Chapter 22
Kidney Transplantation

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Key Points

1. A transplant is the best treatment option for kidney failure but should be planned in the knowledge that further transplants will be required.
2. There is a primary failure rate of 2–3 %, but more than 75 % of kidney transplants survive beyond 5 years.
3. Urological complications are commoner in children with an underlying urological problem.
4. Infection and rejection are common. Immunosuppression needs to be monitored to minimise the risk of both.

Lay Description

A successful kidney transplant is the gold standard renal replacement therapy. However, a transplant is only another treatment option for kidney failure, rather than a cure. Even though transplants now survive longer than in previous eras, it is almost inevitable that a child who has a transplant will need further transplants later in life

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Intended Benefit

When kidney function falls below about 10–15 %, a transplant is the best option to restore quality of life and freedom from dialysis and hospitalisation. A transplant confers most benefit if it can be performed before dialysis is required.

Work Up for Transplantation

This usually happens in parallel with treatment and investigation of kidney failure, and needs to include managing risk of infection by vaccination, nutrition and growth by dietary means (including supplementary feeds if needs be), and safeguarding biochemistry such as calcium, phosphate and potassium levels as these can cause symptoms that can become life-threatening. Sometimes dialysis becomes necessary.

The urinary tract needs to be investigated if it was associated with kidney failure in the first place or there are symptoms. Occasionally problems with the urinary tract need surgery prior to a transplant to provide a safe environment for the transplant. Heart function needs to be investigated as this can be affected by kidney disease and can affect the transplant if poor. Also, the transplant team needs to know that suitable blood vessels are present for implanting a new kidney. At the time an organ becomes available, it needs to be matched optimally (tissue type) to maximise its survival and to lower the risk of rejection, and 'cross-matched' to ensure that the recipient's immune system does not react immediately to cause loss of the kidney.

Organ Sources

The availability of an organ tends to be the rate-limiting step in transplantation. Kidneys can be from living or deceased donors. A living donor is frequently a relative (such as a parent) but not exclusively so and there is an increasing trend for altruistic donation. Deceased donors fall into two categories: donors after brain death and donors after cardiac death. The outcomes of transplants from both of these groups is similar. Living donors have a slightly better outcome in terms of life of the graft.

Timing of the Operation

A living donor transplant is a planned procedure, so allows the recipient to be as fit as possible. A deceased donor transplant frequently happens as an emergency as and when a suitable organ becomes available.

Technique

Before the transplant operation can begin, the kidney needs to be inspected and prepared for implantation. The kidney is stored and transported in cold preservation fluid surrounded by ice. Rarely, damage to the kidney or its blood vessels, or an abnormality such as a previously-unknown tumour, prevents its implantation. If there are multiple renal arteries, they sometimes need to be reconstructed to make the transplant easier. There is an increased risk of thrombosis with multiple vessels or if a vascular reconstruction is required.

The recipient is under general anaesthetic, and will have a central venous catheter and peripheral venous and sometimes arterial lines placed, and a bladder catheter either through the urethra or into a urinary reconstruction.

The incision varies from surgeon to surgeon, and according to the size of the recipient. It is usual for the incision in an older child or adult to be curved on one side of the abdomen. In a small child (for example under 15 kg), it is sometimes easier to open the abdomen through a midline incision (Fig. 22.1).

The recipient blood vessels for implantation are identified. In children above 15 kg, it is usually preferable to stay outside the peritoneal cavity – this preserves the peritoneum for dialysis and also lowers the risk of damaging intraperitoneal structures. In smaller children, or if the peritoneum cannot be reflected away, the vessels are prepared through the peritoneal cavity. A space is created for the kidney to lie.

Generally, the largest recipient vessels in relation to the donor vessels are selected. In small children, this usually means the aorta and inferior vena cava. In older children the iliac vessels are usually acceptable.

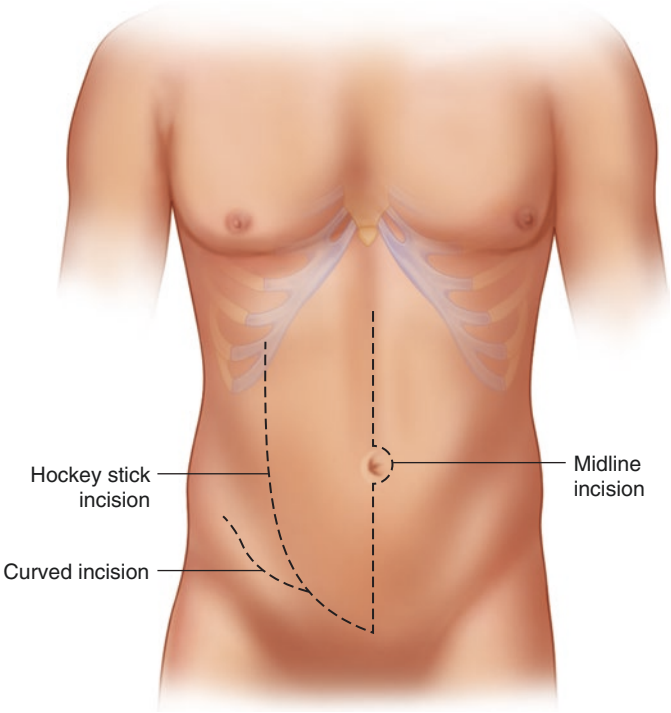

Fig. 22.1 Incisions for renal transplant

When the recipient vessels have been prepared, the kidney is removed from ice and the vessels are sutured into place on the recipient vessels. When the vascular anastomosis is complete, the kidney is reperfused with the recipient's blood. Any bleeding at this time can be controlled.

The bladder (or urinary reservoir) is then identified and the ureter of the transplant is sutured to this. Sometimes a ureteric stent is left in place, to be removed at a later date.

The abdominal muscles are closed if possible, usually leaving a drain. Occasionally, in smaller children, it is necessary either to use a patch of a prosthetic material, or leave the muscles open with a plan to return to the operating room to close the muscles when tissue swelling has resolved after a few days. It is important that the kidney is not under pressure if the abdomen is closed.

Postoperative Expected Course

Children are sometimes nursed in the intensive care unit after a transplant. This is more likely in smaller children who need more intensive monitoring of fluid balance and if they need medicines to regulate their blood pressure. Also, if they require ventilation after the surgery.

Between 2 and 3 % of kidneys fail to work – the cause of this is usually thrombosis in the vessels. Around 15 % of deceased donor kidneys have delayed graft function (DGF), where dialysis might be necessary while waiting for transplant function to begin. The incidence of DGF in living donor kidneys is lower at around 5 % [1].

Children can usually eat and drink within a day or 2 of their transplant, as long as they do not have an ileus. The drain in the wound will remain until its output is virtually nil, and the bladder catheter will stay in for 4–5 days normally. The central venous line is removed when no longer needed for fluid administration or monitoring.

Recipients will need to start oral immune suppressant medication immediately (this can sometimes be given intravenously at the start) and prophylaxis against infection. The exact medication will vary from patient to patient and on local protocols. Levels of immunosuppression will need to be monitored.

Follow Up

After discharge from hospital, transplant recipients require very intensive follow up on an outpatient basis. In the early weeks post-transplant, this can be several times per week, gradually decreasing. Medication needs frequent alterations and monitoring, but less so as time goes on and stable state is reached with a functioning transplant. If a stent was left in the ureter at the time of transplant, it will need to be removed via a cystoscopy at a later date. If a child was on dialysis before the transplant, the dialysis catheter may need to be removed under an anaesthetic in the operating room.

Some units have protocols for biopsies of the transplant. Sometimes a biopsy is require to exclude rejection or to follow up treatment of rejection. A biopsy can usually be done under local anaesthetic and sedation in older children, but may need general anaesthesia in younger children.

Outcome

Table 22.1 shows graft survival for all groups at 1, 3 and 5 years post transplant for living and deceased donor kidney transplants.

An important consideration in paediatric transplantation is that the majority of children who undergo transplantation will need transitional care into adulthood, with need for further renal replacement therapy (including retransplantation). The period of transition (aged 15–19 years) has the highest rate of graft failure and is therefore a critical time for ongoing monitoring and care.

Risks and Complications

Bleeding

Immediate bleeding from the vascular anastomoses is controllable directly by suturing. Vessels in the graft hilum may bleed but this will settle usually with pressure or suturing. Return to the operating room because of bleeding is rare (less than 5 %).

Vascular Thrombosis

This may be an immediate phenomenon, requiring oxne of the vessel anastomoses to be re-done because of poor flow, or may occur in the days after transplantation. Up to 7 % of recipients may suffer a venous or arterial thrombosis [2]. Venous

Table 22.1 Graft survival (%) at 1, 3, and 5 years post transplant according to year of transplant and organ source

		LD			DD	
	1 year	3 year	5 year	1 year	3 year	5 year
1987–1990	89	81	75	75	63	55
1991–1994	92	85	80	85	76	70
1995–1998	94	91	85	91	82	74
1999–2002	96	92	87	93	84	79
2003–2010	97	92	84	95	84	78

NAPRTCS Annual Report 2010 [1]
LD live donor, *DD* deceased donor

thrombosis is commonest in the first 5 days or so. It may present with pain over the transplant (as it becomes congested because of poor outflow), hematuria, or loss of function. Rarely, a graft rupture can occur needing emergency operation to control life-threatening bleeding. Arterial thrombosis is commonest in the first few days and presents usually with abrupt loss of urine output or rise in serum creatinine. If a thrombosis is suspected an urgent Doppler ultrasound is required to determine the need for surgical re-exploration of the transplant. Thrombosis can only very rarely be recovered. A graft nephrectomy is the usual outcome.

Ureteric Complications

These occur in up to 10 % [3] of transplants. A urine leak is an early phenomenon, and causes persistent or increased drainage via the wound drain (or through the wound), or pain or swelling under the wound with a rise in creatinine. A stent may delay the diagnosis. With a stent in place and catheter drainage, a urine leak may stop spontaneously. If it does not a diverting nephrostomy may need to be placed. A urine leak that cannot be managed by drainage alone will require exploration of the transplant to redo ureteric drainage.

A ureteric stenosis may present late with rising creatinine or hydronephrosis of the transplant. If a stent can be placed (usually from nephrostomy puncture of the kidney) that may be all treatment is required. If a stent fails to treat a stenosis, exploration of the transplant and revision of the ureter-bladder anastomosis will be required. This sometimes requires use of a native ureter or bladder flap if the length of stenosis is substantial.

Ureteric complications are slightly commoner in recipients whose underlying kidney disease was associated with a urinary tract malformation or urinary tract surgery.

Lymphocele

This is an uncommon condition where lymphatic fluid collects around the graft and can cause obstruction to ureteric drainage (and more rarely still to the vessels). Initially drainage is helpful, but it persistent drainage occurs then it can be treated by opening the lymphocele into the peritoneum to allow reabsorption of interstitial fluid.

Infection

Infection is very common as an early or late complication of transplantation. This is because of the need for immunosuppressant medication. Increasingly frequent or severe infections might be a marker of over-immune suppression. Systemic infection

with bacteria or viruses need aggressive and early treatment, and in some cases monitoring (as in the case of cytomegalovirus [CMV] or Epstein-Barr virus [EBV]). If the transplant is from a know CMV positive donor into a CMV negative recipient, prophylaxis is usually recommended in many centres. It is also usual in the first few months after transplantation for recipients to receive antibiotic prophylaxis (with co-trimoxazole) against opportunistic infections such as Pneumocystis species.

Rejection

Up to 20 % paediatric recipients will suffer an episode of acute rejection, usually within the first 6 months post-transplant [1]. This usually presents with a rise in creatinine and requires a biopsy to diagnose and classify. Many episodes of rejection can be managed by an acute short course of steroids and modulating baseline immunosuppression. Sometimes extra treatment by lymphocyte depletion or plasma exchange is needed. A major cause of rejection in paediatric transplantation is non-adherence with immunosuppression. Monitoring drug levels sometimes helps, as does close supervision.

Long Term Risks

Transplant kidneys inevitably fail in the long term. This is usually because of a combination of factors. Some immune suppressants are relatively nephrotoxic (such as tacrolimus and cyclosporin) and cause damage and scarring within kidneys. Immunological 'chronic rejection' despite immunosuppression undoubtedly plays a part in long term graft loss. There are risks of transmission of occult tumours or infection from the donor (normally in the setting of deceased donor transplantation where donor workup is inevitably less complete than it can be in the living donor scenario). Immunosuppression per se increases the risks of malignancies in the recipient, especially skin malignancy, so regular clinical surveillance is important. Metabolic risks of chronic kidney disease and medications include hypercholesterolaemia and bone mineralisation problems are important to survey in recipient, as is the development of hypertension and proteinuria, both of which can accelerate graft loss as well as indicate the development of generalised vascular disease.

Conclusions

A successful kidney transplant is undoubtedly the best treatment for established renal failure, but it remains only a treatment rather than a cure. The majority of children who receive transplant will require a further transplant, so work up needs

to be as comprehensive as possible, and the first kidney needs to be as well matched as possible to favour subsequent transplants. Lifelong follow up for long term as well as short term problems is required. Because urological problems are more common in the paediatric population, ongoing urology follow up for these recipients will also be needed.

References

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