# Two cases of methaemoglobinaemia secondary to amyl nitrate use

# Two Cases of Methaemoglobinaemia Secondary to Amyl Nitrate Use

***Abstract:***

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**Abstract**

We wish to report two cases of methaemoglobinaemia secondary to amyl nitrate use. A 55-year-old male presented with saturations in the mid 80s despite FiO2 of 1.0 and GCS 10 and a 22-year-old female who presented with fluctuating GCS and a slate grey colour. Both were found to have high levels of metheamoglobinaemia on ABG, were treated with methylene blue and made excellent recoveries. These cases illustrate the risk of methaemoglobinaemia secondary to amyl nitrate. Appropriate and prompt management can lead to very good outcomes.

**Introduction**

We wish to report two recent cases of life threatening methaemoglobinaemia secondary to amyl nitrate use.

**Case Reports**

A 55-year-old male was brought to the Emergency Department (ED) with an unknown cause of collapse. Though haemodynamically stable he was markedly cyanosed. Oxygen saturations were in the mid 80s, despite FiO2 of 1.0. GCS was 10. Immediate resuscitation included intubation and ventilation with 100% oxygen. Blood was noted to be chocolate brown in colour. Arterial blood gas (ABG) analysis revealed a very elevated Met-Hb level of 76% (normal range 0-3%), as well as a raised anion gap metabolic acidosis, with a pH of 7.2. Gas exchange was notable for pO2 37kPa, pCO2 6kPa on FiO2 1.0. He was treated with methylene blue intravenously, responded rapidly with resolution of cyanosis and blood gas abnormalities. Collateral history revealed abuse of amyl nitrate "poppers" as well as alcohol abuse. Blood alcohol level was found to be 440mg/dl.

A 22-year-old female was brought into ED with fluctuating GCS and slate grey cyanosis. She had a known background history of heroin and methadone use. An empty bottle of amyl nitrate was found beside her. She was maintaining her own airway but intermittently apnoeic. She smelt strongly of alcohol. Oxygen saturations were 87%. Met-Hb was 67% on ABG analysis. The urinary toxin screen was positive for Benzodiazepine and tetrahydrocannabinol. Initially the patient was haemodynamically unstable with a heart rate of 125 and a blood pressure of 80/60mmHg. Prompt treatment with methylene blue, naloxone infusion, vasopressors and high flow O2 via facemask led to a quick recovery with an overnight stay in ED. The patient self discharged the next day.

**Discussion**

Methaemoglobinaemia occurs when red blood cells contain greater than 1% methaemoglobin. Methaemoglobin has an oxidized ferric iron (Fe 3+) rather than the reduced ferrous form (Fe 2+) found in haemoglobin. This structural change is responsible for methaemoglobin’s inability to bind oxygen. In addition, ferric iron has slightly greater affinity for oxygen due to its chemical structure, thus shifting the oxygen dissociation curve to the left, resulting in decreased release of oxygen in tissues. Cyanosis despite oxygen treatment results from both of these effects[1]. Methaemoglobinaemia may be congenital or acquired. Acquired causes of relevance to critical care physicians include drug abuse with nitrates including the street drug â  poppersâ   and local anaesthetic toxicity[1,2]. Occurrences of reported methaemoglobinaemia due to local anaesthetic involved use of either benzocaine or prilocaine in more than 90% of cases. Such events are unpredictable, particularly those related to benzocaine[3]. Some patients may develop methaemoglobinaemia after a single short spray of benzocaine.

Congenital methaemoglobinaemia generally results from exposure to a drug that provides a sufficient oxidative stress to overwhelm the endogenous reductive pathways. The most common cause of congenital methaemoglobinaemia is cytochrome b5 reductase deficiency (type Ib5R). The major enzymatic system involved reducing methaemoglobin to haemoglobin is adenine dinucleotide (NADH)â  dependent methaemoglobin reduction[4]. Cytochrome b5 reductase plays a major role in this process by transferring electrons from NADH to methaemoglobin, which results in the reduction of methaemoglobin to haemoglobin. This enzyme system is responsible for the removal of 95-99% of the methaemoglobin that is produced under normal circumstances.

Complications of methaemoglobinaemia include hypoxic encephalopathy, myocardial infarction, and death. As methaemoglobin levels increase, patients demonstrate evidence of cellular hypoxia. At high levels of methaemoglobin, the pulse oximeter reads a saturation of 85%, which corresponds to equal absorbance of both wavelengths. Pulse oximetry measures the relative absorbance of 2 wavelengths of light to differentiate oxyhaemoglobin from deoxyhaemoglobin. Methaemoglobin absorbs both of wavelengths equally. Death may occur when methaemoglobin fractions approach 70%. Treatment with methylene blue induces the endogenous reductive system, restores the normal redox status of heme-bound iron, and allows conversion of methaemoglobin to haemoglobin.

We believe these cases demonstrate the need for continuing vigilance regarding methaemoglobinaemia and cellular poisoning secondary to amyl nitrate abuse, which continues to be a problem presenting to the Emergency Department. A high index of suspicion can confirm this diagnosis rapidly, and it responds immediately to treatment.

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Comments: