CHAPTER 13

Insertion of the kidney

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1. General principles

There are certain general principles which should be followed during the insertion of the kidney (Table 29).

2. The standard kidney transplant operation

With the exception of patients receiving a kidney from a live donor, the transplant patient is normally 'on call', and living at home. When a donor kidney becomes available and the tissue type results are known, the patient will be notified by phone to come immediately to hospital. Occasionally when the donor tissue type matches more than one patient several patients may be prepared, pending the cross-match results. Almost all of these patients are receiving either haemodialysis or continuous ambulatory peritoneal dialysis (CAPD) and it is sometimes necessary to give a period of dialysis immediately pre-operatively to correct electrolyte and fluid imbalances in order to minimise the risks of surgery.

The operation of kidney transplantation is performed under general anaesthesia, although it would be technically possible to perform it under epidural anaesthesia. As these patients will receive immunosuppressive drugs, it is important that the highest standards of sterility are maintained to avoid complications of infection. The bladder is catheterised under strict aseptic conditions using a size 16 Ch. silastic catheter (silastic catheters have a lower incidence of infection compared to ones of latex) and the bladder drained of urine. The anastomosis of the ureter to the bladder is facilitated if the bladder is partly distended and it is customary to fill the bladder with 100 ml of saline. The catheter is spigotted for the duration of the surgery.

The abdomen is prepared with savlon, spirit and iodine and draped. It is customary to place a right kidney into the left iliac fossa and a left kidney into the right iliac fossa as this positions the kidney with the renal pelvis anterior to the artery and vein. It is then easier to puncture or explore the

Mary G. McGeown (ed.), Clinical Management of Renal Transplantation, 167–179.

Table 29. General principles of insertion of the kidney

1. Surgical technique should be meticulous to avoid early post-operative morbidity and achieve the best long-term results.
2. The kidney should be placed in an accessible position for subsequent percutaneous procedures, e.g. biopsy or nephrostomy.
3. There should be easy access to an adequate arterial supply and adequate venous drainage.
4. The kidney should be placed as close to the bladder as possible to keep the ureter short and minimise the risk of vascular insufficiency and stricture formation.
5. The anastomosis of the ureter to the bladder should be performed in such a way as to minimise bleeding and the anastomosis should have anti-reflux properties.
6. Drains should be avoided – they provide a portal for the entry of infection and tend to hinder the post-operative mobility of the patient.

renal pelvis subsequently which is occasionally necessary in the treatment of complications such as the development of a stricture at the ureteric-bladder anastomosis. However, either kidney can be placed in either iliac fossa should the need arise, e.g. when a patient is having a second or third transplant. Occasionally, when it is important to keep the pelvis in the anterior position, the ipsilateral kidney can be placed in the iliac fossa in the upside down position without impairment of urine drainage. However, in this position the ureter is of necessity considerably longer than when the kidney is in the normal transplanted position.

The incision is made 2–3 cm above and parallel to the inguinal ligament extending from the midline to opposite the anterior superior iliac spine. The external oblique aponeurosis, internal oblique and transversus abdominus muscles are divided to reach the surface of the peritoneum. The peritoneum is swept medially, lifting it off the lateral pelvic wall muscles. This is usually accomplished by a minimal amount of sharp dissection, sweeping the peritoneum medially by hand. In a thin patient the external iliac artery and vein are immediately seen lying on the psoas and illiacus muscles. Care should be taken to avoid entering the peritoneal cavity. This has become increasingly important as many of the patients undergoing kidney transplantation are receiving peritoneal dialysis, which may have to continue in the post-operative period. A suitable self-retaining retractor is placed into the wound to allow adequate exposure of the iliac vessels from the bifurcation of the common iliac and internal iliac to the inguinal ligament. Some surgeons expose the entire common iliac artery up to the bifurcation with the aorta. The common iliac vessels are intimately associated with lymphatic vessels running over their anterior surfaces. During mobilization of the vessels some surgeons carefully identify and ligate these lymphatics to prevent the formation of a lymphocele. In Belfast we do not routinely mobilise the common iliac artery and vein, but mobilise the external iliac vessels along their entire length. We do not routinely ligate lymphatics and have not found a high incidence of formation of lymphocele.

When the vessels have been exposed the kidney is removed from the ice pack. The ends of the donor artery and vein are tidied and inspected for

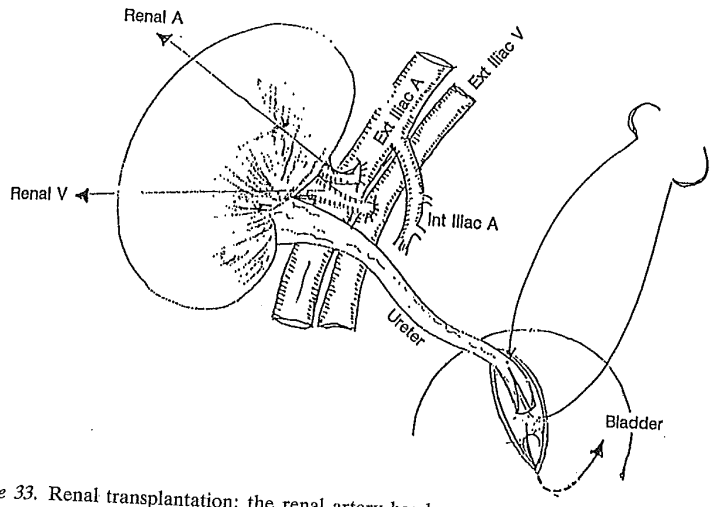

Figure 33. Renal transplantation: the renal artery has been anastomosed to the external iliac artery and the renal vein to the external iliac vein. The ureter is spatulated. Note that the needles are passed in the direction of the arrow.

inadvertent damage during organ retrieval; any open branches are tied and if metal clips have been used for haemostasis they are replaced by ligatures which we feel are more secure. Occasionally, if the artery is very long it may be shortened. This means sacrificing the aortic patch making the anastomosis slightly more difficult. However, redundant artery may lead to kinking and altered blood flow.

The kidney is placed in the wound in the position in which it is most likely to lie post-operatively and the best positions for the vascular anastomoses are noted. The kidney is removed from the wound to prevent excessive warming and suitable vascular clamps (Swinney clamps) are placed on the artery and vein. We do not routinely heparinise the distal femoral artery and vein and have not found this to be necessary. The kidney is clipped with artery forceps to the side of the wound in a position to allow best access for performing the vascular anastomoses. Either the arterial or venous anastomosis can be performed first depending on the preference of the surgeon and the anatomy of the vessels.

A suitable venotomy and arteriotomy are made with a fine scalpel and vascular scissors. The vein is sutured end to side using a continuous 5/0 polypropelene (Prolene) suture. The artery is anastomosed on its patch to the external iliac artery using a 6/0 polypropelene suture. On completion of both anastomoses (Figure 33) both clamps are released and any leaks identified and ligated. It is important that the anaesthetist is told when the clamps are about to be released as immunosuppressive drugs may need to be administered before the kidney is perfused and there is usually a reduction in blood pressure. On releasing the clamps the kidney usually perfuses immediately,

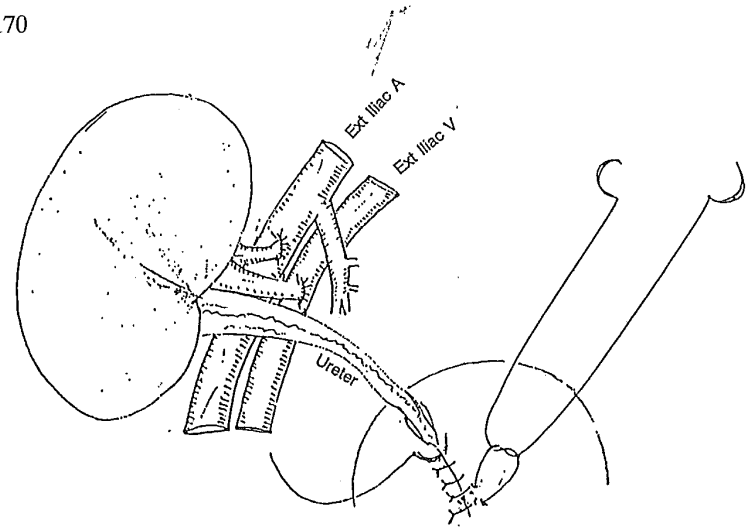

Figure 34. Renal transplantation: the muscle layer is approximated over the ureter.

changing from pale buff to pink in colour, becoming up to 30% larger in volume and pulsatile. If perfusion is sluggish this may mean a problem with the anastomosis, or spasm in the renal vasculature. The latter sometimes responds to an intravenous bolus of frusemide.

The next stage of the operation is to implant the ureter into the bladder. It is best to implant it in a position where the bladder is easily accessible and where the ureter can be kept reasonably short thereby maximising the blood supply to its end. The ureter is usually implanted onto the dome of the bladder in an anterolateral position. The bladder can be clearly identified by blunt dissection which has been facilitated by prior instillation of saline into the bladder. The dome of the bladder is held up between two stay sutures. With very careful use of diathermy, a 4 cm incision is made through the bladder muscle in the longitudinal or oblique plane. Careful dissection allows the bladder mucosa to bulge into the myotomy. The ureter is trimmed to a suitable length, and any bleeding points carefully ligated. The end of the ureter is spatulated over a distance of 1 cm and a double ended suture of polyglactin 2/0 is passed through the distal end of the ureter as shown in the diagram (Figure 34). A small hole is made in the bladder mucosa at the caudal end of the muscle incision and the needle coming through nearest to the spatulated part of the ureter is inserted through the hole in the bladder mucosa to enter as far as possible into the bladder. The needle coming through the distal end of the ureter is inserted through the hole in the bladder to exit from the bladder 1 cm proximal to the first needle. The ureter is passed through the hole in the bladder mucosa and pulled tight with this double ended suture. The suture is tied with the knot on the outside of the bladder. This causes the spatulated end of the ureter to assume the shape

of an everted nipple. The muscle coat of the bladder is sutured over the reimplanted ureter to form a sub-muscular tunnel thus providing the anti-reflux mechanism. The urethral catheter is left to drain the bladder for five days.

This method of ureteric implantation is known as the modified Lich technique and its advantages over other methods are that the bladder is approached from the outside avoiding a cystotomy, bleeding is minimal and therefore there is little risk of catheter blockage in the post-operative period. The anastomosis is anti-reflux due to the submucosal tunnel and is very leak resistant. The technique is simple, quick and easy to perform.

Although in the past we routinely performed a capsulotomy and drained the retroperitoneal space with a tube drain we have not employed these measures for the past 18 months with no detriment to our results.

It is essential that surgical technique is meticulous with great attention paid to adequate haemostasis. The wound is closed in layers using absorbable sutures and a sub-cuticular skin suture.

3. Variations in technique

3.1. *Arterial anastomosis*

When the donor kidney is received without a patch of aorta or in the case of a live donor kidney, it is sometimes necessary to perform an end to end arterial anastomosis to the internal iliac artery (Figure 35). In some centres

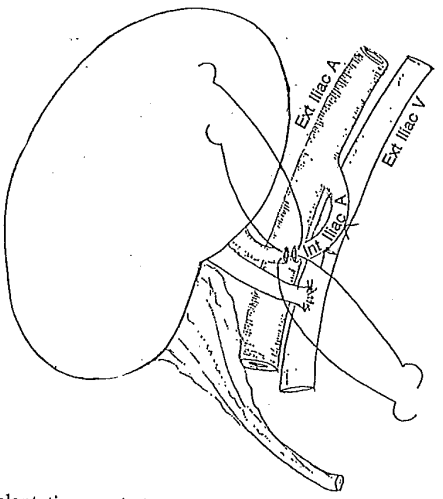

Figure 35. Renal transplantation: variations in technique: End-to-end anastomosis of the renal artery to the internal iliac artery.

this is the preferred technique for all transplants, but this necessitates a more extensive dissection to mobilise the internal iliac artery and swing it forwards into a suitable position.

3.2. *Multiple renal arteries*

It is not uncommon to transplant a kidney with more than one renal artery. If the origin of the arteries are close to each other on the aorta and are contained on a single patch, this can be anastomosed to the external iliac artery in the normal way (Figure 36). If there are several arteries without a patch then the options are to individually anastomose each artery to the external iliac artery or to anastomose the renal arteries to each other before transplanting the kidney (Figure 37). This latter technique has the advantage that it can be done on the bench thus reducing warming of the kidney. If there are two arteries of equal size then the ends can be spatulated and anastomosed to form a single ostium which can be anastomosed to the external iliac artery (Figure 38). Small upper polar arteries supplying less than 10% of the renal substance can be ignored and ligated. Lower polar arteries can contribute a significant proportion of the blood supply to the ureter and it is important to try and preserve these to safeguard the ureteric blood supply.

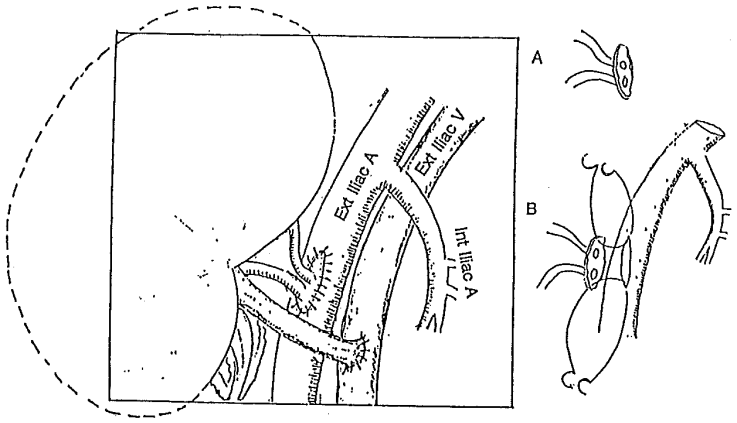

Figure 36. Renal transplantation: variations in technique: Carrel patch with two renal arteries anastomosed to the external iliac artery.

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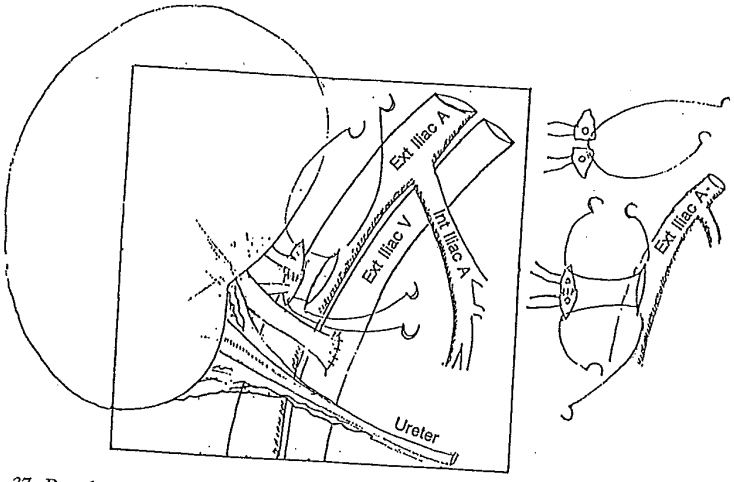

Figure 37. Renal transplantation: variations in technique: Two renal arteries on separate patches, patches are joined together, then anastomosed on one patch to the external iliac artery.

3.3. *Abnormalities of the veins*

Multiple venous drainage of the kidney is common. As there is adequate venous communication within the kidney the main draining vein is usually used for the anastomosis, the others being ligated.

3.4. *Transplantation in patients who have had multiple previous transplants*

Occasionally it may be necessary to anastomose donor kidney vessels onto the recipient aorta and vena cava. This may occur in spina bifida patients who have dysplastic lower limbs and in some patients who have had two previous transplants. In this instance a mid-line incision is made. The aorta and both common iliac vessels are identified and clamped. The vena cava and both common iliac veins are identified and clamped and if necessary lumbar veins posteriorly are also clamped. The operation is then carried out as described above and the ureter is reimplanted into the bladder in the same way. The kidney in this situation lies in the peritoneal cavity and may have bowel between it and the abdominal wall thus making biopsy more hazardous.

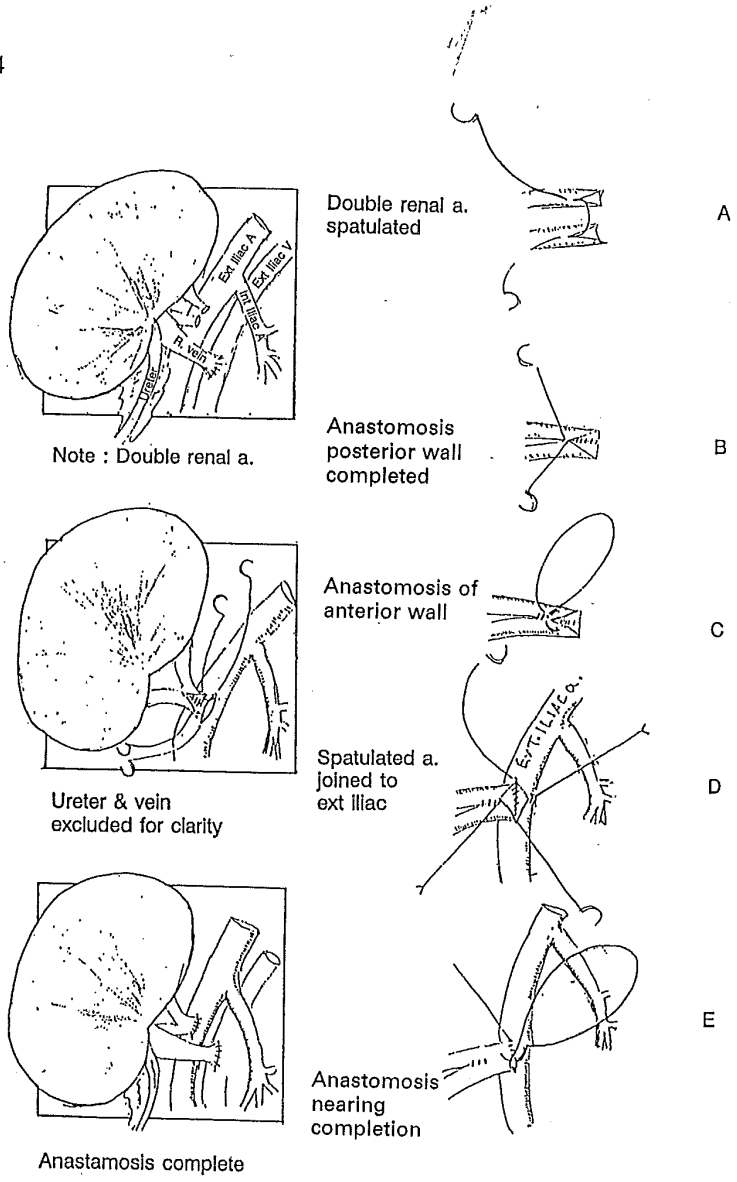

Figure 38. Renal transplantation: variations in technique: Steps of anastomosis of double renal arteries to one another and to the external iliac artery. A double renal arteries spatulated; B anastomosis of the posterior wall of artery completed; C anastomosis of the anterior wall; D the spatulated artery joined to the external iliac artery; E the anastomosis nearing completion.

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3.5. *Alternative techniques for reimplanting the ureter*

There are many methods of ureteric reimplantation which may be employed; while some have advantages over others most operating surgeons have their own preference. Techniques include a "drop in" technique where the ureter is simply inserted into the bladder with 1–2 cm lying free in the bladder and the ureter secured to the bladder mucosa with 3–4 chromic catgut sutures. The Politano-Leadbetter type of reimplantation implants the ureter as close to the trigone as possible while forming a submucosal tunnel to prevent reflux. Both these techniques require a large cystotomy with the attendant risk of bleeding and catheter blockage.

The "lay on" technique involves suturing the mucosa of the ureter to the mucosa of the bladder after making a small cystotomy in the dome of the bladder. The bladder muscle is then sutured loosely over the anastomosis and distal 2 cm of the ureter to form an anti-reflux valvular effect.

The modified Lich technique as already described above and the "lay on" technique avoid formally opening the bladder and there is a lower incidence of bleeding and catheter blockage.

Occasionally the donor ureter has been damaged. In this case the patient's own native ureter can be used. An anastomosis can be formed between the donor renal pelvis and the recipient's ureter. However, the rate of anastomotic failure with this technique is much higher than reimplantation of the donor ureter into the bladder.

4. Post-operative care

In Belfast the patients are nursed in a purpose designed transplant unit complete with positive pressure ventilation etc. The staff are required to change into theatre garb. The patient's visitors are not allowed direct access to the patient but can see and communicate with him through a clean/dirty corridor arrangement. While it is accepted with current knowledge that these restrictions are excessive, we feel that it helps to maintain high standards of patient care and restricts the number of personnel coming into contact with the patient thus reducing the risk of infection.

The surgery is carried out in an operating theatre dedicated to transplantation and related procedures. It is situated within the transplant unit. On transfer to the ward routine observations are made, which include quarter hourly pulse, blood pressure and hourly estimations of CVP and urine output measurements. There may be occasional bleeding from the end of the implanted ureter. It is important that the catheter does not become blocked and if this occurs it should be cautiously washed out with saline, so that the anastomosis is not compromised.

Usually the patient can take oral fluids and medication after 24 hours and can take a normal diet on the second post-operative day. The patient should

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be encouraged to become mobile as quickly as possible and should sit out of bed on day one. In this regard we have found that the abandonment of drains has been most beneficial.

5. Transplantation in children

Transplantation in children is more difficult than in adults and this bears a direct relationship to the age of the child. A fifteen year old is technically little different from an adult and presents little difference from an anaesthetic point of view, however, a two year old child presents more surgical and more anaesthetic problems.

Until recently transplantation in children younger than five years has shown poor results. Trumpeter et al. reported on 16 transplants performed in 15 children less than five years old in Guys Hospital, London. The mean follow up was 1–2 years with a 25% death rate.

The results of transplantation in children less than one year old remain poor and several centres have stopped transplanting children of this age, maintaining them on CAPD until they are old enough to reduce the risks. Miller et al. from Minnesota consider that live related donor transplants in the 1–5 age group give better results than cadaver transplants. Reports on these patients exhibiting catch-up growth remain at present contradictory.

5.1. *Problems in the under five age group*

The problems which may be encountered in children under five years are summarized in Table 30.

Table 30. Problems encountered in transplantation in children under five years

1. There will probably be disparity in size between the donor kidney and the recipient vessels and vice versa.
2. Vascular anastomosis is technically more challenging due to the small vessel size.
3. The kidney cannot usually be placed retroperitoneally in the pelvis due to inadequate space.
4. Fluid balance, particularly during initial perfusion of the kidney is more critical than in the adult due to the smaller intra-vascular volume and limited cardiac output in the small child.
5. Small children pose more difficult anaesthetic problems.
6. Post-operative care is more demanding than in adults.
7. Biopsy of the graft can be more hazardous due to the intra-peritoneal position of the graft.
8. Immunosuppression in children may lead to a greater incidence of malignancy.
9. Post-transplant hypertension is common.

5.1.1. *Disparity in size between the donor kidney and the recipient.* It is possible to transplant an adult kidney into a baby less than one year old. The kidney must be placed intraperitoneally and because the baby's iliac

vessels are of small calibre it is necessary to anastomose the graft vessels onto the aorta and vena cava. The anastomosis of the ureter to the bladder is not usually a problem and the same technique is employed as in adults.

Conversely a donor paediatric kidney 18 months old can be transplanted into an adult subject to the surgeon's ability to anastomose the small graft vessels satisfactorily. It is generally thought that a kidney from a paediatric donor older than 1.5 years can provide adequate function for an adult recipient. Kidneys from donors less than one year old should probably not be used routinely in adults due to the technical problems of vascular anastomosis.

5.1.2. *Vascular anastomosis.* When an adult kidney is transplanted into a child vascular anastomoses do not pose any technical difficulties, provided the graft vessels are anastomosed onto suitable sized recipient vessels such as the common iliacs, aorta or vena cava. However, it is good practice to use interrupted sutures rather than continuous so that the anastomosis can grow with the child.

When a paediatric kidney is transplanted into an adult the vascular anastomoses are usually straightforward provided that patches of aorta and vena cava are present on the donor vessels. If there are no patches difficulties can be encountered due to the small size of the donor vessels and artheroma in the recipient vessels. When a paediatric donor kidney becomes available for use in an adult it is important to transplant it into a relatively young adult to minimise the technical problems.

5.1.3. *Placement of the kidney.* In children the pelvis is shallow and underdeveloped. This means that generally, even in older children there is insufficient space to place the graft in the usual retroperitoneal position in the iliac fossa. This can result in compression and kinking of the vessels especially the vein resulting in graft thrombosis. The loss of some kidneys in children in Belfast was thought to be due to this cause. It is therefore advisable to place the kidneys intraperitoneally to avoid this risk.

5.1.4. *Fluid balance.* In babies and very young children where it is necessary to anastomose the graft vessels to the aorta and vena cava, it is usually necessary to cross clamp the abdominal aorta during the anastomosis. When the kidney is perfused metabolites from the ischaemic lower limbs are released into the circulation causing vaso-dilatation and relative hypovolaemia. In addition an adult kidney when reperfused will take up 250 mls of blood which in a baby represents a significant proportion of the blood volume. These two factors can cause significant hypotension and fall in cardiac output on reperfusion of the kidney. This can be counteracted by ensuring that there is adequate fluid replacement as judged by the central venous pressure before the kidney is perfused. If this is neglected the kidney may initially perfuse but the perfusion may not be maintained therefore placing the graft at risk of thrombosis.

5.1.5. *Anaesthetic problems.* Babies and small children pose significant anaesthetic difficulties which are discussed elsewhere.

5.1.6. *Post-operative care.* Babies and small children should be nursed in a paediatric intensive care unit to facilitate the monitoring of central venous pressure, arterial pressure etc. In general, while it may seem appropriate to perform the surgery in an adult transplant unit, there can be difficulties in the post-operative management of babies and small children mainly because the staff in an adult transplant unit do not have the requisite experience in managing paediatric cases. In Belfast, transplants under five years of age are performed in the Royal Belfast Hospital for Sick Children where adequate post-operative care facilities are available.

5.1.7. *Biopsy of the graft kidney.* When grafts are placed intraperitoneally, loops of bowel may lie anteriorly and may pose a problem when needle biopsies are performed. In general we have not found a problem in practice and would not regard intraperitoneal placement as a contraindication to routine biopsy when indicated. It has been said that grafts placed intraperitoneally may have a high incidence of ureteric complications due to the inability of the ureter to pick up a collateral blood supply from the peritoneum and some surgeons tunnel the ureter behind the peritoneum before implanting it into the bladder. As the ureter usually has an adequate blood supply from the blood supply to the kidney, this seems no more than a theoretical point. In Belfast we do not tunnel the ureter behind the peritoneum in intraperitoneal grafts and have not encountered an undue incidence of ureteric problems.

5.1.8. *Immunosuppression in children.* In children with kidney transplants receiving immunosuppression there have been a few cases of malignant lymphomas. This is of course worrying, but further experience and long-term follow up will be required before this can be evaluated.

5.1.9. *Post-transplant hypertension.* Hypertension in the immediate post-transplant period is common in paediatric recipients. The mechanism causing this is at present unclear. It would be tempting to believe that an adult kidney transplanted into a small child may suffer from relative ischaemia due to under perfusion. However, graft renal vein renin sampling has not shown this to be the case and at present the cause is undefined. In most patients hypertension is transient and responds to the new anti-hypertensives such as nifedipine.

Further

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1988.
Bishop, M
Hendry

Further reading

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