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CASE REPORT

Ingestion of 70% Ethanol with Methylene Blue in a Novel Rubbing Alcohol Formulation

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Abstract

Recreational use of sanitizing alcohols, like rubbing alcohol, is a topic every emergency and intensive care Physician should be familiar with. Overindulgence in these substances can lead to ethanol toxicity. However, it's crucial for clinicians to recognize that these products often contain various other chemicals with harmful effects, such as methylene blue. In our analysis of the components of one such product, we present a case report of a patient who experienced alcohol poisoning after consuming it. Fortunately, the patient fully recovered after a brief stay in the intensive care unit. Our conclusion is that the oral ingestion of methylene blue in this product didn't exhibit significant or concerning clinical features. Therefore, the approach to managing such cases should be supportive, akin to dealing with ethanol toxicity.

Introduction

Sanitary alcohols (also known as “rubbing alcohols” or “surgical spirits”) are liquids primarily used as topical antiseptics, but also have many uses in both industry and household products. Isopropyl alcohol is most commonly the primary ingredient. Other brands, particularly in parts of Eastern Europe, include ethyl alcohol (70%) mixed with methylene blue and methyl salicylate. Common brands include “Mona”, “Saniblu”, “Prima” and “Oneida”. Other toxic alcohols described in the literature include methanol, diethylene glycol and propylene glycol, however these will not be discussed at length in this case report [1].

Ethanol

Ethanol, more commonly known as “alcohol”, is a widely consumed psychoactive substance [2]. It is commonly used in alcoholic drinks and is also found in a variety of household cleaning products, such as cleaning detergents, rubbing alcohols, antiseptics and perfumes [3]. Excessive consumption of alcoholic beverages, or consumption of ethanol containing household products, can lead to ethanol toxicity, which poses significant health risks.

Metabolism and liver effects

Ethanol is primarily metabolised by the liver by alcohol dehydrogenase, which produces acetaldehyde, a highly toxic compound [2]. Acetaldehyde is

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transformed into acetate by aldehyde dehydrogenase, which is eventually metabolised into carbon dioxide and water. Excessive ethanol consumption can lead to toxic accumulation of acetaldehyde [2]. Acetaldehyde can damage cellular structures and DNA, leading to alcoholic hepatitis, fatty liver disease and cirrhosis [2].

Acute ethanol toxicity

The pathophysiology of acute ethanol toxicity involves the disruption of neurotransmitters, primarily Gamma-Amino Butyric Acid (GABA) and glutamate, leading to impaired cognitive and motor function [4]. Ethanol induced oxidative stress and inflammation, and the build-up of acetaldehyde in the liver, all contribute to liver damage, ranging from mild derangement in liver function to end stage liver failure [5].

Acute ethanol toxicity can be divided into mild, moderate, severe and fatal. Mild to moderate ethanol toxicity occur with ethanol levels <100 mg/dl, and symptoms include decreased reaction time, loss of fine motor coordination, dysarthria and nausea. With increasing blood alcohol concentrations of 100-200 mg/dl, blurred vision, aggression, disorientation, confusion and vomiting can all occur [3].

Severe toxicity occurs with blood ethanol levels ranging from 200-450 mg/dl, and can lead to hypothermia, seizures, hypoglycaemia and coma [3].

Respiratory depression, haemodynamic instability, loss of protective airway reflexes, coma and hypoglycaemia are all recognised with blood alcohol levels of >450 mg/dl³. This can also lead to life threatening arrhythmias such as atrial fibrillation and atrioventricular block, whilst acute myocardial infarction has been described following an acute ingestion of large quantities. In addition, metabolic acidosis can occur with or without ketoacidosis. Rhabdomyolysis, lactic acidosis and acute hepatitis have all also been described [3].

Management of acute ethanol toxicity

The primary aim of managing acute ethanol toxicity is to support the patient whilst facilitating the elimination of ethanol from their system. This includes, but is not limited to:

- Airway Management and Oxygenation: Ensure a patent airway and provide supplemental oxygen if oxygen saturations are low. In severe

cases endotracheal intubation may be necessary to maintain proper oxygenation, especially in the case of a low Glasgow Coma Scale (GCS), or in the setting of an aspiration event [5,6].

- Intravenous fluids and correction of any electrolyte imbalances: Intravenous fluid administration and correction of any subsequent electrolyte derangements is essential due to the diuretic effects of ethanol [7].
- Monitoring and supportive care: Continuous monitoring of vital signs, including heart rate, blood pressure, oxygen saturations and urine output is crucial. Cardiac monitoring may be needed in severe cases [6].
- Glucose and thiamine: Intravenous glucose is given to correct any hypoglycaemia, a common complication of acute ethanol toxicity. Thiamine (Vitamin B1) supplementation is often co-administered to prevent Wernicke's encephalopathy and to correct any vitamin deficiency [8].
- Dialysis: In rare instances, haemodialysis may be considered to accelerate ethanol elimination, particularly if the patient deteriorates despite maximal supportive therapy, or in the setting of severe metabolic derangement [9].

Methylene blue

Methylene blue, or methylthionium chloride is a thiazine dye which has various uses. Commercially it is used as a redox indicator, a simple dye or as a treatment for various fish infections [10]. It can be bought on its own, or in some countries is added to rubbing alcohols in house-hold (or industrial) cleaning agents. Given its antimicrobial properties, methylene blue is often added to ethanol, to enhance any disinfectant effects. Clinically it can be used intra-operatively as a dye to identify certain structure or blockages, in the treatment of methaemoglobinaemia, or in the management of severe septic shock [10].

Methylene blue facilitates the conversion of methaemoglobin to haemoglobin in cases of methaemaglobinaemia. This process involves reduction by methaemoglobin reductase and Nicotinamide Adenosine Dinucleotide Phosphate (NADPH). This leads to leukomethylene blue formation, which reduces methaemoglobin to

haemoglobin [11,12]. Glucose-6-Phosphate Dehydrogenase (G6PD) is required for NADPH generation [11,12].

Methylene blue toxicity

Methylene blue ingestion is relatively uncommon, however accidental ingestion when added to rubbing alcohols or other over the counter industrial products has been known to occur. There have been no cases of serious toxicity reported following oral ingestion of methylene blue [10].

Oral bioavailability of methylene blue is around 75%, however this figure is noted to be variable [10]. Peak concentrations of methylene blue after oral administration are reached after 1-2 hours, whilst the elimination half-life is noted to be anywhere from 5-27 hours [10,12,13].

Methaemaglobinaemia can occur following IV administration of methylene blue. Features of methylene blue toxicity and methaemaglobinaemia include cyanosis, lethargy, headache, confusion, dizziness and sweating. These features can progress to cause arrhythmias, syncope, dyspnoea, central nervous system depression, convulsions and eventual coma [10]. Methaemaglobinaemia causes a characteristic normal PO₂ on arterial blood gas reading, with a low peripheral oxygen saturation (normally 80-90%) [10]. At high doses, methylene blue can lead to haemolytic anaemia and formation of Heinz bodies, independent of concurrent methaemaglobinaemia [10].

Management of methylene blue toxicity

The use of methylene blue for the treatment of methaemaglobinaemia secondary to methylene blue is contraindicated, and is not recommended as a treatment option.

Although there have been no serious cases of toxicity following oral ingestion of methylene blue, it is essential to follow the basic steps when presented with a possible methylene blue toxicity [10]:

- **Airway management and oxygenation:** Ensure airway patency and provide supplemental oxygen in symptomatic patients. In severe cases of methaemaglobinaemia, endotracheal intubation may be necessary to maintain proper oxygenation or in response to a low GCS [10].

- **Monitoring and supportive care:** Full haemodynamic monitoring, with close monitoring of vital signs. Perform a 12 lead ECG, and check rhythm, QTC and QRS duration. Check blood glucose for hypoglycaemia and treat if low. Perform neurological observations, with particular attention to pupillary size and ankle clonus.
- **Blood tests:** Check blood glucose, FBC, UEC, CMP and ABG.
- **Methaemaglobinaemia:** Methylene blue is contra-indicated in methylene blue induced methaemaglobinaemia. In these cases, exchange transfusion or transfusion of packed red blood cells may be necessary [10].
- **Hypotension:** Early treatment with IV fluids for hypotension. If blood pressure is resistant to initial management, early Critical Care review is warranted for consideration of vasopressor support.

Case Report

A 38 year old male was found with a reduced level of consciousness, following reports of intentional and recreational ingestion of around 500 mls of a sanitary alcohol, of a brand noted to be normally found in Romania. The brand in question contained ethyl alcohol (ethanol) 70% and methylene blue. His initial Glasgow Coma Scale was 8/15.

On review in the emergency department, his airway was patent, and his oxygen saturations were 94% on room air. He was warm and well perfused, with normal haemodynamics. His Electrocardiogram (ECG) showed normal sinus rhythm, with a QTc of <450 ms. The patient's abdomen was soft and non-tender, and there was no evidence of any long bone fractures. Glasgow Coma Scale at the time was initially noted to be 8/15 with a blood glucose of 5.9, however he became intermittently agitated in the emergency department, and was given sedation with anxiolytics.

The Emergency Medical team opted to not treat the above patient with activated charcoal and gastric lavage, given the rapid rate of absorption of ethanol from the gastro-intestinal tract. A CT brain was performed which did not show any evidence of acute intra-cerebral haemorrhage or subdural haemorrhage. His biochemistry showed the following results:

| |
|--|
| - ABG: PH 7.43, PCO2 36.1, PO2 91.8, HCO3- 24, BE 1.2 |
| - Lactate 2.8 |
| - Hb 136 g/l, WCC 6.3 x 10 ⁹ /l, platelets 121 x 10 ⁹ /l / neutrophils 3.0 x10 ⁹ /l |
| - Ca ²⁺ 1.97 mmol/l, Mg ²⁺ 0.9 mmol/l, phosphate 1.87 mmol/l |
| - Na ⁺ 145 mmol/l, K ⁺ 3.7 mmol/l, Creatinine 76 mmol/l, urea 3.5 mmol/l |
| - Bilirubin 12 umol/l, ALT 106 unit/l, ALP 87 unit/l |
| - CRP 8 mg/l |
| - Blood ethanol level 260 mg/dl |
| - Urinary drugs screen: +ve cannabinoids |

He was subsequently admitted to intensive care for observation and for supportive management. He was treated with IV thiamine 300 mg TDS, IV fluids and chlordiazapoxide for alcohol withdrawal. His haemodynamics and biochemistry remained stable and within normal range. He did not show any clinical or biochemical signs of methaemoglobinaemia, and did not suffer from convulsions or serotonin syndrome. The presenting patient was discharged from intensive care after a period of 24 hours monitoring.

Discussion

In accordance with our research and literature review, our case report did not delineate any explicit treatment necessity for the oral ingestion of substances containing methylene blue.

In patients where potential oral ingestion of methylene blue is suspected, it is imperative to execute all requisite foundational measures for a comprehensive medical assessment, aiming to discern any untoward manifestations or indicators of methylene blue toxicity. Should the clinician harbour concerns regarding methylene blue toxicity, the predominant therapeutic approach is supportive, entailing the adept management of ensuing complications within an appropriate medical milieu, such as a critical care unit.

In accordance with prevailing norms in medical practice, diagnosing ethanol intoxication as the aetiology of altered mental state and agitation follows a paradigm of exclusion. Regardless of the blood alcohol level, alternative causes for altered mental status and agitation necessitate meticulous exploration. This includes the systematic elimination of hypoglycaemia, sepsis, hypothermia, hypoxia, head injury, or pronounced metabolic derangements.

Conclusion

The patient achieved complete recovery subsequent to the ingestion of ethanol 70% and methylene blue. Notwithstanding the irritant properties inherent in the aforementioned substances, such ingestions mandate a regimen of supportive measures for ethanol intoxication, as delineated earlier. Concurrently, it is imperative to undertake an exhaustive exclusionary process targeting other potential contributory factors and to maintain vigilant monitoring for any indicators suggestive of methylene blue toxicity.

References

1. Atluri P, Vasireddy D, Malayala SV. Toxic Alcohol Ingestion: A Case Report and Review of Management Pathways. *Cureus*. 2021 Feb 3;13(2):e13092. doi: 10.7759/cureus.13092. PMID: 33728115; PMCID: PMC7934107.
2. Lieber CS. Alcoholic fatty liver: its pathogenesis and mechanism of progression to inflammation and fibrosis. *Alcohol*. 2004 Aug;34(1):9-19. doi: 10.1016/j.alcohol.2004.07.008. PMID: 15670660.
3. ToxBASE. UK National Poisons Information Service. 2023.
4. Lahood A, Kok J. USA Stat Pearls Publishing. 2023.
5. Lieber CS. The discovery of the microsomal ethanol oxidizing system and its physiologic and pathologic role. *Drug Metab Rev*. 2004 Oct;36(3-4):511-29. doi: 10.1081/dmr-200033441. PMID: 15554233.
6. Mirijello A, Sestito L, Antonelli M, Gasbarrini A, Addolorato G. Identification and management of acute alcohol intoxication. *Eur J Intern Med*. 2023 Feb;108:1-8. doi: 10.1016/j.ejim.2022.08.013. Epub 2022 Aug 16. PMID: 35985955.
7. Morgan MY. Acute alcohol toxicity and withdrawal in the emergency room and medical admissions unit. *Clin Med (Lond)*. 2015 Oct;15(5):486-9. doi: 10.7861/clinmedicine.15-5-486. PMID: 26430192; PMCID: PMC4953238.
8. Dixit D, Endicott J, Burry L, Ramos L, Yeung SY, Devabhakthuni S, Chan C, Tobia A, Bulloch MN. Management of Acute Alcohol Withdrawal Syndrome in Critically Ill Patients. *Pharmacotherapy*. 2016 Jul;36(7):797-822. doi: 10.1002/phar.1770. Epub 2016 Jun 30. PMID: 27196747.
9. Roberts DM, Yates C, Megarbane B, Winchester JF, Maclaren R, Gosselin S, Nolin TD, Lavergne V, Hoffman RS, Ghannoum M; EXTRIP Work Group. Recommendations for the role of extracorporeal treatments in the management of acute methanol poisoning: a systematic review and consensus statement. *Crit Care Med*. 2015 Feb;43(2):461-72. doi: 10.1097/CCM.0000000000000708. PMID: 25493973.
10. ToxBASE. UK National Poisons Information Service. 2023.
11. Kotalayi WM, Silberstein P. Methemoglobinemia. In: Enna SJ,

- Bylund DB, editors. XPharm: The Comprehensive Pharmacology Reference. Elsevier; 2007. p.1-5.
12. Garza F, Kearney TE. Methylene Blue. In: Olson KR, Anderson IB. Poisoning & Drug Overdose. 7th ed. McGraw Hill; 2018. p.3-49.
13. Walter-Sack I, Rengelshausen J, Oberwittler H, Burhenne J, Mueller O, Meissner P, Mikus G. High absolute bioavailability of methylene blue given as an aqueous oral formulation. Eur J Clin Pharmacol. 2009 Feb;65(2):179-89. doi: 10.1007/s00228-008-0563-x. Epub 2008 Sep 23. PMID: 18810398.

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