

# METHEMOGLOBINÉMIE

Mgr., Bc. Michal Čečrle

- Kazuistika po aplikaci EMLA krému

# Případ 3,5 letého chlapce



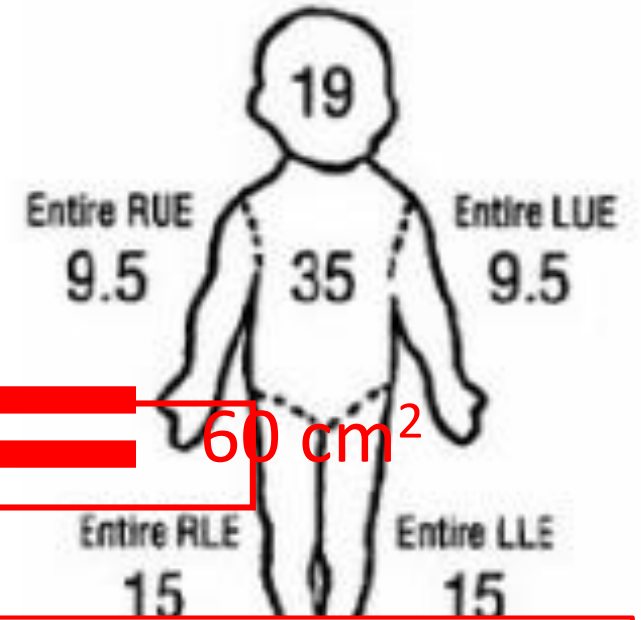
- Na dermatologickém odd. pro četná molusca téměř po celém těle indikován krém Emla (***lidocain + prilocain***)
- Aplikace (12:30) na velkou plochu (zabalen do potravinářské folie?) → celkové zarudnutí, výrazná spavost
- Hospitalizace 15:52 → Kontaktován TIS 17:42 – **spavý, šedofialový, saturace 85-89% na kyslíku**
- **MetHb nevyšetřen**, Astrup v normě
- Úprava stavu a dimise za 24h
- Terapie: Ventolin, oxygenoterapie až **7l/min**, Dexamethason supp., krystaloidy

# Dítě 3,5 let

6000 cm<sup>2</sup>  
Paediatrická populace

Tabulka 2 Paediatrická populace ve věku 0-11 let

Věková skupina	Výkon	Dávka a doba aplikace
	Menší výkony, např. před injekční aplikací a chirurgickou léčbou lokálních lézí.	Přibližně 1 g/10 cm <sup>2</sup> po dobu 1 hodiny (blíže viz příloha)
Novorozenci a kojenci 0-2 měsíce <sup>1) 2) 3)</sup>		Až 1 g a 10 cm <sup>2</sup>
Kojenci 3-11 měsíců <sup>1, 2)</sup>		1 g a 10 cm <sup>2</sup>
Batolata a děti 1-5 let		1 g a 10 cm <sup>2</sup>
Děti 6-11 let		1 g a 10 cm <sup>2</sup> po dobu 1-5 hodin <sup>6)</sup>
Paediatrická populace s atopickou dermatitidou	Před odstraňováním molusek	Doba aplikace: 1-5 hodin <sup>6)</sup>



Až 10 g a 100 cm<sup>2</sup> po dobu 1-5 hodin<sup>6)</sup> tj. 1,7%

<sup>1)</sup> U ~~do~~nošených novorozenců a kojenců do 3 měsíců se má v průběhu 24 hodin aplikovat po jednotlivých dávkách. U dětí od 3 měsíců a starších maximálně 2 dávky s odstupem nejméně 12 hodin v průběhu 24 hodin, viz body 4.4 a 4.8.

4800 cm<sup>2</sup>  
(tělo bez hlavy)

80%

**Tabulka 3 Nežádoucí účinky**

Třídy orgánových systémů	Časté	Méně časté	Vzácné
Poruchy krve a lymfatického systému			Methemoglobinemie <sup>1</sup>
Poruchy imunitního systému			Hypersenzitivita <sup>1, 2, 3</sup>
Poruchy oka			Iritace rohovky <sup>1</sup>
Poruchy kůže a podkožní tkáň			Purpura <sup>1</sup> , petechie <sup>1</sup> (zvláště po delší době aplikace u dětí s atopickou dermatitidou nebo mollusca contagiosa)
Celkové poruchy a reakce v místě aplikace	Pocit pálení <sup>2, 3</sup> Svědění v místě aplikace <sup>2, 3</sup> Erytém v místě aplikace <sup>1, 2, 3</sup> Edém v místě aplikace <sup>1, 2, 3</sup> Horkost v místě aplikace <sup>2, 3</sup> Zblednutí v místě aplikace <sup>1, 2, 3</sup>	Pocit pálení <sup>1</sup> Iritace v místě aplikace <sup>3</sup> Svědění v místě aplikace <sup>1</sup> Parestézie v místě aplikace <sup>2</sup> např. brnění Horkost v místě aplikace <sup>1</sup>	

<sup>1</sup> Kůže

<sup>2</sup> Sliznice pohlavních orgánů

<sup>3</sup> Bércový vřed

## 4.9 Předávkování

Vzácně byly hlášeny významné klinické projevy methemoglobinemie. Prilokain může ve vysokých dávkách zvyšovat hladiny methemoglobinu, zvláště u citlivých jedinců (viz bod 4.4), při příliš častém dávkování

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u novorozenců a kojenců ve věku do 12 měsíců (viz bod 4.2) a ve spojitosti s jinými látkami indukujícími tvorbu methemoglobinu (např. sulfonamidy, nitrofurantoin, fenytoin a fenobarbital). V případě zvýšené frakce methemoglobinu mohou pulzní oxymetry nadhodnocovat aktuální saturaci kyslíkem, což je třeba vzít v úvahu; proto může být v případech podezření na methemoglobinemii vhodné monitorovat saturaci kyslíkem CO-oxymetrií.

Klinicky závažnou methemoglobinemii je nutné léčit podáním pomalé intravenózní injekce methylenové modři (viz též bod 4.4).





## Prilocaine

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### *Methemoglobinemia*

Local anesthetics, most commonly benzocaine and **prilocaine**, can cause oxidation of hemoglobin and the formation of methemoglobinemia. [\[44\]](#)[\[45\]](#) Neonates are particularly at risk for methemoglobinemia as they have reduced concentrations of methemoglobin reductase. [\[46\]](#)[\[47\]](#)[\[48\]](#)[\[49\]](#) Oxygen therapy is indicated and methylene blue administration may be required to reverse this condition. [\[50\]](#)[\[51\]](#)

Observe patient for:

- Dyspnea

- Skin color changes

Measure methemoglobin concentrations:

- Co-oximetry (spectrophotometry)

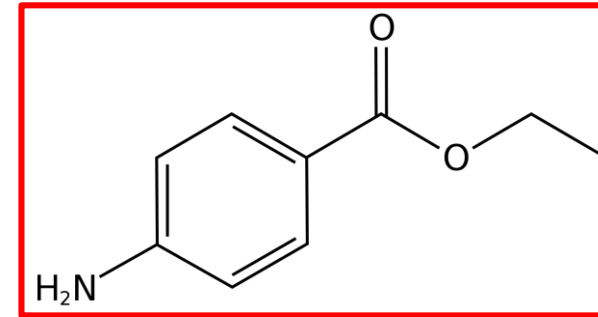
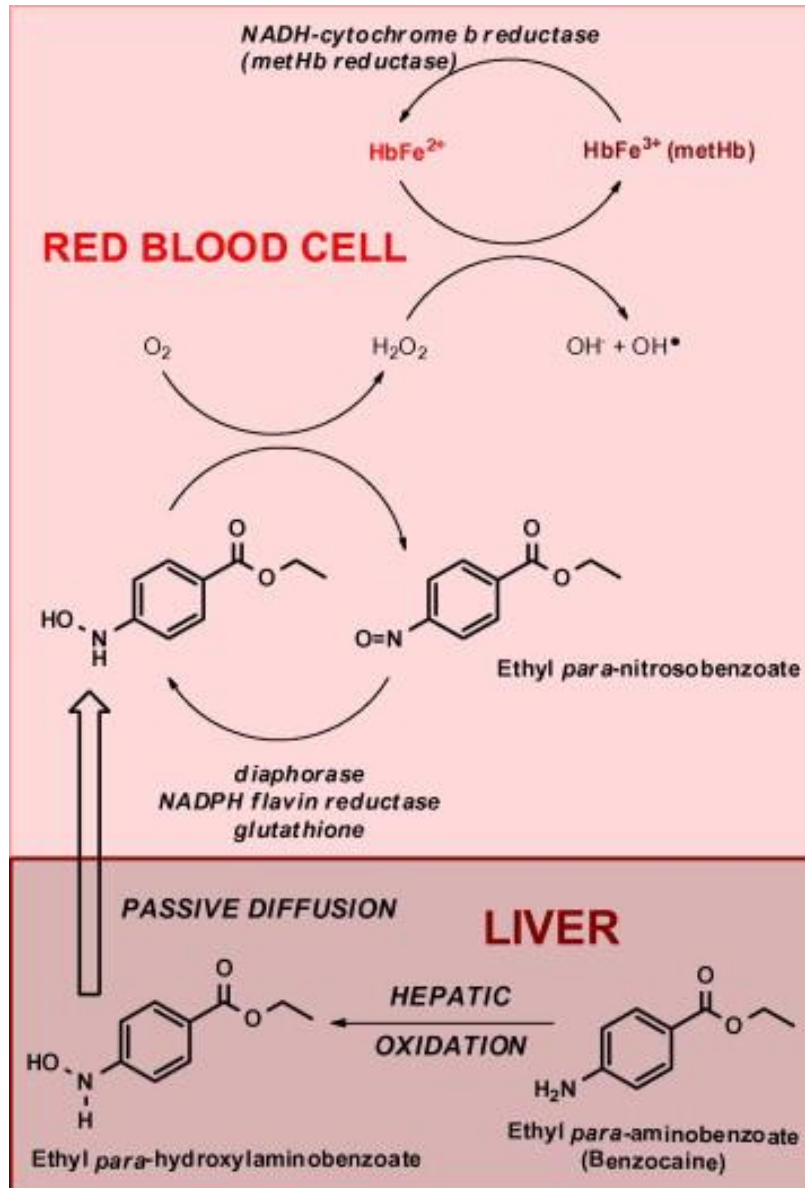
Note the following investigations may be inaccurate:

- Pulse-oximetry

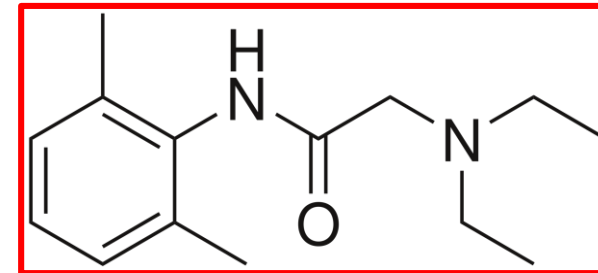
  - This investigation will indicate a significant concentration of methemoglobinemia only as a mild to moderate oxygen desaturation and cannot be used to determine percentage of methemoglobinemia.

- Blood gas analysis

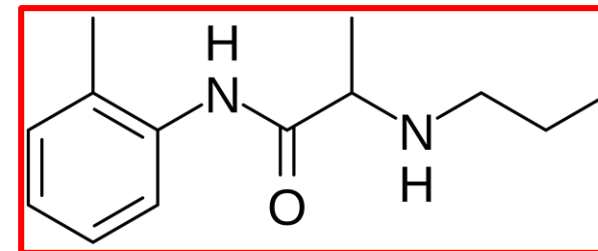
  - Most analyzers (without co-oximetry) will not detect methemoglobinemia, and show normal oxygen saturation since oxygen saturation in arterial blood gas is calculated from PaO<sub>2</sub> which is normal in methemoglobinemia. The difference between oxygen saturation from the pulse oximetry and the arterial blood gas is called oxygen saturation gap.



Benzocain



Lidokain



Prilokain

# MetHb – Stále aktuální (EAPCCT Kongres Mnichov 2024)

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POISON CENTRES AND CLINICAL TOXICOLOGISTS **EAPCCT** 2024 MUNICH

## Methemoglobinaemia resulting from intentional car exhaust fume inhalation

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**Background**  
Methemoglobinemia (MetHb) is an uncommon consequence of car exhaust fume inhalation. It is most likely from exposure to nitrogen oxides. However, it is thought to be less likely in petrol-powered cars with exhaust catalytic converters.

**Case Report**  
A previously healthy 45-year-old male with a history of depression treated with olanzapine and paroxetine was found unresponsive in his vehicle (2013 Mazda 6). A pipe was connected from the car exhaust into the cabin. He was exposed to exhaust gases for an unknown time. Bystander CPR was performed for unresponsiveness until paramedic arrival. On paramedic arrival, the patient was comatose and described as 'grey cyanosis' and cool peripheries.

**Discussion**  
This case parallels three previous reports since 1992 of acquired MetHb from car exhaust fume inhalation in individuals with no other causative factors. All cases observed similarly low COHb percentages despite high Methb after exhaust fume inhalation. Methb is a dyshemoglobinemia caused by oxidation of the iron component of heme, altering its charge from the ferrous (Fe<sup>2+</sup>) state to the ferric (Fe<sup>3+</sup>) state. This results in a leftward shift in the oxygen-haemoglobin dissociation curve, and a functional anaemia. Nitrogen Dioxides (NO<sub>x</sub>) are formed during the process fuel combustion with air. Petrol engines typically produce less NO<sub>x</sub> compared to diesel engines.

**Case Report (continued)**  
The patient was admitted to ICU and remained intubated for 36 hours. His Methb remained within normal limits after administration of methylene blue. He was extubated on admission day-3 which was complicated by delirium. He remained confused until day-6 of his admission, after which he was neurologically normal. The patient reported co-ingestion of 'street' benzodiazepines and pregabalin which were sourced online. He was discharged from ICU on admission day-7, and after remaining medically well was admitted to a private psychiatric facility on day-10.

**Chemical Reaction Diagram:**  
Inadequate CO to react with NO<sub>x</sub> → Damaged catalytic converter → ↑ NO<sub>x</sub>  

$$2CO + 2NO \rightarrow 2CO_2 + N_2$$

$$2CO + O_2 \rightarrow 2CO_2$$

$$H_2C + 3O_2 \rightarrow 2CO_2 + 2H_2O$$

**Figure 1:** Oxidation/reduction reactions in gasoline-powered internal combustion engine exhaust gases within a three-way catalytic converter.

**Table 1: Summary of relevant investigations**

Initial Methb%	32.8% (0 - 2.0%)
Methb% after methylene blue	1.9%
Initial COHb%	1.3% (0 - 2.0%)
Troponin I	5 ng/L (0 - 20ng/L)

**Table 2: Venous blood gas**

pH	7.26
CO <sub>2</sub>	72 mmHg
bicarbonate	32 mmol/L
Lactate	3.8 mmol/L

**Table 3: Methb: 32.8% (normal range 0 - 2.0%)**

**Table 4: Comprehensive urine drug screen**

Amphetamine	Not detected
Alprazolam	Not detected
Cannabis	Not detected
Diazepam	Not detected
Nonibuprofen	Not detected
Oxycodone	Not detected
Tamoxifen	Not detected
Riboflavin	Not detected
Olanzapine	Not detected
Paroxetine	Not detected

**Table 5: G-6-PD screen**

Normal	Normal
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**Table 6: Red cell Methb reduction (CYBSR)**

16.1 (12.9b - 18.9)	Normal
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## Navigating the blue abyss: successful treatment of extreme methemoglobinemia at 88.9% caused by intentional sodium nitrite poisoning

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**Objective**  
Sodium nitrite is used as a coloring agent, fertilizer, preservative in food and as an antimicrobial agent in meat products. Sodium nitrite intoxication is a common cause of severe methemoglobinemia (MetHb) and Methb levels of >70% are considered fatal (1). In this report, we describe the successful treatment of a case of severe Methb of 88.9% due to intentional sodium nitrite poisoning.

**Case report**  
A 20-year-old woman with a Glasgow Coma Scale (GCS) score of 3 was presented to the emergency department. At the time of the initial examination, the patient was cyanotic, with insufficient spontaneous breathing at 8 BPM rate with SpO<sub>2</sub> of 78%, BP 92/47 mmHg, HR 85 BPM was documented. Minutes later, the patient was intubated, and a drip of vasopressors started at 0.22 - 0.44 -> 0.66 (mcg/kg/min). Initial arterial blood gas analysis showed a pH of -7.4; pCO<sub>2</sub>-22.5 mmHg; pO<sub>2</sub>-47.3 mmHg; normal electrolytes; glucose-16.3 mmol/L, lactate 11.66 mmol/L and on Methb of 88.9% (normal range 0-2%). Life-threatening methemoglobinemia was diagnosed, a clinical toxicologist was contacted, and it was decided to start a methylene blue infusion (2mg/kg). Additional 7.5 g of ascorbic acid with 5% glucose solution was given. The patient was admitted to the Toxicology ICU for further treatment. After an hour of antidote treatment, Methb was 11.0%, and a few hours later it reached a normal range of 1.1%.

**When recovered, patient explained that on that day she drank a bottle of sodium nitrite for suicidal purposes after searching for information on the internet days before. As was later known, the patient had a history of depression and anxiety and was on sertraline. As she started having stomach cramps, nausea and general weakness, she informed her brother, who then called the ambulance. After almost a month in the ICU, the patient was moved to the psychosomatic ward, haemodynamically stable, spontaneously breathing and without any neurological deficit, for further psychiatric treatment.**

**Chemical Reaction:**  
$$Fe^{2+} + NO \rightarrow Fe^{3+} + NO^-$$

**Figure 1: Patients blood gas analysis**

Parameter	Value	Normal Range
pH	7.08	7.35-7.45
pCO <sub>2</sub>	22.5	35-45
pO <sub>2</sub>	47.3	80-100
SpO <sub>2</sub>	78%	94-98%
HR	85	60-100
BP	92/47	120/80

**Figure 2: Patients arterial blood sample**

**Figure 3: Patients urine after treatment**

**Conclusions**  
This case highlights the critical importance of rapid recognition and intervention in cases of life-threatening methemoglobinemia induced by intentional sodium nitrite poisoning. Severe methemoglobinemia may be fatal, therefore, accurate diagnosis of methemoglobinemia is very important so that specific antidote treatment can be started as soon as possible.

**References**  
1. Kōfobami K, Hayakawa M, Gando S. Severe Methemoglobinemia due to Sodium Nitrite Poisoning. Case Rep Emerg Med. 2016;2016:9013814.

## Sodium Nitrate poisoning with a fatal outcome

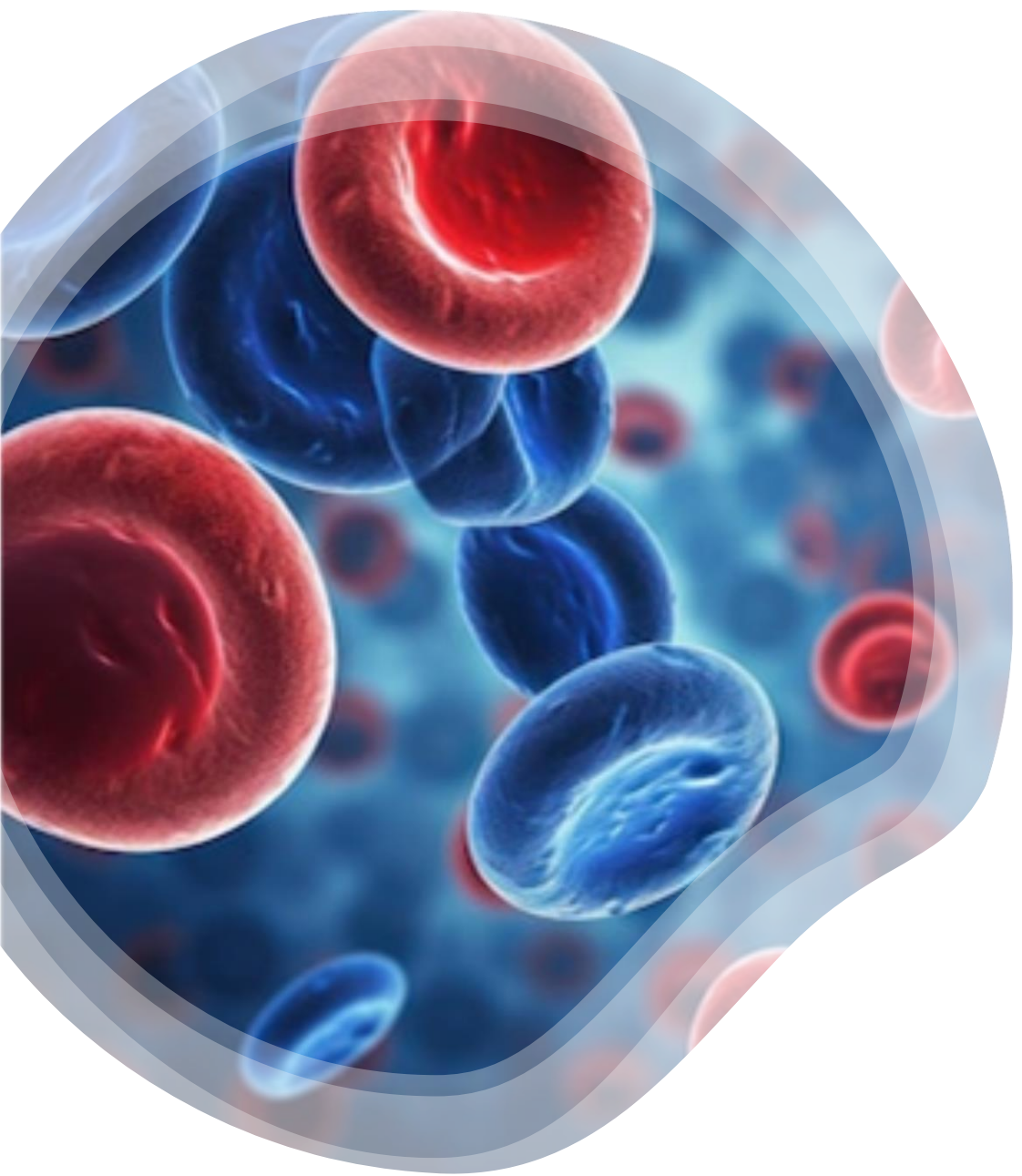
Piada Torcato, Álvaro Caldeiro-Benito, António F. Costa-Dreyfus, Filipa Costa-Hermoso, Raquel Soares, Sara Paes da Hora, Mariana Martins, Sara da Silva, Mariana Almeida, Mariana Soares, Mariana Soares, Mariana Soares

**Objective**  
Sodium nitrate serves as a food preservative and scalds of delirious ingestion have led to severe methemoglobinemia. Nitrites do not oxidize hemoglobin directly, but instead serve as an electron acceptor, which is then oxidized to methemoglobin. The majority of documented cases of sodium nitrate poisoning stem from intentional ingestion.

**Case Reports**  
A 23-year-old male required urgent medical attention after deliberate ingestion of 25 grams of sodium nitrate (only thought to be a suicide attempt). Upon arrival at the Emergency Department, the patient exhibited a pronounced cyanotic appearance of the skin and extremities. Full resuscitation through the endotracheal tube. At this point, he experienced severe cardiopulmonary arrest in the form of asystole. Blood analysis revealed elevated levels of sodium (155 mmol/L), potassium (6.1 mmol/L), ALT (GPT) (883 U/L), AST (GOT) (1826 U/L), prothrombin activity (41%), INR (1.88), and fibrinogen (143 mg/dL).

**Conclusions**  
In cases of sodium nitrate poisoning resulting in methemoglobinemia, hypoxia develops rapidly, is resistant to blood transfusion, and may not be present. Symptoms can range from cyanosis and dyspnea to a picture of respiratory shock. The severity of poisoning after oral ingestion of 7 mg of sodium nitrate. The severity of poisoning after oral ingestion of 7 mg of sodium nitrate. The severity of poisoning after oral ingestion of 7 mg of sodium nitrate. The severity of poisoning after oral ingestion of 7 mg of sodium nitrate.





*Tis*

Děkuji za pozornost