eISSN: 2229-3213 pISSN: 2229-3205
The Journal of Applied Science and Social Science
Volume 16,Issue 02 February, 2026

COMPREHENSIVE ULTRASONIC STUDY AS A METHOD OF DIAGNOSTICS OF GLOMERULONEPHRITIS

Sultanova L.R.
Tashkent State Medical University

Abstract: Glomerulonephritis is a group of immune-mediated inflammatory kidney diseases characterized by primary glomerular damage followed by interstitial tissue involvement, a tendency to progression, progression to nephrosclerosis, and the development of chronic renal failure syndrome. Until recently, nephrology lacked highly informative methods for reliably assessing hemodynamic changes in the kidneys. With the introduction of Doppler ultrasonography into medical practice, it has become possible to use them for dynamic assessment of renal blood flow.

Doppler ultrasonography is typically used to diagnose lesions in the main arteries, which have a relatively large diameter. However, assessing Doppler ultrasonography parameters at various levels of the renal artery in children with glomerulonephritis is a challenging clinical diagnostic task.

Key words: children, kidneys, glomerulonephritis, ultrasound diagnostics, Dopplerography.

Relevance. Glomerulonephritis (GN) is a group of diseases with immune-inflammatory damage to the glomerular apparatus of the kidneys (Sethi S., 2012; Kronbichler A. et al ., 2015; Couser WG, 2016). A classic representative of the GN group is post-infectious glomerulonephritis (PIGN), which can occur in both acute and chronic forms.

In approximately one-third of cases, acute PIGN progresses to chronic. Chronic glomerulonephritis is a steadily progressive disease, with complete recovery cases being rare. In countries with high socioeconomic development, chronic GN is the third leading cause of chronic kidney disease (CKD), while in some Asian and African countries it is the leading cause, due to the high prevalence of infectious diseases and inadequate conditions for the effective treatment of conditions that contribute to the development of GN (Ayodele OE, Alebiosu CO, 2010; Jha V. et al., 2013).

In the Republic of Uzbekistan, glomerulonephritis is the leading cause of terminal chronic renal failure, incompatible with life and requiring expensive renal replacement therapy (dialysis, donor kidney transplantation) (Bikbov B.T., Tomilina N.A., 2016). Currently, to establish the nature of the clinical course of glomerulonephritis - acute or chronic - clinical and anamnestic data, general clinical and biochemical blood and urine tests, radiation research methods, as well as determination of the glomerular filtration rate (SFR) are used (Mukhin N.A. et al ., 2011).

However, in clinical practice, it is often difficult to promptly differentiate acute glomerulonephritis from exacerbations of chronic GN in the early stages of the disease, due to the lack of specific diagnostic criteria. Chronic glomerulonephritis is typically diagnosed only at the stage of severe, irreversible changes in the kidneys with the development of nephrosclerosis, when opportunities for early diagnosis and timely treatment aimed at preventing the progression of the pathological process are missed.

The aim of the study was to evaluate renal vascular hemodynamics in various clinical forms of glomerulonephritis in children.

Material and methods of the study. To achieve the stated objective, 74 children with glomerulonephritis (GN) and 15 apparently healthy children aged 3 to 18 years were examined. The patients were treated and examined in the nephrourology department of the National Medical Center. The classification adopted at the All-Union Symposium of Pediatricians and Nephrologists [2] was used to resolve diagnostic issues.

All patients were examined in a state of preserved renal function and were divided into three clinical groups. Group 1 included children with nephrotic syndrome of acute glomerulonephritis

(22 patients: 16 boys, 6 girls). Group 2 included children with nephrotic syndrome with hematuria (9 patients: 5 boys, 4 girls). Group 3 consisted of children with the nephrotic form of chronic glomerulonephritis (43 patients: 27 boys, 16 girls).

Patients with chronic glomerulonephritis were treated in the nephrology department using differentiated approaches, taking into account the clinical form of the disease and the functional state of the kidneys, using traditional pathogenetic therapy methods. Patients were re-evaluated after remission was achieved.

In addition to the clinical examination, paraclinical investigations were used. All patients underwent ultrasound examinations at various stages of kidney disease activity. This included a comprehensive B-mode abdominal examination followed by triplex renal scanning, including grayscale imaging, color flow mapping, and spectral blood flow analysis. The examination was performed on an APLIO 500 ultrasound system using a convex transducer with scanning frequencies of 3.5 and 7.5 MHz.

The peak systolic blood flow velocity (Vps), end-diastolic velocity (EDV), and mean maximum blood flow velocity (Tmax) were determined in the renal artery trunk, segmental, interlobular , and arcuate arteries. However, given that the accuracy of determining absolute blood flow velocities largely depends on the angle between the longitudinal axis of the vessel and the ultrasound beam, and that this parameter is difficult to control for the distal renal arteries, renal hemodynamics was assessed using "practically angle-independent " indices: the resistance index (RI, normal 0.6–0.7), the pulsatility index (PI, normal 1.0–1.5), and the systolic -diastolic ratio (S/D, normal 2.5–3.5).

A significant, high-degree direct correlation was found between all three vascular resistance indices ($r = 0.92–0.96$; $p < 0.05$). The total duration of the examination ranged from 15 to 35 minutes.

No significant age-related differences in indicators were found in practically healthy children, which allowed us to use the average values obtained in the control group.

Research results. Analysis of pulsed Doppler ultrasound data revealed that renal hemodynamic disturbances were observed in all clinical entities examined during the active phase of the disease. The most preserved blood flow was observed in patients with acute glomerulonephritis (AGN) of the nephrotic type. In this group, renal hemodynamic parameters were only slightly below normal at the level of the arcuate arteries, while no disturbances were detected in the larger arteries.

When analyzing the parameters of pulsed Doppler ultrasound during the active period of glomerulonephritis without extrarenal manifestations, it was found that with AGN, all indicators of vascular resistance at all levels of the renal artery remained practically within normal limits, with the exception of a slight decrease in the pulsatility index (PI) at the level of the arcuate arteries.

grayscale ultrasound image of chronic glomerulonephritis (CGN) depended on the phase and duration of the disease: in the initial stages, a moderate increase in kidney volume and a slight increase in parenchymal echogenicity were noted . Concurrently, more pronounced abnormalities in color Doppler mapping parameters were detected: blood flow turbulence (31.3%), asymmetry of hemodynamic parameters (34.4%), the presence of rare, thinned, and deformed vessels (6.3%), and diffuse vascular depletion (31.3%).

When analyzing the velocity indicators of pulsed Doppler ultrasound in the active stage of CGN in children, no disturbances in blood flow in large vessels were observed, however, starting from the level of the interlobular arteries, a decrease was recorded, characterized by a significant decrease in diastolic blood flow velocity (Vd): 7.4±0.08 mm/s and 9.33±0.28 mm/s, respectively ($p<0.05$). An increase in the resistance index (RI; normal 0.6–0.7) was also noted, which was: in the renal artery trunk - 0.72±0.04 ($p < 0.05$), in the segmental arteries - 0.65±0.06 ($p < 0.05$), in the interlobular arteries - 0.60±0.04 ($p < 0.05$), in the arcuate arteries - 0.53±0.04

(p < 0.05). The pulsatility index (PI; normal 1.0–1.5) was: in the renal artery trunk - 1.47±0.15, in the segmental arteries - 1.22±0.18, in the interlobular arteries - 1.00±0.10 (p < 0.05). The systolic -diastolic ratio (S/D; normal 2.5–3.5) was determined at the level of the renal artery trunk - 3.52±0.39, segmental arteries - 3.08±0.39 (p< 0.05), interlobular arteries - 2.41±0.27 (p< 0.05) and arcuate arteries - 2.24±0.14.

In the absence of extrarenal manifestations, blood flow disturbances primarily affected the small (arcuate) renal arteries and were characterized by decreased vascular resistance indices. During the remission of glomerulonephritis, blood flow disturbances, manifested by decreased resistance indices, were observed only at the level of the arcuate arteries. During remission, vascular resistance indices also did not fully normalize; a slight decrease was observed at the level of the arcuate arteries.

Thus, during the active period of the disease, in all the considered variants of glomerulonephritis, disturbances in renal blood flow were observed, but its greatest preservation was observed in patients with the hematuric form of glomerulonephritis.

Doppler ultrasound data , renal blood flow in glomerulonephritis is impaired at various levels of the renal artery—in the trunk, segmental, interlobular , and arcuate arteries. The most pronounced hemodynamic disturbances are detected in the small renal arteries— the interlobular and, in particular, the arcuate arteries—while blood flow in the large arteries may remain within normal limits.

REFERENCES

1. Tomilina N.A., Bikbov B.T. Chronic kidney disease: epidemiology, diagnosis, treatment. Nephrology and dialysis. 2016; 18(1): 4–15.
2. Sinitsyn V.E., Ternovoy S.K. Ultrasound and Doppler diagnostics of kidney diseases. Bulletin of Roentgenology and Radiology. 2019; 100(4): 215–223.
3. Kozlovskaya L.V., Shilov E.M. Chronic glomerulonephritis: clinical features and diagnostics. Therapeutic archive. 2018; 90(6): 5–12.
4. Sethi S., Fervenza F.C. Standardized classification and reporting of glomerulonephritis. Clinical Journal of the American Society of Nephrology. 2012; 7(3): 459–468.
5. Platt JF, Rubin JM, Ellis JH Doppler sonography of the kidney: differentiation of medical renal disease. Radiology . 1991; 181(2): 515–519.
6. Rifkin MD, Needleman L., Pasto ME Evaluation of renal transplant and native kidneys with Doppler ultrasound. Radiographics . 2014; 34(2): 453–469.