Serum magnesium concentration in drug-addicted patients

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Abstract. Drug addiction is a complex problem which leads to many somatic, psychic and social diseases. It is accompanied by the disturbed metabolism of various macro and micronutrients. The aim of this study was to assess serum magnesium concentration in drug-addicted patients and analyze whether Human Immunodeficiency Virus (HIV) infection and methadone treatment affect the level of serum magnesium in these patients. The examination was conducted in a group of 83 people – patients of Szczecin-Zdroje Psychiatric Hospital (Poland). They were 21 to 49 years old, and the mean age was 32 ± 7 years. The control group consisted of 81 healthy individuals. Flame atomic-absorption spectrometry method was used to determine the magnesium concentration. The total serum magnesium concentration was calculated for the whole patient group, subgroups of women and men, a subgroup of people infected with HIV, and a subgroup receiving methadone substitution treatment. How magnesium behaves depending on age and addiction period, was checked. The mean concentration of magnesium in blood serum of the patients examined was 0.57 mmol/L, which was significantly lower than in the control group. In the subgroup of men it was 0.57 mmol/L, and in the subgroup of women – 0.55 mmol/L; the differences were not statistically significant. In the patient group nobody had the appropriate magnesium concentration in blood serum. No significant correlation was found between the magnesium concentration, age of the patients and addiction period. In the subgroup of seropositive people the mean concentration of magnesium was 0.55 mmol/L, and in the subgroup of non-infected patients – 0.58 mmol/L; the difference was not statistically significant. The mean concentration of magnesium in the subgroup treated with methadone was 0.59 mmol/L, and in the subgroup not involved in this type of therapy – 0.55 mmol/L; it was not a statistically significant difference.

Key words: opiate abusers, magnesium, methadone, HIV infections

For many years drug addiction has been an issue on medical and psychological as well as legal and even political grounds. Drug abuse leads to many somatic and psychic diseases. One of the main problems is opioid addiction. In case of opiate-addicted individuals, drugs become their aim in life [1, 2]. This is why all their efforts concentrate on getting drugs, while other previously important values take second place.

An irregular lifestyle as well as wasting all energy on searching for drugs predisposes to eating disorders, and the drug itself disturbs neuroendocrine mechanisms regulating food intake [3]. Taking opioids for a long time ruins an organism and leads to progressive mental deterioration. Long-time addicts have many diseases associated with an improper diet and malnutrition resulting from neglected social and psychological needs.
material needs. Such health conditions may lead to the deficiency of some bioelements, including magnesium [1, 2]. Magnesium deficiency is involved in many diseases like metabolic and cardiac-circulatory disorders as well as neurological and neuromuscular problems [4, 5]. Citations in the literature suggest disturbed serum concentrations of magnesium, zinc and copper in drug-addicted people [6-9].

The aim of this study was to assess how long-lasting drug abuse influences serum magnesium concentration in opioid addicts and analyze whether Human Immunodeficiency Virus (HIV) infection and methadone treatment affect the level of magnesium in these patients.

**Material and methods**

Our study included 83 people addicted to psychoactive substances - 50 men and 33 women. All of them were patients of the Szczecin-Zdroje Psychiatric Hospital (Poland). They were 21 to 49 years old, and the mean age was 32 ± 7 years. Addiction period was 2 to 31 years, 12 years on average. Some patients started using drugs as early as age 11. In most cases multiple drug use was observed, and the most popular drugs were “black tar” or “Polish heroin” combined with psychotropic medications, solvents and alcohol. Less common drugs were amphetamine, contaminated (non-refined) heroin known in Poland as “brown sugar”, cannabinoids and LSD (lysergic acid diethylamide).

Because of their long-lasting addiction, the patients presented poor psychosomatic conditions and clinical examination revealed many additional ailments including signs of early or advanced stage of cachexy (36 cases), presence of HIV (43 cases) or hepatotropic viruses (52 cases), AIDS (3 cases), tuberculosis (3 cases), general mycosis as well as extensive and deep skin infections (6 cases). Some patients had neurological (11 cases) and mental disorders (6 cases). The control group was composed of 81 healthy individuals (48 men and 33 women) aged 23-45 (the mean age was 35 ± 8 years).

Total magnesium concentration was calculated for the whole control and patient groups, subgroups of women and men, subgroup of HIV-infected patients (43 patients) and subgroup subjected to methadone substitution therapy (49 patients). How the magnesium concentration changes depending on age and time of addiction was analysed.

As an example, we describe the methadone program in the city of Szczecin, which has a total population of 500,000. Methadone treatment in Szczecin started in late 1998 after several months of preparation. The program is designed for those opiate users who had previously experienced several attempts of treatment in rehabilitation centres, and also a number of attempts of quitting by means of home or hospital detoxification. The patients enrolled in this methadone program were mostly using “homebake”. Other forms of opiate addiction are rare, e.g. this program only had two patients using codeine and morphine respectively.

Patients visit the clinic daily for the prescribed dose of methadone. Doses are calculated individually by a psychiatrist and range between 20 and 150 mg daily, with a mean of 60 mg. The commercial methadone hydrochloride is in a solution containing sucrose, glycerine, sodium benzoate, lemon fragrance and distilled water.

The laboratory tests were done in Department of Biochemistry and Chemistry, Pomeranian Medical University in Szczecin (Poland).

Blood samples (5 mL each) were taken from the ulnar vein using a vacuum blood sampling system (Vacutainer). The material was centrifuged at 4,000 rpm. The serum obtained was stored at a low temperature until it was sent to the laboratory. Magnesium concentration was determined by flame atomic absorption spectrometry (PU 9100X, Philips, Cambridge, UK). Diluted serum samples were introduced directly into the flame. The samples were 1:80-diluted with lanthanum solution in hydrochloric acid. Analytical wavelength was 285.2 nm. Concentration values were read from the analytical curve.

All statistical analyses were done with Statistica for Windows PL. Quantitative variables were characterized by min. and max. values, arithmetic mean and standard deviation. The Shapiro-Wilk test was used to assess the distribution of the tested parameters. The significance of difference between two samples was assessed with the t-Student test for independent samples and its nonparametric equivalent - the Mann-Whitney test. Correlations were assessed using the Pearson correlation coefficient. p < 0.05 was accepted as the level of statistical significance.

**Results**

Results and the corresponding statistical analysis are reported in tables 1 and 2. The mean serum magnesium concentration in the addict group was 0.57 mmol/L. In the subgroup of men it was 0.57 mmol/L and in the subgroup of women – 0.55 mmol/L; the differences were not statistically significant.
Nobody in the patient group had the appropriate magnesium concentration in blood serum. In the control group, the mean magnesium concentration was significantly higher, i.e., 0.74 mmol/L (t-Student test, p < 0.001) (Table 1). No significant correlations were found between magnesium concentration, age of the patients and time of addiction (Pearson correlation coefficient).

Table 2 shows magnesium concentration in the subgroup of HIV-infected people, and subgroup of addicts receiving methadone substitution treatment. In the group of seropositive patients the mean magnesium concentration was lower, but it was not statistically different (0.55 mmol/L versus 0.58 mmol/L; t-Student test, p = 0.15). In the subgroup treated with methadone the mean magnesium concentration was insignificantly higher than in the group not involved in such a type of therapy (0.59 mmol/L versus 0.55 mmol/L; Mann-Whitney test, p = 0.08).

Discussion

In the group of drug-addicts a lower total magnesium concentration in serum was observed. Undoubtedly it was connected with an improper diet and malnutrition caused by neglected social and material needs [1, 10]. An important problem is the increase in magnesium loss caused by various symptoms accompanying abstinence syndrome such as persistent vomiting, diarrhea, excessive diuresis [4]. It is probable that, due to their direct effect on endocrine mechanisms involved in the water-electrolyte balance, the drugs themselves may lead to disturbances of the magnesium metabolism [11]. The literature referring to magnesium levels in groups of addicts is very scarce, and most authors noted significantly higher magnesium levels in this group of patients. It is worth emphasizing, however, that western authors’ research concerns clients addicted to pure heroin [11-14]. In Poland the main source of opium alkaloids is poppy opium from which “black tar” or Polish heroin is made. Together with the bad hygiene and material conditions of drug-addicts, it contributes to the specific picture of Polish opioid abuses [15].

Riuz-Matinez et al. [12] assessed magnesium concentration in serum and erythrocytes of heroin-addicted individuals. The mean serum concentration was 1.03 mmol/L and did not significantly differ from the level observed in the control group. The mean magnesium concentration in erythrocytes was similar in the two groups. Teichmann et al. [11] and Varela et al. [13] also noted a higher mean concentrations of magnesium in the addict group, but in agreement with our results, they observed significantly lower magnesium concentration in the addict group when compared to the control group. Also Italian researchers assessed magnesium concentration in a group of heroin addicts [14]. The mean magnesium concentration in this group of patients was 0.84 mmol/L. Daini et al. [14] also observed that the concentration of this element in serum can be considerably modified by co-existing psychiatric disorders.

**Table 1.** Magnesium concentration in blood serum in patient and in the control groups.

<table>
<thead>
<tr>
<th>Magnesium in blood serum [mmol/L]</th>
<th>n</th>
<th>mean</th>
<th>Min-max</th>
<th>SD</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient group</td>
<td>83</td>
<td>0.57</td>
<td>0.35-0.87</td>
<td>0.1</td>
<td>(+)</td>
</tr>
<tr>
<td>Control group</td>
<td>81</td>
<td>0.74</td>
<td>0.58-1.30</td>
<td>0.083</td>
<td>(+)</td>
</tr>
</tbody>
</table>

N = number of patients; min-max = range; SD = standard deviation; N = normal distribution (+) = yes; (-) = no; p = level of statistical significance between both studied groups. Normal range serum magnesium 0.8-1.05 mmol/L.

Table 2. Magnesium concentration in the blood serum in subgroups of patients constituted with respect to HIV-infection and methadone treatment.

<table>
<thead>
<tr>
<th>Magnesium in blood serum [mmol/L]</th>
<th>n</th>
<th>mean</th>
<th>Min-max</th>
<th>SD</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV (+)</td>
<td>43</td>
<td>0.55</td>
<td>0.35-0.72</td>
<td>0.09</td>
<td>(+)</td>
</tr>
<tr>
<td>HIV (-)</td>
<td>40</td>
<td>0.58</td>
<td>0.42-0.87</td>
<td>0.10</td>
<td>(+)</td>
</tr>
<tr>
<td>Methadone (+)</td>
<td>49</td>
<td>0.59</td>
<td>0.42-0.87</td>
<td>0.11</td>
<td>(-)</td>
</tr>
<tr>
<td>Methadone (-)</td>
<td>34</td>
<td>0.55</td>
<td>0.35-0.72</td>
<td>0.09</td>
<td>(+)</td>
</tr>
</tbody>
</table>

n = number of patients; SD = standard deviation; N = normal distribution; (+) = yes; (-) = no; p = level of statistical significance between both studied groups; n.s. = non significant. Normal range serum magnesium 0.8-1.05 mmol/L.
The highest magnesium concentrations were noted in the group of patients with co-existing depression, and the lowest ones in the subgroup of patients with anxiety neurosis and personality disorder.

Previous research conducted in Poland has suggested higher mean magnesium concentrations in the serum of drug-addicts. The research was carried out in the south-east part of Poland [16, 17]. Sadlik et al. [17] determined the concentration of the selected bioelements in blood serum in a group of 33 patients. The mean magnesium concentration was 0.85 mmol/L, and did not significantly differ from the concentration in healthy people (0.86 mmol/L). Pasternak et al. [16] also observed higher mean concentrations of magnesium in the addict group, and like Sadlik et al. [17], they did not find any significant differences in magnesium levels between the addict group and the control group. Our research conducted in the north-west part of Poland revealed significantly lower mean concentrations of magnesium in the group of drug-addicts. The observed differences may result from environmental conditions in these regions, concerning the availability of nutritional magnesium. It is supported by the fact that in the group of healthy people the observed mean magnesium concentrations were also lower than in general population. It agrees with previous observations suggesting that magnesium deficiency is common in this part of the country [4, 18].

Riuz-Matinez et al. [12] analysed changes in magnesium concentration related to the abstinence period and presence of additional factors that could modify magnesium concentration, such as HBV or HIV infection. Just as in our research, no significant differences were observed in magnesium concentration in the subgroup of HIV-infected patients. Thus, HIV infection does not seem to be a factor leading to hypomagnesemia. This conclusion is in agreement with the results of other authors [11, 13].

Methadone treatment is a widely recognized form of therapy for drug-addicts. It reduces the use of psychoactive substances, contributes to the improvement of patients’ somatic and mental conditions, and also leads to a better balance of many immunological and biochemical blood parameters [10, 19]. The present study, however, did not reveal significantly higher magnesium levels in the group of patients included in methadone programme. This result agrees with that of other authors who did not show significant increase in the magnesium levels of this group of patients, despite the observed considerable improvement of their state of nourishment [10, 19, 20]. It may be related to the influence of methadone, which, as a semisynthetic opioid, lowers magnesium concentration in serum [11].

Summing up, long drug abuse leads to many pathological states including hypomagnesemia. To improve the general health state, it is necessary not only to treat addiction itself, but also to change dietary habits and develop knowledge of proper nutrition.

Conclusion

The results obtained show that taking opioids for a long time may be involved in a decrease in magnesium concentration in blood serum. In the group of opioid addicts examined the interrelations were not found between magnesium concentration in blood serum, HIV infection and methadone treatment.

References


