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SIGNIFICANCE OF METABOLIC PARAMETERS OF THE HEART IN CARDIORENAL INTERACTIONS IN ACUTE GLOMERULONEPHRITIS IN CHILDREN

Murodova M.D., Yuldashev B.A.

Samarkand State Medical Institute, Uzbekistan

✓ Resume

Acute glomerulonephritis (OG) is an acute diffuse immune inflammation of the renal glomeruli under antigenic effects. The presence and severity of this pathology are following main syndromes: urinary, edematous and hypertensive, which leads to dysfunctioning of central hemodynamics, overloading and changings in the metabolism of the heart.

The aim of the study was to study the metabolic parameters of the heart in children with OG. We examined 98 children to determine the main indicators of the metabolism of the heart muscle with the help of cardiometry. Metabolic changes in the heart were revealed depending on the level of glomerular filtration rate of the kidneys (GFR).

Key words: acute glomerulonephritis, children, cardiometry, metabolic indicators of the heart.

BOLALARDA O'TKIR GLOMERULONEFRITDA KARDIORENAL O'ZARO TA'SIRIDA YURAKNING METABOLIK PARAMETRLARINING AHAMIYATI

Murodova M.D., Yuldashev B.A.

Samarqand davlat tibbiyot instituti, O'zbekiston

✓ Rezyume

O'tkir glomerulonefrit (OG) - antigen ta'siridan keyin rivojlanadigan buyrak glomerulining o'tkir diffuz immun yallig'lanishi. Ushbu patologiya bilan quyidagi asosiy sindromlarning mavjudligi ajralib turadi: siydik, shish va gipertonik, quyidagilar markaziy gemodinamikaning buzilishiga, ortiqcha zo'riqish va yurakning metabolizmining o'zgarishlarga olib keladi.

Tadqiqotning maqsadi OG bilan kasallangan bolalarda yurakning metabolik parametrlarini o'rganish edi. Biz yurak mushaklari metabolizmining asosiy ko'rsatkichlarini aniqlash uchun kardiometriya yordamida 98 nafar bolani tekshirdik. Buyraklarning glomerulyar filtratsiya tezligi (GFR) darajasiga qarab yurakdagi metabolik o'zgarishlar aniqlandi.

Kalit so'zlar: o'tkir glomerulonefrit, bolalar, kardiometriya, yurakning metabolik ko'rsatkichlari.

ЗНАЧИМОСТЬ МЕТАБОЛИЧЕСКИХ ПОКАЗАТЕЛЕЙ СЕРДЦА В КАРДИОРЕНАЛЬНЫХ ВЗАИМОДЕЙСТВИЯХ ПРИ ОСТРОМ ГЛОМЕРУЛОНЕФРИТЕ У ДЕТЕЙ

Муродова М.Д., Юлдашев Б.А.

Самаркандский государственный медицинский институт, Узбекистан

✓ Резюме

Острый гломерулонефрит (ОГ) - острое диффузное иммунное воспаление почечных клубочков, развивающееся после антигенного воздействия. При данной патологии выделяют наличие и выраженность следующих основных синдромов: мочевого, отеочного и гипертензивного, последний из которых приводит к нарушению центральной гемодинамики, перегрузке работы и изменению метаболизма сердца.

Целью исследования явилось изучение метаболических показателей сердца у детей с ОГ. Обследовано 98 детей, которым выполнена кardiометрия для определения основных показателей метаболизма сердечной мышцы. Выявлены метаболические изменения в сердце в зависимости от уровня скорости клубочковой фильтрации почек (СКФ).

Ключевые слова: острый гломерулонефрит, дети, кardiометрия, метаболические показатели сердца.

Relevance

Acute glomerulonephritis is an infectious-allergic disease that develops suddenly with the development of hematuria, edema in 70% of cases, arterial hypertension in 50% of cases, and transient renal failure with the development of pathological processes in other organs and systems. [1,2]. Mechanisms for the development of congestive heart failure include pressure overload (hypertension) and volume overload (edematous syndrome), which increase in proportion to the decrease in kidney function. Increased blood pressure, changes in intracardiac hemodynamics, deterioration of arterial compliance contribute to the acceleration of cardiovascular events [4].

The aim of the study was to study the metabolic parameters of the heart in children with acute glomerulonephritis.

Materials and methods

We studied 98 children with acute glomerulonephritis (AGN) aged 3 to 18 years (7 ± 2.7), 46 girls, 52 boys were hospitalized in the Samarkand Regional Children's Multidisciplinary Medical Center (Fig. 1)



Fig 1. Quantitative ratio of patients by age and sex.

nephritic syndrome n=29	Nephrotic syndrome n=69
- extrarenal symptoms - edema or pastosity in 78 patients (79%), - increased blood pressure in 29 (30%), - renal - oliguria in 89 children (90%), - hematuria in 67 (68%), - proteinuria up to 1 g per day in 98 (100%), - cylindruria in 16 (17%) children.	- oliguria to anuria in 34 (35%), - massive proteinuria (more than 3 g/24 h) in 23 (24%), - hypo- and dysproteinemia (decrease in albumin below 25 g/l) in 87 patients (88%), - hyperlesterolemia in 26 (27%), - complete nephrotic syndrome (NS) in 78(79%). "Incomplete" NS in 9 (10%) proceeded without edema.

Fig. 2 Symptomatic manifestation of acute glomerulonephritis

In addition to the standard examination for nephrological patients (Fig. 2), the glomerular filtration rate (GFR) was assessed in each patient, according to the NKF (USA) clinical guidelines, while the studied value was estimated using the Schwartz formula: Formula by Schwartz et al. (1976):

$$\text{GFR} = \frac{40 \times \text{Height (cm)}}{\text{Scr } (\mu\text{mol/l})}$$

Scr – serum creatinine concentration, determined by enzymatic method, Architect technology, Abbot. [3].

At the same time cardiometry data were recorded using the Cardiocode device to assess the physiological state of the cardiovascular system, namely the metabolic parameters of the heart muscles and systemic regulation parameters determined using cardiometry [5,6,7]. (Fig. 3).

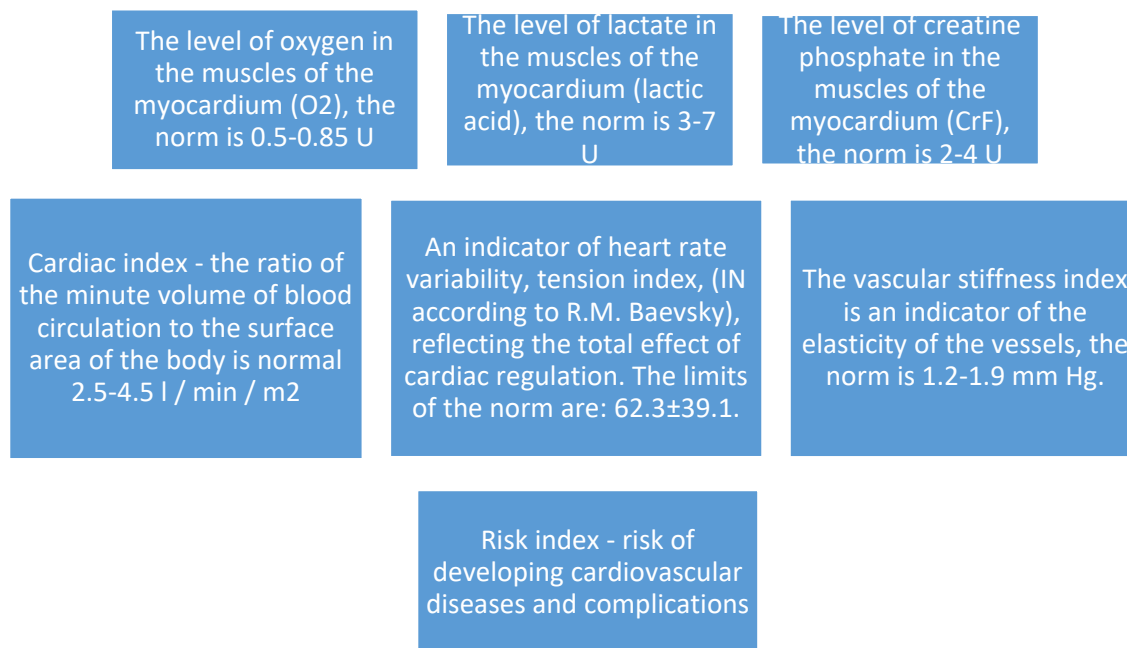


Fig.3 Metabolic parameters of the heart muscles and system parameters of regulation

Results and discussions

The form of the ECG indirectly reflects the qualitative and quantitative metabolic processes of the heart. In the cardiac cycle, the phases of systole are divided into two groups, the first in which contractions of the heart muscles occur in the aerobic process, the second - in the anaerobic process, which made it possible to obtain data on the resources of the cardiovascular system. This is evaluated using the mathematical graphical derivative of the ECG. The studied patients revealed the most pronounced deviations from the norm in metabolic parameters in the age group of 7-10 years (Tab. 1).

The table shows that the metabolic characteristics have deviations from the norm. The need of the heart muscles for oxygen was increased in all age groups against the background of a significant deviation of renal parameters such as urea and creatinine in the blood and the level of glomerular filtration rate and averaged 0.78 ± 0.4 U. at a rate not lower than 0.5. Lactate was also increased, on average, it was 9.1 ± 1.3 U., with a norm of 3 to 7, which indicates its accumulation in the heart muscles. Creatine phosphate, which is responsible for the restoration of ATP, characterizing the reserve for the cost of instantaneous energy consumption, was equal to an average of 9.4 ± 2.1 , with a norm of 2 to 7. ($p < 0.05$).

Table 1. Cardiac Metabolism Rates by Age in Renal Impairment

Age years	3-6			7-10			11-14			15-18		
	min	median	max	min	median	max	min	median	max	min	median	max
BMI kg/m ²	10,4	16,6	18,4	11,4	19,2	54,6	12,4	22,4	59,2	17,6	21,5	24,2
GFR ml/min/1.73 m ²	5,4	23,2	27	8,1	34,5	121,2	7,3	32,6	84,5	11,5	24,2	37
Creatinine μ mol/l	75	284,2	311,3	34	217,6	590	71	312,6	882	162	345,6	592
Urea mmol/l	5,1	15	33	4,4	13,6	30	6,4	16,2	31	9,1	17,4	27
Oxygen U.	0,14	0,4	0,78	0,14	0,4	0,8	0,18	0,41	0,78	0,28	0,44	0,72
Lactate U.E.	0,43	5,2	15	3,9	9,03	15	0,43	4,1	6,3	3,4	6,05	11,6
Creatine Phosphate U.E.	0,6	5,1	24,4	1,5	9,4	24,4	0,6	4,1	16	1,64	3,8	7,8

Indicating a decrease in the efficiency of the heart. The efficiency of aerobic processes remained at the level of 0.14. Anaerobic processes indicating the accumulation of lactic acid in the muscles increased from 0.6 to 7.8. The body switched to an anaerobic process of muscle work. At the same time, the tension index became 267 ± 24.3 . This is very high, but not critical (tab. 2)

Table 2. Adaptive capacity of the heart in different age groups

Age years	3-6			7-10			11-14			15-18		
	min	median	max	min	median	max	min	median	max	min	median	max
Tension index	53	317	992	28	267	792	69	313	992	123	309	548
Cardiac index l/min/m ²	5	8,3	16	0,33	7,4	16	3,6	7,1	11	2,4	5,2	9,34
Vessel stiffness index mm Hg \ ml.	0,19	0,23	0,25	0,16	0,2	0,25	0,14	0,17	0,25	0,1	0,16	0,2
Risk index U.	8,2	36,2	121	5,4	28,6	64	5,5	27,1	84,8,1	8,1	22,8	37

The system parameter is the tension index, which is calculated according to the method of R.M. Baevsky, very high, indicates excessive tension of the cardiovascular system. Reduced vascular stiffness index averaged 0.1 ± 0.06 mm Hg/ml, indicating a decrease in vascular elasticity. The cardiac index averaged 7.1 ± 1.3 l/min/m², and was increased, which indicates a decrease in blood circulation of organs and systems in this category of patients. All of these indicators indicate a significant load in the work of the cardiovascular system with pronounced decreases in kidney function in acute glomerulonephritis. Also, based on the indicators of the risk index for the development of cardiovascular diseases and complications, which averaged 28 ± 3.4 , one can indicate cardiorenal interactions in case of damage to one organ to the deterioration of the other.

Conclusion

1. The dynamics of changes in metabolic parameters - oxygen, lactate and creatinine phosphate in myocardial muscles and adaptive reactions in acute glomerulonephritis directly depends on the degree of decrease in kidney function
2. The nature of the damage to one organ leads to damage to another and vice versa, indicating a cardiorenal relationship.

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