CLINICAL-EPIDEMIOLOGICAL ISSUES OF ACQUIRED CHILD METHEMOGLOBINEMIA

Letiţia-Doina DUCEAC1, Paula MERLUŞCĂ2, Ioana PĂVĂLEANU3, Maricica PĂVĂLEANU4, Cristina DOBRE5, Oana DARABĂ1, Simona NICHTITUS1, Igor VELENCIUC5, Cristina JITĂREANU1

1 Assist. Prof., PhD, „Academician Ioan Haulica” Institute of Researches, „Apollonia” University of Iasi, Romania
2 Univ. Assist., PhD Student, „Academician Ioan Haulica” Institute of Researches, „Apollonia” University Iasi, Romania
3 PhD student, Faculty of Dental Medicine, “Gr. T. Popa” University of Medicine and Pharmacy Iasi, Romania
4 Assoc. Prof., PhD, „Academician Ioan Haulica” Institute of Researches, „Apollonia” University of Iasi, Romania
5 Surgeon, CF General Hospital of Paşcani, Romania
Corresponding author: simonaratoi@yahoo.com

Abstract

Nowadays, intoxication with nitrates continues to represent an important aspect in child pathology. Methemoglobinemia symptoms appear when the human body is exposed to high amounts of toxic compounds. The aim of this work was to evaluate the main clinical, biological and development issues of affected patients hospitalized in a specialized clinic. Acquired methemoglobinemia cases of the “blue child syndrome” type are more frequent than inborn ones. The factors considered for the study were the environment from which patients came, a thorough clinical inspection, data on age, nutrition, methemoglobinemia values, other treatments followed, associated diseases and evolution prognosis. The conclusion of the investigation was that a low living standard, a poor health education, the climate, the presence of ground fertilizers and the type of nourishment determined a significant increase of methemoglobinemia patients.

Keywords: nitrates intoxication, methemoglobinemia, child, clinical issues.

1. INTRODUCTION

In the adult organism, dietary nitrate is converted to nitrite by the bacteria present in the mouth. In the acidic environment of the stomach, the ingested nitrite is converted to NO, where it has a protective effect by increasing blood flow and mucus production, and also by modulating the microbial flora of the GI tract. Ingested nitrite has also been related to improved cardiovascular function in adults. [1] Nitrate is ubiquitous in environmental media (air, water and soil) and other sources (some medicines, inorganic fertilizers and household chemicals). It is a hemoglobin-oxidizing agent that can cause methemoglobinemia.

Oral bacterial conversion of nitrate to nitrite in infants was either undetectable or markedly lower than the conversion rates of adults. Some researchers found out that no measurable reductase activity was found in infants within the first two weeks of life, despite the presence of oral nitrate reducing bacteria, such as Actinomyces odontolyticus, Veillonella atypica, and Rothia mucilaginosa. They concluded that relatively small nitrite amounts reach the infant gastrointestinal tract, due to the lack of oral bacterial nitrate reductase activity. Given the importance of the nitrate–nitrite–NO axis in adults, the lack of oral nitrate-reducing bacteria in infants may be relevant as to the vulnerability of newborns to hypoxic stress and gastrointestinal tract pathologies. [2]

The effect of nitrate on infants is well known, but less is known about nitrate-induced methemoglobinemia in young children. [3]

Methemoglobinemia represents a clinical-biological syndrome characterized by an over 2% increase of the methemoglobin level.

Acquired methemoglobinemia cases like “the blue child syndrome” are more frequent than the congenital ones. Methemoglobinemia symptoms appear when the human body is exposed to high quantities of toxic compounds, the enzymatic reduction abilities being out of proportion.

Nitrite is an intermediary product in bacterial nitrification and dentrification process in the nitrogen cycle, being commonly present as a contaminant in aquatic environments. [4,5] Nitrite concentration in natural water is tipically lower
than 1 μm. [6] A high nitrite concentration leads to oxidation of iron (Fe$^{2+}$) from oxyhemoglobin, to form (Fe$^{3+}$) methemoglobin. [7,8]

In order to evaluate the major issues of nitrite-intoxicated patients, a number of hospitalized children was investigated in a specialized clinic from the St. Maria Hospital of Iasi.

2. MATERIALS AND METHOD

A group of 141 patients (with ages between 0 and 2 years), hospitalized at the Toxicology Regional Center from St. Maria Hospital of Iasi, diagnosed with different symptoms of acquired methemoglobinemia, were considered for the study.

The study was conducted by retrospective evaluation of file records.

All patients were evaluated considering hospitalization reasons, origin, clinical inspection, age, nutrition, methemoglobinemia values, treatment, associated diseases, treatment evolution and healing prognosis.

3. RESULTS AND DISCUSSION

Warm weather determined a significant increase of rural origin patients hospitalized in the Toxicology Regional Center, the reason being the drinking water from fountains, and the groundwater polluted by fertilizers (Fig. 1).

Artificial nutrition or mixed diet favoured the installation of acquired methemoglobinemia in 70% cases. The 8% incidence of naturally fed infants was due to nitrites intoxication caused by the contaminated fountain water used for tea preparation, as shown in Fig. 2.

In most cases, around 97%, cyanosis was the main reason to request a medical consult for these patients, 68% of them presenting diarrheal disease and 60% vomiting.

Deficiency anaemia and protein malnutrition of various stages was met in 55%, respectively 56% of patients, which reflects the poor socioeconomic conditions and precarious healthcare.

The etiologic agent of acute diarrheal disease was identified in 31% of patients, C. jejuni being present in 22% of them (Fig. 3).
Infants poisoned with nitrates manifest clinically with cyanosis, dyspnoea, anxiety, palpitations and confusions. Furthermore, cyanosis becomes obviously at methaemoglobin levels in 10-15% of total haemoglobin.

Treatment of this condition consisted in administration of vitamin C and Methylene Blue.

4. CONCLUSIONS

The effects of nitrite exposure on haematological changes, namely increased level of methemoglobinemia, were investigated.

Nitrites intoxication, leading to oxidation of iron \( \text{Fe}^{2+} \rightarrow \text{Fe}^{3+} \) and high level of methemoglobin - which affects tissues oxygenation - continues to be a public health problem of our country, reflecting the low living conditions and the poor health education.

Several factors, such as reasons for hospitalization, origin, nutrition and other symptoms in patients presenting cyanosis on clinical examination, were taken into account.

References