

## Physiological Bases in Definition of Leukocyturia and Erythrocyturia

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### Abstract

**Background:** In amount of leukocyturia and erythrocyturia has been used to diagnose renal diseases for a long time. In addition the mentioned features are the ones among principal criteria to identify urinary syndrome.

The aim of the research work was to define such the proper physiological regimen of kidneys functioning working that permits to meet stability of the conditions in kidneys and the blood cells preservation in urine for further improvement of the urinary syndrome diagnostic methodology.

**Methods and materials:** There were examined 24 healthy volunteers at the age of 19–25 without clinical and laboratory signs of kidneys pathology. Research work was carried out in the monitoring from 9–11 on an empty stomach. The general investigation scheme included the emptying of the urinary bladder after that hydrosaline loading was carried out per os in volume of 0.5 % from the body mass. In an hour examinee the person under the test emptied his bladder and the volume of diuresis was measured precisely up to 1 ml. They used photometric method to find out creatinine concentration by Popper's methodology, also photometric method was used to find out protein concentration according to the reaction with sulfosalicylate acid on the spectrophotometer SF – 46 (Russia) and urine osmolality applying crioscopic method on osmometer, model 3D3 made by "Advanced Instrument Inc." (USA).

We have also carried out the four-serial investigation: with running water loading (1<sup>st</sup> group) and with natrium chloride solutions loading, 0.1 % (2<sup>nd</sup> group), with 0.25 % (3<sup>rd</sup> group) and with 0.5 % (4<sup>th</sup> group). The achieved results were up statistically applying the Student criteria.

**Results:** The achieved data prove that the running water loading and the 0.1 %, 0.25 %, and 0.5 % natrium chloride solutions loading considerably rise diuretic level and diuresis amount per 1 min exceeds diurnal diuresis level 2 – 3 times with recount for 1 minute. On the whole it is excreted from 25 % up to 90 % of the drunk liquid volume. Withal, diuresis amounts don't differ greatly from each other with all types of loading. That is, the proposed by us volume of hydrosaline loading provides equal diuresis exceeding. Mechanism of diuresis increase differs greatly: with water loading kidneys are functioning in regimen of urine dissolving what is proved by decreasing of urine osmolality to the level which is typical of blood plasma and below. Urine osmolality of some tested volunteers was fluctuating between 120 – 200 mosmol/kg. There is no doubt that such a dynamic causes depression of kidneys' concentration ability due to supplying an organism with considerable amount of running water, osmolality of which is not more than 5 mosmol/kg.

### Conclusions:

1. Hydrosaline loading in 0.5 % volume of body mass with water and 0.1 %, 0.25 % and 0.5 % solutions of natrium chloride maintains diuresis speed keeping on the level of 2 – 3 ml per 1 min, but differs in urine osmolality amount.
2. After hydrosaline loading with 0.5 % solution of natrium chloride urine osmolality forms physiologically more optimum conditions and could be recommended for leukocyturia and erythrocyturia determination.

**Keywords:** Erythrocyturia; Leukocyturia; Urinary syndrome

### Introduction

It is known that quantity features of leukocyturia and erythrocyturia have been used for a long time to diagnose renal diseases and are the ones principal criteria to identify urinary syndrome. As, a rule, there is quantity and quality determination of the cell composition of the daily urine sediments on the base of such test or realization of the probe by Nechipurenko or Amburje [1]. The last ones differ on, that the cell composition of urine which is defined is collected for the shorter period of time, in addition leukocyturia and erythrocyturia calculation per volume unit is being done simultaneously regarding the time of diuresis. However, the existing methods don't allow considering the conditions that define the blood cells' stability in urine and the character nature and quantity of functioning nephrons.

The aim of the research work was to define such the proper physiological regimen of kidneys functioning working that permits to meet stability of the conditions in kidneys and the blood cells

preservation in urine for further improvement of the urinary syndrome diagnostic methodology.

### Methods

There were examined 24 healthy volunteers at the age of 19–25 without clinical and laboratory signs of kidneys pathology. Research work was carried out in the monitoring from 9–11 on an empty

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stomach. The general investigation scheme included the emptying of the urinary bladder after that hydrosaline loading was carried out per os in volume of 0.5 % from the body mass. In an hour examinee the person under the test emptied his bladder and the volume of diuresis was measured precisely up to 1 ml. They used photometric method to find out creatinine concentration by Popper's methodology, also photometric method was used to find out protein concentration according to the reaction with sulfosalicylate acid on the spectrophotometer SF-46 (Russia) and urine osmolality applying crioscopic method on osmometer, model 3D3 made by "Advanced Instrument Inc." (USA) [2]. They took out 10 cm<sup>3</sup> from the total urine amount for 10 min centrifuging it with 1500 revolutions per minutes, the count of erythrocytes and leukocytes was estimated in Gorjaev camera. All accounts were done of the kidneys functioning indices in accordance with Bradley and Peleshchuk [2,3]. We have also carried out the four-serial investigation: with running water loading (the 1<sup>st</sup> group) and with natrium chloride solutions loading, 0.1 % (the 2<sup>nd</sup> group), with 0.25 % (the 3<sup>rd</sup> group) and with 0.5 % (the 4<sup>th</sup> one).

The achieved results were up statistically applying the Student criteria.

## Results

The achieved data prove that the running water loading and the 0.1 %, 0.25 %, and 0.5 % natrium chloride solutions loading considerably rise diuretic level and diuresis amount per 1 min exceeds diurnal diuresis level 2 – 3 times with recount for 1 minute. On the whole it is excreted from 25 % up to 90 % of the drunk liquid volume. Withal, diuresis amounts don't differ greatly from each other with all types of

loading. That is, the proposed by us volume of hydrosaline loading provides equal diuresis exceeding (See Table 1).

However, the mechanism of diuresis increase differs greatly: with water loading kidneys are functioning in regimen of urine dissolving what is proved by decreasing of urine osmolality to the level which is typical of blood plasma and below. Urine osmolality of some tested volunteers was fluctuating between 120–200 mosmol/kg. There is no doubt that such a dynamic causes depression of kidneys' concentration ability due to supplying an organism with considerable amount of running water, osmolality of which is not more than 5 mosmol/kg.

Necessary to note that the diuresis character was changing with hydrosaline loading. So, after loading with solutions of growing up concentration of natrium chloride, urine osmolality develops regularly and reaches the maximum point when applying 0.5 % solution of natrium chloride (See Table 1). In the background of the real excretion increasing of creatinine the given fact manifests that there occurring changing from tubular into glomerular (more ancient phylogenetically) regulation level. According to our aim and targets it is necessary to note that in the 4<sup>th</sup> group the urine of all volunteers was hyperosmotic, that is, its osmolality exceeded 300 mosmol/kg. Correspondingly, while erythrocyturia and leukocyturia it has been stated that the amount of blood cells in 1 cm<sup>3</sup> of urine was min in the 1<sup>st</sup> group and an average rising was 50 % in the 4<sup>th</sup> group (See Table 2). At our sight that is not so much due to increase of erythrocytes and leukocytes penetrating into urine as conditions' optimization of their safety maintenance.

Thus as osmotic lysis of erythrocytes starts in solutions corresponding to 0.5 % solution of natrium chloride, which osmolality

Index	Water loading	Loading with 0.1 % natrium chloride solution	Loading with 0.25 % natrium chloride solution	Loading with 0.5 % natrium chloride solution
	n <sup>1</sup> = 14	n = 10	n = 11	n = 24
Diuresis, ml/per hour	174 ± 33	177 ± 37	143 ± 33	158 ± 19
Relative diuresis, %	55.8 ± 11.4	53.8 ± 9.1	43.3 ± 9.6	49.2 ± 6.2
Urine creatinine, mmol/l	7.9 ± 1.5	5.2 ± 1	12.3 ± 3.5	12.5 ± 1.7 p <sup>2</sup> = 0.05
Excretion of creatinine, mmol/per hour	1.1 ± 0.2	0.8 ± 0.1	0.9 ± 0.1	1.8 ± 0.2 p < 0.05
Osmolality of urine, mosmol/kg	379 ± 45	397 ± 81	569 ± 106 p < 0.05	617 ± 58 p < 0.05
Excretion of osmotically active substances, mosmol/ per hour	62.9 ± 11.5	58.3 ± 8.9	56.6 ± 8.1	85.9 ± 9
Standardized excretion of osmotically active substances (mosmol/mmol of creatinine per 70 kg of body mass)	58.3 ± 5.5	84.2 ± 9.9 p < 0.05	78.5 ± 20.1	56.7 ± 3.2

<sup>1</sup>n – number of observations

<sup>2</sup>p – true index of differences in comparison with water loading.

**Table 1:** Functional urine condition of healthy volunteers at water and hydrosaline loading in 0.5 % of the body mass (X ± m).

Index	Water loading	Loading with 0.5 % natrium chloride solution
	n <sup>1</sup> = 18	n = 23
Diuresis. ml/per hour	174 ± 33	158 ± 19
Osmolality of urine, mosmol/kg	379 ± 45	617 ± 58 p <sup>2</sup> < 0.05
Erythrocyte amount in 1 ml of urine	1097 ± 27	1576 ± 34 p < 0.05
Leukocyte amount in 1 ml of urine	639 ± 45	978 ± 33 p < 0.05
Protein of urine, mg/l	9 ± 1	15 ± 1 p < 0.05

<sup>1</sup>n – number of observations

<sup>2</sup>p – true index of differences in comparison with water loading

**Table 2:** Leukocyturia and erythrocyturia indices of healthy volunteers after water loading and loading with 0.5 % natrium chloride solution in volume of 0.5 % from the body mass. (X ± m).

according to our measurements is equal to 160 mosmol/kg, it is possible to make a prognosis, that with osmolality of urine more than 200 mosmol/kg (considering considerable portion of carbamide in urine osmolality formation) osmotic lysis of erythrocytes and leukocytes decreases considerably. It is supposed logically that increase above 400 mosmol/kg point by urine osmolality, practically is a guarantee from blood cells lysis in urine according to osmotic mechanism. Further increase of urine osmolality could lead to cells shriveling due to their dehydration. However, it doesn't produce the cell lysis with this, more of it – while microscoping they appear more visible. Individual analysis of leukocyturia and erythrocyturia after water loading without natrium is its confirmation. Thus, 3 under the test volunteers™ have diuresis that increases up to 365 ml/per hour, and urine osmolality fluctuates between 160 – 270 mosmol/kg, that is the urine was hypotonic. All these patients have no defined erythrocytes and leukocytes in urine. Whereas, after hydrosaline loading of the tested volunteers their diuresis was between 160 – 190 ml/per hour, osmolality 307 – 440 mosmol/kg and there were defined erythrocytes and leukocytes in all probes.

## Discussion

It is known, that urine osmolality at the entrance to the distal nephron section approaching isoosmolality, and further on passing with luminal fluid along convoluted part of distal tubules and connecting duct, urine concentration or its dilution happen, and owing to that urine becomes hypotonic or hypertonic. Besides, it's easy to suppose, that urine index pH could seriously act upon blood cells safety in conditions of spontaneous diuresis, which is fluctuating widely. At

that time, the proposed and advised by us method permits to approach neutral pH index of urine. On the base the above mentioned arguments we consider that the optimum condition for studying leukocyturia and erythrocyturia is microscopic analysis of the urine cellular contents after hydrosaline loading with 0.5 % solution of natrium chloride in volume 0.5 % of the body mass.

## Conclusions

1. Hydrosaline loading in 0.5 % volume of body mass with water and 0.1 %, 0.25 % and 0.5 % solutions of natrium chloride maintains diuresis speed keeping on the level of 2–3 ml per 1 min, but differs in urine osmolality amount.
2. After hydrosaline loading with 0.5 % solution of natrium chloride urine osmolality forms physiologically more optimum conditions and could be recommended for leukocyturia and erythrocyturia determination.

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