Indian Journal of Medical Case Reports ISSN: 2319–3832(Online)
An Open Access, Online International Journal Available at http://www. cibtech.org/jcr.htm
2014 Vol. 3 (4) October-December, pp. 16-18/Naik and Bhatt
Case Report

A RARE CASE OF METHAEMOGLOBINEMIA DUE TO NITRITE POISONING

***Vismay Naik and Parul Bhatt**
Department of Medicine, GMERS Medical College and Hospital, Gandhinagar, Gujarat
**Author for Correspondence*

ABSTRACT
Methaemoglobinaemia due to nitrite poisoning is rare. Methemoglobinemia should be considered in all cyanotic patients who remain unresponsive to oxygen therapy. Rapid diagnosis is very important in emergency cases as timely administration of methylene blue may be life saving. We report a case of methaemoglobinaemia as a result of sodium nitrite poisoning.

Keywords: *Methaemoglobinemia, Nitrites, Acquired Cyanosis*

INTRODUCTION
Cyanosis occurring due to methaemoglobinaemia is a rare condition. When cyanosis fails to improve after usual measures, one should think of presence of methaemoglobinaemia. Sodium nitrite poisoning is a rare but an important cause of methaemoglobinaemia. Sodium nitrite is used in industry during manufacture of synthetic dyes. In low concentrations, it is also used as a meat preservative. Nitrites convert haemoglobin to methaemoglobin. Severe methaemoglobinaemia, a potential fatal condition if left untreated; may be managed effectively with administration of i.v. methylene blue 1%. Therefore, the awareness of this condition in a cyanosed patient not responding to oxygenation, and timely administration of methylene blue may be life saving.

CASES
A 25 year old unmarried male was referred to our hospital with complaints of tachypnea, headache and dizzines after alleged ingestion of an unknown substance. He was working in the dye industry. On arrival at the emergency department, patient's lips were pale grey, his nail beds were cyanotic. Vital signs at presentation were as follows: pulse rate, 90 beats/min; respiratory rate, 30breaths/min; and blood pressure, 100/60mmHg. Bilateral breath sounds were clear on auscultation of his chest. His blood samples appeared chocolate brown; the color did not change when oxygen was given through a facemask. On 8L/min of supplemental oxygen, pulse oximetry showed a saturation of 88% and the arterial blood gas analysis showed a pH of 7.34, PO2=186 mm Hg, SO2= 95%, PCO2=30 mm Hg, HCO3- =16.2 mEq/L and methaemoglobin (metHb) levels= 45.2% (Normal levels, <1% to 2%).
A disparity was found between the symptoms observed clinically and pulse oximeter readings and calculated oxygen saturations. The patient was initially treated with 100% oxygen through non-rebreather mask, gastric lavage, and administration of activated charcoal. However, the symptoms worsened with an increasingly bluish appearance of the hands, feet, and lips, as well as deterioration of consciousness.
In view of elevated metHb levels, a diagnosis of sodium nitrite dye poisoning causing methaemoglobinaemia leading to central cyanosis was kept. He was given methylene blue 1% i.v. infusion in normal saline, in a dose of 1 mg/kg body weight as an antidote. The clinical conditions of the patient improved dramatically within 30 minutes, along with a gradual resolution of the cyanotic discoloration. On subsequent ABG after 12 hours, metHb levels reduced to 0.7%. Next day he was discharged in stable condition.

DISCUSSION
Acute methaemoglobenaemia is a metabolic disorder that occurs when haemoglobin in blood is oxidised to methaemoglobin (metHb). Methemoglobin represents the oxidized form (Fe3+-Hb) of hemoglobin, which is incapable of carrying oxygen (Ash-Bernal *et al.,* 2004). Ingestion of oxidising agents such as

nitrites and nitrates are among the most frequent causes (Chan, 1996). Nitrite and nitrates can convert Hb to metHb by oxidising iron from ferrous to ferric form. Sodium nitrite is used in industry during manufacture of synthetic dyes. In low concentrations, it is also used as a meat preservative. Signs and symptoms of methaemoglobinaemia (methaemoglobin >1%) include shortness of breath, cyanosis, mental status changes (~50%), headache, fatigue, exercise intolerance, dizziness and loss of consciousness. Patients may present with cyanosis when the methemoglobin concentration reaches levels of approximately 10% of the total hemoglobin level (Henretig *et al.,* 1988). In normal circumstances, the enzyme nicotinamide adenine dinucleotide-methemoglobin reductase reduces methemoglobin to hemoglobin, preventing the accumulation of methemoglobin. If this usual mechanism is overwhelmed by exogenous oxidative stress, acquired methemoglobinemia ensues. A second enzymatic pathway uses nicotinamide adenosine dinucleotide phosphate and nicotinamide adenosine dinucleotide phosphate-methemoglobin reductase, which is important for the antidotal effect of methylene blue when administered exogenously (Rehman, 2001). Patients with methemoglobinemia tend to present with a more serious condition than anemic patients, who show a similar reduction in oxygen-carrying capacity due to a leftward shift in the oxyhemoglobin dissociation curve. Profound cyanosis incompatible with the degree of respiratory distress, especially where cyanotic symptoms are unresponsive to oxygen therapy, should raise the suspicion of methemoglobinemia. This diagnosis is supported by the chocolate-brown coloration of blood samples obtained from these patients, and the diagnosis may be confirmed by the results of CO-oximeter.

Nitrites and aniline derivatives have been reported to be among the chemical agents that most commonly cause methemoglobinemia (Donovan, 1990). A review of the literature showed that the reported lethal dose of sodium nitrite in adults is approximately 2.6g (Wright *et al.,* 1999). The onset of methemoglobinemia occurs usually within 20 to 60 minutes of chemical exposure, although the clinical evolution is difficult to predict concerning these toxic agents. Generally, 10% to 15% methemoglobin saturation produces obvious cyanosis (Coleman, 1996). Methemoglobin concentrations of 50% to 60% impair oxygen delivery, resulting in myocardial ischemia,depressed mental status and seizures.

The oxygen saturation measured by pulse oximetry typically presents values of around 85% in patients with methemoglobinemia (Haymond *et al.,* 2005). When patients have significantly elevated methemoglobin levels (>20%), the pulse oximeter falsely indicates high levels of oxygen saturation. Arterial blood gas analysis may also be initially deceptive, because the partial pressure of O2, as a measure of dissolved oxygen, is normal. Thus, extrapolation of this figure to predict the expected oxygen saturation will provide a falsely elevated result. The best definitive diagnostic test is multiple wavelength COoximetry, an in vitro spectrophotometric method that is capable of differentiating between oxy-, deoxy-, metand carboxyhemoglobin.

For patients diagnosed with methemoglobinemia, the optimum treatment is adequate oxygen delivery and appropriate antidotal therapy. Methylene blue is indicated as the first-line antidotal therapy for patients with severe methemoglobinemia. Although successful treatment with plasma exchange therapy, hyperbaric oxygen therapy and ascorbic acid has also been reported, these therapies should be considered as second-line treatments for patients unresponsive to methylene blue. As the methemoglobin level falls, the most severe signs and symptoms will be the first to resolve. Cyanosis usually resolves somewhat later, after the levels of methemoglobin have fallen to below 1.5g/dL. The initial dose of methylene blue is 1 to 2mg/kg intravenously. If symptoms of hypoxia fail to subside, the same dose may be repeated within 1 hour (Rees and Nelson, 2004).

Conclusion

Methemoglobinemia should be considered in all patients with cyanosis who are unresponsive to oxygen therapy. Rapid diagnosis and early intervention with antidotal therapy should prevent a fatal outcome.

REFERENCES

Ash-Bernal R, Wise R and Wright SM (2004). Acquired methemoglobinemia: a retrospective series of 138 cases at 2 teaching hospitals. *Medicine (Baltimore)* **83** 265–273.

Chan TY (1996). *Southeast Asian Journal of Tropical Medicine and Public Health* **27** 189-192.
Coleman MD and Coleman NA (1996). Drug induced methemoglobinemia. Treatment issues. *Drug Safety Journal* **14** 394–405.
Donovan JW (1990). Nitrates, nitrites and other sources of methemoglobinemia. In *Clinical Management of Poisoning and Drug Overdose*. Edited by Haddad LM and Winchester JF (W.B. Saunders Company) Philadelphia 1419–1431.
Haymond S, Cariappa R, Eby CS and Scott MG (2005). Laboratory assessment of oxygenation in methemoglobinemia. *Clinical Chemistry* **51** 434–444.
Henretig FM, Gribetz B, Kearney T, Lacouture P and Lovejoy FH (1988). Interpretation of color change in blood with varying degree of methemoglobinemia. *Journal of Toxicology: Clinical Toxicology* **26** 293–301.
Rees SM and Nelson LS (2004). Dyshemoglobinemias. In: *Emergency Medicine – a Comprehensive Study Guide*, 6th edition. Edited by Tintinalli JE, Kelen GD and Stapczynski JS (McGraw-Hill) New York 1169–1171.
Rehman HU (2001). Methemoglobinemia. *Western Journal of Medicine* **175** 193–196.
Wright RO, Lewander WJ and Woolf AD (1999). Methemoglobinemia: etiology, pharmacology, and clinical management. *Annals of Emergency Medicine* **34** 646–656.