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Differences in Methanol Intoxication Patient Outcomes in First Admission and Re-admission: A Case Report

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ABSTRACT

"*Oplosan* Liquor" is an Indonesian term that refers to illegally made alcoholic beverages created by mixing ethanol or alcohol with other ingredients. The ethanol content in these beverages is uncontrolled and can pose a significant threat to human health. Consuming *oplosan* liquor with high levels of ethanol can cause alcohol poisoning and, in extreme cases, death. Methanol intoxication can impact patient outcomes, influencing factors such as appropriate treatment, adequate medical and psychological support, and the patient's ability to avoid future methanol exposure. Differences in outcomes exist between patients mitted for the first time and those experiencing readmission. This case report aims to elucidate the unique distinctions in patient outcomes between those admitted for the first time and those readmitted after methanol intoxication. Materials and Methods: This case report describes an instance that occurred in the same patient, detailing their medical history, clinical symptoms, diagnostic tests, and treatment provided during their stay in the emergency department. Variances in outcomes were observed between two patients, with one succumbing to the effects and the other managing to survive. We share our experience in treating a patient with methanol intoxication during their initial admission and subsequent readmission to a hospital in Indonesia. Indonesian people are acquainted with a drink called "*Oplosan* Liquor," which is fermented to achieve an alcohol content of up to 90%. This beverage is consumed by many young people who lack knowledge about the use of alcoholic beverages.

Keyword: Alcohol, Adolescent, Methanol intoxication, *Oplosan* liquor, Patient

1. Introduction

Methanol poisoning occurs when a person is exposed to or consumes an excess of methanol (Drennan et al., 2020). Methanol, a clear liquid used as a fuel, solvent, and industrial chemical (Liu et al., 2023) can also be present in illegal or unregistered alcoholic beverages, leading to serious poisoning (Arslan et al., 2015).

According to data from world health organization (WHO)((WHO), 2019), methanol poisoning is a significant global public health issue. It is estimated that there are thousands of cases of methanol poisoning every year, with the majority occurring in developing countries where illegal or unregistered alcoholic beverages are still commonly consumed (WHO), 2019).

Methanol poisoning in developing countries poses a severe health problem. Methanol, also known as methyl alcohol or CH_3OH, is a clear, colorless, and volatile liquid widely used in commercial and industrial settings, as well as in products such as paint removers, varnishes, some brands of cologne and perfume, and even contaminated whiskey (Algahtani et al., 2018). The amount of methanol that can lead to toxicity ranges from 15-500 ml of a 40% solution to 60% pure methanol. The risk of methanol toxicity increases in the presence of low tetrahydrofolate, thereby affecting the metabolic rate (Kraut & Kurtz, 2008).

"*Oplosan* Liquor" is an illegal alcoholic drink produced in Indonesia by blending ethanol or alcohol with other ingredients (Heryawan, 2021). However, its ethanol content is uncontrolled and poses significant dangers to human health (Uddarojat, 2016). *Oplosan* liquor gained popularity in Indonesia due to economic factors, as it is cheaper than legal alcoholic beverages (Heryawan, 2021).

Lack of knowledge and proper attitudes towards alcohol consumption and its dangers can lead people to consume *oplosan* liquor (Sudhinaraset et al., 2016). Additionally, psychological factors such as the desire to socialize and experience euphoria or pleasure can also influence individuals to consume *oplosan* liquor (de Wit & Sayette, 2018).

Methanol is metabolized in the liver to formaldehyde and formic acid, leading to metabolic acidosis (Nugrahanti et al., 2020). The accumulation of formic acid in the blood can cause damage to various organs, including the eyes, kidneys, and central nervous system. The initial symptoms of methanol toxicity may include headaches, dizziness, nausea, and vomiting, which can progress to visual disturbances such as blurred vision, blindness, or visual hallucinations (Can & Kirci, 2017).

If methanol toxicity is left untreated, it can result in more severe symptoms such as seizures, coma, Acute Kidney Injury (AKI), shock, and multi-organ failure (Chang et al., 2019). Therefore, it is crucial to seek medical attention immediately if methanol toxicity is suspected. This article reports cases of methanol poisoning and their initial treatment to reduce mortality.

2. Methods

This case report details an incident involving a patient, encompassing their medical history, clinical symptoms, diagnostic tests, and the treatment administered during their stay in the emergency department. The case was documented at the Emergency Department of PKU Muhammadiyah Yogyakarta.

Case 1

A 39-year-old patient, Mr. N, was brought to the emergency room by ambulance in a state of reduced consciousness, registering a Glasgow Coma Scale value of 3. The initial anamnesis in the emergency room revealed that the patient had recently consumed 'moonshine' alcohol. A comprehensive assessment was conducted, yielding the following results: gurgling (+), sputum (+), respiration rate 29 times a minute, SpO_2: 85%, blood pressure 90/60 mmHg, pulse rate times a minute, and temperature 35°C. Both pupils were reactive to light. The initial treatment involved fluid resuscitation and gastric lavage in the emergency room. However, the patient's condition significantly deteriorated, leading to their transfer to the Intensive Care Unit (ICU). The latest electrolyte lab results indicated Creatinine 3.7 U per liter, Na: 137 mmol per liter, K: 3.7 mmol per liter, Cl: 109 mmol per liter, and urea 118 mg per dl. Based on these results, the patient underwent hemodialysis (HD) therapy. The patient remained in the ICU for 12 days, undergoing HD four times. On day 13, the patient was transferred to a standard treatment room and discharged on day 16.

Case 2

Three months later, the patient returned to the emergency room with the same diagnosis: methanol poisoning. The study found a decrease in consciousness to GCS 3, accompanied by respiratory failure. Emergency room intervention included CPR, fluid resuscitation, and the placement of an endotracheal tube (ET) and ventilator. Laboratory examination results showed leukocytes at 16.7 ul, Urea: 164 mg per dl, Creatinine: 4.1 U per Liter, Na: 127 mmol per liter, Cl: 108 mmol per liter, K: 6.2 mmol per liter, SGOT: 157 units per liter, SGPT: 106 units per liter, Bill indirect: 2.1 mg per dL, Bill direct: 0.8 mg per dL, Bill total: 2.9 mg per dL, AGD pH: 7.157, PCO2: 31.8 mmHg, PO2: 163 mmHg, HCO3: 11.3 mEq per Liter, BE: -17, and SpO2: 78%. Once the patient's condition stabilized, they were transferred to the ICU for hemodialysis (HD) treatment. However, a day later, the patient experienced a cardiac arrest and was pronounced dead.

3. Discussion

Methanol is well absorbed in the gastrointestinal tract, with peak levels reached within 30-90 minutes, and a serum half-life ranging from 14-20 hours (Brent et al., 2001). The volume of methanol distribution is 0.6-0.7 liters per kg, and it is primarily eliminated through liver metabolism, with only 2-5% excreted through the kidneys (Algahtani et al., 2018). Toxicity arises from the formation of formaldehyde and formic acid through liver alcohol dehydrogenase (Pereska et al., 2021).

For patients experiencing methanol poisoning, it is crucial to provide immediate relief to prevent further organ damage and reduce mortality. The principles of managing methanol poisoning cases involve initial resuscitation, support for cardiopulmonary function, correction of acidosis, prevention of the formation of metabolic toxins, and acceleration of the disposal of the parent composition and resulting metabolic toxins (Yun Jufan et al., 2016). Treatment options include administering metabolic inhibitor drugs, gastric lavage, or hemodialysis (HD) (Gautam et al., 2022).

Gastric lavage, as a treatment measure for 'moonshine' alcohol intoxication patients, is most effective in the first few hours post-poisoning (Pereska et al., 2021). The optimal window for administering gastric lavage is within 30-60 minutes after methanol ingestion. However, another study demonstrated that gastric lavage remained effective within the first 6 hours after methanol consumption (Kraut & Kurtz, 2008). The procedure is typically performed once the patient's resuscitation is complete, and they are in a stable condition (Guillaume et al., 1987). Gastric lavage can be conducted using saline and specific agents to irrigate the entire intestine (Pravinson et al., 2021). This intervention is indicated in cases of alcohol intoxication and has proven to be 33% effective in improving poisoning outcomes, especially when accompanied by the risk of aspiration, epistaxis, upper respiratory tract disorders, esophageal and gastric perforation, pneumothorax, and arrhythmia (Pravinson et al., 2021).

Upon the patient's arrival at the emergency room, gastric lavage is initiated as an effort to clear the stomach of remaining toxic substances, preventing continuous methanol absorption. However, despite gastric lavage, the patient's condition did not improve, leading to their transfer to the Intensive Care Unit (ICU) for more intensive treatment. This lack of improvement is likely attributed to the extended time interval between the patient's methanol consumption and the administration of gastric lavage. Unfortunately, this case did not investigate the specific time gap between methanol consumption and the gastric lavage procedure.

The subsequent treatment is hemodialysis (HD), which is one of the therapies used to eliminate methanol and correct metabolic poisoning due to methanol in the blood, thereby addressing acid-base disorders. Individuals experiencing moderate concentrations of methanol poisoning (80 mg per dL or 2.5 mmol per L) are treated with fomepizole alone[9]. In this case, the results of the electrolyte lab examination showed BUN: 27.3 mg per dl, Creatinine: 3.7 U per L, Na: 137 mmol per L, K: 37 mmol per L, Cl: 109 mmol per L, and urea: 118 mg per dl. Some of these indicators suggested that the patient required HD therapy. Indications for HD therapy in methanol poisoning patients are similar to conditions of metabolic acidosis: pH <7.25, anion gap >30 mEq per liter, symptoms of organ damage (visual, CNS, renal abnormalities), worsening of vital signs (Drennan et al., 2020). Electrolyte abnormalities, and serum methanol levels exceeding >50 mg per liter (Nekoukar et al., 2021).

In the second re-treatment, the patient presented to the emergency room with a loss of consciousness accompanied by respiratory arrest. Respiratory arrest often serves as a terminal symptom occurring 6-36 hours after intoxication (Algahtani et al., 2018), indicating the possibility of the patient having an intoxication duration of ≥6 hours. Cardiopulmonary resuscitation (CPR) was performed following the American Heart Association Guideline (Drennan et al., 2020)

In this condition, gastric lavage was not performed as the initial focus was on respiratory resuscitation. The patient experienced respiratory arrest, leading to the administration of CPR, endotracheal tube (ET) installation, and the use of a ventilator. Furthermore, the patient underwent hemodialysis (HD) with laboratory result indicators: Urea 164 mg per dl, Creatinine 4.1 U per L, Na 127 mmol per L, Cl 108 mmol per L, K 6.2 mmol per L, AGD pH results at 7.157, and PCO2 at 31.8 mmHg.

Based on the case above, several possibilities could have caused the patient's death. First, the patient may have experienced Acute Kidney Injury (MMR), indicated by abnormalities in kidney lab results, along with the occurrence of metabolic acidosis. The mortality rate in patients with alcohol intoxication in hospitals was reported at 66.0%, primarily caused by AKI (Gautam et al., 2022). The main etiologies of MMR are ischemia, hypoxia, or nephrotoxicity, as well as endotracheal intubation. Subsequently, the patient underwent HD with such indicators.

The second possibility involves patients with respiratory and circulatory system failure (Thongprayoon et al., 2021). This can be observed from the laboratory results showing AGD pH 7.157, PCO2 31.8 mmHg, PO2

163 mmHg, HCO3 11.3 mEq per liter, BE -17, and SpO2 88%. Another study revealed that methanol poisoning induces severe symptoms in the central nervous system, primarily due to dysfunction of the Na-K pump. This malfunction of the Na-K pump also leads to cerebral edema and, in severe cases, cerebral hemorrhage (Thongprayoon et al., 2021).

The third possibility involves elevated potassium levels in the patient's blood, recorded at 6.2 mmol per L. Hypernatremia resulting from methanol poisoning induces hyperosmolarity, leading to the manifestation of severe head injury (Thongprayoon et al., 2021).

4. Conclusion

Symptoms in patients with methanol poisoning may manifest slowly due to methanol's efficient absorption in the digestive tract, with peak levels reached within 30-90 minutes and a serum half-life ranging from 14-20 hours. Symptoms associated with methanol intoxication include headache, vertigo, dizziness, multiorgan failure, seizures, and even death. Treatment for methanol poisoning includes the administration of metabolic inhibitor drugs, gastric lavage, or hemodialysis (HD).

In the first case, the patient lapsed into a coma and underwent gastric lavage before receiving HD. The patient's condition improved, leading to discharge.

In the second case, the patient experienced a coma accompanied by respiratory arrest and potential multiorgan failure. Treatment involved cardiopulmonary resuscitation (CPR), endotracheal tube (ET) installation, ventilation, and HD. Despite intervention, the patient's condition did not improve, resulting in death. This highlights the severity of the methanol poisoning, exacerbated by the patient's previous history of methanol poisoning.

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