

Case Report: The use of propofol and ketamine for intravenous sedation of a pediatric dental patient with MTHFR deficiency

Dan Chun^{1,2}, Shona Jain¹, Achim Younker¹, Priya Mullassaril¹, Glen Atlas¹

¹Rutgers University, Newark, New Jersey

²Roger Williams Medical Center, Providence, Rhode Island

Abstract

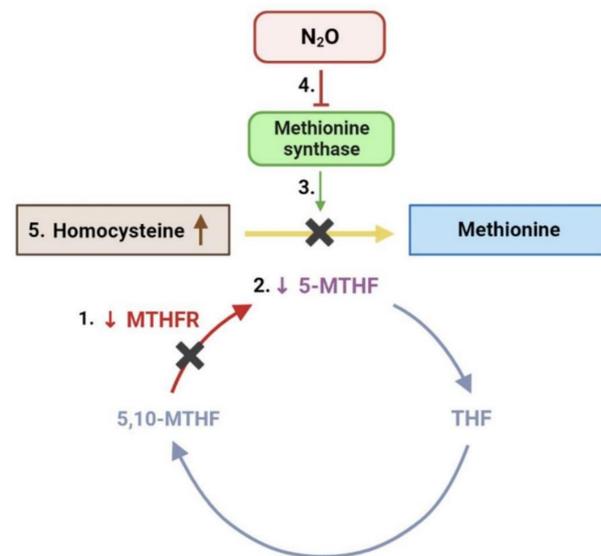
- Review of the anesthetic management of a pediatric dental patient with methylenetetrahydrofolate reductase (MTHFR) deficiency
- MTHFR deficiency is a contraindication for the use of nitrous oxide (N₂O)
- In this case, propofol and ketamine were utilized together to safely deliver intravenous (IV) sedation

Introduction

- Methylenetetrahydrofolate reductase (MTHFR): an enzyme that breaks down the amino acid homocysteine (HCY)
- Patients with MTHFR deficiency are unable to metabolize HCY and subsequently develop elevated blood levels of HCY
- Complications include seizures, intellectual disability, and venous thrombosis
- Labs reveal homocystinuria, hyperhomocysteinemia, low serum methionine level, and normal vitamin B12 level
- MTHFR deficiency is a contraindication to N₂O administration
- N₂O increases plasma HCY concentrations by inhibiting the enzyme which metabolizes HCY (methionine synthase)
- Dentists commonly use N₂O as an inhaled sedative agent for procedures
- N₂O is potentially deleterious in patients with pre-existing elevated levels of HCY
- In this patient, the combination of both propofol and ketamine were successfully utilized for IV sedation, thus avoiding N₂O

Case Presentation

- 9-year-old male with history of MTHFR gene mutation
- Presented for a dental procedure for multiple dental restorations and extractions
- No contraindications to the use of propofol and ketamine as anesthetic agents
- Had received general endotracheal anesthesia for an ORIF five months prior and tolerated well
- Weight 31.8 kg and family history unremarkable
- Medications: leucovorin, B vitamins, and fish oil
- ASA grade III
- Induction: 50 mg ketamine with 0.1 mg glycopyrrolate IM
- Total of 140 mg ketamine IV given during the 2-hour procedure
- IV propofol was given at rate of 85 µg/kg/min with a total amount 226 mg
- Vitals remained stable throughout procedure and dentistry uneventful
- Patient tolerated procedure well and had no complications upon awakening or on follow up



A deficiency of MTHFR enzyme (1) leads to the inability to breakdown 5,10-MTHF into 5-MTHF. Subsequently, the concentration of 5-MTHF is reduced. This deficiency in 5-MTHF results in the inability of methionine synthase to convert homocysteine into methionine (3). In addition, N₂O also independently inhibits methionine synthase (4). Thus, the combination of a decreased level of 5-MTHF in the presence of N₂O leads to excessive levels of homocysteine (5).

Discussion

- MTHFR deficiency has an autosomal recessive inheritance pattern
- Most common MTHFR gene mutations are two distinct point mutations, which affect enzyme's ability to convert 5,10-methylenetetrahydrofolate to 5-methyltetrahydrofolate, thereby elevating serum HCY level and decreasing serum methionine level
- Decreased methionine level is significant because methionine serves as a key substrate in many biochemical reactions, such as myelin sheath assembly, DNA synthesis in rapidly-proliferating cells, and folate production
- Patients homozygous for these mutations have higher HCY levels than heterozygous patients
- For our dental patient, ketamine with propofol was decided upon
- Ketamine is a potent analgesic and primarily acts by noncompetitively antagonizing NMDA receptors in the CNS
- The side effect profile of ketamine includes hypersalivation and stimulation of the sympathetic nervous system
- One disadvantage of this technique compared to the use of N₂O is that the propofol and ketamine combination have a slower onset and offset of effects
- Patient did not experience any hallucinations or dysphoria, most likely due to concomitant administration of propofol
- Propofol and ketamine are a safe choice for anesthesia induction, maintenance, and sedation

Conclusion

- For patients with MTHFR deficiency, anesthesia can be safely and effectively achieved with the use of propofol and ketamine
- Using propofol and ketamine avoids the use of opioids, which is preferable in office-based dental patients with this condition
- Using propofol and ketamine also avoids the use of N₂O, which is contraindicated in patients with MTHFR deficiency
- The case lends evidence that propofol with ketamine can be used to safely and effectively anesthetize office-based dental patients with MTHFR deficiency

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