

WATER AND ELECTROLYTE METABOLISM IN PATIENTS WITH GRADE 3–4 COXARTHROSIS IN HIP JOINT IN THE CONDITIONS OF USE OF THE CATHOLYTE – LIQUIDS WITH NEGATIVE REDOX POTENTIAL

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The influence of the fluid with a negative redox potential (ORP) on indicators of water and electrolyte metabolism (VEO) in patients with grade 3–4 coxarthrosis of various etiologies, which were produced cementless total hip replacement prosthesis Baimetov. The study of these parameters analyzed in the early perioperative period (the first day the patient is in intensive care), on the fifth day after the surgery and on the twelfth day of stay (at the time of removal of sutures to surgical wound on the primary healing and the patient is discharged to outpatient treatment). Revealed the following changes: use catholyte orally two times a day in patients with grade 3–4 coxarthrosis early perioperative after Tatsu, significantly improves the studied parameters to 12 days, an increase of six indexes – the total protein (albumin) in blood plasma, hemoglobin, sodium concentration in serum, plasma osmolality, mean corpuscular volume (MCV), the mean corpuscular hemoglobin concentration (MCH). All of this contributes to the conservation of water and electrolyte homeostasis, which in turn is the prevention of possible physical complications.

Operation total hip replacement tazobedrennoy joint THA (CHP) is today one of the most popular surgical procedures – in traumatology and orthopedics. Like any high-tech operation TETS causes significant shifts of homeostasis, which reduces the adaptability of the organism and contributes to the development of various somatic complications. Currently, the study of related mechanisms of water and electrolyte metabolism in hip arthroplasty are attracting more attention of clinicians and researchers in the field of basic medicine. It is well known that water and electrolyte metabolism is one of the major systems of regulation of homeostasis responsible for the integrity and heterogeneity. This set of metabolic processes involved in the regulation of homeostatic parameters by compartmentalization through the dual system of transport of water and ions [2, 4] In the last decade, found that a significant effect on water and electrolyte metabolism, and other parameters of homeostasis has physical and chemical condition of the water [8]. The achievements of modern clinical medicine in the treatment

of disorders of water and electrolyte metabolism, the problem of increasing the efficiency of the treatment of these pathological conditions to date is far from the final solution. In connection with the search for means of optimization of complex surgical treatment of orthopedic pathology our attention electroactivated aqueous solutions – a liquid with a negative redox potential (ORP). Despite the fact that currently there are numerous publications on the use of liquids with various AFP in clinical medicine [1, 3, 5, 6, 7, 9], and their mechanisms of action of pharmacological effects not completely understood. In light of this problem of particular relevance is the study of the impact of water-programmed solutions to the structural properties of the body, the control parameters of water-electrolyte metabolism and course of orthopedic pathology in the early perioperative period.

Objective: to study and determine the features changes of water and electrolyte metabolism (VEO) at the complex surgical treatment of coxarthrosis grade 3–4 (TETS) in the early perioperative period on the background of the catholyte – liquids with negative ORP.

Material and methods. To assess VEO laboratory parameters studied, were divided into two groups: indicators to assess the extracellular fluid volume; indicators for the intracellular fluid volume. The volume of extracellular fluid was assessed using the following parameters:

- the number of erythrocytes in peripheral blood;
 - concentration of total protein (albumin) in blood plasma;
 - the concentration of hemoglobin in the blood;
 - hematocrit.
- Intracellular fluid volume was assessed by:
- sodium concentration in serum;
 - plasma osmolality;
 - mean corpuscular volume (MCV);
 - the average concentration of hemoglobin (MCH).

In the study conducted on 80 patients of both sexes with a primary Tatsu distributed into 3 equal groups: Group 1 comparisons (without ve); 2nd and 3rd experimental group (use of catholyte) aged 42–67 years from deforming coxarthrosis grade 3–4 in complex surgical treatment in the early perioperative period on the basis of the Center of Traumatology and Orthopedics CST on art. Voronezh-1 Russian Railways since September 2012 to September 2014. The study complied with the ethical rules were laid down in the Helsinki Declaration of 1964, modified 41 World Assembly, Hong Kong, 1989 and the 52nd WMA General Assembly, Edinburgh, Scotland (UK), October 2000. Each patient signed an informed consent.

Patients of the first group ($n = 40$), the correction parameters HEO conducted standard pharmacological methods adopted in our clinic. In the second and third groups of patients catholyte used in two ways, respectively. Patients of the second group ($n = 20$) received a negative

ORP liquid follows: po – catholyte (pH 8,2–8,9; ORP = –480–520 mV) 1 time per day in the 900 – the rate of 2 ml 1 kg of body weight daily for the entire period of the patient in the hospital with a first day, three days prior to surgery, with the exception of the day of surgery and then every day during the early postoperative period until complete healing n/a wound and discharge from the hospital on the 12th day). The patients of the third group ($n = 20$) were treated orally with the catholyte (the same specifications) 2 times per day and 900 to 1200 at the rate of 2 ml catholyte 1 kg body weight of the patient during the entire period of the patient in the hospital (similar 2nd patients).

The liquid with predetermined properties were obtained by setting the “Carat” (mod 20) and TU 9451-005-51702726-2006 electroactivator domestic water “Karat M” TU 3468-001-51702726. Investigations were carried out in three stages.

The study of these parameters analyzed in the early perioperative period in three stages: the first stage – the first day the patient is in intensive care; the second stage – the fifth day after the surgery; third stage – on the twelfth day of hospital stay. The indicators were examined preoperatively from all patients in the first, second and third groups. These second and third groups were not significantly different from those in the first group.

Results indicators were compared between these two patients ($n = 20$) and third ($n = 20$) groups, and the figures of the same parameters of

the first group ($n = 40$), which conducted the standard perioperative management of patients without the use of catholyte. Simultaneously, patients in all three groups with a standard adopted by the conservative support for patients in a clinic on the 2nd day after surgery until discharge from hospital. In some cases (8 patients) – appointed by cardiac drugs (with concomitant cardiac pathology) with individual selection of average daily doses, depending on the degree of comorbidity.

Statistical data processing was performed using the Student t-test, using SPSS 11.0 and spreadsheet Excel. Statistically significant – effects were seen at $p < 0,05$.

Results and discussion. In the first stage on the first day the patient is in intensive care after TETS investigated following indicators VEO (Table 1).

In the first stage on the first day the patient is in intensive care after TETS first group of patients was statistically significant reduction of HGB 21,7% ($p \leq 0,05$); the concentration of total protein (albumin) in blood plasma by 15% ($p \leq 0,05$); serum sodium concentration of 9,5% ($p \leq 0,05$); MCV 12,3% ($p \leq 0,05$); MCH by 31,7% ($p \leq 0,05$) compared with the first group before the operation.

Patients of the second group was significantly outside the concentration of total protein (albumin) in blood plasma to more than 7,35% ($p \leq 0,05$); plasma osmolality higher by 9,3% ($p \leq 0,05$) when compared with the same parameters of the first group on the first day after surgery.

Table 1

Dynamics of some indicators of VEO in patients with coxarthrosis grade 3–4 in the first stage after TETS

Number	Indicators to assess the extracellular fluid volume	Before surgery	On the first day after surgery (STAGE 1)		
		The first group ($n = 40$)	The first group ($n = 40$) without the catholyte	The second group ($n = 20$) catholyte 1 per day	The third group ($n = 20$) catholyte two times a day
1	The number of erythrocytes in peripheral blood	6,22 ± 1,31	3,2 ± 1,44	3,38 ± 1,54	3,42 ± 1,27
2	Concentration of total protein (albumin) in blood plasma	80 ± 1,6	68 ± 1,1*	73 ± 0,9*	79 ± 0,3*
3	The concentration of hemoglobin in the blood	138 ± 3,12*	108 ± 3,56*	114 ± 2,88	124 ± 3,22*
4	The value of hematocrit	0,586 ± 1,84	0,348 ± 1,45	0,367 ± 1,98	0,387 ± 2,12
Performance measures intracellular fluid volume					
5	The concentration of sodium in serum	137 ± 2,31	124 ± 1,45*	142 ± 1,21	149 ± 1,13
6	Plasma osmolality	265 ± 1,6	258 ± 1,1	282 ± 0,9*	291 ± 0,3*
7	Mean corpuscular volume (MCV)	106,8 ± 4,42*	93,6 ± 3,34*	94,2 ± 3,78	97,4 ± 4,06*
8	The average concentration of hemoglobin (MCH)	37,2 ± 1,58*	25,4 ± 1,88*	26,2 ± 2,12	28,6 ± 1,66

Note. The significance of differences compared with the norm: * $p < 0,05$.

In the third group of patients was significantly increased following parameters: concentration of total protein (albumin) in the blood plasma of 16,2% ($p \leq 0,05$); the concentration of hemoglobin in the blood of 14,8% ($p \leq 0,05$); plasma osmolality by 12,7% ($p \leq 0,05$); mean corpuscular volume (MCV) 4% ($p \leq 0,05$) when compared with the parameters of the first group on the first day after surgery.

In the second stage, on the fifth day after the operation – that's an analysis of the eight indicators to assess the volume of the extracellular and intracellular fluid. The resulting values of the above parameters were compared between the patients of the second ($n = 20$) and third ($n = 20$) groups, and with the values of the same parameters of the first group ($n = 40$), which conducted a standard postoperative management of patients without the use of liquids with negative ORP (Table 2).

In the second stage on the fifth day after the TETS patients of the first group was a statistically significant decrease in the concentration of total protein (albumin) in the blood plasma of 10,3% ($p \leq 0,05$); HGB content of 14,9% ($p \leq 0,05$); Serum sodium concentration of 8,1% ($p \leq 0,05$); mean corpuscular volume (MCV) by 7,6% ($p \leq 0,05$) as compared with the first group on the first day after surgery.

Patients of the second group was significantly higher than the concentration of total protein (albumin) in blood plasma by 14,8% ($p \leq 0,05$); plasma osmolality by 15,8% ($p \leq 0,05$) when compared with the parameters of the first group on the fifth day after the surgery.

In the third group of patients was significantly increased the number of red blood cells in the peripheral blood of 12,6% ($p \leq 0,05$); the concentration of total protein (albumin) in blood plasma by 19,7% ($p \leq 0,05$); the concentration of hemoglobin in the blood by 23,9% ($p \leq 0,05$); sodium concentration in the serum of 20,1% ($p \leq 0,05$); plasma osmolality by 18,8% ($p \leq 0,05$); mean corpuscular hemoglobin concentration (MCH) by 39,5% ($p \leq 0,05$) when compared with the parameters of the first group on the fifth day after the surgery.

In the third stage in the early perioperative period with complex surgical treatment of patients with coxarthrosis grade 3–4 studied the effect of the catholyte on the 12th day of hospital stay. Results indicators were compared between these two patients ($n = 20$) and third ($n = 20$) groups, and the figures of the same parameters of the first group ($n = 40$), which conducted a standard postoperative management of patients without the use of catholyte (Table 3).

Table 2

Changes in the patients with a VEO coxarthrosis–4 degrees without catholyte (first group $n = 40$) and with the catholyte ($n = 20$ second, and the third group $n = 20$) in a second step after TETS (the fifth day after the operation)

Number	Indicators to assess the extracellular fluid volume	In the 1st day after surgery	On the fifth day after surgery (Stage 2)		
		The first group ($n = 40$)	The first group ($n = 40$) without the catholyte	The second group ($n = 20$) catholyte 1 per day	The third group ($n = 20$) catholyte two times a day
1	The number of erythrocytes in peripheral blood	3,2 ± 1,44	3,0 ± 1,22	3,22 ± 1,46	3,38 ± 1,25*
2	Concentration of total protein (albumin) in blood plasma	68 ± 1,1*	61 ± 1,1*	70 ± 0,4*	73 ± 0,6*
3	The concentration of hemoglobin in the blood	108 ± 3,56*	92 ± 3,56*	110 ± 2,43	114 ± 3,1*
4	The value of hematocrit	0,348 ± 1,45	0,332 ± 1,48	0,347 ± 1,74	0,365 ± 2,18
Performance measures intracellular fluid volume					
5	The concentration of sodium in serum	124 ± 1,45*	114 ± 1,31*	127 ± 1,26	137 ± 1,15*
6	Plasma osmolality	258 ± 1,1	234 ± 1,2	271 ± 0,6*	278 ± 0,1*
7	Mean corpuscular volume (MCV)	93,6 ± 3,34*	86,5 ± 3,24*	88,1 ± 3,54	92,5 ± 3,12
8	The average concentration of hemoglobin (MCH)	25,4 ± 1,88*	23,5 ± 1,56	28,3 ± 2,15	32,8 ± 1,35*

Note. The significance of differences compared with the norm: * $p < 0,05$.

Table 3

Changes in the patients with a VEO coxarthrosis 3–4 degrees without catholyte (first group $n = 40$) and with the catholyte ($n = 20$ second, and the third group $n = 20$) in the third stage after TETS (twelfth day after the operation)

Number	Indicators to assess the extracellular fluid volume	In the 1st day after surgery	On the twelfth day after operation (Stage 3)		
		The first group ($n = 40$)	The first group ($n = 40$) without the catholyte	The second group ($n = 20$) catholyte 1 per day	The third group ($n = 20$) catholyte two times a day
1	The number of erythrocytes in peripheral blood	$3,2 \pm 1,44$	$2,8 \pm 1,68$	$3,1 \pm 1,35$	$3,2 \pm 1,46$
2	Concentration of total protein (albumin) in blood plasma	$68 \pm 1,1^*$	$63 \pm 1,2$	$74 \pm 0,3$	$76 \pm 0,4^*$
3	The concentration of hemoglobin in the blood	$108 \pm 3,56^*$	$92 \pm 2,68^*$	$118 \pm 2,21^*$	$121 \pm 2,14^*$
4	The value of hematocrit	$0,348 \pm 1,45$	$0,322 \pm 1,68$	$0,378 \pm 1,24$	$0,392 \pm 1,12$
Performance measures intracellular fluid volume					
5	The concentration of sodium in serum	$124 \pm 1,45^*$	$118 \pm 1,31$	$133 \pm 1,28^*$	$142 \pm 1,15^*$
6	Plasma osmolality	$258 \pm 1,1$	$236 \pm 1,6$	$275 \pm 0,4^*$	$283 \pm 0,5^*$
7	Mean corpuscular volume (MCV)	$93,6 \pm 3,34^*$	$89,4 \pm 2,45$	$95,7 \pm 2,12$	$97,5 \pm 2,88^*$
8	The average concentration of hemoglobin (MCH)	$25,4 \pm 1,88^*$	$23,1 \pm 1,12$	$27,2 \pm 1,25^*$	$27,9 \pm 1,42^*$

Note. The significance of differences compared with the norm: $p < 0,05$.

In the third step on the twelfth day after TETS first group of patients was statistically significant reduction of HGB 14,8% ($p \leq 0,05$) compared with the first group on the first day after surgery.

Patients of the second group was significantly increased hemoglobin concentration in the blood of 28,2% ($p \leq 0,05$); sodium concentration in the serum of 12,7% ($p \leq 0,05$); plasma osmolality by 16,5% ($p \leq 0,05$); mean corpuscular hemoglobin concentration (MCH) by 17,7% ($p \leq 0,05$) when compared with the parameters of the first group on the 12th day after the operation.

In patients of the third group was significantly increased the concentration of total protein (albumin) in blood plasma by 20,6% ($p \leq 0,05$); the concentration of hemoglobin in the blood of 31,5% ($p \leq 0,05$); sodium concentration in the serum of 20,3% ($p \leq 0,05$); plasma osmolality by 19,9% ($p \leq 0,05$); mean corpuscular volume (MCV) 9%

($p \leq 0,05$); mean corpuscular hemoglobin concentration (MCH) by 20,7% ($p \leq 0,05$) when compared with the parameters of the first group on the 12th day after the operation.

Conclusions

1. There is a clear trend towards reduction indicators such as: hemoglobin, total protein (albumin) in blood plasma, serum sodium, mean corpuscular volume (MCV), mean corpuscular hemoglobin concentration (MCH) to the first and fifth day after TETS.

2. Patients with catholyte 1 time per day convincing effect observed in the first and fifth day after the operation, upwards following parameters of water-electrolyte metabolism: total protein (albumin) in plasma osmolality. On the 12th day significantly increased three indicators: hemoglobin, serum sodium concentration, the average concentration of hemoglobin (MCH).

3. Use of the catholyte (negative fluid AFP) orally two times a day in patients with grade 3–4 coxarthrosis early perioperative after TETS significantly improves the studied parameters to 12 days, an increase of six indexes – the total protein (albumin) in blood plasma, hemoglobin, serum sodium concentration, osmolality, mean corpuscular volume (MCV), the mean corpuscular hemoglobin concentration (MCH).

4. Using a liquid with a negative ORP if that contributes to the conservation of water and electrolyte homeostasis, which in turn is the prevention of possible physical complications.

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