INCIDENCE PARTICULARITIES OF METHEMOGLOBINEMIA CASES IN BACĂU COUNTY DURING 2000 – 2005 PERIOD

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Key words: child methemoglobinemia, water quality in the rural environment, descriptive epidemiologic study, prevention on the basis of an interdisciplinary documentation.

Abstract. The methemoglobinemia annual monitoring within the National Communitarian Health Program represented the support of the descriptive epidemiologic study of the medical cases in Bacau county, in 2000-2005 period, compared to former periods of time and to other Moldavian territories (Romania). On a decreased incidence background in the Romanian Eastern part of the territory, Bacau county maintains an incidence level of 2.0-5.3‰, with a slightly increased (and sometimes constant) tendency in Moldavia. The total of 161 cases registered in Bacau County, in 2000–2005 period, represents 19.1% of the cases in Moldavia. With descriptive aspects regularly met in cases of methemoglobinemia regarding gender, age, child’s alimentation, over half of them were produced because of exposure to nitrates quantity in water over 101 mg/dm determined by inadequate hygienic conditions of the fountains. The territorial distribution of the cases outlines the risk areas of the county, indicating, at the same time, the measures of the primary prophylaxis that must be taken. The actual documentation of the prevention strategy is still in deficit (the relation between the location of the fountains and the local relief, the hydrogeologic conditions, the actual geomorphologic processes, the spatial dwelling structure and the land use being completely ignored). The remedy, with a long term profit, consists of interdisciplinary actions, implying the fundamental and applied geographical research.

Introduction

The rural area of Bacau County is characterized by frequent nitrous substances pollution of drinkable water, representing – by the high number and the intensity of the pollutions – an increased risk in territory.

Thus, between 1984-1995, Bacau County joins among the Romanian territory within the 50–75% out of the increased nitrates concentration fountains, with a level which surpassed three times over the CMA in about 9% of the situations. (1)
At the same time, for a long period of time, Bacau County has characterized itself by an increased tendency of number of acute methemoglobinemia cases among newborn babies, so the county places between the Romanian territories with an incidence of 1–5 %. (2)

From the first description of an acute intoxication with nitrates at a baby, made by Comly in 1945, there have been a lot of clinic and epidemiologic proofs (our country included) concerning nitrous substances contamination of water and food, and the acute and chronic effects on health.

Over the Moldavia territory, annual pursue of acute methemoglobinemia cases being part of the activity of Health Ministry – National Communitarian Health Program, and as epidemiologic investigations concerning the long period effects of consuming contaminated nitrous substances water, it has been proved that in Bacau county there already existed characteristic features, and by knowing them they can constitute the support of some prevention and control measures in the territory.

These elements constituted the foundation of making a descriptive epidemiologic study of acute methemoglobinemia in newborn babies, in Bacau county, between 2000 – 2005, compared to former periods of time and to some other Moldavian territories.

1. Materials and methods

This study used as statistic unity the “hospitalized case” with certain diagnosis of acute nitrates intoxication, in 2000-2005.

Investigation sheet of the case – unitary at national level – includes:
- Identification data of the hospitalized patient: age, gender, place of residence.
- Data concerning the disease: diagnosis, evolution, treatment
- Exposure data: chemical and bacteriological quality of drinkable water consumed by the child, before the intoxication took place.

The results were processed by:
- the annual incidence rate per 1000 children, 0-1 year old, living in the patient’s place of residence;
- tendency;
- using statistic meaning indicators of frequency differences between various territories or periods - $\lambda^2$.

2. Results and discussions

Between 2000-2005, in 8 counties from Eastern Romania, there have been registered 844 cases of acute methemoglobinemia, 19.1‰ in Bacau County. This figure creates an annual incidence average rate on Moldavia of 2.68% with
The number of cases in Bacau county represents:

<table>
<thead>
<tr>
<th>YEAR</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>25.9</td>
</tr>
<tr>
<td>2001</td>
<td>29.8</td>
</tr>
<tr>
<td>2002</td>
<td>13.7</td>
</tr>
<tr>
<td>2003</td>
<td>15.5</td>
</tr>
<tr>
<td>2004</td>
<td>15.4</td>
</tr>
<tr>
<td>2005</td>
<td>24.2</td>
</tr>
</tbody>
</table>

Out of the total number of cases in Moldavia, in the same interval, the “contribution” of the county territories varies between 3% in Vrancea and Suceava and 34% in Iasi (figure 1).
Evolution of the cases meets 2 distinct stages: between 1996 – 2000 where there has been an increased tendency, and in the last 6 years where there has been a decreased tendency.

For the entire period of this last decade on the Moldavia territory the decreased trend of the case number is mentioned and Bacau County is included in this trend.
Incidence particularities of methemoglobinemia cases in Bacău county

Fig. 3 - The trend of methemoglobinemia cases between 1996 - 2005 period in Moldavia and Bacau county.

For the same period of time, the incidence level keeps the decrease trend for the Moldavia territory, but with a slight increase for Bacau County. (fig.4)

Fig. 4 - The trend of methemoglobinemia incidence in Moldova territory and Bacau county 1996 – 2005 period.

Comparing the annual incidence on counties, we observe that starting with 1999, in every transversal shot, Bacau county has an incidence level over the average of Moldavia, thus confirming the hierarchy of Moldavian territories, pointed out by some other former studies. Figure 5 reveals the situation in 1999, 2005 and for the total period.
In detail, descriptive analyse in Bacau county between 2000 and 2005 years registered 161 cases in 45 rural areas (over 65% in county localities) and Bacau and Onesti cities. In 6 years of this study it were produce a number of 1-2 cases (in 26 rural localities and 4 urban places) till 12 cases (Plopana) (fig. 6). These dates determined mean annual rates of incidence between 0,51‰ in Bacau, 1.64‰ in Girleni and 72.72‰ in Plopana (fig. 7).

We added chronologic and geographic criteria some personal aspects of cases:

- the equal percentage of diagnosed cases in all 4 quarters;
- around 9 at 10 cases were registered at age group less 3 months (fig. 8)
  - More than half of cases were boys
  - More than three fourths of infants were formula or breast and formula feeding (figure 9)
Incidence particularities of methemoglobinemia cases in Bacău county

Fig. 8 - Age distribution of methemoglobinemia cases during 2000 – 2005 in Bacau county and Moldavia

Fig. 9 - The type feeding frequency

- in 7/10 cases there has been a slight evolution of healing, in the same period, in Moldavia there have been several cases with severe forms and 3 deaths (0.4%).

<table>
<thead>
<tr>
<th>Clinic form</th>
<th>JUD. BACAU</th>
<th>MOLDOVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Easy</td>
<td>75.2%</td>
<td>46.9%</td>
</tr>
<tr>
<td>Average</td>
<td>9.3%</td>
<td>25.4%</td>
</tr>
<tr>
<td>Severe</td>
<td>15.5%</td>
<td>27.1%</td>
</tr>
<tr>
<td>Deaths</td>
<td>0.35%</td>
<td></td>
</tr>
<tr>
<td>ASOCIATION with Acute Diarrheic Disease</td>
<td>30.4%</td>
<td>30.8%</td>
</tr>
<tr>
<td>ASOCIATION with respiratory disease</td>
<td>9.3%</td>
<td>6.5%</td>
</tr>
</tbody>
</table>
The causality in relationship to water nitrates has been distinguished by some characteristic features of supplying with drinkable water.
- in 57.1% of the cases there were low depth public fountains, below 10 metres (56.4%); 19.9% were situated near the latrines and 44.1% have no elementary measures of sanitary protection.

The situation is even more unfavourable compared to other Moldavian territories, with just 30% out of sanitary unprotected fountains.

The nitrates quantity in the water at the moment the child falls ill is presented in table no.2

Tab. 2 - Distribution of methemoglobinemia cases on nitrates levels in well water samples in Bacau county, compared to Moldavia.

<table>
<thead>
<tr>
<th>CASES % NO3 MG/L</th>
<th>BACAU</th>
<th>MOLDAVIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 50</td>
<td>23.0</td>
<td>13.5</td>
</tr>
<tr>
<td>51-100</td>
<td>26.1</td>
<td>27.7</td>
</tr>
<tr>
<td>101-500</td>
<td>48.5</td>
<td>54.9</td>
</tr>
<tr>
<td>over 500</td>
<td>2.5</td>
<td>3.8</td>
</tr>
</tbody>
</table>

Tab. 3 - Distribution of Moldavia counties on methemoglobinemia cases in three different periods

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Areas without risk (E)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Areas with incidence rate &lt;1%o (D)</td>
<td>Vrancea</td>
<td>Vaslui</td>
<td>Suceava</td>
</tr>
<tr>
<td>Areas with incidence rate 1-5%o (C)</td>
<td>Bacau, Vaslui, Galati</td>
<td>Bacau, Neamt, Galati, Vrancea</td>
<td>Bc, Bt, Gl, Is, Vs, Vn, Nt</td>
</tr>
<tr>
<td>Areas with incidence rate 6-10%o (B)</td>
<td>Iasi</td>
<td>Iasi, Botosani</td>
<td></td>
</tr>
<tr>
<td>Areas with incidence rate +10%o (A)</td>
<td>Botosani</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

Data source: * Tanase Irina - ISP Bucuresti; ** Vasilov Marieta – ISP Iasi

From this point of view, the situation in Bacau is more favourable compared to the rest of Moldavia territory, the difference being obvious from the statistic point of view ($\chi^2=8.07$, GL = 3, p<0.05.)
Depending on the hierarchic criteria of the established territories through national level studies (2) and for the Moldavian territories (5) we mention the improvement tendency of the situation in the Moldavian counties, which nevertheless remain areas with risk, characterized by methemoglobininemia incidence of 1 – 5%. (table 3)

**Conclusions**

- Acute methemoglobininemia of the newborn babies represents the direct and dramatic effect of his/her exposure to nitrates contamination of the drinkable water.
- On a background of a decreasing trend of a number of cases and of the incidence in the last 10 years in Moldavia, Bacau County maintains a slightly increasing tendency of the incidence and it situates itself in an almost constant manner over the annual rate of the Moldavia incidence.
- Although, generally speaking, it manifests in easy forms and has a favourable evolution, towards clinical healing, acute methemoglobininemia of the newborn babies represents a public health issue, in Moldavia mostly, and particularly in Bacau county, closely linked to the environment element – drinkable water – which has an inadequate quality in the rural environment.
- The performed study indicated the increased risk areas in the county, so there must be carried out primary prevention measures.

**The need for an interdisciplinary approach**

The comparative analysis of the morbidity dynamics (tables no.2 and 3) and of the inner spatial variability (figures no. 5 and 7) of the methemoglobininemia in the Bacau county demonstrates the maintaining in this county of a high risk level, fact which imposes severe and immediate preventing measures.

But having in view, on the one side, the fact that the medical statistics is limited at the addressability based on some data (the number of hospitalized cases with a precise diagnostic) and, on the other side, the fact that the etiological reference is done exclusively on the analysis of the (fountain) drinking water, at least two other commonly neglected aspects, powerfully conditioning the organization and the efficiency of the preventing of sickness, should be taken into consideration:

a. the great amount of nitrates which appear in the new born children’ diet, although slightly under the maximum admitted concentration, may induce individual reactions, concretized in physiological adaptation efforts which apply
Fig. 6 - Teritorial distribution of those 161 cases in territories between 2000-2005 period

Fig. 7 - Level of incidence rate on territories between 2000-2005 period
Incidence particularities of methemoglobinemia cases in Bacău county
stresses to the respective organisms, reducing their vital capacity, even if the proper sickness doesn’t set in;

b. besides, the nitric pollutants infiltrated into the underground water, there are also other potentially polluted sources, involved in the daily diet: the foddering of milk producing animals with vegetal products obtained from fields fertilized with nitrates, their foddering with forage prepared on the basis of nitric preserving substances, some nitric substances used as food additives, swallowed and than transmitted my means of the mother milk and, finally, the nitric pollutants penetrating into the water distributed by means of centralized system after the exit of this water form the purification installations.

Even in the situation when the analysis is limited to the fountain water, as a pathogen factor, one may see also that the prevention organization of the methemoglobinemy is not based on a sufficiently complete documentation, the basic information being a post-factum realized premise. The quality of the water of the older fountains, as that of the newer ones is hardly tested by means of the declared sickness cases and the utility, so as the efficiency of the water use are let on the responsibility of the individual appreciations, these ones being generally completely incorrect: the sub/superficial waters (the most vulnerable) are considered “the best”, being exploitable by not too deep fountains.

In fact, the quality guarantee of the fountain water can be confirmed only by means of a correct zoning of the drinking conditions, conditions which can be appreciate after a complex of natural conditions (the superficial flow, the rata superficial flow- infiltration, the depth of the underground waters and their insured flow, the level oscillation and the lateral dynamics of the utile ground waters, the depth and stability of the superficial deposits, the micromorphology and the declivity of the ground) and socio-economic ones (the morphology of the human settlements, the house keeping level, the functional structure, the land use, etc)

With a purely geographic orientation, for the exclusively technical or medical approaches, such a type of documentation may seem useless specialized and detailed. But, so long the fountains will be open at random, in a complete ignorance about the subterraneous feeding and transfer circuits, so as about the positional relation of the water levels with the (urban and especially rural) superposed infrastructure, of the relations (half) natural feeding – consumption of the water levels etc., the preventing approach will not have other results than illusory ones. For the time being, the space is appreciated in an undifferentiated manner, by means of the number of the declared cases, at a level of a rural “commune”, which generally is formed by many villages. The variability of the fountain distribution on the area of the villages which form a commune, their depth
and their position related to the sanitary annexes (on the slopes, in the alluvial plains etc) are completely ignored.

If one has a sight even an only aspect of the geographical approach, strictly necessary in order to maintain the qualities of the water and to avoid some undrinkable sources, the *genetic zoning of the local relief*, in two of the communes having the highest incidence of sickness (10-15‰) – figures no. 10 and 11, a good knowledge of the utile locations is firstly necessary in order to prevent the methemoglobinemia is a complex action, which, between the earn and the realization must cover in a responsible manner the trajectory of the interdisciplinary research.

**References**


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