

Gozhenko Anatoliy I., Kushneruk Anatoliy V., Zukow Walery, Popovych Igor L. Comparative study of electrolyte exchange in patients with varying severity of urinary syndrome of chronic pyelonephritis. *Journal of Education, Health and Sport*. 2015;5(1):305-310. eISSN 2391-8306. DOI <http://dx.doi.org/10.12775/JEHS.2015.05.01.024>
<https://apcz.umk.pl/JEHS/article/view/JEHS.2015.05.01.024>
<https://zenodo.org/record/6503503>

Deklaracja. Specyfika i zawartość merytoryczna czasopisma nieulega zmianie. Zgodnie z informacją MNIŚW z dnia 2 czerwca 2014 r., że w roku 2014 nie będzie przeprowadzana ocena czasopism naukowych; czasopismo o zmienionym tytule otrzymuje tyle samo punktów co na wykazie czasopism naukowych z dnia 31 grudnia 2014 r.
The journal has had 5 points in Ministry of Science and Higher Education of Poland parametric evaluation. Part B item 1089. (31.12.2014).

© The Author (s) 2015;

This article is published with open access at Licensee Open Journal Systems of Kazimierz Wielki University in Bydgoszcz, Poland and Radom University in Radom, Poland Open Access. This article is distributed under the terms of the Creative Commons Attribution Noncommercial License which permits any noncommercial use, distribution, and reproduction in any medium, provided the original author(s) and source are credited. This is an open access article licensed under the terms of the Creative Commons Attribution Non Commercial License (<http://creativecommons.org/licenses/by-nc/3.0/>) which permits unrestricted, non commercial use, distribution and reproduction in any medium, provided the work is properly cited. This is an open access article licensed under the terms of the Creative Commons Attribution Non Commercial License (<http://creativecommons.org/licenses/by-nc/3.0/>) which permits unrestricted, non commercial use, distribution and reproduction in any medium, provided the work is properly cited.

Conflict of interest: None declared.

Received: 05.01.2015. Revised 15.01.2015. Accepted: 31.01.2015

Comparative study of electrolyte exchange in patients with varying severity of urinary syndrome of chronic pyelonephritis

Anatoliy I. Gozhenko¹, Anatoliy V. Kushneruk^{1,2}, Walery Zukow³, Igor L. Popovych^{1,4}

¹Ukrainian Scientific Research Institute of Medicine of Transport, Odesa, Ukraine
prof.gozhenko@gmail.com

²National Medical University, Ivano-Frankivsk, Ukraine kanotoli2011@gmail.com

³Kazimierz Wielki University, Bydgoszcz, Poland w.zukow@ukw.edu.pl

⁴Bohomolets' OO Institute of Physiology of National Academy of Sciences, Kyiv, Ukraine i.popovych@biph.kiev.ua

Abstract

Background. The severity of urinary syndrome in chronic pyelonephritis varies widely. Concomitant changes in electrolyte exchange are also differently expressed. The aim of this study is to compare the rates of electrolyte metabolism in patients with minimal and moderate manifestations of urinary syndrome. **Materials and Methods.** The object of clinical-physiological observation were 68 men and 20 women aged 24-76 years, who underwent rehabilitation treatment in the Truskavets' spa of chronic pyelonephritis in remission with of neuroendocrine-immune complex dysfunction. Urinary syndrome was assessed by quantitative and quantitative-qualitative levels of bacteriuria, leukocyturia and erythrocyturia. We determined in daily urine and blood plasma the concentration of sodium, potassium, chloride, calcium, magnesium and phosphates. **Results.** By transforming the actual values into normalized (Z-score) in patients with minimal expressed urinary syndrome (n=25) compared with moderately expressed (n=63) more pronounced decrease in phosphatemia ($-1,26 \pm 0,17$ vs $-0,77 \pm 0,13$), while a more significant increase in excretion of magnesium ($+1,16 \pm 0,34$ vs $+0,27 \pm 0,24$), sodium ($+2,92 \pm 0,64$ vs $+1,41 \pm 0,31$) and chloride ($+2,44 \pm 0,76$ vs $+1,04 \pm 0,37$). **Conclusion.** Probably, common causal factors for both sets of parameters are changes in neuro-endocrine regulation of electrolyte exchange and immunity, especially bactericidal mechanisms, which, in turn, cause a reduction in bacteriuria and leukocyturia, ie resolving chronic pyelonephritis. Evidence of this hypothesis we have obtained and will be presented in the next article.

Keywords: chronic pyelonephritis, urinary syndrome, electrolyte exchange.

INTRODUCTION

The severity of urinary syndrome in chronic pyelonephritis varies widely. Concomitant changes in electrolyte exchange are also differently expressed [1,3,14]. The aim of this study is to compare the rates of electrolyte metabolism in patients with minimal and moderate manifestations of urinary syndrome.

MATERIALS AND METHODS

The object of clinical-physiological observation were 68 men and 20 women aged 24-76 years, who were at different stages of rehabilitation treatment in the Truskavets' spa [17] of chronic pyelonephritis in remission with of neuroendocrine-immune complex dysfunction.

Urinary syndrome was assessed by quantitative and quantitative-qualitative [14] levels of bacteriuria, leukocyturia and erythrocyturia. To qualitatively assess the manifestations of pyelonephritis, a single-point IL Popovych's [14] scale, built on the basis EC Harrington's desirability function [6], was used.

In particular, bacteriuria over 10^6 CFU/mL is quantified at 0,9 points (strongly expressed), within $(0,3 \div 1,0) \cdot 10^6$ CFU/mL – 0,715 p (more than average, but not strong), 10^5 CFU/mL – 0,5 p (moderately expressed), $(0,2 \div 0,5) \cdot 10^5$ CFU/mL – 0,285 p (weakly expressed), $(0,01 \div 0,1) \cdot 10^5$ CFU/mL - 0,1 p (very weak), less than $0,01 \cdot 10^5$ CFU/mL - 0 p (absent).

Leukocyturia over $60 \cdot 10^3$ /mL - 0,715 p, within $(20 \div 60) \cdot 10^3$ /mL – 0,5 p, $(4 \div 20) \cdot 10^3$ /mL – 0,285 p, $(2 \div 4) \cdot 10^3$ /mL – 0,1 p, less than $2 \cdot 10^3$ /mL – 0 p.

Erythrocyturia over $30 \cdot 10^3$ /mL - 0,715 p, within $(10,1 \div 30) \cdot 10^3$ /mL – 0,5 p, $(2,1 \div 10) \cdot 10^3$ /mL – 0,285 p, $(1 \div 2) \cdot 10^3$ /mL – 0,1 p, less than 10^3 /mL – 0 p.

We determined in daily urine and blood plasma the concentration of electrolytes: calcium (by reaction with arsenase III), magnesium (by reaction with colgamite), phosphates (phosphate-molybdate method), chloride (mercury-rhodanidine method), sodium and potassium (flamming photometry). The analysis carried out according to instructions [4] with the use of analyzers "Reflotron" (BRD) and "Pointe-180" (USA) with corresponding sets of reagents, and flamming photometer "CΦ-47".

Reference values of variables are taken from the database of the Truskavetsian Scientific School of Balneology. For statistical analysis used the software package "Statistica 5.5".

RESULTS AND DISCUSSION

At the first stage of the analysis, two groups of comparisons were formed retrospectively. The first group consisted of 48 men and 15 women with moderate or weak urinary syndrome, and the second - 20 men and 5 women in whom bacteriuria and leukocyturia were absent or very weak (Table 1). The mean age of patients was $50,1 \pm 1,5$ and $48,7 \pm 2,9$ years, respectively.

At the next stage, the raw parameters were normalized by recalculation by the formulas:

$$Z = (V - N)/SD = (V/N - 1)/Cv, \text{ where}$$

V is the actual value; N is the normal (reference) value; SD is the standard deviation in the norm; Cv is the coefficient of variation in the norm.

Table 1. Comparative characteristics of the symptoms of urinary syndrome

Indications of the urinary syndrome	Parameters	Expression of the urinary syndrome		Student's Statistics		Reference value	
		Moderately & weakly (n=63)	Very weakly & absent (n=25)	t	p	Mean	SD
Bacteriuria, 10 ² •CFU/mL	V±SE	181±36	1,9±0,7	4,94	<0,001	0	
Leukocyturia, L•10 ³ /mL	V±SE	8,29±2,23	1,55±0,25	3,00	<0,01	1,00	
Erythrocyturia, E•10 ³ /mL	V±SE	1,56±0,14	1,09±0,15	2,28	<0,02	0,50	
Bacteriuria, lg CFU/mL	V±SE Z±SE	1,69±0,11 1,73±0,11	0,18±0,07 0,18±0,08	11,7	<0,001	0	0,98
Leukocyturia, lg L/mL	V±SE Z±SE	3,53±0,07 1,06±0,15	2,91±0,13 -0,17±0,26	4,17	<0,001	3,00	0,21
Erythrocyturia, lg E/mL	V±SE Z±SE	3,09±0,04 1,53±0,15	2,94±0,06 0,95±0,23	2,13	<0,05	2,70	0,21
Bacteriuria, points	V±SE Z±SE	0,38±0,06 1,59±0,12	0,05±0,01 0,20±0,04	10,9	<0,001	0	0,24
Leukocyturia, points	V±SE Z±SE	0,20±0,02 1,32±0,14	0,04±0,01 0,24±0,07	7,17	<0,001	0	0,15
Erythrocyturia, points	V±SE Z±SE	0,11±0,01 1,11±0,13	0,09±0,02 0,86±0,18	1,13	>0,2	0	0,10

Table 2 illustrates that the different severity of the urinary syndrome is accompanied by both normal parameters of electrolyte metabolism and different variants of their abnormalities.

Table 2. Comparative characteristics of the indication of the electrolytes exchange

Indications of the Electrolytes Exchange	Parameters	Expression of the urinary syndrome		Student's Statistics		Reference value	
		Moderately & weakly (n=63)	Very weakly & absent (n=25)	t	p	Mean	Cv
Sodium Plasma, mM/L	V±SE Z±SE	142,4±1,1 -0,53±0,21 ^a	145,4±1,8 +0,07±0,37	1,41	>0,1	145,0	0,034
Chloride Plasma, mM/L	V±SE Z±SE	101,4±0,8 -0,04±0,26	103,7±1,4 +0,68±0,44	1,41	>0,1	101,5	0,032
Potassium Plasma, mM/L	V±SE Z±SE	4,34±0,07 -0,44±0,15 ^b	4,37±0,10 -0,39±0,21	0,21		4,55	0,104
Calcium Plasma, mM/L	V±SE Z±SE	2,20±0,02 -0,69±0,15 ^c	2,20±0,03 -0,68±0,23 ^b	0,03		2,30	0,065
Magnesium Plasma, mM/L	V±SE Z±SE	0,833±0,004 -1,34±0,09 ^c	0,833±0,010 -1,33±0,20 ^c	0,02		0,90	0,056
Phosphates Plasma, mM/L	V±SE Z±SE	1,05±0,03 -0,77±0,13 ^c	0,95±0,03 -1,26±0,17 ^c	2,32	<0,05	1,20	0,167
Diuresis, L/24h	V±SE Z±SE	1,91±0,09 +1,31±0,24 ^c	2,19±0,13 +2,07±0,33 ^c	1,83	>0,05	1,40	0,274
Sodium Excretion, mM/24h	V±SE Z±SE	200±10 +1,41±0,31 ^c	249±21 +2,92±0,64 ^c	2,12	<0,05	154	0,211
Chloride Excretion, mM/24h	V±SE Z±SE	198±11 +1,04±0,37	238±22 +2,44±0,76 ^b	1,66	>0,1	167,5	0,172
Potassium Excretion, mM/24h	V±SE Z±SE	70,5±4,5 +0,32±0,26	76,9±7,4 +0,68±0,42	0,74		65,0	0,269
Calcium Excretion, mM/24h	V±SE Z±SE	4,69±0,36 +0,34±0,39	6,02±0,68 +1,76±0,73 ^a	1,72	>0,1	4,38	0,214
Magnesium Excretion, mM/24h	V±SE Z±SE	4,38±0,25 +0,27±0,24	5,32±0,35 +1,16±0,34 ^c	2,15	<0,05	4,10	0,256
Phosphates Excretion, mM/24h	V±SE Z±SE	21,8±1,9 -0,45±0,26	29,0±3,1 +0,51±0,41	1,97	=0,05	25,2	0,294

Note. Significant deviations from the norm are indicated by letters ($p < 0,05^a$, $< 0,01^b$, $< 0,001^c$).

The data in Table 2 are visualized as two profiles (Fig. 1).

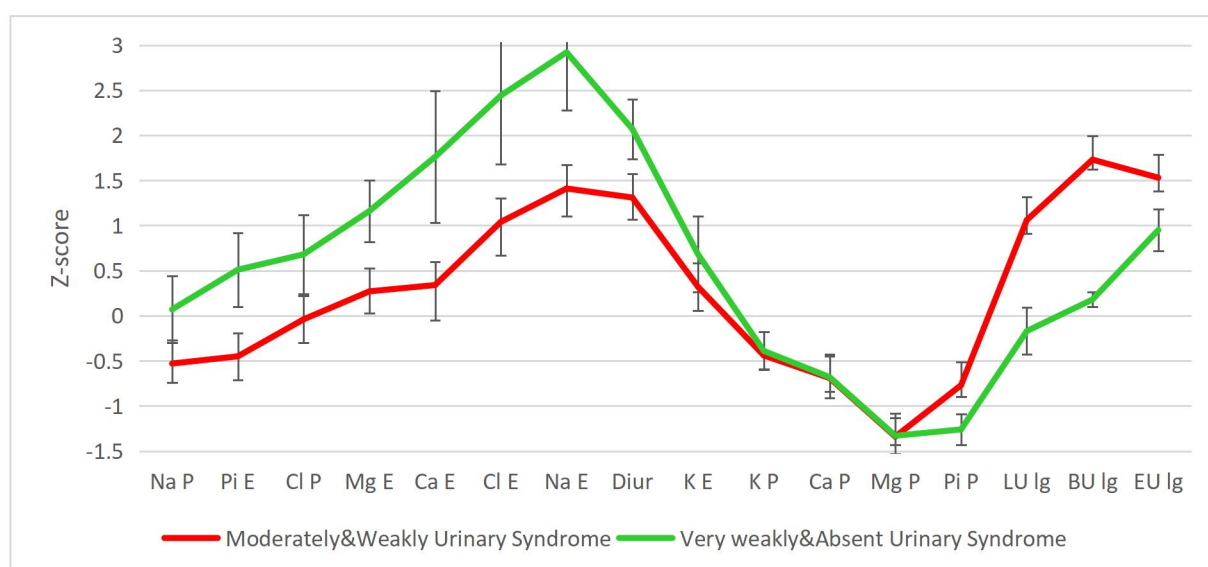


Fig. 1. Profiles (Z±SE) of urinary syndrome and electrolyte exchange

It seems that the reduction of urinary syndrome is accompanied by a further decrease in phosphataemia within the lower zone of normal, increase within the norm of natriaemia, chloridemia, phosphaturia, magnesiumuria and calciumuria as well as movement of upper levels of chloriduria and natriuria above the upper limit of normal.

Such changes in the parameters of the urinary syndrome and electrolyte metabolism are probably caused by balneological factors of the resort, but are unlikely to be related by causation.

Probably, common causal sanogenic factors are changes in the neuro-endocrine regulation of the electrolyte metabolism and immune system, especially its bactericidal mechanisms, which, in turn, cause a reduction in bacteriuria and leukocyturia, ie resolution of chronic pyelonephritis. This assumption is based on data from previous studies of the Truskavets Scientific School of Balneology [2,3,5,7-16].

Evidence of this hypothesis we have obtained and will be presented in the next article.

ACCORDANCE TO ETHICS STANDARDS

Tests in patients are conducted in accordance with positions of Helsinki Declaration 1975, revised and complemented in 2002, and directive of National Committee on ethics of scientific researches. During realization of tests from all participants the informed consent is got and used all measures for providing of anonymity of participants.

For all authors any conflict of interests is absent.

REFERENCES

1. Androssova SO. Sanatorium treatment of persons with kidney diseases. In: Nephrology. A guide for doctors. Volume 2 (edited by IE Tareeva) [in Russian]. Moskva. Meditsina; 1995: 393-396.
2. Balanovs'kyi VP, Popovych IL, Karpynets' SV. About ambivalence-equilibratory character of influence of curative water Naftussya on organism of human [in Ukrainian]. Dopovidi ANU. Mat pryv tekhn Nauky. 1993; 3: 154-158.
3. Chebanenko OI, Flyunt IS, Popovych IL, Balanovs'kyi VP, Lakhin PV. Water Naftussya and Hydro-Mineral Exchange [in Ukrainian]. Kyiv. Naukova dumka; 1997: 141.
4. Goryachkovskiy AM. Clinical Biochemistry [in Russian]. Odesa. Astroprint; 1998: 608.
5. Gumega MD, Levyts'kyi AB, Popovych IL. Balneogastroenterology [in Ukrainian]. Kyiv. UNESCO-SOCIO; 2011: 243.
6. Harrington EC. The desirability function. Industrial Quality Control. 1965; 21: 494-498.
7. Kostyuk PG, Popovych IL, Ivassivka SV (editors). Chornobyl', Adaptive and Defensive Systems, Rehabilitation [in Ukrainian]. Kyiv. Computerpress; 2006: 348 p.
8. Kozyavkina OV, Kozyavkina NV, Gozhenko OA, Gozhenko AI, Barylyak LG., Popovych IL. Bioactive Water Naftussya and Neuro-Endocrine-Immune Complex [in Ukrainian]. Kyiv. UNESCO-SOCIO; 2015: 349.
9. Polovynko IS, Zayats LM, Zukow W, Popovych IL. Neuro-endocrine-immune relationships by chronic stress at male rats. Journal of Health Sciences. 2013; 3(12): 365-374.
10. Popovych IL. The factor and canonical analysis parameters of neuro-endocrine-immune complex, metabolism and erosive-ulcerose injuries of mucous stomach at rats in conditions of acute water immersing stress [in Ukrainian]. Medical Hydrology and Rehabilitation. 2007; 5(2): 68-80.
11. Popovych IL. Functional interactions between neuroendocrine-immune complex in male rats [in Ukrainian]. Achievements of Clinical and Experimental Medicine. 2008; 2(9): 80-87.
12. Popovych IL. The concept of neuroendocrine-immune complex (Review) [in Russian]. Medical Hydrology and Rehabilitation. 2009; 7(3): 9-18.
13. Popovych IL. Stresslimiting Adaptogene Mechanism of Biological and Curative Activity of Water Naftussya [in Ukrainian]. Kyiv. Computerpress; 2011: 300.
14. Popovych IL, Flyunt IS, Alyeksyeyev OI, Hrytsak LYa, Hrinchenko BV, Barylyak LG et al. Sanogenetic Bases of Rehabilitation on Spa Truskavets' Urological Patients from Chornobyl'ian

- Contingent [in Ukrainian]. Kyiv. Computerpress; 2003: 192.
15. Popovych IL, Vis'tak HI, Gumega MD, Ruzhylo SV. Vegetotropic Effects of Bioactive Water Naftussya and their Endocrine-Immune, Metabolic and Hemodynamic Accompaniments [in Ukrainian]. Kyiv. UNESCO-SOCIO; 2014: 163.
 16. Ruzhylo SV, Tserkovnyuk AV, Popovych IL. Actotropic Effects of Balneotherapeutic Complex of Truskavets' spa [in Ukrainian]. Kyiv. Computerpress; 2003: 131.
 17. Truskavetsian mineral waters and methods of their internal use. Guidelines. Truskavets'; 1998: 39.