

CHAPTER 2.2 Surgical-operative procedure in paediatric kidney transplantation

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Selection of graft type

The standard organ in paediatric kidney transplantation is a single kidney graft from a living or deceased adult donor. Not only is there a shortage of age- and size-matched paediatric donors in paediatric kidney transplantation. Data show an increased risk of technical complications and early graft loss in children using organs from small (≤ 20 kg body weight) and especially very small (≤ 10 kg body weight) paediatric donors. However, after surviving the critical initial period, paediatric kidney grafts transplanted into children show a very good growth and superior long-term function compared to adult grafts. It is possible to transplant both kidneys en-bloc from paediatric donors (especially in small donors < 12 – 15 kg body weight). However, in contrast to adult recipients, there is no clear advantage over single kidney transplantation because of the negative impact on the risk of surgical complications and the small increase in nephron mass in paediatric recipients.

Graft placement

Routinely, the kidney graft is placed heterotopically into the iliac fossa. This allows good placement of the transplant, access to the large vessels and proximity to the urinary bladder. The right side is preferred, especially in smaller children, because of its proximity to the vena cava. In very small children and the resulting size mismatch, intraabdominal placement of the kidney protects the graft from increased pressure and reduced graft perfusion. Although there is no general age

or weight limit for paediatric kidney transplantation, most centres prefer a minimum weight of 8–10 kg for the recipient child.

Native nephrectomy

Native kidneys can usually be left in place. Indications for native nephrectomy in children are based on the underlying diagnosis, namely recurrent urinary tract infection, malignant predisposition, resistant hypertension, persistent nephrotic syndrome or polyuria. The decision regarding the timing of surgery (pre-transplant vs. peri-transplant vs. post-transplant), the number of kidneys removed (one vs. both) and the order of removal (same procedure vs. staged procedure) should be discussed individually. The decision should take into account preservation of residual kidney function and residual pretransplant diuresis, avoiding opening of the peritoneal cavity and preserving peritoneal dialysis capability, avoiding unnecessary multiple operations and anaesthesia, creating space for the kidney transplant and removing the focus of infection.

Surgical technique

Access is made in the right (left) lower to mid-abdomen through a J-shaped incision (“hockey stick”). The peritoneum is shifted medially and upwards, and the transplant cavity is prepared extraperitoneally. The distal aorta and vena cava or the iliac vascular axis are dissected, protecting the surrounding lymphatic vascular plexus. First, the venous anastomosis is made between the renal vein and the vena cava as an end-to-side anastomosis. The arterial anastomosis is then made between the renal artery and the aorta in small children or with the common iliac vessels in older recipients. In the case of multiple kidney arteries, each artery must be anastomosed to avoid poor perfusion and function. In particular, the polar arteries of the lower pole are important because they provide blood flow to the ureter. These arteries can be reconstructed and reperfused sequentially after reperfusion to avoid long warm ischaemic times. All vascular anastomoses are made with fine (6-0 or 7-0), monofilament, absorbable sutures to allow for growth. At least the transplant ureter is directly connected to the bladder by a ureterocystostomy. Technique and pitfalls are described more in detail in chapter 2.3 [1–7].

Management of complications

The likelihood of complications after paediatric kidney transplantation depends on patient and donor factors such as age and size, immunosuppression, and surgical technique. In paediatric transplantation, the size and weight of the recipient and donor have an important impact on surgical complications. Complications rates are particularly high in small recipients [8]. Perioperative complications requiring revision are reported to occur in 15% of patients at a large German transplant centre [9]. Typical complications include:

Injury to other organs and structures

As with all surgery, nerves, blood vessels, or organs in the surgical area may be injured. Because kidney transplantation is usually performed retroperitoneally, injuries to the bowel or other viscera are rare. In small children, the kidney may be placed intra-abdominally. This increases the risk of injury to abdominal organs, adhesions or other intestinal problems. In rare cases, boys may have damage to the spermatic cord. Typically, injury to the lymphatic vessels can occur during dissection of the pelvic arteries. This can lead to lymphocele, some of which may need to be drained. The rate of lymphocele requiring drainage has been reported to be 4–10% in larger studies [10]. In small children, the vascular anastomoses are usually sutured to the vena cava and aorta, so injury to the great vessels is a major concern.

Vascular disorders

Vascular anastomoses can be challenging, especially in small children. As adult kidneys are usually transplanted into children, the donor renal artery may be larger in diameter than the child's aorta. In addition, children often have low blood pressure, which can present an anaesthetic and surgical challenge in perfusing the graft. Graft thrombosis is, therefore, the most feared complication. Vascular complications are higher than in adult kidney transplantation and have been reported in up to 10% of paediatric recipients [8, 10]. Vascular complications need to be rapidly identified by duplex sonography and clinic examination if the graft is to be salvaged [11].

Bleeding

Large blood vessels are connected during kidney transplantation. In addition, the kidney is an organ with a strong blood supply, which means that bleeding

may occur during and after surgery, requiring replacement of blood loss with blood transfusions/blood products.

The need for plasmapheresis or immunoadsorption, for example in the case of ABO incompatible transplantation or high immunological risk, can also increase the risk of bleeding [12]. Fortunately, these conditions are very rare in children. Intra- and postoperative bleeding complications are reported in less than 5% of paediatric patients [10].

Complications of the ureter-bladder anastomosis

Several children require transplantation because of congenital anomalies of the kidney and urinary tract (CAKUT). In these patients, the ureter-bladder anastomosis can be challenging [13] (see chapter 2.3). Although urethral leaks are rare, they usually require surgical intervention. This is also true for early ureteral/anastomotic stenosis, such as those caused by torsion of the ureter.

The incidence of ureteral complications has been reported to be 5–9% in adults in a review and was lower with the most common Lich-Gregoir extravesical technique than with an intravesical technique, and lower with a double J (DJ) stent than without [14, 15]. Data in children show comparable results [10], but ureteral complications are significantly higher in recipients with pre-existing bladder pathology [13]. If a DJ stent has been used, it should not be left behind but removed by cystoscopy. Mono-J ureteral stents are more commonly used in small children as they can be removed without this procedure.

Wound healing problems

In contrast to adult recipients, wound healing problems in children are very rare (<2%) [10]. In small children, abdominal wall closure sometimes requires the interposition of a resorbable (Vicryl-)mesh. However, hernias in children are fortunately rare.

Risk of infection from blood products and the donor organ

As with blood transfusions, the risk of disease transmission from the donor organ cannot be completely excluded. In individual cases, fatal diseases (e.g., rabies, melanoma) have been transmitted through organ donation.

Summary

Vascular complications are more common in paediatric kidney transplantation than in adults. Duplex sonography and careful clinical assessment (e.g., urine output, pain, haematuria) are important to detect vascular problems as early as possible. Children with CAKUT are at higher risk of urological complications and require multidisciplinary management.

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