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ASSESSMENT OF HEMODYNAMIC INDICATORS OF THE HEART IN CHILDREN WITH ACUTE GLOMERULONEPHRITIS

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Key words: acute glomerulonephritis, children, cardiometry, hemodynamic parameters of the heart.
Tayanch so'zlar: o'tkir glomerulonefrit, bolalar, kardiometriya, yurakning gemodinamik ko'rsatkichlari.
Ключевые слова: острый гломерулонефрит, дети, кардиометрия, гемодинамические показатели сердца.

Kidney pathologies in childhood are distinguished by their causes and features, including the impact on growth, the occurrence of cardiovascular complications and the risk of developing chronic renal failure. The innovative diagnostic methods make it possible to determine the prognosis of the disease and overcome the difficulties of diagnosis and treatment. The study aimed to study the hemodynamic parameters of the heart in children with renal pathologies. Cardiometry was performed on 98 children with acute glomerulonephritis, depending on the level of glomerular filtration rate (GFR), to determine the hemodynamic parameters of the heart. As a result, the changes in the hemodynamic parameters of the heart were related to a reduced level of GFR in the kidneys.

O‘TKIR GLOMERULONEFRIT BILAN KASALLANGAN BOLALARDA YURAKNING GEMODINAMIK KO’RSTKICHLARINI BAHOLASH

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Bolalik davrida buyrak patologiyalari ularning sabablari va xususiyatlari, jumladan, o’sishga ta’siri, yurak-qon tomir asoratlari paydo bo’lishi va surunkali buyrak etishmovchiligini rivojlanish xavfi bilan ajralib turadi. Innovatsion diagnostika usullari kasallikning prognozini aniqlash va diagnostika va davolashdagi qiyinchiliklarni bartaraf etish imkonini beradi. Tadqiqot buyrak patologiyalari bo'lgan bolalarda yurakning gemodinamik ko'rsatkichlarini o'rganishga qaratilgan. Yurakning gemodinamik ko‘rsatkichlarini aniqlash uchun o‘tkir glomerulonefrit bilan og‘rigan 98 nafar bolada glomerulyar filtratsiya tezligi (GFR) darajasiga qarab kardiometriya o‘tkazildi. Natijada, yurakning gemodinamik ko'rsatkichlaridagi o'zgarishlar buyraklardagi GFR darajasining pasayishi bilan bog'liqligi aniqlandi.

ОЦЕНКА ГЕМОДИНАМИЧЕСКИХ ПОКАЗАТЕЛЕЙ СЕРДЦА У ДЕТЕЙ С ОСТРЫМ ГЛОМЕРУЛОНЕФРИТОМ

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Патологии почек в детском возрасте отличаются причинами возникновения, особенностями, включающими воздействие на рост, риск развития сердечно-сосудистых осложнений, хронической почечной недостаточности. Использование инновационных методов диагностики позволяет определить прогноз заболевания и преодолеть трудности диагностики и лечения. Целью исследования явилось изучение гемодинамических показателей сердца у детей с почечной патологией. Кардиометрия выполнена 98 детям с острым гломерулонефритом в зависимости от уровня скорости клубочковой фильтрации (СКФ) для определения гемодинамических показателей сердца. Изменения гемодинамических показателей сердца были связаны со снижением уровня СКФ в почках.

Introduction. Glomerulonephritis (GN) is one of the severe kidney diseases in children, characterized by the frequent development of complications and progression to chronic renal failure (CRF) [2,5]. Kidney pathology can occur with kidney damage and a decrease in their function, based on indicators: glomerular filtration rate (GFR) less than 90 ml / min / 1.73 m^2 leads to the risk of developing renal failure and cardiovascular complications [1,4]. The combination of damage to the cardiovascular system and kidneys exacerbates the dysfunction of one another, increasing mortality in case of damage to one or another system, which refers to the state of the cardiorenal syndrome [3]. Therefore, it is so important to conduct timely clinical and laboratory studies and assess the volume of blood entering the aorta at different moments of the cardiac cycle systole - diastole, quantitative parameters, determining the functional state of the cardiovascular system, using cardiometry to assess the severity of the disease and prevent the development of complications. [6,7].

Materials and research methods. 98 children aged 3 to 18 years (7 ± 2.7) were examined, 46 girls, 52 boys who were hospitalized in the Samarkand Regional Children's Multidisciplinary Medical Center with a diagnosis of acute glomerulonephritis (AGN) (Fig. 1).

29 patients were diagnosed with AGN with nephritic syndrome and 69 patients with AGN with nephrotic syndrome.

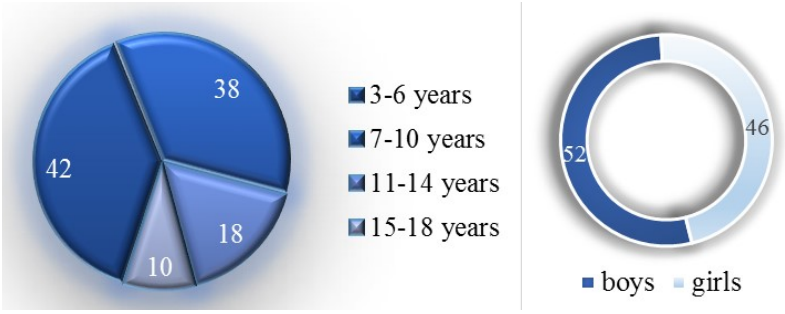

Fig. 1. Quantitative ratio of patients by age and sex.

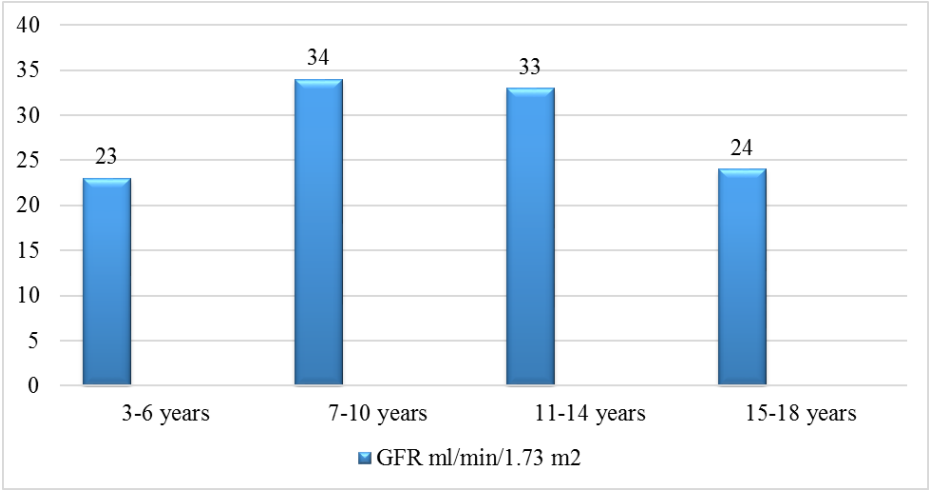

Fig. 2. Level of GFR ml/min/1.73 m^2 in patients with AGN by age.

In each patient, the glomerular filtration rate (GFR) was assessed (Fig. 2). In children over the age of 2 years, the NKF (USA) clinical guidelines suggest assessing the value using the Schwartz formula:

Schwartz et al. (1976) formula:

$$GFR = \frac{40 \text{ x Height (cm)}}{\text{Scr (µmol/l)}}$$

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

First of all, these are hemodynamic indicators - the volume of blood circulating in the cardiovascular system. The most informative are the seven-phase volumes of blood (Table 1):

- SV - stroke volume of blood (ml),
- MV - cardiac output (l/min),
- PV1 - the volume of blood entering the ventricle of the heart in early diastole (ml),
- PV2 - the volume of blood entering the ventricle of the heart during atrial systole (ml),
- PV3 - the volume of blood expelled from the ventricle of the heart in the phase of rapid expulsion (ml),
- PV4 - the volume of blood expelled from the ventricle of the heart in the phase of slow ejection (ml),
- PV5 - the volume of blood pumped by the ascending aorta into systole (ml).

These indicators are used to calculate the ejection fraction RV1= PV1/SV (%). It is measured as a percentage and corresponds to the ratio of the volume of blood entering the left ventricle at the beginning of diastole to the volume pushed into the aorta. This value shows the ability of the heart to provide the real need of the body with blood. Normally, it is about 62%, if higher, then this indicates hypertrophy of the heart, if less - hypo function.

The blood volumes themselves are a function of the duration of the phases of the ECG cardiac cycle. Their measurement and substitution into the equations of hemodynamics G. Poedintseva-O. Voronov, we obtain the above volumes of blood.

An important parameter of echocardiography helps to obtain information about the ejection fraction of the heart according to the Simpson method - this indicator determines the efficiency of

1 table.

Normative values of hemodynamic parameters during cardiometry.

3 years	5 years	7 years	11 years	13 years	15 years	18 years
SV=8-16 ml	SV=9-18 ml	SV=11-22 ml	SV+11,31-28,1 ml	SV=18-35 ml	SV=24-46 ml	SV=34-76 ml
MV=0,8-1,6 l	MV=0,9-1,9 l	MV=1-2 l	MV=0,97-3,23 l	MV=1,6-3,2 l	MV=2,2-4,4 l	MV=3,2-7,2 l
PV1=4,3-8,3 ml	PV1=3,23-6,1ml	PV1=6--12ml	PV1=3,38-12,55ml	PV1=8,71-16,86ml	PV1=11-21ml	PV1=17,4-38,5ml
PV2=4,7-9 ml,	PV2=6-11,6ml,	PV2=5-10ml,	PV2=4,80-22ml,	PV2=9-18 ml,	PV2=13-25ml,	PV2=16,3-37,2ml,
PV3=4,3-8,3 ml	PV3=5,4-10,6 ml	PV3=6,6-13ml	PV3=6,71-16,13,	PV3=10,5-20,7,	PV3=14-27ml,	PV3=20-45 ml
PV4=3,2-6,2ml	PV4=3,7-7,2ml	PV4=4,5-8,7 ml	PV4=4,6-11	PV4=7,2-14ml	PV4=9.6-18,7	PV4=14-31ml
PV5=1,2-1,54ml	PV5=1,4-1,9 ml	PV5=1,7-2,35ml,	PV5=1,77-3,15ml,	PV5=2,8-4ml,	PV5=3,7-5,25ml,	PV5=5-8 ml,

the work done by the heart with each beat.

The ejection fraction of the left ventricle is normally in the range of 55-70%. Indicators of 40-55% indicate a decrease in EF below normal. An EF level below 40% indicates heart failure.

Results and discussions. In a clinical study, the following signs were identified by syndromes (Fig. 3):

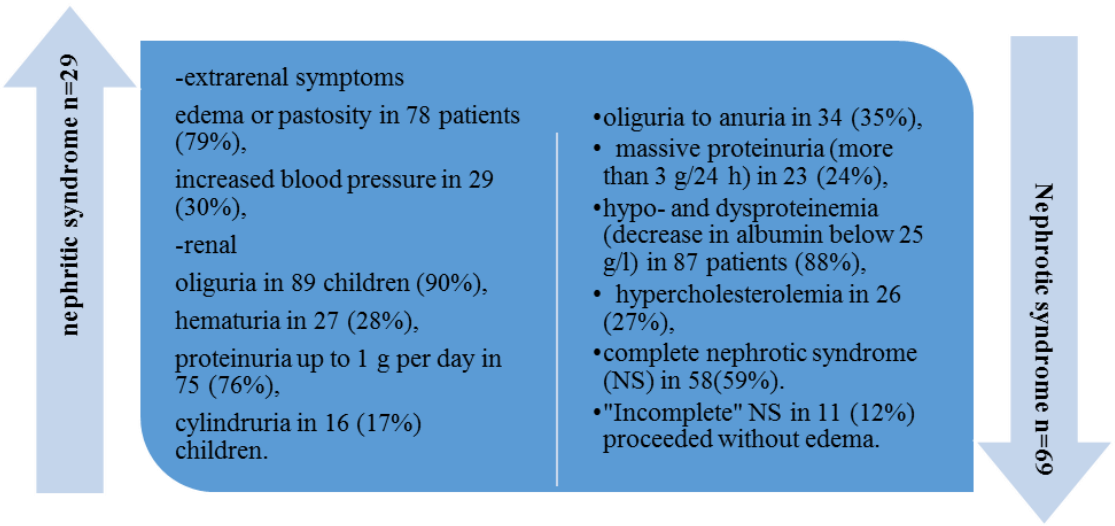

Fig. 3. Symptom complex of signs in AGN.

One of the manifestations of impaired renal function is fluid retention in the tissues in the form of edema. There are several types of edema: hydrostatic edema, resulting from an increase in pressure in the capillaries; hypoproteinemic, due to a decrease in oncotic pressure during the loss of blood proteins, more often albumins. In our patients, the level of total protein in the blood plasma averaged 46.6 g/l, and albumin 25.7 g/l, which indicated a significant decrease in indicators below the norm; membranogenic, manifests itself with an increase in the permeability of capillaries as a result of their damage.

Objectively, edema is detected during examination and palpation (with pressure, a fossa remains), with a significant (up to 4-9 l) accumulation of fluid in the body - pre-edema. The mechanism of edema formation in AGN is the retention of salt and water by the glomerular apparatus of the kidneys, a decrease in the concentration of proteins in the blood plasma and an increase in the permeability of the vascular wall (tab.2).

In diseases of the kidneys (nephritis and others), edema occurs throughout the body, face, is more pronounced around the eyes, when pressed, they are soft, the skin over them is pale. Initially, edema occurs in the lower extremities in 35% of cases (with a vertical position of the body), the sacrum, lower back (in a horizontal position), later there is a complete edema of the subcutaneous

2 table.

Indicators of objective components leading to edema.

Indicators	Body mass index kg/m²	Heart-beats per minute	Systolic BP mmHg	Diastolic BP mm.Hg	Daily diuresis ml	Presence of proteins in urine ‰	Total blood protein g/l	Blood albumin g/l
Average	31.3	100	121	77	356.5	2	46.6	25.7
Maximum value	40	134	190	120	900	6.6	68	40
Minimum value	12	44	90	28	50	0.033	32	18

tissue (anasarca) in 6% of patients, fluid also accumulates in the pleural cavity (hydrothorax) in 7% of patients and the peritoneum (ascites) in 10% and the pericardial cavity (hydropericardium) in 8% of patients (Fig. 4).

SV – stroke volume of blood, (ml) corresponds to the level of 55 ml; MV is the minute volume of blood (cardiac output), (l/min) corresponds to 3.7 l/min. The range of normal changes in measured blood volumes is ±30%.

In the group of patients with acute glomerulonephritis, as GFR decreased from a maximum of 119 to a minimum of 5.4 ml/min/1.73 m2, hemodynamic volume indicators decreased: SV – stroke volume 8.7 ml; MV - cardiac output or minute blood volume is 0.85 l / min; PV1 - blood volume, during the period of the beginning of diastole in the ventricle of the heart, evaluating the pumping function of the ventricle, 0.62 ml of filling volume; PV2 is the volume of blood in the atrial systole phase, an indicator of the contractile function of the atrium, 3.5 ml of filling volume.

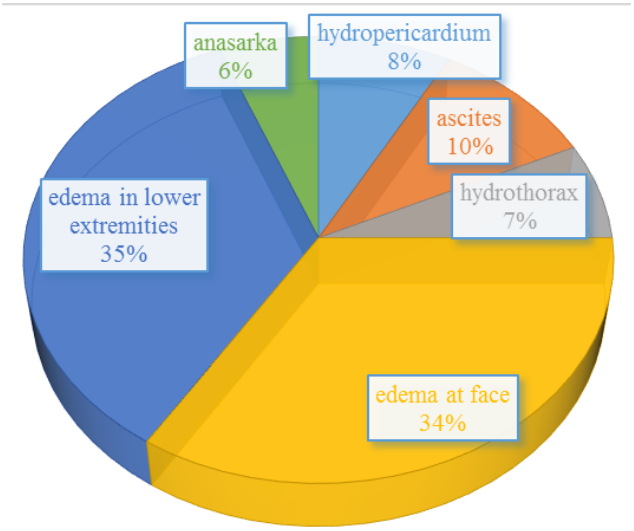

Fig. 4. Percentage of the manifestation of edema.

PV3 - blood volume during the period of rapid expulsion from the ventricles of the heart, amounted to 5.16 ml; PV4 - blood volume during the period of slow expulsion from the ventricles of the heart, amounted to 3.5 ml; PV5 - the volume of blood in systole pumped by the ascending aorta is 2.8 ml. (Table 3) If it is high, then the aorta works under load, helping the blood move through the vessels with low elasticity of the heart muscles. Often this is enough to understand the state of the myocardium. PV2 averaged 14.4 ml, indicating an overload state of the myocardium. Stroke volume SV = PV1 + PV2 = PV3 + PV4. The stroke volume SV is below normal and corresponds to the level of 42.8 ml. Minute volume MV averaged 1.82 litres of the border of the range between the norm and pathology. The PV5 parameter is an average blood volume of 2.8 ml (part of SV), pumped by the ascending aorta as a peristaltic pump, characterizes a part of the blood volume, moving through the vessels. Functionally, it is associated with the energy of blood flow into the aorta.

The dynamics of the change in the RV1 parameter - the ejection fraction, when assessing acute glomerulonephritis, averaged 54%, which, relative to the ejection fraction on echocardiography of 63%, indicats lower parameters (Table 4). Ejection fraction (EF) refers to the percentage of blood volume ejected into the vessels from the ventricle of the heart during each contraction. If

3 table.

Hemodynamic parameters of the heart during cardiometry depend on the level of GFR (n=98).

Indicators	GFR ml/min/1.73 m²	SV ml	MV l/min	PV1 ml	PV2 ml	PV3 ml	PV4 ml	PV5 ml	Heart rate per min bpm
Maximum	119.2	54	4.3	22.5	36.6	32.06	22	8.6	160
Minimum	5.4	8.7	0.85	0.62	3.5	5.16	3.5	1.1	57
Medium	29.2	19	1.82	9.6	14.4	11.2	7.6	2.8	101.6

4 table.

Ejection fraction of the heart depends on the level of GFR in patients with acute glomerulonephritis (n=98).

Indicators	GFR ml/min/1.73 m^2	RV1 %	Ejection fraction %
Maximum	121	73	73
Minimum	5.4	36	42
Medium	29.3	54	63

there was 100 ml of blood in the ventricle, and 55 ml entered the aorta after the heart contracted, it is considered that the ejection fraction was 55%.

Ejection fraction, more often refers to the EF of the left ventricle (LV), since it is the left ventricle that ejects blood into the systemic circulation.

The heart in a normal resting state ejects more than half of the blood from the left ventricle into the vessels with each beat. A decrease in EF indicates heart failure. In our case, a low GFR in patients with an EF of 42% and an RV1 of 36%, indicates a decrease in the contractile function of the heart (Table 4).

When studying the relationship, a positive correlation was found between GFR and hemodynamic parameters in patients with acute glomerulonephritis (Table 5). This indicates a trend towards a decrease in hemodynamic parameters with a decrease in the level of kidney GFR in acute glomerulonephritis and when assessing the energy potential of the heart, the indicators indirectly indicate heart fatigue.

5 table.

Correlation between GFR and hemodynamic parameters in patients with acute glomerulonephritis (n=98).

SV ml	MV l/min	PV1 ml	PV2 ml	PV3 ml	PV4 ml	PV5 ml	SV ml	MV l/min	PV1 ml	RV1 %	Ejection fraction %
0.45	0.38	0.24	0.4	0.45	0.45	0.3	0.14	0.2	0.2	0.4	0.2

Conclusion:

1. A decrease in cardiac hemodynamics has a direct average correlation with a decrease in kidney GFR in acute glomerulonephritis

2. Characteristic signs of changes in hemodynamic parameters make it possible to identify the degree of initial changes in hemodynamics in renal pathologies.

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