

## Case Report

# Transdermal Methanol Intoxication

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Methanol is a clear liquid with high toxicity. Methanol intoxication may result from accidental exposure, overconsumption of compounds containing methanol with suicidal intent, or following consumption of distilled and contaminated alcoholic beverages. This report describes a case of transdermal methanol intoxication, which is a rare condition. A 58-year-old woman presented with nausea, vomiting, weakness, diplopia and dizziness. On neurological examination, she only had diplopia. On physical examination, a hyperemic lesion with clear borders was found over the right knee. The patient's recent medical history revealed that four days prior to the onset of symptoms, she had covered her knee with a methanol-soaked bandage in an attempt to alleviate her knee pain. She had a high osmolar gap as well as high anion-gap metabolic acidosis (HAGMA). Methanol intoxication was suspected due to HAGMA and high osmolar gap. Serum methanol levels were subsequently measured and found to be 37.9 mg/dL. The patient was treated with intravenous (IV) bicarbonate, IV ethyl alcohol and hemodialysis. She was discharged with no central nervous system or ophthalmologic sequelae. Methanol poisoning should be kept in mind in patients with diplopia and unexplained metabolic acidosis. Although most methanol intoxication cases occur after oral ingestion, it should be considered that methanol poisoning may occur transdermally.

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**Introduction**

Methanol (methyl alcohol, CH<sub>3</sub>OH) is a highly toxic, clear liquid.<sup>1</sup> It is a component of solvents, varnishes, paint removers, antifreeze solutions, cologne, perfumes and fuel.<sup>2</sup> Methanol poisoning may result from accidental exposure, overconsumption of compounds containing methanol with suicidal intent, or following consumption of distilled and contaminated alcoholic beverages. The presentation of methanol poisoning includes headache, visual disturbance, nausea, vomiting, weakness, high anion-gap metabolic acidosis (HAGMA), high osmolar gap and central nervous system depression leading to respiratory failure.<sup>2-4</sup> Stupor, coma, or even death can develop following high dose methanol intake.<sup>2</sup> Here, we report an unusual case of transdermal methanol intoxication. Few previous reports of transdermal methanol intoxication have been recorded in the literature.

**Case Report**

A 58-year-old woman presented with nausea, vomiting, weakness, diplopia and dizziness. Her vital signs were as follows: blood pressure of 140/70 mm Hg, core temperature of 36.3°C, heart rate of 56 beats per minute, and oxygen saturation of 96%. On neurological examination, she only had diplopia, and the Glasgow Coma Scale score was 15. On physical examination, a hyperemic lesion with clear borders was found over the right knee (Figure

1). The patient's recent medical history revealed that four days prior to the onset of symptoms, she had covered her knee with a methanol-soaked bandage in an attempt to alleviate her knee pain. Complete blood count and blood biochemistry parameters were normal. Metabolic acidosis was found in the patient: pH=7.19, anion gap=20 mmol/L and bicarbonate=15.3 mmol/L. The osmolar gap was 12. Methanol intoxication was suspected due to HAGMA and high osmolar gap. Serum methanol levels were subsequently measured and found to be 37.9 mg/dL. For the patient, intravenous (IV) bicarbonate and ethyl alcohol infusion were started via a femoral venous access.

Despite bicarbonate infusion, metabolic acidosis persisted (pH = 7.15 bicarbonate, 17.2 mmol/L, anion gap = 18). Hemodialysis was initiated. The patient was

**Figure 1.** Hyperemic Lesion Over the Right Knee.

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diagnosed with methanol poisoning and transferred to the intensive care unit. She was treated with IV ethyl alcohol for the next five days and two sessions of hemodialysis were performed during this time. After two sessions of hemodialysis, blood gas analysis indicated normalization of metabolic acidosis and methanol levels were measured at 0 mg/dL on the fifth day of IV ethyl alcohol treatment. The patient was discharged with no central nervous system or ophthalmologic sequelae.

### Discussion

Methanol is a potent central nervous system (CNS) depressant that can be highly toxic with excessive exposure via inhalation, ingestion, or transdermal absorption.<sup>1</sup> Even under ideal circumstances, methanol intoxication is associated with high risk of morbidity and mortality.<sup>4</sup> Visual loss, severe nausea and vomiting, headache, and weakness are characteristic symptoms of methanol intoxication. High dose methanol intoxication is associated with stupor and seizures and may ultimately result in coma or death.<sup>3</sup> The mechanism of methanol toxicity is indirect. Methanol is converted into formic acid in the liver.<sup>1</sup> The CNS is highly sensitive to formic acid toxicity, which inhibits cytochrome oxidase and blocks adenosine triphosphate production in mitochondria. The resulting axonal cell death causes histological hypoxia.<sup>2,5</sup>

The majority of published accounts of methanol intoxication address incidents of oral overconsumption; however, transdermal intoxication has been previously documented as rarely occurring.<sup>3</sup> Saturation of clothes and external garments with methanol has been known to cause percutaneous exposure.<sup>2</sup> Methanol-containing plants are sometimes used as analgesic and anti-inflammatory treatments for edema, sore throat, abdominal pain, and rheumatoid arthritis.<sup>1</sup> Complications resulting from methanol exposure during these practices are rare. The duration of application, the size and condition of the exposed skin, and individual variability in the skin may affect transdermal absorption of methanol.<sup>5</sup> In the present case, application of methanol to the knee for about four days caused intoxication. HAGMA, high osmolar gap and high serum methanol levels are clear indicators of methanol intoxication.<sup>3</sup>

Bicarbonate support is the primary treatment for methanol intoxication.<sup>3</sup> The affinity of ethyl alcohol for

alcohol dehydrogenase enzymes is 10-20 times greater than that of methanol. Therefore, fomepizole or ethyl alcohol supplementation can be used to decrease the metabolism of methanol into formic acid. Removal of toxic metabolites and correction of acidosis can also be achieved with hemodialysis. In hemodynamically unstable patients, hemodialysis is the preferred method of treatment.<sup>3,4</sup> In our case, metabolic acidosis persisted despite bicarbonate infusion; therefore, hemodialysis was initiated. After two sessions of hemodialysis, blood gas tests showed normal levels and on the fifth day of IV ethyl alcohol treatment, the blood methanol level was 0 mg/dL.

Methanol poisoning should be kept in mind in patients with diplopia and unexplained metabolic acidosis. Although most methanol intoxication cases occur after oral ingestion, it should be considered that methanol poisoning may occur transdermally.

### Authors' Contribution

ABO, MG and OP participated in conducting the practice and designing case report. SiG and SeG did literature research. ABO wrote the draft of the manuscript. All authors revised subsequent drafts of the paper. ABO prepared this manuscript for publication.

### Conflict of Interest Disclosures

The authors have no conflicts of interest.

### Ethical Statement

Written informed consent was obtained from the patient for publishing this case report.

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