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Early Predictors Of Graft Function In Pediatric Living-Related Kidney Transplantation

Makhmudov Kodirjon Oltinboevich

Republican Specialized Scientific and Practical Medical Center of Surgery named after Academician V. Vakhidov, Tashkent, Republic of Uzbekistan

Tashkent State Medical University, Tashkent, Republic of Uzbekistan

Mardonov Jamshid Normurotovich

Republican Specialized Scientific and Practical Medical Center of Surgery named after Academician V. Vakhidov, Tashkent, Republic of Uzbekistan

Tashkent State Medical University, Tashkent, Republic of Uzbekistan

Urinov Jasur Bahodirovich

Republican Specialized Scientific and Practical Medical Center of Surgery named after Academician V. Vakhidov, Tashkent, Republic of Uzbekistan

Nabijonov Bahodirbek Sodiqjon ugli

Republican Specialized Scientific and Practical Medical Center of Surgery named after Academician V. Vakhidov, Tashkent, Republic of Uzbekistan

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Abstract: Objective. To identify simple and clinically accessible early predictors of graft function in children after living-related kidney transplantation. Materials and Methods. A retrospective analysis of 50 pediatric kidney transplantations performed from 2018 to 2025 was conducted. All transplants were obtained from first-degree related donors. The following parameters were analyzed: preoperative creatinine, hemoglobin, sodium, potassium levels, daily urine output in the first 24 hours after transplantation, and creatinine dynamics on postoperative days 1, 3, and 7. The prognostic significance of early diuresis and creatinine reduction was evaluated. Results. All patients demonstrated pronounced early diuresis (5–8 L/day) during the first postoperative day. A consistent decrease in serum creatinine was observed: 495 ± 30 µmol/L on day 1, 215 ± 18 µmol/L on day 3, and 97 ± 9 µmol/L on day 7. Patients with more intensive early diuresis showed faster normalization of creatinine levels. No cases of delayed graft function or primary non-function were observed. Conclusion. Daily urine output in the first 24 hours and the rate of serum creatinine reduction within the first 7 days are reliable and easily accessible early predictors of adequate graft function in children after living-related kidney transplantation.

Keywords: Pediatric kidney transplantation, early graft function, predictors, diuresis, creatinine.

Introduction: Kidney transplantation is considered the optimal treatment for children with end-stage chronic kidney disease. Despite advances in surgical techniques and immunosuppressive therapy, early graft function remains a critical factor determining both short-term and long-term outcomes. The ability to predict graft performance in the earliest postoperative period is of great practical importance [1-5,7, 13-15].

In clinical practice, simple and reproducible indicators are needed to assess early graft function. Complex imaging and invasive monitoring techniques are not always available, especially in resource-limited settings. In this context, routine laboratory parameters, such as urine output and serum creatinine dynamics,

remain the most accessible tools for early assessment [6,8-12].

Although numerous studies have addressed long-term survival and immunological aspects of pediatric kidney transplantation, fewer publications have focused specifically on early predictors of graft function in children. Most available data relate to adult populations, while pediatric-specific evidence remains limited [1,5,7,11-15].

Therefore, the present study aimed to analyze simple clinical and laboratory predictors of early graft function in children after living-related kidney transplantation based on a single-center experience.

METHODS

A retrospective study was carried out including 50 children aged 5 to 18 years who underwent kidney transplantation from living-related donors between 2018 and 2025. The study was performed at the Republican Specialized Scientific and Practical Medical Center of Surgery named after Academician V. Vakhidov.

The following indicators were analyzed:

- preoperative serum creatinine, hemoglobin, sodium, and potassium levels;
- daily urine output during the first 24 hours after graft reperfusion;
- serum creatinine levels on postoperative days 1, 3, and 7.

The main prognostic parameters were defined as:

1. volume of early diuresis,
2. rate of creatinine decrease during the first postoperative week.

The analysis was descriptive and aimed at identifying clinically relevant trends.

RESULTS

A total of 50 pediatric patients aged between 5 and 18 years who underwent living-related kidney transplantation were included in the analysis. All recipients had end-stage chronic kidney disease at the time of transplantation and demonstrated pronounced metabolic and hematological disturbances prior to surgery (tab.1).

Table 1.

Dynamics of early clinical and laboratory predictors of graft function in pediatric recipients after living-related kidney transplantation

Parameter	Preoperative value	Day 1 after transplantation	Day 3 after transplantation	Day 7 after transplantation	Dynamic trend / Prognostic value
Serum creatinine (μmol/L)	420 ± 34	495 ± 30	215 ± 18	97 ± 9	Rapid decrease indicates good early graft function
Hemoglobin (g/L)	85.7 ± 3.6	–	–	–	Reflects severity of pre-transplant condition
Serum sodium (mmol/L)	134.3 ± 1.3	Tendency to decrease	Normalization	Normal range	Early stabilization reflects recovery of tubular function
Serum potassium (mmol/L)	4.5 ± 0.2	Normal range	Normal range	Normal range	Stable level indicates adequate tubular adaptation
Daily urine output (L/24 h)	–	5–8	–	–	High early diuresis is a strong positive predictor of early graft function

Preoperative laboratory profile. Before transplantation, all children showed signs of advanced renal failure. The mean serum creatinine level was 420 ± 34 µmol/L, with some patients demonstrating values exceeding 600–700 µmol/L. Hemoglobin concentration was reduced in most cases and averaged 85.7 ± 3.6 g/L, reflecting chronic renal anemia. Serum sodium levels were slightly decreased (134.3 ± 1.3 mmol/L), indicating a tendency toward moderate hyponatremia. At the same time, serum potassium remained within physiological limits (4.5 ± 0.2 mmol/L) (fig.1-2 and tab.1).

These findings confirmed the severity of the patients' condition before transplantation and the necessity of urgent restoration of renal function.

Early diuresis after transplantation. Immediately after graft reperfusion, all recipients developed marked polyuria. During the first 24 hours after surgery, daily urine output ranged from 5 to 8 liters. This high-volume diuresis was interpreted as a clinical sign of prompt reperfusion of the transplanted kidney and early activation of its filtering function.

Importantly, no cases of oliguria or anuria were observed in the study group during the first postoperative day.

Dynamics of serum creatinine. Analysis of postoperative creatinine levels demonstrated a characteristic and uniform pattern across the cohort. On postoperative day 1, the mean serum creatinine level was 495 ± 30 µmol/L, which was slightly higher than the preoperative values and was considered to be associated with active elimination of accumulated nitrogenous waste products.

By postoperative day 3, a rapid and substantial reduction in creatinine concentration was recorded, with a mean value of 215 ± 18 µmol/L. By day 7 after transplantation, the creatinine level further decreased to 97 ± 9 µmol/L, approaching age-adjusted normal ranges in most patients.

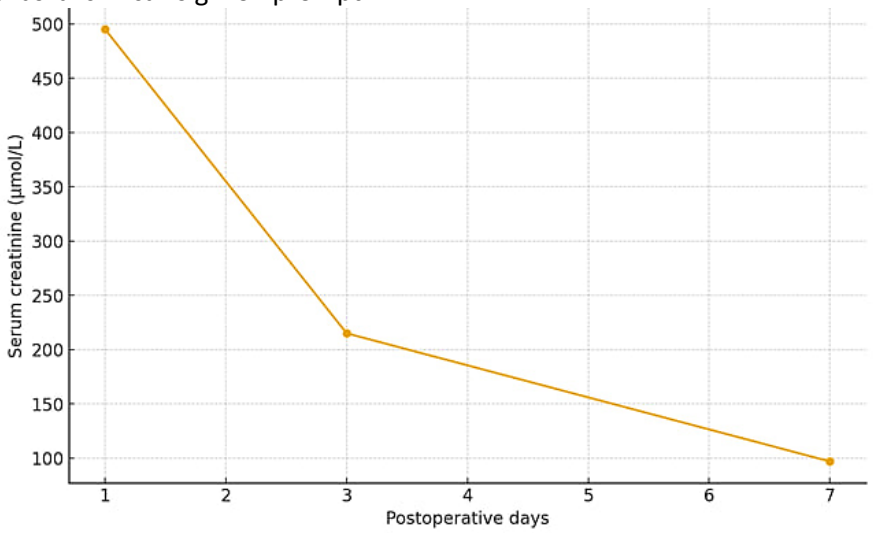

Figure 1. Dynamics of serum creatinine after transplantation

A clear clinical relationship was noted between urine output and creatinine dynamics: children with more pronounced early diuresis generally demonstrated a faster rate of creatinine decline.

Electrolyte balance in the early postoperative period. During the first postoperative day, some patients maintained a tendency toward hyponatremia, which was attributed to pronounced diuresis. However, with appropriate infusion therapy, serum sodium levels stabilized by postoperative days 2–3.

Serum potassium concentrations remained within the normal range throughout the early postoperative period, indicating adequate recovery of tubular function of the transplanted kidney (fig.2).

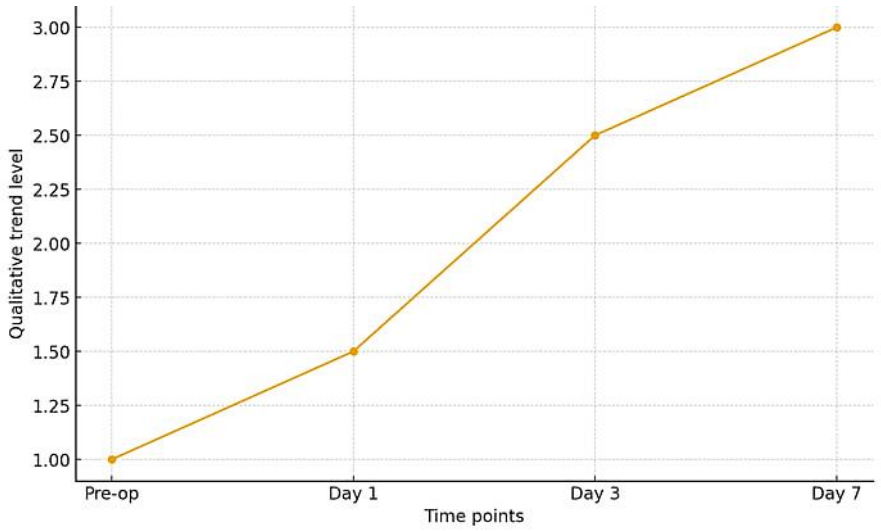

Figure 2. Trend of serum sodium levels after transplantation

Early graft performance. No cases of delayed graft function or primary non-function were recorded in this cohort. All transplanted kidneys demonstrated immediate functional activity, expressed by early diuresis and rapid normalization of laboratory parameters.

Thus, the obtained data indicate that early urine output and the rate of serum creatinine decline are closely associated with successful early graft function in pediatric recipients of living-related kidney transplants.

DISCUSSION

The present study demonstrates that simple, routinely available clinical and laboratory parameters obtained in the very early postoperative period may serve as reliable predictors of adequate graft function in pediatric living-related kidney transplantation. In our series, all children demonstrated pronounced early diuresis and a rapid decrease in serum creatinine, which together reflected prompt functional recovery of the transplanted kidney.

One of the most important findings of our study was the observation of high-volume diuresis (5–8 L/day) during the first 24 hours after transplantation in all recipients. This phenomenon is widely described in transplant literature as a favorable sign of effective graft reperfusion and early restoration of glomerular filtration. Several authors have emphasized that the absence or insufficiency of urine output during the first postoperative hours is typically associated with delayed graft function and worse short-term outcomes. Our data fully support these observations, as no cases of delayed graft function or primary non-function were recorded in our cohort [2,6,8,12-15].

The dynamics of serum creatinine in our patients followed a classical pattern described in pediatric and adult transplant populations. A transient increase during the first postoperative day, followed by a rapid and consistent decrease by days 3 and 7, reflected progressive recovery of filtration capacity. In our study, the mean creatinine level decreased from 495 ± 30 µmol/L on day 1 to 97 ± 9 µmol/L by day 7. Similar patterns have been reported in international multicenter studies, where early normalization of creatinine within the first week is considered a hallmark of favorable early graft function and is associated with better long-term graft survival.

Our preoperative data also provide important context for interpretation of the postoperative results. All recipients had severe chronic kidney disease prior to transplantation, characterized by marked uremia and anemia (mean creatinine 420 ± 34 µmol/L, hemoglobin 85.7 ± 3.6 g/L). These findings are consistent with reports from other pediatric transplant centers, where the majority of children reach transplantation in advanced stages of renal failure. The rapid improvement in biochemical parameters observed in our cohort therefore reflects not only successful engraftment but also the dramatic reversal of long-standing metabolic disturbances.

The prognostic role of early urine output has been widely explored in both adult and pediatric studies. According to published data, high early diuresis is closely linked to shorter ischemia-reperfusion injury, better microcirculatory integrity of the graft, and lower risk of acute tubular necrosis. Our findings are in agreement with these conclusions and further demonstrate that even in resource-limited settings, simple monitoring of urine output offers valuable prognostic information [1-7,9-15].

Living-related donation, which was used in all cases in the present study, may have played a decisive role in the favorable early outcomes observed. Previous studies have clearly shown that kidneys from living-related donors are associated with shorter cold ischemia time, better size matching, and improved

immunological compatibility, resulting in superior early graft function compared with deceased donor transplantation. The absence of delayed graft function in our cohort further supports this concept and emphasizes the advantages of living-related transplantation in pediatric practice [8,15].

Another important aspect of our findings is their practical applicability. While modern transplant centers increasingly use sophisticated imaging and biomarker-based methods to assess graft function, such techniques are not always available in daily practice, especially in developing healthcare systems. Our results demonstrate that two simple and universally available parameters — early urine output and serum creatinine dynamics — provide sufficient information to predict early graft performance. This approach is in line with current international clinical guidelines, which prioritize routine biochemical and clinical monitoring in the immediate postoperative period [3,5-9,12-14].

It is also important to mention that several authors have reported a strong association between early graft function and long-term outcomes. Delayed decrease in creatinine levels and oliguria in the first days after transplantation have been linked to higher rates of chronic allograft dysfunction and reduced graft survival. Although our study did not aim to evaluate long-term outcomes, the favorable early dynamics observed in all patients may be considered a positive prognostic indicator for future graft performance.

Overall, comparison of our results with data from national and international publications shows a high degree of consistency. The early laboratory and clinical patterns observed in our center correspond well with the trends described in leading transplant registries and large pediatric transplant cohorts. This confirms the reliability of classical, simple predictors of graft function and highlights their value in everyday clinical practice.

Despite the strengths of the present study, certain limitations should be acknowledged. The retrospective design and single-center setting may limit the generalizability of the results. In addition, the relatively small sample size precluded more detailed statistical analysis. Nevertheless, the homogeneity of the cohort and the consistency of the observed trends strengthen the validity of our conclusions [10-12].

Taken together, the findings of this study indicate that early diuresis volume and the rate of serum creatinine decrease represent robust, inexpensive, and easily reproducible predictors of early graft function in pediatric living-related kidney transplantation. Their routine use may improve clinical decision-making and optimize postoperative management.

CONCLUSION

The results of this study demonstrate that simple and routinely available clinical and laboratory parameters obtained in the very early postoperative period have significant prognostic value for assessing graft function in pediatric recipients of living-related kidney transplants. In particular, the volume of urine output during the first 24 hours and the rate of serum creatinine reduction within the first postoperative week were shown to be reliable and practical indicators of early graft performance.

Our findings confirm that most pediatric patients undergoing transplantation present with severe metabolic and hematological disturbances before surgery, including pronounced uremia, anemia, and electrolyte imbalance. Despite this, rapid restoration of renal function is achievable when favorable conditions for graft reperfusion are created, as demonstrated by the uniform pattern of early polyuria and rapid normalization of biochemical parameters observed in this cohort.

The consistent association between high early diuresis and accelerated creatinine decline underscores the physiological importance of prompt graft reperfusion and early recovery of glomerular filtration. These indicators are particularly valuable because they do not require complex technology or specialized equipment and can be easily implemented in routine clinical practice, including in resource-limited healthcare settings.

The study also highlights the advantages of living-related kidney transplantation in the pediatric population. The absence of delayed graft function in our cohort, together with the rapid improvement in laboratory parameters, supports current evidence that living-related donation offers superior early functional outcomes compared with deceased-donor transplantation, largely due to better immunological compatibility and shorter ischemia times.

Although the study was limited by its retrospective design and single-center nature, the homogeneity of the cohort and the consistency of the observed trends strengthen the credibility of the results. Further multicenter prospective studies with larger sample sizes are warranted to validate these findings and to evaluate their impact on long-term graft survival.

In conclusion, early urine output and the dynamics of serum creatinine represent robust, inexpensive, and universally applicable predictors of early graft function in children after living-related kidney transplantation. Systematic monitoring of these parameters should be considered an essential component of postoperative care and may contribute to improved clinical outcomes

through timely optimization of therapeutic strategies.

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