Nat. Volatiles & Essent. Oils, 2021; 8(4): 8070-8076

# Metabolic Characteristics Of The Heart In Children With Chronic Kidney Disease.

**Murodova Malika Djamolovna[1] , Yuldashev Botir Axmatovich[2] , Mukhammedova Fariza Farkhodovna[3]**

[1]Basic doctoral student of the Department of 2-Pediatrics. Samarkand State Medical Institute E-mail: mali007@mail.ru orcid:0000-0002-5861-5329

[2]Associate Professor of the Department of Pediatrics 2 Samarkand State Medical Institute

[3]Scientific applicant. Samarkand State Medical Institute, Faculty of Pediatrics. orcid: 0000-0002-1077-3854

**Abstract:** The most common causes of chronic kidney disease (CKD) in North America and Europe are diabetic nephropathy, hypertension, and glomerulonephritis. These three causes account for approximately 75% of all adult cases.

In pediatrics, the term "chronic kidney disease" was first used by R.J. Hogg in 2003 is identical to the term used in therapeutic practice. Currently, the definition and classification of CKD by stages in children do not differ from those in adults and is widely used in children's clinics and in scientific research. CKD aimed to determine the relationship between the degree of renal dysfunction and the various complications that arise, primarily from the cardiovascular system, as well as the risk of progression of CKD. In the early stages, it is important to determine the metabolic parameters of the heart; in cardiomyocytes, glucose breaks down – glycolysis. Therefore, an integrated approach is important in order to track the moment of the onset of changes in the cardiovascular system in the early stages to prevent the course of the disease and prevent complications.

**Keywords:** Chronic kidney disease,children,cardiovascular system, metabolic characteristic of the heart.

## I. INTRODUCTION.

Chronic kidney disease (CKD) - kidney damage and decreased function, based on indicators: glomerular filtration rate (GFR) less than 60 ml/min / 1.73 m2 for 3 months or more, azotemia, high blood pressure, electrolyte disturbances (decreased calcium and sodium, increased magnesium and potassium), acidosis, anemia (due to impaired renal production of erythropoietin), changes in blood or urine composition indicators (proteinuria, albuminuria), serum creatinine more than 0.132 mmol / l, urea more than 8, 3 mmol / l, pathomorphological changes in renal tissue according to biopsy data. [2] There are 5 stages of CKD in terms of patient management tactics and the risk of developing end-stage renal failure and cardiovascular complications.

Stages 3-5 correspond to chronic renal failure (decrease in GFR 60 ml/min or less). Stage 5 corresponds to end-stage chronic renal failure (uremia).

With the death of less than 50% of nephrons, chronic renal failure can be detected only with a functional load.

**Stages of the disease.**

1. Polyuric (stage of compensation, latent, preazotemic) - clinical manifestations associated with the underlying disease, as well as polyuria, nocturia and isostenuria.

2. Stage of clinical manifestations (azotemic, oligoanuric) - the appearance of intoxication: anorexia, neurological disorders (headache, apathy, decreased vision, insomnia), pain in bones and joints, itching. Dyspeptic disorders appear - diarrhoea, vomiting. From the side of the cardiovascular system - tachycardia, arrhythmia.

3. Stage of decompensation - stomatitis, gingivitis, pleurisy, pericarditis, pulmonary oedema join.

4. Terminal (uremic, anuric) stage. The outcome is usually fatal, the only way out in this situation is a radical kidney transplant. Also, this stage can be delayed by lifelong hemodialysis.[1].

The minimum set of diagnostic methods for CKD recognition includes: Anthropometry (measurement of height, body weight, waist circumference, calculation of body mass index); Determination of blood pressure; General urinalysis, including examination of microalbuminuria; Biochemical blood test (determination of the creatinine level is mandatory); The most important parameter is the determination of the glomerular filtration rate for the diagnosis of chronic kidney disease and the stage of chronic kidney disease (CKD).

To assess the glomerular filtration rate (GFR) in children over the age of 2 years, the NKF clinical guidelines (USA) suggest evaluating the value using the Schwartz formula:

Formula Schwartz et al. (1976):

$$CKF = \frac{40 \times \text{Height (cm)}}{\text{Scr (µmol / L)}}$$

Scr - serum creatinine concentration

A decrease in GFR less than 60 ml / min / 1.73 m2 for more than three months indicates chronic kidney disease. Kidney pathology can also occur with a GFR of more than 90 ml / min / 1.73 m2. The study results should be interpreted in conjunction with other studies (including assessment of urinary albumin excretion), history and clinical situation.Changes in the cardiovascular system: arterial hypertension;

heart failure; acute left ventricular failure; pericarditis; cardiomyopathy; The mechanisms of congestive heart failure include pressure overload (arterial hypertension) and volume overload (anemia, edema), which increase in proportion to decreased renal function. An increase in blood pressure, changes in intracardiac hemodynamics, and a deterioration in arterial compliance contribute to the acceleration of cardiovascular events. AV block, up to cardiac arrest, with a potassium content of more than 7 mmol / l. The initial deceleration of conduction is characterized by a lengthening of the PR interval, a shortening of the QT interval. First of all, high symmetrical peaked T waves are visible, the QRS interval widens, the P wave disappears, impulse drops and ventricular arrhythmias are observed. Eventually the QRS complex flattens out and ventricular fibrillation or asystole occurs [3]. Echocardiographic imaging of cardiac cavities and its importance in the diagnosis of cardiovascular diseases In the early stages, it is important to determine the metabolic parameters of the heart; in cardiomyocytes, glucose breaks down - glycolysis. Glycolysis can occur with the participation of oxygen (aerobic process), then as a result, two molecules of pyruvate are formed, and without the participation of oxygen (anaerobic process), in this case, two molecules of lactate are formed. In the aerobic process, pyruvate is eventually oxidized to carbon dioxide and water. And the anaerobic process includes the same reactions as the aerobic one, only at the end pyruvate is converted into lactate. As a result of the breakdown of glucose with the participation of oxygen, 38 ATP molecules are formed - a source of energy in living organisms, and after anaerobic glycolysis, only 2 ATP molecules. The implication of this is that the anaerobic process takes place in the muscles at the beginning of intense physical activity when the supply of oxygen is limited[5]. What is a complete clinical and laboratory study and an algorithm for assessing the volume of blood entering the aorta at various points in the cardiac cycle of systole - diastole, in 2004 the first device for cardiometry "Cardiocode" was created, with the help of which it is possible to simultaneously measure the phase structure of the ECG and rheogram and obtaining quantitative parameters that determine the functional state of the human CVS metabolic parameters of the heart, using cardiometry to analyze the quantitative indicators of oxygen, lactate and creatine phosphate (in arbitrary units):

1. Amount of oxygen: average initial normal level for untrained people, range in units from 0.5 to0.55. For average fitness from 0.6 to 0.65. For high fitness and endurance from 0.7 to 0.85.

2. Amount of lactate: the range of assessing the energy costs of anaerobic-glycolytic processes, the norm is from 3 to 7. 3. Amount of creatine phosphate: the range of assessing the energy costs of creatine phosphate processes, the rate is from 2 to 4. The accumulation of lactate indicates that the heart is functioning and coping with work. But it should not be much higher than the norm. With its indicators significantly below the norm, we can talk about the depletion of the resources of the heart. The creatine phosphate indicator indicates the possibility of ATP resynthesis already in the next cardiac cycle. If all three metabolic indicators are below normal, then this indicates a complete expenditure of energy from the cardiovascular system. This is usually a critical condition.[4]

**2. MATERIAL AND METHODS** We examined 100 children (43 boys, 57 girls) aged 3 to 17 years (7 ± 2.7) on the basis of the Samarkand Regional Children's Multidisciplinary Medical Center in the Department of Nephrology from 2019-2021. The nosology consisted of: 1-group: children with chronic pyelonephritis-48, 2-group with acute glomerulonephritis-24, 3- with chronic glomerulonephritis-28. Patients underwent a complete clinical and laboratory study, as well as additional cardiometry with a cardiocode apparatus to determine metabolic parameters hearts.

**3. RESULTS**: In the group of patients with chronic pyelonephritis, grade 1 CKD was detected in 4 patients, the average level of GFR averaged 102 ± 4.2 ml / min / 1.73 m2, grade 2 in 15 children GFR = 72 ± 3.8 ml / min / 1.73 m2, grade 3 in 21 patients with GFR was 44 ± 3.5 ml / min / 1.73 m2, grade 4 was 7 children with a GFR level of 23 ± 3.7 ml / min / 1.73 m2, as well as 5 degree in 2 patients GFR = 8.5 ± 2.4 ml / min / 1.73 m2 (table 1)

**GFR indices in patients with chronic pyelonephritis Table 1**

| CKD | Number of patients | Schwartz GFR level ml / min / 1.73 m2 |
|---|---|---|
| 1 degree | 4 | 102±0,7 |
| 2 degree | 15 | 72±0,8 |
| 3 degree | 21 | 44±0,5 |
| 4 degree | 7 | 23±0,7 |
| 5 degree | 2 | 8,5±0,4 |

In group 2, grade 1 CKD was detected in 2 patients, the average level of GFR was 102± 3.3 ml / min / 1.73 m2, grade 2 in 4 children, GFR = 68.45 ± 2.4 ml / min / 1.73 m2, grade 3 in 9 patients, GFR was 43 ± 2.1 ml / min / 1.73 m2, grade 4 were 3 children with a GFR level of 20 ± 2.7 ml / min / 1.73 m2, as well as grade 5 in 6 patients GFR = 9 ± 3.4 ml / min / 1.73 m2 (table 2).

**GFR indices in patients with acute glomerulonephritis Table 2**

| CKD | Number of patients | Schwartz GFR level ml / min / 1.73 m2 |
|---|---|---|
| 1 degree | 2 | 102±0,3 |
| 2 degree | 4 | 68,45±0,4 |
| 3 degree | 9 | 43±1,1 |
| 4 degree | 3 | 20±0,7 |
| 5 degree | 6 | 9±0,4 |

Group 3 consisted of patients with CKD grade 2, 1 patient had GFR = 61 ml / min / 1.73 m2, grade 3 in 9 patients, GFR was 42 ± 4.1 ml / min / 1.73 m2, grade 4 was 11 children with GFR level 19 ± 2.3 ml / min / 1.73 m2 and grade 5 in 7 patients GFR = 12 ± 1.4 ml / min / 1.73 m2. (table 3)

**GFR indices in patients with chronic glomerulonephritis Table 3**

| CKD | Number of patients | Schwartz GFR level ml / min / 1.73 m2 |
|---|---|---|
| 1 degree | 0 | - |
| 2 degree | 1 | 61 |
| 3 degree | 9 | 42±1,1 |
| 4 degree | 11 | 19±0,3 |
| 5 degree | 7 | 12±0,4 |

The metabolic parameters of the heart were shown in 1 group of patients with 1 stage of CKD, the oxygen level in U.E. equaled on average 0.43, 2 st -0.42, 3 st-0.41, 4 st-0.39, 5 st-0.24. Lactate level in U.E. was at 1 st-5.52, 2 st-5.61, 3 st-5.95, 4 st-6.38, 5 st-7.18. The level of creatinine phosphate in U.E. was 1 st-2.4, 2 st-2.8, 3 st-3.8, 4 st-4.6, 5 st-4.9 (table 4).

**Metabolic parameters of the heart in chronic pyelonephritisTable 4**

| CKD | Oxygen in conventional units | Lactate in conventional units | Creatinine phosphate in conventional units |
|---|---|---|---|
| 1 degree | 0,43 | 5,52 | 2,4 |
| 2 degree | 0,42 | 5,61 | 2,8 |
| 3 degree | 0,41 | 5,95 | 3,8 |
| 4 degree | 0,39 | 6,38 | 4,6 |
| 5 degree | 0,24 | 7,18 | 4,9 |

In group 2 of patients with 1 stage of CKD, the oxygen level in U.E. equaled on average 0.42, 2 st -0.39, 3 st-0.35, 4 st-0.31, 5 st-0.22. Lactate level in U.E. was at 1 st-5.0, 2 st-5.8, 3 st-6.3, 4 st-5.5, 5 st-6.4. The level of creatinine phosphate in U.E. was 1 st-2.3, 2 st-2.7, 3 st-3.6, 4 st-4.4, 5 st-5.2 (table 5).

**Metabolic parameters of the heart in acute glomerulonephritisTable 5**

| Schwartz GFR level ml / min / 1.73 m2 | Oxygen in conventional units | Lactate in conventional units | Creatinine phosphate in conventional units |
|---|---|---|---|
| 102±0,3 | 0,42 | 5,0 | 2,3 |
| 68,45±0,4 | 0,39 | 5,8 | 2,7 |
| 43±1,1 | 0,35 | 6,3 | 3,6 |
| 20±0,7 | 0,31 | 5,5 | 4,4 |
| 9±0,4 | 0,22 | 6,4 | 5,2 |

In group 3 of patients, the oxygen level in U.E. equaled with CKD 2 st -0.38, 3 st-0.35, 4 st-0.32, 5 st-0.21. Lactate level in U.E. was at 2 st-5.8, 3 st-6.3, 4 st-6.5, 5 st-7.1. The level of creatinine phosphate in U.E. amounted to 2 st-4.9, 3 st-5.3, 4 st-5.7, 5 st-2.2 (table 6).

**Metabolic indicators of the heart in chronic glomerulonephritisTable 6**

| CKD | Oxygen in conventional units | Lactate in conventional units | Creatinine phosphate in conventional units |
|---|---|---|---|
| 1 degree | - | - | - |
| 2 degree | 0,38 | 5,8 | 4,9 |
| 3 degree | 0,35 | 6,3 | 5,3 |
| 4 degree | 0,32 | 6,5 | 5,7 |
| 5 degree | 0,21 | 7,1 | 6,2 |

**4. DISCUSSION** Our purpose was to determine metabolic parameters of the heart in children with chronic kidney disease. The results showed the most metabolic changes in patients with chronic glomerulonephritis, which appears with decline in performance of oxygen in the 2 degree of CKD. In that way compensatory mechanism steps in with rising of level lactate and creatinine in units. The same changes happen in patients with chronic pyelonephritis only in the 4 degree of CKD. However, shifts in metabolic parameters of the heart in acute glomerulonephritis becomes apparent with the changes in

level lactate and creatinine nearly normal the same levels. In conclusion, In the early stages of kidneys disease mostly in the level of GFR nearly at 90 ml / min / 1.73 m2 it shows significant decreasing the level of oxygen in cardiac cells which begins to compensate with the rising the level of lactate and creatinine phosphate.

**REFERENCES**

1. David L. Nelson, Michael M. Cox. Lehninger Principles of biochemistry. - Fifth edition. - New York: W. H. Freeman and company, 2008. - 1158.

2. Hogg R.J., Furth S., Lemley K.V. et al. National Kidney Foundation's Kidney Disease Outcomes Quality Initiative clinical practice guidelines for chronic kidney disease in children and adolescents: Evaluation, classification, and stratification. Paediatrics. 2003; 111 (6): 1416-1421.

3. ImanovB.Zh., Murkamilov I.T., Sabirov I.S., SarybaevA.Sh. INFLUENCE OF RENAL DYSFUNCTION ON THE CARDIOVASCULAR SYSTEM. POSSIBILITIES OF EARLY DIAGNOSTICS OF RENAL DYSFUNCTION. Archive of Internal Medicine. 2018; 8 (4): 260-265. https://doi.org/10.20514/2226-6704-2018-8-4-260-265.

4. Olga K. Voronova, Mikhail Y. Rudenko, Vladimir A. Zernov. The G.Poyedintsev - O. Voronova mathematical model of hemodynamics. Cardiometry; Issue 14; May 2019; p.10-15; DOI: 10.12710/cardiometry.2019.14.1015

5. Vladimir A. Zernov, Konstantin K. Mamberger, Dmitry F. Makedonsky, Sergey M. Rudenko. Metabolic processes evaluation in cardiac muscles on the basis of cardiometry. Cardiometry; Issue 13; November 2018; p.99-100; DOI: 10.12710/cardiometry.2018.13.99100;