

Renal Transplantation

Single Surgical Procedures

13

A Colour Atlas of

Renal Transplantation

Roy Calne



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Die Wiedergabe von Gebrauchsnamen, Warenbezeichnungen und dergleichen in diesem Buch berechtigt nicht zu der Annahme, daß solche Namen ohne weiteres von jedermann benutzt werden dürfen. Vielmehr handelt es sich häufig um gesetzlich geschützte, eingetragene Warenzeichen, auch wenn sie nicht eigens als solche gekennzeichnet sind.

Contents

Introduction	6
Donor operation	
Cadaver donor	
Preservation technique	
Living donor	
Recipient operation	
Special hazards	
Acknowledgements	8
Donor operation	9
Live donor operation	23
Recipient operation	27
Diagrams of stages in ureteric implantations	51
Alternative method of transplantations of an adult kidney in a child	73
References	94
Index	95

Introduction

The object of renal transplantation is to provide the recipient suffering from irrecoverable renal failure with an allografted vascularised kidney that will function and maintain him in good health for a long period. The selection and preparation of recipients, their postoperative monitoring and immunosuppressive treatment do not form part of this work.

The operation itself is not difficult but must be performed carefully in order to reduce the incidence of technical complications, which are probably higher than most transplant surgeons would like to admit. There is a choice of two possible donors: one a cadaver donor, the other a living volunteer.

Donor operation

Cadaver donor

Most kidneys are removed from patients who have died from head injury or cerebrovascular catastrophe in whom complete and irreversible death of the brain stem has been demonstrated according to accepted criteria^{(1) (2)}.

Increasingly common now is removal of multiple organs from the same donor, often the wish of the relatives. We have on a number of occasions removed both kidneys, liver, pancreas and heart as well as the corneas from the same donor, and all have functioned satisfactorily when transplanted into their respective recipients. Careful and time-consuming dissection is required. A bilateral subcostal incision is made and if the heart is to be removed, a vertical extension includes division of the sternum in the midline.

A category of donor that is uncommon now is the patient who is brought in dead, usually from a road traffic accident, stroke, or myocardial infarct. In such cases rapid removal of kidneys within one hour of cardiac arrest is essential; damage may be minimised by inserting a triple lumen double-balloon catheter into a femoral artery, passing it into the aorta and inflating the lowermost balloon. The catheter is pulled back so that the distended balloon is sited at the aortic

bifurcation. The upper balloon is then inflated and it should lie at the level of the diaphragm. Through the intervening portion of the catheter between the two balloons cold preservation fluid is infused, which will cool the organs supplied by the abdominal aorta. While this cold infusion is in progress the kidneys are removed as quickly as possible and plunged into ice-cold saline.

Preservation technique

Once removed, whether from a living or dead donor, the cold preservation technique is the same. The kidney lies in a bowl of normal saline at 4°C and the renal artery is cannulated by hand. The cannula is attached to tubing connected to a bag containing hypertonic citrate solution at 4°C on a dripstand approximately one metre above the kidney. Perfusion through the renal artery continues until the surface of the kidney blanches and the effluent from the renal vein contains no macroscopic blood. 200–300 ml of perfusion fluid may be needed. The kidney is then double-wrapped in sterile bags and surrounded by ice and can be kept with confidence for 24 hours. There may be a little damage in the kidney preserved between 24 to 48 hours if the period of warm ischaemia is short and the anastomoses in the recipient done rapidly, say within 20 minutes for the artery and vein. Longer periods of preservation by this simple method should be avoided, because damage will probably be severe.

Living donor

To remove a kidney from a healthy individual should not be undertaken lightly. We require that the donor is a blood relative, who has at least one haplotype of antigens in common with the recipient, for example parent to child. There must be no evidence of disease in the cardiovascular system or renal tract, and no demonstrable antibodies in the recipient against donor lymphocytes. We spend time with the donor and the family to determine that the giving of the kidney is a positive desire of the would-be donor and that he is not being subjected to pressure within the family. The pain of the operation and the definite risks

involved are not minimised, nor the possibility that the graft may fail.

After careful medical examination an arteriogram is performed with free flush of contrast in the aorta to show the anatomy of the renal arteries. Multiple arteries are common and their presence compromises the chances of success. Especially important is a lower polar vessel which usually is a major contributor to the blood supply of the renal pelvis and the ureter of the transplanted kidney. A kidney with a single artery is best and if there are multiple arteries on both sides, the donor may be unsuitable because a patch of aorta containing the orifices of both renal arteries cannot be taken from a living donor.

Under general anaesthesia, with the patient in the lateral position, an intravenous infusion of Mannitol is started. The kidney is approached in the extraperitoneal plane through the bed of the twelfth rib, the distal portion of which is excised. If both kidneys have normal anatomy the left one is preferable because the renal vein is longer. After ligation and division of the renal vessels and ureter, the kidney is plunged into ice-cold saline and perfused with cold hypertonic citrate solution as for a kidney taken from a cadaver donor.

Recipient operation

In adults the kidney is placed in the iliac fossa in the extraperitoneal plane. In small children it may be necessary to use the peritoneal cavity. An arterial inflow is established from the systemic arterial system and venous drainage into the inferior vena caval system. Although a right or left kidney may be grafted to either side, the anatomy of the renal vessels and ureter make certain procedures preferable.

To avoid lymphatic leakage postoperatively, perivascular dissection is limited to provide sufficient mobility of the vessels for clamping and anastomosis. Any lymphatics that have to be divided are ligated with fine catgut. If a patch of aorta has been included, which is usually the case from a cadaver donor, the kidney is most conveniently transplanted to the homolateral side, the anastomoses being made end-to-side to the external iliac vessels.

From a live donor, transplantation to the contralateral side may be preferred, anastomosing the renal artery end-to-end to the proximal divided end of the internal iliac artery, the distal end being ligated. It is

important to exclude severe atherosclerosis of the internal iliac artery, which may make arterial inflow to the kidney unsatisfactory. Venous drainage is to the external iliac vein with an end-to-side anastomosis.

For children, especially when a large kidney is transplanted into a small child, an intraperitoneal abdominal approach is used and the renal vessels are anastomosed end-to-side to the common iliac vessels or the aorta and vena cava. In all cases the ureter is implanted into the bladder near the dome with a submucous tunnel of approximately 2 cm in length. If the kidney has suffered from warm ischaemia, as have many transplants from cadaver donors, the ureter is splinted with a No. 6 Tizzard catheter brought out through the dome of the bladder and a stab incision in the skin. The splint being left in place for 5 days before removal, a retrograde injection of contrast is given, and an xray is taken to show that the graft drainage is satisfactory. The urinary catheter is removed between the 7th and 10th day.

From a live donor splintage of the ureter is usually not necessary. A small biopsy is taken from the lower pole of the kidney to provide the pathologist with a specimen for a baseline reference which may be used for comparison with future biopsies. In donation from a cadaver, the renal capsule is incised longitudinally to permit renal swelling that may result if there is an episode of acute rejection. The wound is drained with a Silastic tube drain 1 cm in diameter brought out through the upper extremity of the wound incision.

The donor and recipient operations usually take between one and two hours each, unless the donor has been brought in dead, in which case kidney removal is as rapid as possible.

The objective of the surgeon should be to ensure the shortest time when the kidney is warm and unperfused both in the donor and the recipient. Dissection is deliberate and gentle so as not to damage the delicate organs and their blood vessels.

Special hazards

1 It is especially important to leave the periureteric connective tissue intact, because the blood supply to the lower end of the ureter coming from the renal artery may be precarious.

2 The placement of the anastomosis on the iliac vessels should be considered not only from the point of view of the ease with which the

surgeon can perform the anastomoses, but also how the vessels and the kidney will lie when the wound is closed. Thus the renal artery and vein should be unhampered, without kinking or twisting. If the renal vein is too long, closure of the wound may compress the renal substance against the vein and cause venous obstruction. If the renal vein is too short, it may be very difficult to join it to the iliac vein; this applies especially on the right side where the renal vein is only 2 cm in length.

3 In removing the donor kidney it is important not to pull the kidney upwards with any force to facilitate dissection. Traction can lead to rupture of the intima, which then curls up inside the renal artery leading to primary or early failure of arterial inflow to the kidney, often misinterpreted as 'hyperacute rejection' by inexperienced surgeons.

4 Any handling of the vascular intima of the donor or recipient vessels should be reduced to a minimum, and special atraumatic forceps should be used if possible. A strabismus hook is often preferable to forceps, to hold open the lumen of the vessels being anastomosed.

5 The details of the operation should be always carefully recorded. It is helpful to do this with a line diagram so that if re-exploration of the kidney is needed at a later date, the arrangement of the anatomy can be anticipated. After the kidney has been in place for some weeks, there is considerable fibrotic reaction around the organ even without significant rejection or infection. This can make re-exploration hazardous and there may be danger of the kidney prolapsing out of the wound and tearing the anastomoses apart, especially if relaxation of the abdominal wall muscles has been inadequate.

The techniques illustrated here are not claimed to be comprehensive. Most surgical operations can be performed in a variety of ways. I have portrayed the typical procedure in our unit. Illustrations have attempted to show the operation as seen by the surgeon, with examples of some common anatomical anomalies.

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Donor operation

1 Arteriogram of potential live donor showing the coeliac, renal and lumbar vessels as well as the aorta. On the left side there is one renal artery, on the right one main renal artery and an artery to the lower pole probably supplying the renal pelvis and upper ureter. The left kidney was therefore used.

