Visual case discussion

Gait instability with history of nitrous oxide abuse

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A 19-year-old man previously healthy presented to the ED with 4–5 days of progressive difficulty walking with lower extremity numbness and urinary retention. Patient denied recent trauma. Review of systems revealed heavy history of nitrous oxide abuse. On exam, patient was alert and oriented. He had mild spasticity in R lower extremity and choreiform movements in hands bilaterally, decreased sensation to pinprick and vibration bilaterally below knee, and reduced sensation to proprioception in great toes. He was too unsteady to take steps.

C-spine MRI showed diffuse dorsal spinal cord signal abnormality extending from C2 to C6 (Fig. 1). MCV was elevated to 101.3 fL. Positive Tox screen and urine THC. Inpatient labs showed normal levels of Vitamins E and B12, Copper, and Folic acid, but elevated levels of MMA to 4.79 μg/dL and Homocysteine to 79.2 μmol/L. Patient significantly improved with therapy and was walking at follow-up.

Questions

1 What vitamin or mineral deficiency is caused by nitrous oxide abuse?
   A) Vitamin B6
   B) folate
   C) Vitamin B12
   D) Vitamin E
   E) Vitamin C

2 What is the most appropriate initial treatment?
   A) change in diet
   B) surgical management
   C) physical therapy
   D) vitamin B12 supplementation
   E) urinary catheterization for urinary retention

Answers

1 Answer: C) Vitamin B12 deficiency may be a result of nitrous oxide exposure. Nitrous oxide oxidizes vitamin B12 and converts the active monovalent form of vitamin B12 to its inactive bivalent form. Vitamin B12 is necessary as a cofactor for methionine synthase and methylmalonyl-CoA mutase. Although our patient’s vitamin B12 levels were normal, his clinical presentation, elevated levels of homocysteine and MMA, and MRI findings are consistent with a diagnosis of nitrous oxide induced vitamin B12 deficiency. A) is incorrect. Vitamin B6 deficiency may lead to convulsions, peripheral neuropathy as well as elevated homocysteine levels, but MMA levels should not be increased. B) is incorrect, folate deficiency does not cause neurologic symptoms. D) is incorrect. Although vitamin E deficiency may cause neurologic symptoms similar to vitamin B12 deficiency, but MCV will be normal and serum MMA will not be increased. E) is incorrect.

2 Answer: D) Subacute combined degeneration of spinal cord (SCD) is caused by Vitamin B12 deficiency, mainly affecting the spinal cord. Vitamin B12 is a co-factor for methylmalonyl-CoA mutase, converting methylmalonyl-CoA to succinyl-CoA. A lack of vitamin B12 disrupts the proliferation, maturation and regeneration of neurons, and leads to an accumulation of methylmalonic acid (MMA). Its effects on the brain and the peripheral nerves are the reason for the term “combined”. SCD is a reversible condition when detected and treated EARLY with vitamin B12 supplementation and cessation of nitrous oxide abuse. Physical therapy after or combined with medical treatment may be effective in allowing patients to regain normal function.
Supplementary materials


Fig. 1. MRI of Cervical Spine: diffuse dorsal spinal cord signal abnormality extending from C2 to C6.

Declaration of Competing Interest

None.