UDC 616.61-089.843-053.2:616-089
DOI http://doi.org/10.30978/GS-2026-2-70

ISSN 2786-5584 print
ISSN 2786-5592 online

Current perspectives on kidney transplantation in low-weight pediatric patients. Review

V. P. Zakordonets, O. Y. Ioffe

Bogomolets National Medical University, Kyiv

✉ Vladyslav Zakordonets: zakordonetsv@gmail.com

V. P. Zakordonets, http://orcid.org/0009-0008-3785-2369
O. Y. Ioffe, http://orcid.org/0000-0002-1306-7920

Kidney transplantation is the treatment of choice for children with end-stage renal disease, providing superior survival and quality of life compared to dialysis. However, transplantation in children with low body weight (≤ 20 kg) remains technically demanding and is associated with a higher risk of complications. These challenges are primarily related to donor–recipient size mismatch, limited anatomical space, and hemodynamic constraints. A narrative review of the literature was performed, focusing on surgical techniques, anatomical and hemodynamic factors, and early and late complications of kidney transplantation in low-weight pediatric recipients. Particular attention was given to the impact of size mismatch, the choice of surgical approach, and strategies for prevention and early detection of vascular complications.

Donor-recipient size mismatch was identified as a central pathophysiological factor influencing outcomes. It contributes to a complex cascade involving impaired venous outflow, graft edema, increased intrarenal pressure, and secondary reduction of arterial perfusion. Both intraperitoneal and extraperitoneal approaches are effective, with no consistent differences observed in long-term graft survival. Outcomes are primarily determined by the adequacy of graft positioning and perfusion. Vascular complications, particularly arterial and venous thrombosis, remain the leading cause of early graft loss in this population. Renal allograft compartment syndrome is a specific manifestation of mechanical and hemodynamic imbalance. Early diagnosis using Doppler ultrasonography and prompt surgical intervention are critical for graft preservation.

Kidney transplantation in children with low body weight requires an integrated surgical and perioperative strategy aimed at compensating for anatomical and hemodynamic mismatch. The success of transplantation depends on the coordinated optimization of graft positioning, vascular geometry, space creation, and postoperative monitoring, rather than on a single technical factor. A proactive, mechanism-based approach is essential to reduce complications and improve outcomes in this high-risk population.

Keywords
kidney transplantation; pediatric; low body weight; donor-recipient size mismatch; vascular complications; graft thrombosis; compartment syndrome; surgical approach; hemodynamics.

ARTICLE • Received 2026-01-26 • Received in revised form 2026-03-03 • Published 2026-05-31

Chronic kidney disease (CKD) in the pediatric population presents a significant medical and social challenge, associated with increased mortality, delayed physical development, neurocognitive disorders, and reduced quality of life for affected patients [52, 64, 67]. International registries report a prevalence of CKD in pediatric patients of 55–75 cases per million, with end-stage renal disease (ESRD) occurring in 9–15 cases per million, and an annual incidence of approximately 5–10 new cases per million [8, 12, 31, 37].

For pediatric patients with ESRD, kidney transplantation is considered the preferred treatment, as supported by data from national registries, including the United States Renal Data System (USRDS) [38].

Congenital anomalies of the kidneys and urinary tract are the primary cause of childhood ESRD, accounting for 28–31 % of cases overall and more than 50 % in young pediatric patients. Glomerular diseases represent approximately 21–22 % of cases and are more prevalent in older pediatric age groups [38]. Consequently, in children with low body weight, particularly those weighing ≤ 20 kg who require kidney transplantation, congenital and hereditary nephropathies predominate as the underlying etiology.

The first successful human kidney transplantation was performed by Joseph Murray and colleagues in 1954 in Boston between identical twins, marking a pivotal advancement in clinical transplantation [64]. In 1959, the same group (Murray, Goodwin, Hodges) achieved the first successful pediatric kidney transplant in a 12-year-old child between identical twins [64]. The subsequent development of pediatric transplantation in the 1960s was facilitated by the introduction of immunosuppressive therapy, which broadened the indications for pediatric transplantation. In later decades, successful transplantation in children with low body weight, including those weighing < 15 kg, was reported as a result of advancements in surgical techniques and intensive care.

Nevertheless, kidney transplantation in pediatric patients, particularly those with low body weight, remains relatively uncommon. In Europe, the incidence is approximately 5.7 cases per million children per year, while in the United States, about 250–300 pediatric transplants are performed annually [15, 32]. Data on recipients with low body weight (< 15–20 kg) are limited and primarily derived from single-center series, highlighting the complexity and rarity of these procedures [9, 13, 24, 65]. For example, E. Benetti et al. reported 96 transplants in children weighing < 15 kg over 35 years, averaging only 2–3 operations per year at their center [9]. Similarly, R. Gander et al. documented 44 transplants in children ≤ 15 kg, representing 26.8 % of all pediatric transplants at their center during a 7-year period [24]. Two leading centers in Belgium reported 72 transplants in children ≤ 15 kg over a multi-year period [13].

Kidney transplantation continues to be the preferred treatment for pediatric patients with ESRD, offering superior survival, growth, and social adaptation compared to dialysis [54, 61, 66]. However, in children with low body weight, the procedure carries a higher risk of technical and postoperative complications due to small vessel diameter, limited abdominal capacity, and donor-recipient size mismatch [16, 24, 42, 65].

Despite these challenges, recent clinical series indicate that transplantation in low-weight pediatric patients is technically feasible and yields satisfactory outcomes. One-year patient survival exceeds 90–95 %, and graft survival ranges from 75–90 %, depending on recipient age and body weight [9, 20, 24, 33]. Nevertheless, children weighing < 10–15 kg remain at elevated risk for early graft loss, primarily due to vascular complications [24, 36, 39, 42].

In this context, transplantation from a living donor, particularly an adult, is crucial, as it allows reduced cold ischemia time, improved surgical planning, and enhanced immunological compatibility [18, 40, 54, 56, 63]. However, donor–recipient size mismatch is most pronounced in these cases, contributing significantly to technical difficulties and complications [27, 56, 65].

The selection of surgical approach, whether intra- or extraperitoneal, remains contentious, as each method offers distinct advantages and limitations within confined anatomical spaces [20, 24, 27, 33, 65]. The primary determinant of transplantation outcomes in this patient population is not only the surgical approach, but also the incidence of early vascular complications, particularly thrombosis, which occurs in 5–10 % of cases and is the leading cause of graft loss [39].

Beyond vascular considerations, compression mechanisms resulting from restricted abdominal volume and elevated intra-abdominal pressure significantly contribute to impaired graft perfusion [27, 56]. Despite their importance, these factors have not been sufficiently systematized in the existing literature.

Therefore, kidney transplantation in pediatric patients weighing up to 20 kg constitutes a complex, multifactorial challenge that necessitates an integrated approach. This approach should consider anatomical, vascular, and hemodynamic characteristics, as well as the optimization of surgical techniques and perioperative management.

Anatomical variations («size mismatch») in kidney transplantation in pediatric patients weighing ≤ 20 kg

Kidney transplantation in children with low body weight has historically been challenged by a mismatch between donor organ size and recipient anatomical capacity. Early clinical series involving children weighing < 15 kg reported technical complication rates of 20–30 %, with early graft loss frequently attributed to vascular disorders and organ compression [45, 47]. Advances in surgical techniques have markedly improved outcomes, making transplantation feasible in pediatric patients weighing 8–10 kg, with one-year graft survival rates now exceeding 80–90 % [24, 42, 47].

Currently, size mismatch is recognized as a multifactorial issue involving not only organ and recipient size differences but also the interplay of spatial, vascular, and hemodynamic factors [3, 28, 44, 56]. The volume of an adult donor kidney (120–180 cm^3) exceeds the retroperitoneal space available in a child weighing 10–15 kg, predisposing to mechanical conflict during implantation [3,

28]. Clinical series indicate that in children weighing ≤ 15 kg, access modification or additional tissue mobilization is required in 15–25 % of cases due to limited anatomical space [27, 65].

Hemodynamic mismatch represents a critical factor in pediatric kidney transplantation. An adult donor kidney requires a blood flow of approximately 300–500 ml/min, whereas a young child has limited cardiac output and a circulating blood volume of 70–80 mL/kg [28, 29]. Under these circumstances, even minor hemodynamic fluctuations may result in graft hypoperfusion and trigger thrombotic mechanisms [29, 56].

Impaired venous outflow, often resulting from mechanical factors, plays a key role in the pathogenesis of complications. Even minimal kinking or compression of the renal vein can lead to venous stasis, increased graft volume, and a subsequent reduction in arterial perfusion [6, 17, 22]. In this context, the venous component may serve as a primary trigger for thrombosis development [6, 39].

The clinical impact of size mismatch is most evident in low-weight pediatric patients, where it directly correlates with increased vascular complication rates. Graft vessel thrombosis occurs in 5–10 % of pediatric cases and rises to 10–12 % in patients weighing < 15 kg, significantly exceeding the incidence in adults (1–3 %) [39, 56]. These complications account for 60–80 % of early graft losses and are primarily attributed to technical and mechanical factors [29, 39].

Renal allograft compartment syndrome (RACS) is a distinct manifestation of anatomical variations and may occur even in the absence of major technical errors. The clinically significant incidence of RACS is 2–5 %, although subclinical forms are likely more prevalent [22]. An increase in graft bed pressure exceeding 10–15 mm Hg is associated with reduced perfusion and impaired graft function [6, 17, 22].

Size mismatch also affects the selection of the surgical access. Intraperitoneal access is typically chosen for low-weight pediatric patients due to the greater available volume, whereas extraperitoneal transplantation necessitates more precise technical adaptation [1, 27, 45, 65]. Nevertheless, current evidence suggests that, with adequate graft bed preparation, the use of adult donor kidneys in low-weight pediatric patients achieves one-year graft survival rates of 85–95 %, comparable to outcomes in older pediatric patients [3, 28, 56].

In summary, anatomical variations are the primary pathophysiological mechanism causing complications in kidney transplantation for pediatric patients weighing ≤ 20 kg. The mismatch results from a combination of factors, including limited intra-abdominal space, vascular disproportion, and hemodynamic constraints. Consequently, targeted optimization of surgical techniques is required to ensure proper graft placement and to prevent vascular and compression-related complications [1, 29, 56].

Surgical access in kidney transplantation for low-weight pediatric patients: intraperitoneal vs extraperitoneal

The selection of surgical access in kidney transplantation for low-weight pediatric patients is a critical factor influencing the technical complexity of the procedure, graft function, and the spectrum of postoperative complications. In contrast to adults, for whom extraperitoneal access is standard, the optimal surgical access in young children, particularly those weighing ≤ 15–20 kg, remains debated. This decision is primarily influenced by anatomical variations and the need to accommodate a relatively large donor organ [45, 47, 65].

Intraperitoneal access

Intraperitoneal access has historically been widely adopted in pediatric transplantation to address the spatial limitations of the retroperitoneal space. Early clinical series from the 1970s and 1980s established its technical feasibility and facilitated its broader application in low-weight pediatric patients [21, 35, 46]. The use of the intraperitoneal space provides optimal conditions for adult donor kidney placement and enables vascular anastomoses on major vessels such as the aorta and inferior vena cava, resulting in more predictable blood flow and a reduced risk of direct graft compression [58].

The principal advantage of intraperitoneal access is the increased available volume, which enables greater flexibility in graft positioning and may decrease the risk of vascular kinking during the final stages of surgery [4, 26, 29, 58]. This benefit is particularly relevant in cases of pronounced anatomical variations, where even minor space constraints can alter the geometry of the vascular bed. Nevertheless, expanding the available volume does not fully eliminate the risk of perfusion disorders, as intra-abdominal pressure and graft positioning after abdominal wall closure can also affect hemodynamics [26].

Despite these advantages, the intraperitoneal access is associated with significant limitations, most notably an elevated risk of intra-abdominal complications. A. Taher et al. reported an overall complication frequency of approximately 18–20 % in pediatric recipients, with low body weight identified as an independent risk factor [62]. A comparative

study by Y. Aoki et al. found a substantially higher rate of surgical complications with intraperitoneal access (39 %) compared to extraperitoneal access (6 %) [4]. E.A. Gerzina et al. observed prolonged postoperative ileus in 28 % of patients, highlighting the considerable impact of surgical access on gastrointestinal function [26].

In summary, while intraperitoneal access provides a larger space for graft implantation, it is also associated with an increased risk of gastrointestinal and intra-abdominal complications, as demonstrated by both comparative studies and clinical series [4, 26]. The overall incidence of such complications in pediatric recipients remains approximately 18–20 % [62].

Extraperitoneal access

Extraperitoneal access has traditionally been the standard in adult transplantation and has been regarded as less suitable for pediatric patients due to the limited retroperitoneal space [27]. Nevertheless, clinical experience over recent decades demonstrates that, with appropriate technical modifications, this approach can be effectively applied even in patients weighing ≤ 15 kg [27, 65].

Clinical series, such as those by S. P. Vitola et al. and F. Ghidini et al., indicate that extraperitoneal transplantation in low-weight pediatric patients yields satisfactory graft survival rates, exceeding 80–90 % at one-year follow-up [27, 65].

Extraperitoneal access offers several important advantages: it is rarely associated with gastrointestinal complications, provides direct access to the graft for biopsy, and preserves the peritoneum for potential peritoneal dialysis [45].

The primary limitation of this approach is the restricted space, which, in cases of anatomical variations, may result in graft compression, vascular kinking, and increased local tissue pressure [1, 6, 17, 22, 27]. According to C. Lee et al., extraperitoneal access offers improved kidney fixation and may reduce the risk of graft rotation and vascular bundle kinking compared to the intraperitoneal access, which is typically used in low-weight pediatric patients when the retroperitoneal space is insufficient [41].

Several studies have reported that in 20–30 % of cases involving low-weight pediatric patients, expansion of the retroperitoneal space or additional tissue mobilization is required to achieve adequate graft placement [1, 27]. These technical factors, rather than the choice of surgical access, primarily determine the risk of vascular and compression complications.

Available data do not demonstrate a significant difference in long-term graft survival between surgical access types. For example, Aoki et al. (2021) reported 10-year graft survival rates of 87 % for intraperitoneal and 97 % for extraperitoneal access, with no statistically significant difference [4]. Similar results have been observed in other studies, indicating that long-term outcomes are primarily influenced by vascular and technical factors rather than the surgical access itself [27, 56].

Therefore, intraperitoneal and extraperitoneal approaches should not be regarded as mutually exclusive alternatives. These are complementary surgical strategies, with the choice determined by the recipient's anatomical and spatial characteristics and the capacity to ensure adequate graft perfusion. In this context, the critical factor is not the type of access but the surgical technique's ability to address anatomical variations and establish stable graft hemodynamics.

Vascular complications of kidney transplantation in low-weight pediatric patients: clinical significance, mechanisms, diagnostic approaches, and early management strategies

Although surgical approaches and transplantation techniques have advanced, vascular complications continue to significantly influence early outcomes of kidney transplantation in low-weight pediatric patients. Their significance arises not only from their frequency but also from the high risk of graft loss if these complications are not promptly diagnosed and managed [55, 60].

As early as the late 1990s, North American Pediatric Renal Trials and Collaborative Studies (NAPRTCS) reports identified vascular thrombosis as a leading cause of early graft loss in pediatric patients, with risk factors including age, body weight, retransplantation, and donor type [60]. Subsequent clinical and registry studies have supported these findings. Current data indicate that vascular complications occur in approximately 5–10 % of pediatric recipients, yet their impact on early graft loss is disproportionately high [39, 48, 55]. According to a review by C. Ponticelli et al., allograft thrombosis may account for up to 35 % of early kidney losses in children, with most episodes occurring within the first 48 hours after surgery [55].

This issue holds particular clinical significance in low-weight pediatric patients. The combination of small vessel diameter, reduced circulating blood volume, increased sensitivity to hemodynamic fluctuations, and pronounced donor–recipient size mismatch creates conditions in which even minor technical or positional deviations may critically impair graft

perfusion [28, 29, 55, 56, 60]. Under these circumstances, vascular complications should be regarded not as isolated incidents but as manifestations of systemic anatomical and hemodynamic imbalance.

Currently, the spectrum of vascular complications encompasses renal artery thrombosis, renal vein thrombosis, arterial anastomotic stenosis, and less common conditions such as pseudoaneurysms, arteriovenous fistulas, and vascular hemorrhage [23, 48]. However, arterial and venous thromboses are of greatest clinical significance, as they most frequently result in immediate or nearly inevitable graft loss [48, 55].

Arterial and venous thrombosis: clinical significance and mechanisms

Arterial thrombosis typically develops in the early postoperative period, most often within 24 to 72 hours. Clinically, it presents as a sudden cessation or marked decrease in diuresis, a rapid rise in creatinine levels, and absence of graft perfusion on Doppler imaging [48, 55]. In low-weight pediatric patients, this complication is predominantly technical and is associated with arterial kinking or torsion, suboptimal anastomotic angle, transplant compression, or systemic hypotension, which, combined with limited cardiac output, results in a critical reduction in arterial inflow [48, 55].

Venous thrombosis, by contrast, involves a distinct pathophysiological mechanism and often arises from primary impairment of venous outflow. Thrombosis of the transplanted renal vein generally occurs shortly after surgery, with a reported prevalence ranging from 0.1 % to 4.2 %. This complication is highly detrimental and leads to graft loss in nearly all cases [19]. Mechanical factors such as venous compression, kinking, graft rotation, or elevated local pressure within the renal bed frequently contribute to its development [6, 17, 22, 55]. These factors promote venous stasis, rapid parenchymal edema, and secondary reduction in arterial inflow. The venous component may therefore serve as a precipitating factor for subsequent vascular compromise, underscoring the importance of early detection.

Clinically, distinguishing between these two complications is essential. Arterial thrombosis is marked by abrupt loss of graft function and absence of Doppler flow, whereas venous thrombosis or severe venous outflow obstruction is more commonly associated with graft enlargement and tension, increased resistive index, diminished or absent venous signal, and occasionally diastolic flow reversal [5, 23, 48]. This distinction is critical in clinical practice, as it informs the underlying mechanism of damage before definitive diagnosis.

Diagnosis of vascular complications

Diagnosis of vascular complications requires close clinical vigilance and prompt Doppler ultrasound. Franke et al. emphasize that ultrasound serves as the primary modality for postoperative management in pediatric kidney transplantation and is generally sufficient for bedside evaluation of vascular patency and early complications [23]. This approach is particularly critical in low-weight pediatric patients, for whom transportation for computed tomography or angiography may be undesirable or technically challenging.

Clinically, vascular complications should be suspected in cases of sudden deterioration in graft function, such as decreased urine output, elevated creatinine levels, graft enlargement and tension, or hemodynamic changes [23, 55]. In arterial thrombosis, the absence of colour and spectral signals in the renal artery and its intra-organ branches is characteristic. In contrast, venous obstruction typically presents with increased graft volume, altered venous signals, an elevated resistive index, and, occasionally, reversal or marked reduction of diastolic blood flow [23, 55]. Notably, Doppler ultrasound enables detection of both established thrombosis and pre-thrombotic conditions, including impaired venous outflow, increased vascular resistance, and reduced diastolic blood flow. Therefore, serial ultrasound monitoring in the initial days following transplantation should be considered an essential tool for the early prevention of graft loss rather than merely an auxiliary measure [23, 55].

In clinical practice, rapid decision-making is paramount in the management of these patients. Gander et al. highlight that vascular thrombosis in pediatric transplantation is associated with nearly 100 % graft loss if timely intervention is not undertaken [25]. Consequently, clinical and ultrasound indicators of impaired perfusion should prompt immediate surgical revision or, at a minimum, urgent decision-making. Aschwanden et al. present a clinical case in which serial duplex sonography facilitated the detection of progressive venous hemodynamic changes and ultimately prevented graft loss [5].

Transplant compartment syndrome as a specific vascular-mechanical complication

Renal allograft compartment syndrome in low-weight pediatric patients is a distinct vascular-mechanical complication characterized by external pressure on the graft or its vessels, leading to venous stasis, parenchymal edema, reduced arterial inflow, and ultimately thrombosis [6, 17, 22]. Damiano et al. defined RACS as a condition in which graft bed pressure exceeds approximately 15–20 mm Hg, leading to external compression of the kidney,

impaired venous outflow, edema, and secondary ischemia [17]. Fontana et al. described this condition as an «underappreciated complication» of pediatric transplantation. Recent reports indicate that RACS may develop not only within the first few hours after surgery but also later if standard interventions fail to improve graft function [22, 51].

Clinically, RACS presents as decreased or absent diuresis, elevated creatinine, increased graft size and tension, elevated resistive index, decreased or reversed diastolic blood flow, and, in some cases, progressive venous stasis on Doppler imaging [17, 23, 51]. Importantly, RACS is potentially reversible if identified promptly and managed with surgical decompression [17, 51]. Therefore, in low-weight pediatric patients, early graft dysfunction should be assessed not only for rejection or acute tubular damage but also for possible mechanical conflict [17, 51].

Vascular complications in this population result from the combined effects of anatomic-spatial, technical, and hemodynamic factors. Timely detection and immediate intervention are essential for graft preservation, as even brief diagnostic delays can lead to irreversible graft loss. This rationale underscores the need to transition from passive observation to proactive management strategies in the early postoperative period.

Prevention of vascular complications: general principles

The prevention of vascular complications in pediatric kidney transplantation extends beyond isolated techniques and should be approached as a comprehensive, multilevel strategy encompassing the preoperative, intraoperative, and postoperative phases. Compared to the limited effectiveness of treating established complications, preventive measures are essential for graft preservation [17, 55].

Key components of prevention include preoperative risk stratification, which involves evaluating body weight, age, vascular anatomy, prior transplants, and potential donor–recipient size mismatch. Additionally, surgical techniques should be optimized based on these factors [7, 17, 55]. Maintaining adequate systemic hemodynamics in the early postoperative period is critical, as adult grafts in small children are especially vulnerable to hypovolemia and hypotension [28, 29].

Early and serial ultrasound monitoring represents an additional preventive measure, enabling the detection of prethrombotic states and perfusion disorders at the preclinical stage [5, 23]. In this context, ultrasound monitoring serves not only as a diagnostic tool but also as a critical element in preventing graft loss.

The use of pharmacological thromboprophylaxis remains a subject of debate. Current evidence suggests that anticoagulant prophylaxis reduces the risk of thrombosis in high-risk populations; however, its application should be tailored to individual patients, balancing thrombotic and bleeding risks [2].

Therefore, the prevention of vascular complications is multifaceted and relies on clinical risk stratification, hemodynamic management, and early monitoring. The subsequent section addresses the detailed surgical considerations involved in implementation.

Late vascular complications: arterial anastomotic stenosis and other blood flow disorders

Unlike early vascular complications, which typically present within the first days following transplantation, late vascular disorders progress insidiously and are often identified weeks or months postoperatively. Transplant renal artery stenosis (TRAS) is the most clinically significant of these and is among the most common late vascular complications in both adult and pediatric recipients [10, 53].

Reported TRAS incidence ranges from 1 % to 23 %, reflecting variability in diagnostic criteria and screening methods [10, 30, 57, 59]. In pediatric patients, incidence rates are generally lower but may be underestimated due to frequent subclinical presentations [53]. Stenosis most commonly occurs at the anastomosis or proximal donor artery segment and is associated with technical factors such as vessel diameter mismatch, flow turbulence, and intimal injury, as well as postoperative vascular wall remodeling [10, 49, 53].

Clinically, TRAS typically presents as resistant or new-onset arterial hypertension and deterioration of graft function [10]. Doppler ultrasound serves as the primary screening tool, enabling detection of characteristic features such as elevated peak systolic blood flow velocity (> 200–250 cm/s), turbulent flow at the stenosis site, and the «tardus–parvus» phenomenon in intrarenal arteries [10, 30, 48].

Angiography remains the gold standard for confirming the diagnosis; however, its use in pediatric patients is limited and primarily reserved for planning interventional treatment [10, 43].

Management of TRAS primarily involves endovascular angioplasty, with stenting reserved for complex cases and surgical reconstruction considered when endovascular approaches are unsuccessful [10, 34, 53]. Most clinical series report that angioplasty improves blood pressure control and stabilizes graft function, although the risk of restenosis persists [10].

In addition to renal artery stenosis, late vascular complications include renal vein stenosis or thrombosis (rare), arteriovenous fistulas, which most often occur after biopsy, and pseudoaneurysms [48, 53]. Most arteriovenous fistulas are asymptomatic and regress spontaneously, but some cases may require endovascular intervention [48].

Late vascular complications, unlike early thrombosis, infrequently result in immediate graft loss but can substantially impair long-term graft function and blood pressure regulation. Among these, renal artery stenosis of the graft is the most clinically significant and typically responds to endovascular intervention when identified in a timely manner [10, 53].

Surgical aspects of preventing vascular and compression complications of kidney transplantation in low-weight pediatric patients

Recent studies suggest that outcomes of kidney transplantation in low-weight pediatric patients depend not only on the choice of surgical access or anastomosis type, but primarily on the surgical technique's capacity to address anatomical and spatial discrepancies between the donor organ and the recipient. Donor–recipient size mismatch represents a central pathophysiological issue underlying most early complications, including both vascular and compression-related events [1, 7, 14, 28, 29].

Historically, technical challenges in this population have been viewed mainly as matters of access selection or anastomosis optimization. However, accumulated clinical experience has revealed the limitations of this approach: even technically flawless execution of individual steps does not ensure stable functional outcomes. Contemporary understanding frames transplantation in low-weight pediatric patients as a distinct surgical model, where the integration of spatial, hemodynamic, and technical factors is essential [6, 14, 17, 22, 29, 55].

A primary component of this model is the selection of appropriate vessels and the creation of anastomoses that maintain stable blood flow without tension, stenosis, or turbulence. In low-weight pediatric patients, major vessels such as the aorta and inferior vena cava are often preferred, as their use reduces technical errors and provides adequate blood flow even in cases of significant size mismatch [47]. Nevertheless, it is increasingly evident that vessel selection alone is insufficient; maintaining optimal anastomotic geometry after final graft positioning is critical.

Vessels that are too short generate tension and alter the entry angle into the major vessel, whereas excessive length can result in loops, torsion, and kinking following graft placement. An acute angle after kidney positioning may functionally mimic stenosis, leading to flow turbulence, venous stasis, and impaired perfusion [1]. Therefore, traditional assessment of vessels during anastomosis should be supplemented by evaluation of vessel behavior in the graft's final position [1].

A second critical factor is graft positioning, which establishes the functional geometry of vessels following reperfusion. Earlier assumptions held that restoration of blood flow eliminated most technical risks. However, recent evidence demonstrates that significant hemodynamic disturbances frequently arise after reperfusion and during wound closure [6, 7, 17, 22, 55].

Even technically flawless anastomoses cannot ensure adequate perfusion if the graft's spatial position changes. In such cases, a characteristic pathophysiological cascade develops: impaired venous outflow leads to graft edema, increased intratissue pressure, and a secondary decrease in arterial perfusion [6, 17, 22, 55]. This cascade encompasses various clinical manifestations, including vascular kinking, graft rotation, and compression, as components of a unified process.

These mechanisms illustrate that vascular and compression complications develop as a sequential pathophysiological continuum with specific points for surgical intervention (Figure). This model underscores that most complications arise as interconnected stages within a single process, which can be strategically addressed during different phases of surgery.

Key stages of intervention include optimizing graft positioning, optimizing vascular anastomosis geometry, forming an adequate bed, and achieving hemodynamic control.

Venous outflow is particularly important, as it is more susceptible to compression and deformation than arterial inflow. While arterial anastomosis was traditionally considered the primary determinant of success, recent evidence suggests that venous outflow disorders are often the initial cause of hemodynamic destabilization [5, 6, 17, 22]. In contrast, arterial complications are typically linked to geometric factors, such as outflow angle or vessel length, and are exacerbated in pediatric patients with limited hemodynamic reserve [7, 50, 55].

The formation of an adequate graft bed represents a third critical element. Previously regarded as secondary to anastomosis technique, this issue is now recognized as central. A limited retroperitoneal space directly increases the risk of compression-related complications. Following reperfusion, the kidney expands in volume, and in the context of restricted space, this results in elevated local pressure,

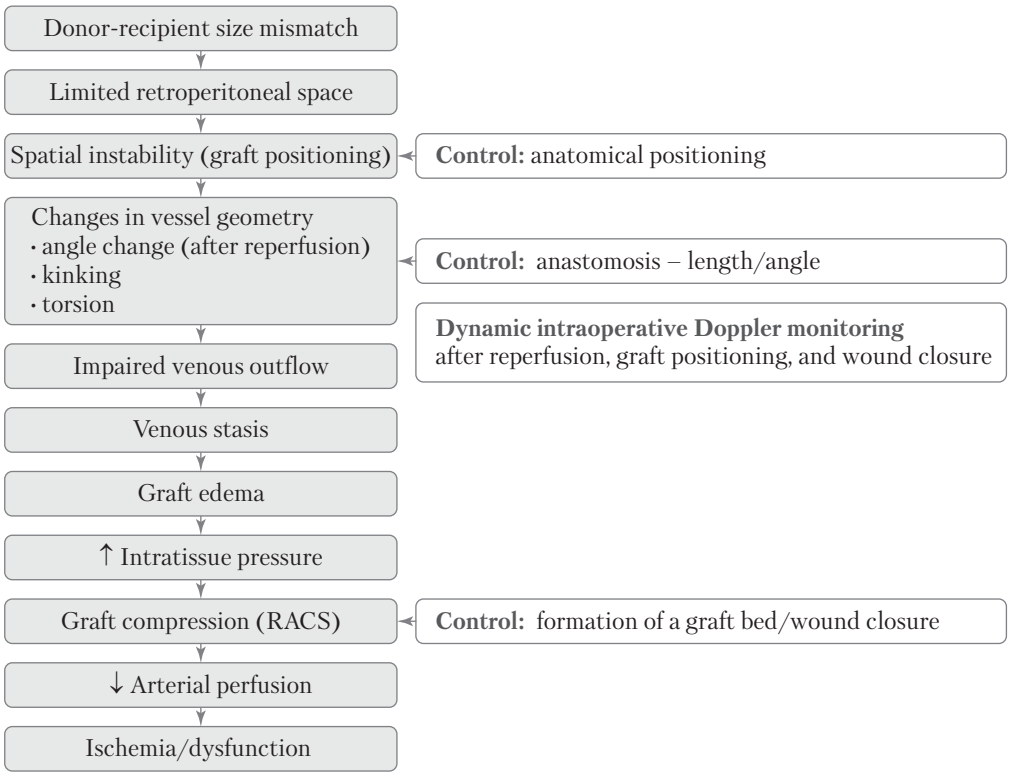

Figure. **Pathophysiological model of vascular and compression complications of kidney transplantation in low-weight pediatric patients with integrated surgical control points**

impaired venous outflow, and the onset of compression-ischemic changes [17]. Pressures exceeding 15–20 mm Hg are associated with the development of renal allograft compartment syndrome [17].

Consequently, contemporary strategies focus not only on adapting the graft to the available space but also on actively creating sufficient space. These strategies include extended mobilization of retroperitoneal structures and techniques designed to establish a more physiological graft bed, such as en bloc mobilization of the liver and native kidney [1]. This reflects a paradigm shift from passive accommodation to deliberate reconfiguration of the surgical field.

The fourth component involves preventing compression during wound closure. While fascial closure was once viewed as merely the final technical step, it is now recognized as a critical phase that can significantly influence graft outcomes. Alterations in tissue configuration during closure may cause abrupt hemodynamic deterioration, even when initial blood flow is adequate [22, 17].

The principle of tension-free closure is particularly crucial in pediatric patients with significant donor–recipient size mismatch. In these situations, fascial expansion techniques or fascia lata grafts are employed to prevent compression without increasing complication rates [7]. It is essential that final wound closure does not compromise graft perfusion.

A fifth element of contemporary surgical strategy is the multi-stage intraoperative assessment of graft function. Whereas previous assessments were confined to the reperfusion phase, current practice involves evaluation after reperfusion, after graft positioning, and following wound closure. This approach is necessary because vessel geometry changes at each of these stages [6, 17, 22, 29].

Intraoperative Doppler ultrasonography enables the detection of hemodynamic disturbances at a preclinical stage, allowing for timely intervention to prevent thrombosis or ischemia [23, 29, 50]. As a result, Doppler monitoring has evolved from a purely diagnostic tool to a key element of preventive surgical strategy.

The contemporary surgical approach to kidney transplantation in low-weight pediatric patients integrates several interrelated principles. The first is ensuring spatial adequacy by creating sufficient volume for graft placement without compression. The second is maintaining hemodynamic stability by optimizing vessel geometry and preventing deformation. The third is dynamic control, involving multi-stage intraoperative assessment of blood flow.

Collectively, these principles represent a paradigm shift in pediatric transplantation, moving from isolated technical solutions to a systemic strategy focused on preventing complications before clinical

manifestation. Within this framework, the choice between intra- and extraperitoneal access is viewed as one of several tools for implementing the overall surgical strategy, rather than as an independent determinant.

Therefore, successful kidney transplantation in low-weight pediatric patients depends on the comprehensive application of surgical techniques that address donor–recipient size mismatch and ensure stable graft perfusion. This integrated approach underpins ongoing optimization of surgical tactics and the development of individualized treatment algorithms for this challenging patient population.

Declaration of interests

The authors declare no conflict of interest.

Funding. This research received no external funding.

Ethics approval and written informed consent statements

This study is based on the analysis and conceptual synthesis of previously published data. No human participants, animals, or patient data were involved; therefore, ethical approval and informed consent were not required.

Authors contributions

V. P. Zakordonets: conceptualization and design, literature analysis and interpretation, drafting of the manuscript; O. Y. Ioffe: critical revision of the manuscript, scientific editing.

References

1. Alameddine M, Jue JS, Morsi M, Gonzalez J, Defreitas M, Chandar JJ, Gaynor JJ, Ciancio G. Extraperitoneal pediatric kidney transplantation of adult renal allograft using an en-bloc native liver and kidney mobilization technique. BMC Pediatr. 2020;20(1):526. doi: 10.1186/s12887-020-02422-0. PMID:33190632.
2. Al-Huniti AH, Malcolmson C, Langlois V, McKay AM, Lorenzo A, Wang Z, Williams S, Teoh CW, Brandão LR. Benefits of anticoagulation prophylaxis in children undergoing kidney transplant: systematic review and meta-analysis. J Thromb Haemost. 2025;23(8):2568-2583. doi: 10.1016/j.jtha.2025.04.032. PMID:40379105.
3. Amesty MV, Fernandez C, Espinosa L, Rivas-Vila S, Lobato R, Monsalve S, Lopez-Pereira PC, Martinez-Urrutia MJ. Long-term outcomes of adult-size and size-matched kidney transplants in small pediatric recipients. J Pediatr Urol. 2020;16(4):481.e1-481.e8. doi: 10.1016/j.jpurol.2020.05.012. PMID:32493667.
4. Aoki Y, Satoh H, Sato A, Morizawa Y, Hamada R, Harada R, et al. Long-term outcomes of living-donor kidney transplant children weighing less than 15 kg: comparison of the surgical approach. J Pediatr Urol. 2021;17(4):542.e1-542.e8. doi: 10.1016/j.jpurol.2021.05.021.
5. Aschwanden M, Thalhammer C, Schaub S, Wolff T, Steiger J, Jaeger KA. Renal vein thrombosis after renal transplantation: early diagnosis by duplex sonography prevented fatal outcome. Nephrol Dial Transplant. 2006;21(3):825-826. doi: 10.1093/ndt/gfi193. PMID:16401628.
6. Ball CG, Kirkpatrick AW, Yilmaz S, Monroy M, Nicolaou S, Salazar A. Renal allograft compartment syndrome: an underappreciated postoperative complication. Am J Surg. 2006;191(5):619-624. doi: 10.1016/j.amjsurg.2006.02.013. PMID:16647348.
7. Bañuelos Marco B, Bergel B, Geppert T, Müller D, Lingnau A. Introducing a new technique for fascial closure to avoid renal allograft compartment syndrome in pediatric recipients: the use of Tutoplast fascia lata. Front Surg. 2022;9:840055. doi: 10.3389/fsurg.2022.840055. PMID:35599790.
8. Becherucci F, Roperto RM, Materassi M, Romagnani P. Chronic kidney disease in children. Clin Kidney J. 2016;9(4):583-591. doi: 10.1093/ckj/sfw047.
9. Benetti E, Bertazza Partigiani N, Moi M, Sangermano M, Fascetti Leon F, Meneghini L, Daverio M, De Corti F. Kidney transplantation in children weighing less than 15 kg: a 35-year single-center experience. J Clin Med. 2025;14(14):4905. doi: 10.3390/jcm14144905. PMID:40725596.
10. Bruno S, Remuzzi G, Ruggenenti P. Transplant renal artery stenosis. J Am Soc Nephrol. 2004;15(1):134-141. doi: 10.1097/01.asn.0000099379.61001.f8. PMID:14694165.
11. Chen W, Kayler LK, Zand MS, Muttana R, Chernyak V, DeBoccardo GO. Transplant renal artery stenosis: clinical manifestations, diagnosis and therapy. Clin Kidney J. 2015;8(1):71-78. doi: 10.1093/ckj/sfu132. PMID:25713713.
12. Chesnaye N, Bonthuis M, Schaefer F, et al. Demographics of paediatric renal replacement therapy in Europe: a report of the ESPN/ERA-EDTA registry. Pediatr Nephrol. 2014;29(12):2403-2410. doi: 10.1007/s00467-014-2884-6. PMID:25039018.
13. Chiodini B, Herman J, Lolin K, et al. Outcomes of kidney transplantation in children weighing 15 kg or less: a retrospective cohort study. Transpl Int. 2018;31(7):720-728. doi: 10.1111/tri.13108. PMID:29281761.
14. Cho MH. Pediatric kidney transplantation is different from adult kidney transplantation. Korean J Pediatr. 2018;61(7):205-209. doi: 10.3345/kjp.2018.61.7.205.
15. Chua A, Cramer C, Moudgil A, et al. Kidney transplant practice patterns and outcome benchmarks over 30 years: the NAPRTCS report. Pediatr Transplant. 2019;23(8):e13597. doi: 10.1111/petr.13597. PMID:31657095.
16. Dall'Amico R, Ginevri F, Ghio L, et al. Successful renal transplantation in children under 6 years of age. Pediatr Nephrol. 2001;16(1):1-7. doi: 10.1007/s004670000492. PMID:11198593.
17. Damiano G, Maione C, Maffongelli A, et al. Renal allograft compartment syndrome: is it possible to prevent? Transplant Proc. 2016;48(2):340-343. doi: 10.1016/j.transproceed.2015.12.051. PMID:27109951.
18. Dick AA, Lerner SM, Boissy AR, Farrell CE, Alfrey EJ. Excellent outcome in infants and small children with thrombophilias undergoing kidney transplantation. Pediatr Transplant. 2005;9(1):39-42. doi: 10.1111/j.1399-3046.2004.00232.x. PMID:15667609.
19. El Zorkany K, Bridson JM, Sharma A, Halawa A. Transplant renal vein thrombosis. Exp Clin Transplant. 2017;15(2):123-129. doi: 10.6002/ect.2016.0060. PMID:28338457.
20. Eren E, Tokac M, Ozkaya O, et al. A single-center kidney transplantation experience in children with low weight: is low weight a contraindication? Eur Rev Med Pharmacol Sci. 2022;26(17):6192-6198. doi: 10.26355/eurrev_202209_29636. PMID:36111919.
21. Fine RN, Tejani A. Renal transplantation in children. Nephron. 1987;47(2):81-86. doi: 10.1159/000184466. PMID:3320778.
22. Fontana I, Bertocchi M, Centanaro M, et al. Abdominal compartment syndrome: an underrated complication in pediatric kidney transplantation. Transplant Proc. 2014;46(7):2251-2253. doi: 10.1016/j.transproceed.2014.07.045. PMID:25242763.
23. Franke D. The diagnostic value of Doppler ultrasonography after pediatric kidney transplantation. Pediatr Nephrol. 2022;37(7):1511-1522. doi: 10.1007/s00467-021-05253-y. PMID:34477970.
24. Gander R, Asensio M, Royo GF, et al. Kidney transplantation in children weighing 15 kg or less is challenging but associated with good outcome. J Pediatr Urol. 2017;13(3):279.e1-279.e7. doi: 10.1016/j.jpurol.2017.02.025. PMID:28359777.
25. Gander R, Asensio M, Royo GF, Molino JA, García L, Madrid A, Ariceta G, Lopez M. Vascular thrombosis in pediatric kidney transplantation: Graft survival is possible with adequate management. J Pediatr Urol. 2018 Jun;14(3):222-230. doi: 10.1016/j.jpurol.2018.01.027. Epub 2018 Mar 20. PMID: 29588143.
26. Gerzina EA, Brewer ED, Guhan M, et al. Good outcomes after pediatric intraperitoneal kidney transplant. Pediatr Transplant. 2022;26(6):e14294. doi: 10.1111/petr.14294. PMID:35470524.
27. Ghidini F, De Corti F, Fascetti Leon F, et al. Extraperitoneal kidney transplantation: a comparison between children weighing ≤ 15 kg and > 15 kg. Transpl Int. 2021;34(11):2394-2402. doi: 10.1111/tri.14015. PMID:34411366.
28. Goldsmith PJ, Asthana S, Fitzpatrick M, et al. Transplantation of adult-sized kidneys in low-weight pediatric recipients achieves short-term outcomes comparable to size-matched grafts. Pediatr Transplant. 2010;14(7):919-924. doi: 10.1111/j.1399-3046.2010.01375.x. PMID:20840437.

29. Gunawardena T, Sharma H, Sharma AK, Mehra S. Surgical considerations in paediatric kidney transplantation: an update. Ren Replace Ther. 2021;7:54. doi: 10.1186/s41100-021-00373-5.
30. Gunawardena T, Sharma H. Transplant renal artery stenosis: current concepts. Exp Clin Transplant. 2022;20(12):1049-1057. doi: 10.6002/ect.2022.0334. PMID:36718003.
31. Harambat J, van Stralen KJ, Kim JJ, Tizard EJ. Epidemiology of chronic kidney disease in children. Pediatr Nephrol. 2012;27(3):363-373. doi: 10.1007/s00467-011-1939-1.
32. Harambat J, van Stralen KJ, Schaefer F, et al. Disparities in policies, practices and rates of pediatric kidney transplantation in Europe. Am J Transplant. 2013;13(8):2066-2074. doi: 10.1111/ajt.12288. PMID:23718940.
33. Hata K, Ishida H, Ishizuka K, et al. Safe renal transplantation to the extraperitoneal cavity in children weighing less than 15 kg. Transplant Proc. 2022;54(2):248-253. doi: 10.1016/j.transproceed.2021.12.038. PMID:35151494.
34. Henning BF, Kuchlbauer S, Böger CA, et al. Percutaneous transluminal angioplasty as first-line treatment of transplant renal artery stenosis. Clin Nephrol. 2009;71(5):543-549. PMID:19473615.
35. Hodson EM, Najarian JS, Kjellstrand CM, et al. Renal transplantation in children ages 1 to 5 years. Pediatrics. 1978;61(3):458-464. doi: 10.1542/peds.61.3.458. PMID:347370.
36. Ismail H, Kaliciński P, Drewniak T, et al. Primary vascular thrombosis after renal transplantation in children. Pediatr Transplant. 1997;1(1):43-47. PMID:10084786.
37. Johansen KL, Chertow GM, Foley RN, Gilbertson DT, Herzog CA, Ishani A, Israni AK, Ku E, Kurella Tamura M, Li S, Li S, Liu J, Obrador GT, O'Hare AM, Peng Y, Powe NR, Roetker NS, St Peter WL, Abbott KC, Chan KE, Schulman IH, Snyder J, Solid C, Weinhandl ED, Winkelmayer WC, Wetmore JB. US Renal Data System 2020 Annual Data Report: Epidemiology of Kidney Disease in the United States. Am J Kidney Dis. 2021 Apr;77(4 Suppl 1):A7-A8. doi: 10.1053/j.ajkd.2021.01.002. PMID: 33752804; PMCID: PMC8148988.
38. Johansen KL, Gilbertson DT, Li S, Li S, Liu J, Roetker NS, Hart A, Knapp CD, Ku E, Powe NR, Snyder J, Peter WS, Weinhandl ED, Wetmore JB. US Renal Data System 2024 Annual Data Report: Epidemiology of Kidney Disease in the United States. Am J Kidney Dis. 2025 Jun;85(6S1):A8-A11. doi: 10.1053/j.ajkd.2025.02.602. PMID: 40379355.
39. Keller AK, Jorgensen TM, Jespersen B. Identification of risk factors for vascular thrombosis. J Transplant. 2012;2012:793461. doi: 10.1155/2012/793461. PMID:22701162.
40. Kruszyna T, Niekowal B, Kraśnicka M, Sadowski J. Enhanced recovery after kidney transplantation surgery. Transplant Proc. 2016;48(5):1461-1465. doi: 10.1016/j.transproceed.2015.11.037. PMID:27496428.
41. Lee C, Oh H, Lee C, Lee S, Lee O, Lee KW, et al. Kidney transplantation in children weighing 15 kg or less: technical challenges and outcome in a single center. Adv Pediatr Surg. 2021;27(2):67-72. doi: 10.13029/aps.2021.27.2.67.
42. Mickelson JJ, MacNeily AE, Leblanc J, et al. Renal transplantation in children 15 kg or less. J Urol. 2006;176(4 Pt 2):1797-1800. doi: 10.1016/S0022-5347(06)00612-4. PMID:16945652.
43. Mirza A, Baig U, Khan M, et al. Clinical utility of duplex ultrasonography in recognition of transplant renal artery stenosis. Diagnostics (Basel). 2025;15(14):1766. doi: 10.3390/diagnostics15141766. PMID:40722517.
44. Muramatsu M, Mizutani T, Hamasaki Y, et al. Transplantation of adult-size kidneys in small pediatric recipients. Pediatr Transplant. 2019;23(4):e13401. doi: 10.1111/petr.13401. PMID:30916370.
45. Nahas WC, Mazzucchi E, Scafuri AG, et al. Extraperitoneal access for kidney transplantation in children weighing 20 kg or less. J Urol. 2000;164(2):475-478. PMID:10893626.
46. Najarian JS, Simmons RL, Tallent MB, et al. Renal transplantation in infants and children. Ann Surg. 1971;174(4):583-601. doi: 10.1097/00000658-197110000-00005. PMID:4329074.
47. Neipp M, Offner G, Lück R, Latta K, Strehlau J, Schlitt HJ, Ehrich JH, Klempnauer J, Nashan Br. Kidney transplant in children weighing less than 15 kg: donor selection and technical considerations. Transplantation. 2002 Feb 15;73(3):409-16. doi: 10.1097/00007890-200202150-00015. PMID: 11884938.
48. Ng CWK, Yeung JTH, Pan KNY, Chan YL, Metreweli C. Pictorial review of paediatric renal transplant vascular complications. Hong Kong J Radiol. 2020;23:227-232. doi: 10.12809/hkjr2017011.
49. Nicholson ML, Yong C, Trotter PB, Grant L, Hosgood SA. Risk factors for transplant renal artery stenosis after live donor transplantation. Br J Surg. 2019;106(3):199-205. doi: 10.1002/bjs.10997. PMID:30346041.
50. Novacescu D, Latcu SC, Raica M, et al. Surgical strategies for renal transplantation: a pictorial essay. J Clin Med. 2024;13(14):4188. doi: 10.3390/jcm13144188. PMID:39064228.
51. Otludil B, Aksoy GK, Koyun M, et al. Delayed-onset renal allograft compartment syndrome in a pediatric recipient. Pediatr Transplant. 2025;29(3):e70070. doi: 10.1111/petr.70070. PMID:40134261.
52. Pais P, Wightman A. Addressing the Ethical Challenges of Providing Kidney Failure Care for Children: A Global Stance. Front Pediatr. 2022 Mar 11;10:842783. doi: 10.3389/fped.2022.842783. PMID: 35359883; PMCID: PMC8963107.
53. Patel NH, Jindal RM, Wilkin T, Rose S, Johnson MS, Shah H, Namyslowski J, Moresco KP, Trerotola SO. Renal arterial stenosis in renal allografts: retrospective study of predisposing factors and outcome after percutaneous transluminal angioplasty. Radiology. 2001 Jun;219(3):663-7. doi: 10.1148/radiology.219.3.r01jn30663. PMID: 11376251.
54. Pérez-Bertólez S, Barrero R, Fijo J, et al. Outcomes of pediatric living donor kidney transplantation. Pediatr Transplant. 2017;21(3). doi: 10.1111/petr.12881. PMID:28133940.
55. Ponticelli C, Moia M, Montagnino G. Renal allograft thrombosis. Nephrol Dial Transplant. 2009;24(5):1388-1393. doi: 10.1093/ndt/gfp003. PMID:19182239.
56. Raza S, Alahmadi I, Broering D, Alherbish A, Ali T. Kidney transplantation in low weight pediatric recipients from adult donors: The short- And the long-term outcomes. Pediatr Transplant. 2021 Mar;25(2):e13860. doi: 10.1111/petr.13860. Epub 2020 Oct 6. PMID: 33022859.
57. Rengel M, Gomes-Da-Silva G, Incháustegui L, Lampreave JL, Robledo R, Echenagusia A, Vallejo JL, Valderrábano F. Renal artery stenosis after kidney transplantation: diagnostic and therapeutic approach. Kidney Int Suppl. 1998 Dec;68:S99-106. doi: 10.1038/sj.ki.4490573. PMID: 9839292.
58. Salvatierra O Jr, Millan M, Concepcion W. Pediatric renal transplantation with considerations for successful outcomes. Semin Pediatr Surg. 2006;15(3):208-217. doi: 10.1053/j.sempedsurg.2006.03.007. PMID:16818142.
59. Simforoosh N, Nayebzade A, Ghaedi M. Transplant renal artery stenosis: a case report and literature review. Urol J. 2024;21(3):195-199. doi: 10.22037/uj.v20i.7962. PMID:38493318.
60. Singh A, Stablein D, Tejani A. Risk factors for vascular thrombosis in pediatric renal transplantation. Transplantation. 1997;63(9):1263-1267. doi: 10.1097/00007890-199705150-00012. PMID:9158019.
61. Splinter A, Tjaden LA, Haverman L, Adams B, Collard L, Cransberg K, van Dyck M, Van Hoeck KJ, Hoppe B, Koster-Kamphuis L, Lilien MR, Raes A, Taylan C, Grootenhuis MA, Groothoff JW. Children on dialysis as well as renal transplanted children report severely impaired health-related quality of life. Qual Life Res. 2018 Jun;27(6):1445-1454. doi: 10.1007/s11136-018-1789-4. Epub 2018 Jan 27. PMID: 29374855; PMCID: PMC5951873.
62. Taher A, Zhu B, Ma S, Shun A, Durkan AM. Intra-abdominal complications after pediatric kidney transplantation. Transplantation. 2019;103(6):1234-1239. doi: 10.1097/TP.0000000000002420.
63. Tanabe K, Takahashi K, Kawaguchi H, Ito K, Yamazaki Y, Toma H. Surgical complications of pediatric kidney transplantation: a single center experience with the extraperitoneal technique. J Urol. 1998 Sep;160(3 Pt 2):1212-5. PMID: 9719313.
64. Verghese PS. Pediatric kidney transplantation: a historical review. Pediatr Res. 2017 Jan;81(1-2):259-264. doi: 10.1038/pr.2016.207. Epub 2016 Oct 12. PMID: 27732587.
65. Vitola SP, Gnatta D, Garcia VD, Garcia CD, Bittencourt VB, Keitel E, Pires FS, D'Avila AR, Silva JG, Amaral RL, Santos LN, Kruel CD. Kidney transplantation in children weighing less than 15 kg: extraperitoneal surgical access-experience with 62 cases. Pediatr Transplant. 2013 Aug;17(5):445-53. doi: 10.1111/petr.12104. Epub 2013 Jun 4. PMID: 23730951.
66. Wightman A, Bradford MC, Smith J. Health-related quality of life after renal transplantation in children. Pediatr Transplant. 2019;23(2):e13333. doi: 10.1111/petr.13333. PMID:30548760.
67. Winterberg PD, Garro R. Long-term outcomes of kidney transplantation in children. Pediatr Clin North Am. 2019;66(1):269-280. doi: 10.1016/j.pcl.2018.09.008.

Сучасний стан трансплантації нирки у дітей із малою масою тіла. Огляд

В. П. Закордонець, О. Ю. Іоффе

Національний медичний університет імені О. О. Богомольця, Київ

Трансплантація нирки є методом вибору при термінальній стадії ниркової недостатності в дітей, що забезпечує кращі показники виживаності та якості життя порівняно з діалізом. Однак трансплантація в дітей із малою масою тіла (≤ 20 кг) є технічно складною та супроводжується підвищеним ризиком ускладнень. Основними причинами цього є невідповідність розмірів донора й реципієнта, обмежений анатомічний простір і гемодинамічні особливості. Проведено наративний огляд літератури, присвячений хірургічним аспектам, анатомо-гемодинамічним чинникам, а також раннім і пізнім ускладненням трансплантації нирки в дітей із малою масою тіла. Особливу увагу приділено ролі невідповідності розмірів, вибору хірургічного доступу та стратегіям профілактики й ранньої діагностики судинних ускладнень.

Показано, що невідповідність розмірів донора й реципієнта є ключовим патофізіологічним чинником, який визначає результати трансплантації. Він формує складний каскад, що охоплює порушення венозного відтоку, набряк трансплантата, підвищення внутрішньотканинного тиску й вторинне зниження артеріальної перфузії. Інтраперитонеальний та екстраперитонеальний доступи продемонстрували порівнянну ефективність щодо довгострокової виживаності трансплантата. Вирішальним чинником є забезпечення адекватного позиціонування та перфузії трансплантата. Судинні ускладнення, насамперед артеріальний і венозний тромбоз, є основною причиною ранньої втрати трансплантата. Компартмент-синдром трансплантата розглядають як особливу форму судинно-механічної дисфункції. Рання діагностика за допомогою допплерографії та своєчасне хірургічне втручання мають критичне значення для збереження функції трансплантата.

Трансплантація нирки в дітей із малою масою тіла потребує інтегрованого підходу, спрямованого на компенсацію анатомо-гемодинамічного дисбалансу. Успіх втручання визначається не окремим технічним чинником, а комплексною оптимізацією позиціонування трансплантата, геометрії судинних анастомозів, формування адекватного ложа та післяопераційного моніторингу. Проактивна механізм-орієнтована стратегія є ключовою для зниження частоти ускладнень і поліпшення результатів лікування у цієї складної категорії пацієнтів.

Ключові слова: трансплантація нирки, діти, мала маса тіла, невідповідність розмірів донора й реципієнта, судинні ускладнення, тромбоз трансплантата, компартмент-синдром, хірургічний доступ, гемодинаміка.

FOR CITATION

Zakordonets VP, Ioffe OY. Current perspectives on kidney transplantation in low-weight pediatric patients. Review. General Surgery (Ukraine). 2026;(2);70-80. http://doi.org/10.30978/GS-2026-2-70.