Assessment of Serum Metallograms in Patients with Purine Urolithiasis Before and After Treatment

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ABSTRACT

Investigations on the homeostasis of the hydroelectrolytic metabolism is important in the assessment of the uroconcrements' biogenesis and of the therapeutic effects (based on diverse procedures).

Our investigations have been performed on patients with purine urolithiasis included in two groups, according to the applied treatment for the removal of the uroconcrements. A group included 23 patients who underwent surgical treatment and the other group included 18 patients treated with Extracorporeal Shock-Wave Lithotripsy (ESWL). Before and after the therapeutic procedure the serum metallograms of the main alkaline (Na, K) and alkaline-earth (Ca, Mg) metals were determined by using spectrophotometry. The obtained results revealed post-treatment changes in the serum metallogram as follows: increase of natriemia and calcemia; decrease of kaliemia and magnesiemia in both groups. The find data show the dyshomeostasis of the main alkaline and alkaline-earth metals after the treatment underlying their implication in urolithogenesis.

Keywords: serum metallogram, purine urolithiasis; ESWL and surgery treatment

INTRODUCTION

Metals are important components of the human organism which are neither produced nor destroyed by the organism and are present in our environment, i.e. food, water, air, soil.

In the investigation of urolithiasis not only the biogenesis mechanisms of concrements formation and problems related to their prevention, metaphylaxy and therapy, but also the quantum of metals in blood serum and biologic fluids are of great importance.

The homeostasis of the hydroelectrolytic metabolism presents a major interest because metals are compounds playing the role of starters in the urolithogenetic processes (Coe and Parks, 1988; Drăgan et al., 1994; Gârban et al., 1998; Kok, 2002). As known, in the first stage of the process –the heterogenous nuleation - the metals intervene and become fixed to inorganic, organic anions or organic compounds with negative polarity. In this way are formed the so called starters or primers which facilitate the precipitation of electrolytes (Matouschek and Huber, 1981).

Mineral compounds, generally, and metals particularly, in the human organism can be evaluated under various aspects presenting interest for physiology, biochemistry, morphology and, evidently, pathology.

From pathological point of view the approach of this problem ca be made in relation with patobiochemistry, physiopathology, respectively morphopathology.

In the organism the development of the normal physiological processes is conditioned by the maintenance of the biochemical homeostasis of the carbohydrate, lipid, protein and hydroelectrolytic metabolisms.

Lithogenesis, in general, is considered as a distrubance of the hydroelectrolytic metabolism, thus a dyshomeostatic phenomenon. To this one can add the dyshomeostasis of specific metabolites, e.g. oxalates, phosphates, urates, cystine, cholesterol a.o. (Coe and Park, 1988; Kok, 2002; Villegas et al., 2012).

The aim of this paper was to find out if the serum metallograms are or not disturbed by the applied treatment.

MATERIALS AND METHODS

Clinical cases. The initiated study have been made on two groups of patients with urolithiasis admitted to the Urological Clinic Timişoara. A group was formed by 23 kidney stone patients - surgically (SU) treated for the removal of calculi and the other group was constituted by 18 kidney stone patients treated with Extracorporeal Shock -Wave Lithotripsy (ESWL).

Clinical chemistry investigations. In the studied group of patients there were determined the concentrations of the main alkaline (Na, K) and alkaline-earth (Ca, Mg) metals in the serum, before and after the intervention. The concentration of the alkaline and alkaline-earth metals in serum and urine of kidney stone patients was studied before (48 hours) and after (72 hours) the treatment in order to find out the role and participation at the formation of concrements.Concentrations of Na and K were determined by flame photometry, of Ca by volumetric and of Mg by spectrophotometric method (Kaplan and Pesce, 2010). Details concerning this methods were presented in a previous paper (Drăgan et al., 1994; Villegas et al., 2012; Gârban, 2015)

Statistical evaluation. Was done by a one-way analysis of variance (ANOVA), followed by the Tukey HSD post-hoc test. The obtained data are expressed as mean (X) and standard deviation (SD).

RESULTS AND DISCUSSIONS

Investigations concerning the metals present in biologic fluids and in tissues are of importance for defining the homeostatic status and eventually, the perturbations of biochemical homeostasis (Gârban et al., 1981; Matouschek and Huber, 1981; Hesse et al., 1993). Metals play an important role in the organism. In the case of lithiasis biogenesis caused by morphophysiologic and/or biochemical factors, metals can be found – in certain cases – in increased amounts contributing at the constitution of cristallization nuclei as precursors of lithiasic concrements (Coe and Parks, 1988; Gârban et al., 1998). These can be formed at the level of urinary tract, gall bladder, salivary gland etc.

The concentration of metals is maintained in the body through homeostasic mechanisms being influenced by environmental factors, age, bioaccumulation processes. Metals in excess can lead to competitive interactions in biological systems modifying the normal metabolic status and inducing certain diseases.

Metal ions presence in blood and urine depends on dynamic characteristics of biologic processes: hydroelectrolytic metabolism, chronobiochemistry, homeostasis. Any hydroelectrolytic inbalance that involves the modification of ions concentration depends on diverse factors, among which a major role plays the nutritional status and the morphofunctional characteristics of the body.

Renal calculi can be removed surgically or disintegated using Extracorporeal Shock - Wave Lithotripsy (ESWL). Diverse surgical interventions as well as the procedures of ESWL are followed by homeostatic modifications decelated through the investigation of serum and urine metabolites (Drăgan et al., 1994; Saxby et al., 1997).

Calculi removal through surgical treatment or ESWL is followed by modifications of the biochemical homeostasis. These can be observed in laboratory investigations specfic for clinic chemistry. Of main importance are the electrolytes because the lithogenetic process is a disorder of the hydroelectrolytic metabolism.

Use of ESWL is beneficial being a non invasive technique; the residues obtained pass spontaneously through the urinary tract (Segura, 1990; Drăgan et al., 1994; Avacovici, 2012). The method is successfully applied for renal and vesical calculi with a diameter between 4-20 cm. Recovery time following ESWL is expected to be minimal. Patients resume activity within a few days after treatment

Obtained data - concerning the aspects of Na^+, K^+, Ca^{2+} and Mg^{2+} ions homeostasis - are presented and discussed separately on both patients groups, i.e. SU-treated and ESWL-treated.

Table 1 presents the values of the metals concentration from the blood serum of patients from the SU-treated group. Determinations on metals were performed before and after surgical treatment. The analytical data are expressed in mmol/L (mM/L).

Table 1: Serum metallogram of patients with urolithiasis surgically treated

Specification		**UM**	**Number of patients (n)**	**Pre-treatement**		**Post-treatement**		**ΔX ($X_1 - X_2$)**
				n_1	$X_1 \pm DS$	N_2	$X_2 \pm DS$	
Alkaline metals	Na	mM/L	23	23	136.12±23.81	21	143.91±30.16	+ 7.79
	K		23	23	4.46 ± 0.34	21	4.26 ± 0.48	- 0.20
Alkaline -earth metals	Ca		23	23	2.59 ± 0.29	21	2.73 ± 0.61	+ 0.14
	Mg		23	23	1.15 ± 0.23	21	1.07 ± 0.26	- 0.08

n- number of patients with purine urolithiasis; n_1 - number of patients investigated before (pre-) treatment;
n_2 - number of patients investigated after (post) treatment.

Data concerning metal concentrations in the serum of the ESWL treated group of patients, presented in Table 2, revealed also a post-treatment dyshomeostasis.

Table 2: Serum metallogram of patients with urolithiasis treated by Extracorporeal Shock-Wave Lithotripsy

Specification		UM	Number of patients (n)	Pre-treatement		Post-treatement		ΔX $(X_1 - X_2)$
				n_1	$X_1 \pm DS$	N_2	$X_2 \pm DS$	
Metale alcaline	Na	mM/L	18	18	138.93±29.16	17	143.69±45.13	+ 4.76
	K		18	18	4.49 ± 0.37	17	4.21 ± 0.52	- 0.28
Metale alcalino-teroase	Ca		18	18	2.51 ± 0.26	17	2.72 ± 0.37	+ 0.21
	Mg		18	18	1.08 ± 0.17	17	1.04 ± 0.29	- 0.04

One can remark that post-treatment the concentration of sodium and calcium increases and the concentration of potassium and magnesium moderately decreases. Results concerning the concentration of alkaline and alkaline-earth metals in blood serum show a post-treatment dyshomeostasis.

Our analytical investigations revealed data that are in the range of analytical values from literature. For serum, Na 100-142 mM/L, K 3.5 - 4.5 mM/L; Ca 2.25 – 2.60 mM/L; Mg 0.7 – 1.11 mM/L. In the case of urinary metallograms in literature are mentioned the following values: Na 100 – 300 mM/24h; K 40 – 100 mM/24h; Ca 1.25 – 7.50 mM/24h; Mg 2.5 – 8.2 mM/24h (Kaplan and Pesce, 2010; Gârban, 2015).

Preliminary papers (Drăgan et al., 1994; Drăgan and Gârban, 2002) showed slightly different values that could be explained by the distribution of metal ions in the intrracellular environment.

CONCLUSIONS

1. Serum metallograms of the main alkaline (Na, K) metals in surgically and ESWL treated kidney stone patients revealed the increase of natriemia and decrease of kaliemia after the treatment.
2. Serum metallograms of alkaline-earth (Ca, Mg) metals in both groups of subjects revealed the post-therapeutic decrease of magnesiemia and the increase of calcemia.

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