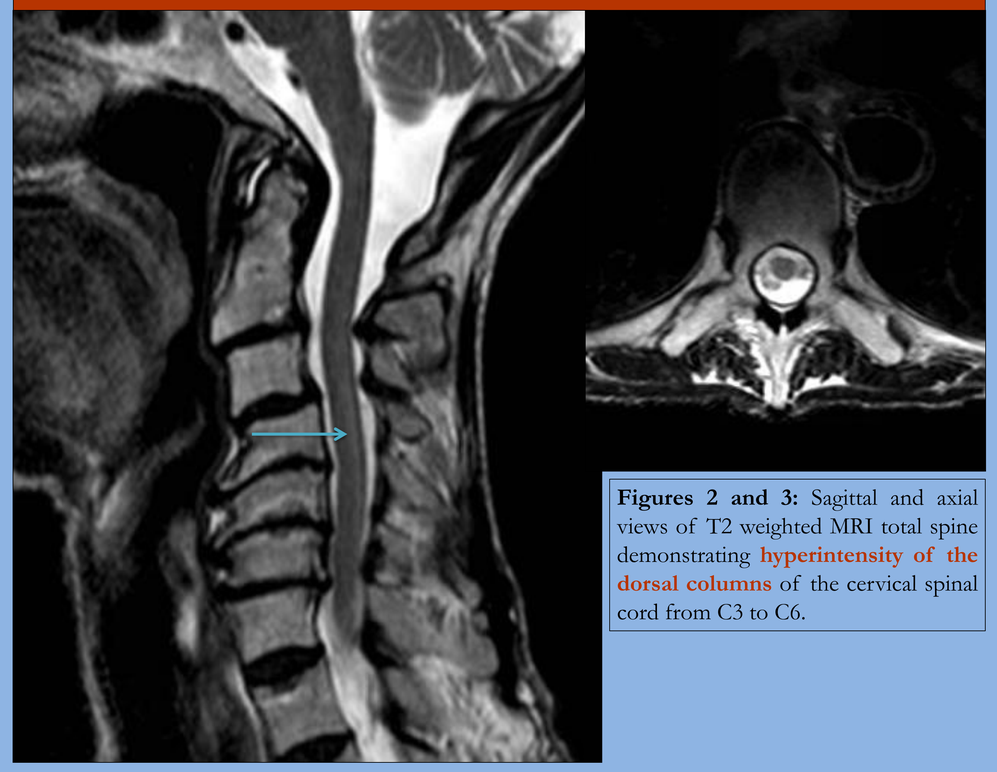
Physical Exam



Laboratory Findings

ABNORMAL	NORMAL
Chronic hyponatremia 124 mEQ/l	Remainder of BMP, Ca^{2+}
Normocytic anemia Hb 10.2 g/dl	ACTH stim testing
B6 low 10 ng/ml	B12, Folate, MMA
Copper low 47 ug/ml (norm 80-155)	Zinc
Ceruloplasmin low 17 ml/dl (norm 20-60)	Niacin
Peripheral smear: hypochromic RBC	TSH
Ferritin low 12.6 ng/ml Iron 31 ug/ml	RPR, SPEP, UPEP
Albumin low 3.4 g/dl	AST, ALT, TB, TP
Platelets elevated 650 x 10^9/L	Urine studies: Na 31, Osm 432

Imaging



Figures 2 and 3: Sagittal and axial views of T2 weighted MRI total spine demonstrating **hyperintensity of the dorsal columns** of the cervical spinal cord from C3 to C6.

Discussion

- **Copper absorption** occurs via P-type ATPase in the **duodenum and stomach**. Sensory ataxia in copper deficiency involves **both central myelopathy** and **length dependent peripheral neuropathy** of axonal large fibers.[11]

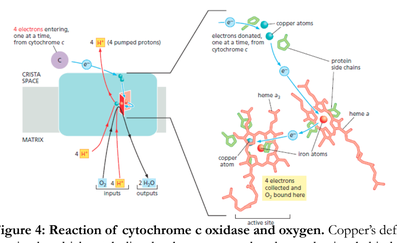


Figure 4: Reaction of cytochrome c oxidase and oxygen. Copper's deficiency in mitochondrial metabolism has been proposed as the mechanism behind the development of myeloneuropathy.[5,6,7]

- **Differential for posterior columnar enhancement** on contrast spinal imaging:

Vitamin B12 deficiency	Adult-onset autosomal dominant leukodystrophy
Vitamin E deficiency	Friedrich's ataxia
Multiple sclerosis	Leukoencephalopathy with brain stem and spinal cord involvement and lactate elevation (LBSL)
AIDS	Copper deficiency

Key Points

- **Unexplained neuropathy, anemia, and sensory ataxia** in a patient with a history of **gastric surgery or malabsorptive disorder** should cue physicians to evaluate for **copper deficiency,** particularly if repletion of B complex vitamins fails to improve symptoms.
- **Repletion with 2-4 mg/day of oral or intravenous then oral therapy** has been reported to prevent further neurologic deterioration even in cases of suspected malabsorption.[4,11]
- Repletion of copper stores and reversal of the underlying etiology (cessation of exogenous zinc, bypass revision) can result in **rapid resolution of the myelopathy and hematologic insults.** However, **complete recovery of the axonal predominant peripheral neuropathy is unlikely.**

References

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