

# Clinical And Laboratory Assessment Of The Functional State Of Kidneys In Leukemia Patients

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Article History	Abstract
Received: 7 <sup>th</sup> March, 2026 Accepted: 7 <sup>th</sup> April, 2026	<p>The literature review presents modern data on kidney damage in leukemia patients and the characteristics of their clinical and laboratory diagnostics. The main pathogenetic mechanisms for the development of renal dysfunction in hemoblastoses, including leukemic infiltration of renal tissue, tumor lysis syndrome, toxic effects of antitumor therapy, infectious-inflammatory complications, and systemic hemodynamic disorders, have been examined. Issues regarding the prevalence of acute kidney damage and chronic kidney disease in leukemia patients, as well as factors influencing the risk and severity of nephropathy, are highlighted. Particular attention is paid to modern methods for laboratory assessment of kidney function. The diagnostic significance of traditional indicators—creatinine, urea, glomerular filtration rate, general urine and electrolyte analysis—as well as promising biomarkers of early kidney damage, such as NGAL, KIM-1, and cystatin C, was analyzed. It has been shown that the use of modern biomarkers contributes to the earlier detection of renal dysfunction and allows for the timely adjustment of treatment tactics. It is emphasized that a comprehensive clinical and laboratory assessment of kidney condition is important for reducing complications, increasing treatment efficacy, and improving the prognosis in leukemia patients.</p>

**Keywords:** Hemoblastoses, leukemia, kidney dysfunction, acute kidney damage, nephrotoxicity, tumor lysis syndrome, kidney damage biomarkers, NGAL, KIM-1, cystatin C, glomerular filtration rate.

American scientist Rupali Wanchoo and colleagues (2018) from the Zucker School of Medicine at Hofstra/Northwell, Department of Kidney Diseases and Hypertension, confirmed in their study that chronic lymphocytic leukemia (CLL) is the most commonly diagnosed type of leukemia among adults in the United States and Western Europe. In 2017, approximately 20,000 new cases of CLL diagnosed in the United States. It is noteworthy that OP is a common complication of cancer, affecting 9% of patients receiving systemic therapy, and is particularly common in patients in critical condition. Of the 388,449 leukemia patients, 9,834 (2.5%) had acute kidney damage (AKL). The average age of patients with leukemia in the OPD group was  $71.2 \pm 13$  years. This is higher than in patients with leukemia hospitalized for all other reasons, where this indicator was  $65.5 \pm 16.8$  years. Racial affiliation, gender, hematopoietic stem cell transplantation, and inpatient hemodialysis did not affect mortality [21].

Thai scientist Limratchapong C. (2022) from the Department of Pediatrics at Prince Songkla University and his colleagues described that 56 (50%) children had episodes of OPD. The median time from diagnosis of OML to the first episode of OPN was 29.5 days (interquartile range: 11.0–92.8), and the median observation time was 10.9 months (interquartile range: 3.6–31.1). Age at diagnosis  $\geq 10$  years (OR 2.75, 95% CI 1.09–6.93), glomerular filtration rate  $< 90$  ml/min/1.73 m<sup>2</sup> at diagnosis of OML (OR 7.58, 95% CI 1.89–30.5), and septic shock (OR 22.0, 95% CI 4.63–104.3) were independently associated with OPN [13]. Kumar R. (2022) together with other scientists from the Department of Pediatrics and the Department of Nephrology at Duke University in the USA described that 222 patients were included in the study. The overall frequency of OPN development in our cohort was high: OPN developed in 101 patients (45.5%, CI 38.8-52.3%). The status of CBD was determined in only 214 patients due to limited data on glomerular filtration rate (GFR) in later stages. The frequency of CBD development was low: CBD developed in only 5 out of 214 patients (2.3%, CI: 0.8-5.4%). The overall frequency of hypertension development at the time of diagnosis was 45.6% (95% CI: 59.1-72%), and 65.8% 1 month after diagnosis (95% CI: 59.1-72.0%). Chronic hypertension detected in only 216 patients due to limited blood pressure data. Chronic hypertension was noted in 34.3% of patients (74/216, 95% CI: 28-41%) [10].

American scientist Wanchoo R. and his colleagues (2018) from the Zucker School of Medicine at Hofstra/Northwell University, Department of Kidney Diseases and Hypertension, identified that specific cytogenetic anomalies identified using fluorescent hybridization in situ (FISH) analysis and anomalies in specific genes identified through molecular genetic testing are of prognostic importance in patients with CLL. Of these, deletion (13q) and trisomy 12 are favorable prognostic signs. Historically, patients with deletion (17p) or deletion (11q) have been at high risk of either ineffective initial treatment or relapse shortly after reaching remission [21].

Turkish scientist, Kumru Şahin G, together with colleagues (2021) from the Department of Nephrology of the Faculty of Medicine at Ankara University, proved that the kidneys are among the organs most frequently affected by leukemia in patients with chronic lymphocytic leukemia (CLL), according to post-mortem autopsy data (63–90%). Li of the kidneys is frequently encountered in CLL, but it is unlikely to be associated with severe OPN. Although the mechanism of this clinical manifestation is unclear, it is hypothesized that the compression of the tubular and microvascular lumen by CLL cells may cause intra-renal obstruction and ischemia. No clear relationship has been identified between the stage of CLL, the intensity of interstitial infiltration, and the severity of renal failure [11].

Cheng B, a Chinese scientist (2024) from the Wuhan Children's Hospital, together with colleagues presented a case of a child with acute lymphocytic leukemia (ALL) who, after achieving remission after treatment, experienced a recurrence of the disease in the kidney, leading to asymptomatic OPD, to remind doctors of the need to consider the underlying disease during clinical assessment. In cases of unexplained POI, if possible, a kidney biopsy should be performed for accurate diagnosis and scientifically grounded treatment. In short, children with leukemia who have reached remission after treatment still require regular monitoring of general urine analysis and kidney function [3]. American physician Howard SC (2024) and his colleagues identified that tumor lysis syndrome (TLS) is a critical oncological condition characterized by extensive destruction of tumor cells, leading to the rapid release of intracellular contents into the systemic bloodstream ahead of homeostatic mechanisms. Although SLE can occur spontaneously, it usually develops shortly after the start of effective treatment, especially in patients with a large mass of cancer cells (defined as  $\geq 500$  g or  $\geq 300$  g/m<sup>2</sup> of body surface area in children). To prevent CLP, careful monitoring and

hydration are necessary to improve renal perfusion and diuresis, as well as to minimize the deposition of uric acid or calcium phosphate in the renal tubules [7]. French scientist Arnaud M (2022) and his colleagues described acute kidney damage caused by tumor lysis syndrome (TLS), which occurs in up to 64% of patients with TLS, significantly reduces the likelihood of complete remission of the primary malignant neoplasm and is associated with a higher level. Crystalline kidney damage in SLE occurs when calcium phosphate, uric acid, and xanthine precipitate in the renal tubules [1]. Italian scientist Vivarelli M (2019) from the Bambino Gesù Children's Hospital and her colleagues have proven that soluble factors produced by leukocytes, such as cytokines and immunoglobulins, as well as other circulating permeability proteins, can directly affect podocytes, leading to the smoothing of podocyte processes and the disruption of the glomerular filtration barrier [20].

Chinese scientist Su Y (2025) from Southwestern Medical University, Luzhou, and his colleagues found that KIM-1 is a sensitive and specific marker of kidney damage and can be used as a prognostic predictor, especially in the context of OPD in adult patients [18]. Belgian scientist Pottel H (2023) from the Department of Public Health and Primary Health Care has proven that serum cystatin C has proven to be an early and accurate biomarker for CBD, especially useful for patients for whom creatinine is an inadequate marker or GFR measurement is impractical. A possible advantage of cystatin C is that, being a large molecule, its filtration may be limited, and the concentration of cystatin C in the blood may increase faster (for example, in the case of minor glomerular damage) [17].

American scientist Parikh A (2017) from Columbia University Medical Center, New York, and his colleagues identified that NGAL is the most studied marker of OPD and demonstrated high sensitivity and specificity in detecting OPD in the emergency department and in predicting a combined clinical outcome, including death and dialysis after hospitalization. It is the most studied because: 1) it possesses a vast dynamic range; 2) responds to injury in a dose-dependent manner; 3) responds within 3 hours after injury, which is important in emergency departments; 4) responds to a wide range of injuries; 5) easy to measure; 6) due to the recent emergence of clinical platforms, including new test strips for determining NGAL; 7) the test is approved in Japan, Korea, and some parts of Europe. It is currently under FDA review in the US. When comparing various potential biomarkers for the study, the authors found that NGAL tracks

significant changes in creatinine levels and has better AUC/ROC values [14]. Spanish scientist Ginès P (2018) from the Institute for Biomedical Research of Augusta Pi and Sunera (IDIBAPS), together with colleagues, made a significant contribution to the discovery of a symptom known as Hepatorenal Syndrome (HRS), which is a form of kidney dysfunction characteristic of liver cirrhosis. Recently, the terminology has changed: acute GRS has been referred to as acute kidney injury (AKI) - GRS. OPP-GRS is characterized by severe impairment of renal function due to renal artery vasoconstriction in the absence of significant changes in the histological picture of the kidneys. The main provoking factors of OPP-GRS are bacterial infections, especially spontaneous bacterial peritonitis. The diagnosis of OPP-GRS is a complex task due to the lack of specific diagnostic tools and primarily involves differential diagnosis with other forms of OPP, especially with acute tubular necrosis [4].

Turkish scientist Kerem Izmirliglu (2024) from the Faculty of Medicine at Gazi University and his colleagues examined 135 patients with hematological malignant neoplasms. Among these patients, OPD was detected in 69% upon admission and developed in 31% during their stay in the intensive care unit. The overall mortality rate in the intensive care unit was 51% in the study group. The mortality rate was 67% in patients with OPD, while in patients without OPD, it was 8%.  $p < 0.01$ ) [9]. American scientist Poston JT (2019) from the Department of Pulmonology and Intensive Care and his colleagues found that sepsis is associated with OPN in up to 50% of cases, and OPN develops in up to 60% of patients with sepsis. Patients with sepsis complicated by OPD have a significantly higher mortality rate compared to patients without OPD. Furthermore, patients with OPN associated with sepsis have a significantly higher mortality rate compared to patients with OPN of other etiologies [16]. American scientist Perazella MA (2016) from Yale University School of Medicine, together with colleagues, proved that hypertension, proteinuria, acute kidney damage (AKD), and thrombotic microangiopathy complicate the use of angiogenesis-suppressing drugs, while acute and chronic tubulointerstitial damage is observed after exposure to other targeted drugs [15].

American scientist Kashani K (2019) from the Department of Nephrology and Hypertension, Mayo Clinic, together with colleagues, proved that serum creatinine remains the most common functional biomarker of the kidneys. The Jaffe reaction is a colorimetric method based on interaction with alkaline picrate; however, its main disadvantage is low specificity due to the influence of

pseudochromogens such as glucose proteins, ketones, bilirubin, and drugs such as cephalosporins, which can falsely increase the result. Fermentative methods possess significantly higher specificity and minimize the impact of side effects, ensuring higher analytical accuracy. IDMS standardization implies that modern methods must be traceable to mass spectrometry of isotope dilution, which is necessary to ensure the comparability of results between different laboratories and the correctness of RSKF formulas [8]. American scientist Gounden V (2024) from Kwazulu-Natal University and its colleagues have confirmed that when blood urea levels are elevated, the ratio of urea to creatinine can be useful for differentiating between prerenal and renal causes. In prerenal diseases, this ratio is close to 20:1, while in congenital kidney diseases, it is closer to 10:1. Bleeding from the upper gastrointestinal tract may be associated with a very high ratio of urea to creatinine (sometimes >30:1) [5]. Chinese scientist Zhou H (2022) from The Department of Integrative Traditional Chinese and Western Medicine and its colleagues identified that violations in urine analysis: Deviations were identified in 54.2% of patients. Proteinuria was detected in 34.9%, and hematuria in 31.3%. In the UIT group, disorders were more pronounced: proteinuria in 57.9%, and hematuria in 52.6%. The specific weight of urine is higher in UTI (1.027 vs. 1,021) [22].

Chinese scientist Tan D (2022) from the Main Hospital of the Chongqing Metallurgical Plant, together with colleagues, stated in their articles that ROC analysis showed that the combined determination of IL-8, NGAL, and KIM-1 in urine after 12 hours had a larger area under the curve (AUC) than the determination of each marker individually (0.997, 95% CI: 0.991–0.998), and sensitivity and specificity were 98.2% and 96.7%, respectively. Pearson's correlation analysis showed that NGAL levels in urine after 4, 12, 24, and 48 hours in patients with OPN were positively correlated with KIM-1 and IL-18 levels in urine ( $p < 0.01$ ) [19]. Polish scientist Latoch E (2021) from the Department of Pediatric Oncology and Hematology, Medical University in Bialystok, and his colleagues conducted research in patients who underwent treatment for acute lymphocytic leukemia (ALL), revealing an increase in NGAL and KIM-1 levels. These changes were observed even at normal creatinine values, indicating the presence of subclinical kidney damage. The obtained data indicate that traditional kidney function indicators, including creatinine and the calculated glomerular filtration rate, do not allow for the early detection of kidney function disorders. NGAL and KIM-1 are considered more sensitive markers of early renal

tubular damage and allow for the detection of nephrotoxic damage at the preclinical stage [12]. Turkish scientist Güneş A (2016) from The Medical Faculty of Dicle University and its colleagues in their studies of tubular markers have shown that increased levels of NGAL and KIM-1 are accompanied by early changes in kidney function, even in the absence of pronounced changes in standard laboratory parameters such as creatinine. It is also noted that changes may be combined with disorders of the water-electrolyte balance, including sodium and potassium indicators, but these changes are late and non-specific. Canalicular biomarkers allow for the early detection of kidney damage that is not detected through routine blood and urine analyses [6].

**Conclusion.** Clinical and laboratory assessment of kidney damage in patients with leukemia remains one of the important stages in diagnosing and monitoring patient conditions. Kidney function disorders may develop due to leukemic infiltration, tumor lysis syndrome, infectious complications, sepsis, as well as the nephrotoxic effect of chemotherapy. Traditional laboratory indicators such as creatinine, glomerular filtration rate, general urine analysis, and electrolytes remain important in assessing the functional state of the kidneys. Along with this, modern biomarkers, including NGAL, KIM-1, and cystatin C, allow for the early detection of kidney damage. However, individual laboratory changes may also occur in other pathological conditions, so they must be evaluated in conjunction with clinical data. In this regard, the clinical and laboratory diagnosis of kidney damage in leukemia patients remains of great practical importance, and the use of modern biomarkers in combination with a comprehensive diagnostic approach ensures a higher accuracy in the early detection of renal dysfunction.

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