AMSER Case of the Month August 2025

Bilateral Distal Limb Sensory Deficit in a 35-Year-Old Female

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LOMA LINDA UNIVERSITY HEALTH

AMSER

Patient Presentation

- HPI: A 35-year-old female with a history of organ transplantation due to ESLD secondary to alcohol use and ESRD secondary to hepatorenal syndrome on immunosuppression presented with 2 days of bilateral upper and lower distal limb paresthesia. She reports difficulty walking due to decreased sensation in her feet, along with nausea, vomiting, and abdominal pain. She also reports daily nitric oxide inhalation for the past 2 months.
- Vital signs: BP 108/71, Pulse 83, Temp 98.6F, Resp 16, SpO2 99%
- Physical Exam: Decreased light touch sensation in a stocking-glove distribution.

Pertinent Labs

- CBC: Hgb 9.9 g/dL (↓), MCV 89.8 (WNL)
- UDS: positive for Cocaine
- Homocysteine: 132.7 µmol/L (↑)
- Vitamin B12: 187 pg/mL (↓)
- Methylmalonic acid: 13.5 nmol/mL (↑)
- Folate: >20 ng/mL(↑)

What Imaging Should We Order?

Select the applicable ACR Appropriateness Criteria

Revised 2020

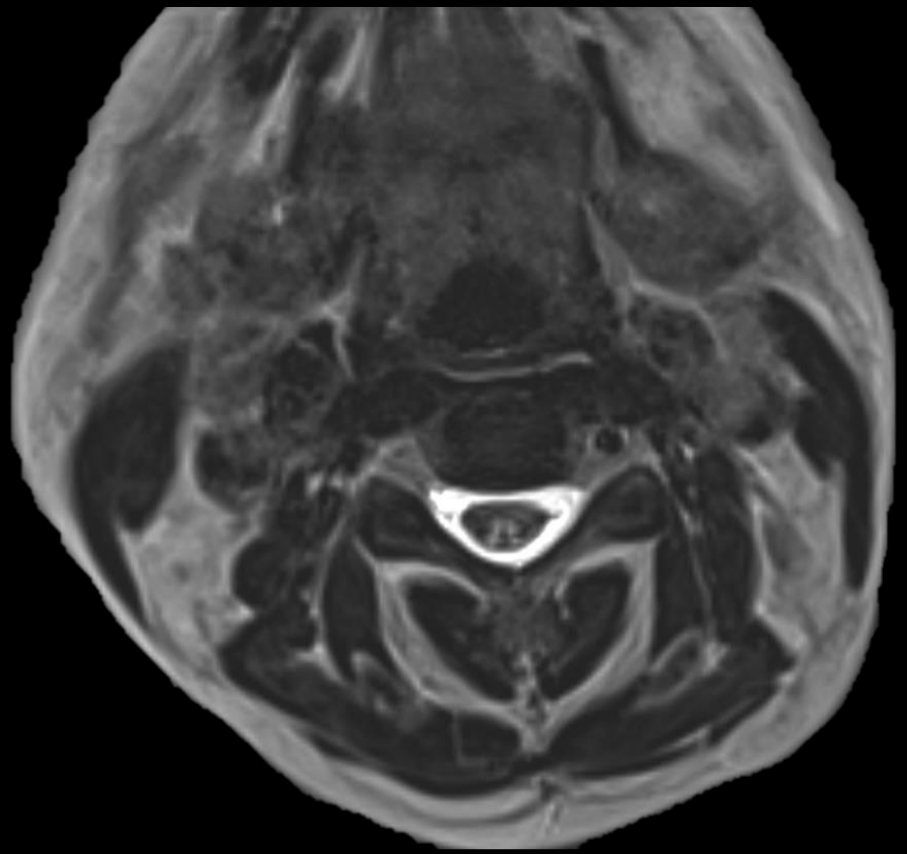
American College of Radiology
ACR Appropriateness Criteria®
Myelopathy

Variant 1: **Acute onset myelopathy. Initial imaging.**

Procedure	Appropriateness Category	Relative Radiation Level
MRI spine area of interest without and with IV contrast	Usually Appropriate	O
MRI spine area of interest without IV contrast	Usually Appropriate	O
CT myelography spine area of interest	May Be Appropriate	Varies
CT spine area of interest with IV contrast	May Be Appropriate	Varies
CT spine area of interest without IV contrast	May Be Appropriate	Varies
Arteriography spine area of interest	Usually Not Appropriate	Varies
Radiography spine area of interest	Usually Not Appropriate	Varies
MRA spine area of interest with IV contrast	Usually Not Appropriate	O
MRA spine area of interest without and with IV contrast	Usually Not Appropriate	O
MRA spine area of interest without IV contrast	Usually Not Appropriate	O
MRI spine area of interest with IV contrast	Usually Not Appropriate	O
CT spine area of interest without and with IV contrast	Usually Not Appropriate	Varies
CTA spine area of interest with IV contrast	Usually Not Appropriate	Varies

This imaging modality was ordered by the ER physician after consulting neurology

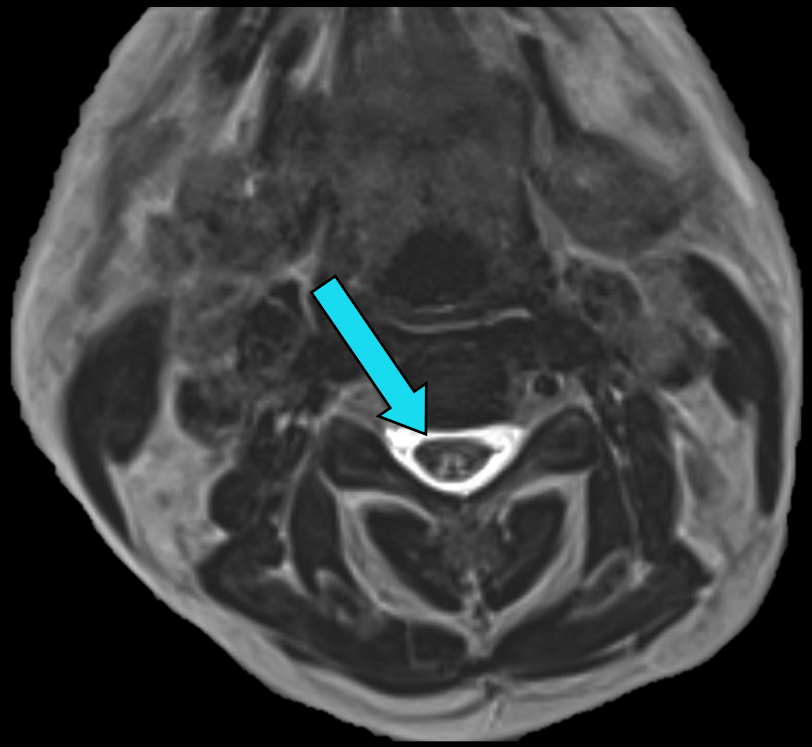
Findings (unlabeled)

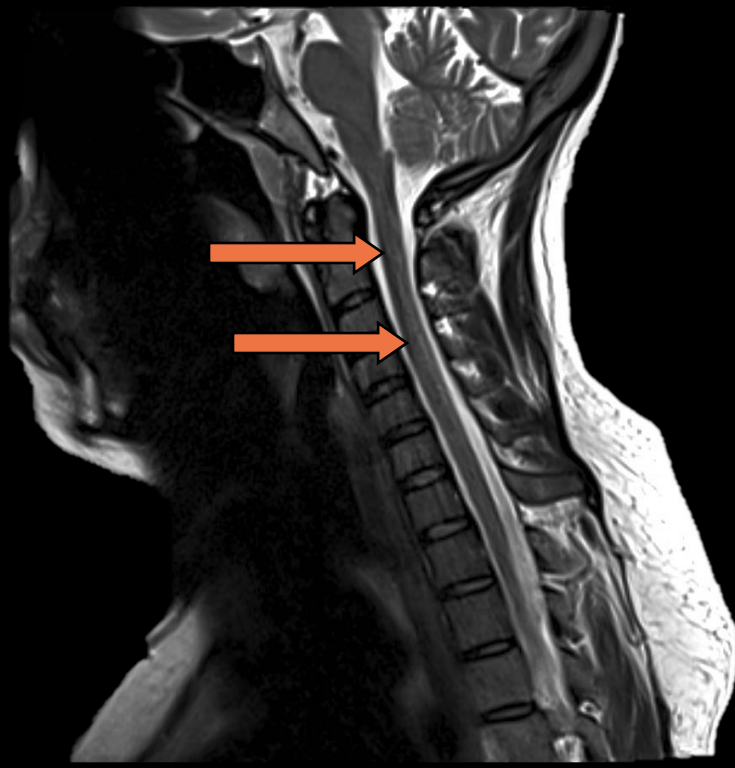


T2 with :

- Symmetric hyperintensity confined to dorsal columns on axial view
- Linear hyperintense signal along the dorsal columns, extending contiguously on sagittal views

Findings: (labeled)





Differential Diagnosis

- Symmetric enhancement of dorsal columns
  - Subacute Combined Degeneration (SCD)
  - Copper Deficiency Myelopathy
  - Vitamin E Deficiency
  - Methotrexate-Induced Myelopathy

Final Dx:

Nitric Oxide-Induced Subacute Combined Degeneration

Nitric Oxide-Induced Subacute Combined Degeneration

- Definition: neurological disorder characterized by demyelination of the spinal cord, primarily affecting the dorsal columns, due to functional vitamin B12 deficiency caused by nitrous oxide (N_2O) exposure.
- Etiology: Inhalation of nitrous oxide, often recreationally.
- Pathophysiology: Nitrous oxide inactivates vitamin B12 by oxidizing the cobalt atom at its core, rendering it unable to function as a cofactor for methionine synthase. This leads to impaired myelin synthesis and accumulation of neurotoxic metabolites (homocysteine, methylmalonic acid), resulting in demyelination of the spinal cord.
- Risk Factors: Prolonged or heavy N_2O use, concurrent use of medications that impair B12 absorption or increases neuro- susceptibility.

Nitric Oxide-Induced Subacute Combined Degeneration

- Imaging findings:
  - MRI signal characteristics help identify key features:
    - Axial T2 MRI of the c-spine shows Symmetric, bilateral hyperintensity in the dorsal columns of the cervical (and sometimes upper thoracic) spinal cord presenting as inverted "V" sign, also known as the inverted rabbit ears sign .
      - Dorsal columns are vulnerable due to high metabolic demand of the ascending sensory fibers of the fasciculus gracilis and cuneatus.
    - Sagittal T2 MRI shows longitudinal hyperintensity extending over multiple segments, typically C1–C6.
  - No Cord Expansion: The spinal cord maintains normal size and shape.
  - Contrast Enhancement: Usually absent; very rare cases may show mild enhancement in severe disease.
  - Brain MRI: May show nonspecific white matter changes in a minority of cases

Nitric Oxide-Induced Subacute Combined Degeneration

- Clinical features:
  - Paresthesias (stocking-glove distribution)
  - Sensory ataxia (gait impairment)
  - Autonomic symptoms (nausea/abdominal pain)
- Treatment:
  - Medical Management
    - Immediate Cessation of Nitrous Oxide Exposure
      - Essential to prevent further neurological damage.
    - Vitamin B12 Replacement
      - High-dose parenteral (intramuscular) B12 injections are the mainstay of therapy. Treatment should continue until clinical improvement plateaus
    - Supportive Care: Physical rehabilitation for persistent deficits

References:

Nitrous oxide toxicity. Radiopaedia. https://radiopaedia.org/articles/nitrous-oxide-toxicity?lang=us. Published June 15, 2025. Accessed June 30, 2025.

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