

90 Pancreas transplantation

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BACKGROUND AND INDICATIONS History

BACKGROUND AND INDICATIONS History

Kelly , Lillehei and colleagues performed the first successful pancreas transplant in a human at the University of William D Kelly , 1922–2006, led the surgical team at University of Minnesota, Minneapolis, MN, USA, that performed the first pancreas transplant. Clarence W Lillehei , 1918–1999, part of the surgical team at University of Minnesota, Minneapolis, MN, USA, that performed the first pancreas transplant, subsequently went on to pioneer open heart surgery . Minnesota, USA, in 1966. Initial results were poor, with high mortality associated with sepsis, rejection and other complications, but over the subsequent 30 years there was a steady increase in the numbers of pancreas transplants and an improvement in outcomes. Important factors in this improvement were changes in surgical techniques and the introduction of the immunosuppressive agent ciclosporin in the mid-1980s: this reduced both the need for steroids and the - incidence of rejection. By 1996 patient survival and pancreas graft survival were 91% and 72% at 1 year and 84% and 62% at 3 years, respectively . The introduction of tacrolimus and mycophenolate mofetil as maintenance immunosuppression and the use of T-cell-depleting agents such as rabbit antithymocyte globulin (ATG) and alemtuzumab in the 1990s and 2000s resulted in further reductions in cellular rejection rates and improved graft survival. Continued refinement of surgical technique, organ preservation and postoperative care have led to steady improvements in outcomes of all types of pancreas transplant.

The common surgical and long-term complications of • solid organ pancreas transplant and their principles of management To appreciate: The principles of pancreas retrieval and preservation •

Complications

Complications

Major abdominal surgery carries a number of general risks which are well detailed elsewhere; for the sake of brevity, they will not be discussed here. Pancreas transplant patients are Frederic Eugene Basil Foley, 1891–1966, urologist, Ancker Hospital, St Paul, MN, USA. and to ensure that they are suitable for major surgery. Despite this, longstanding diabetes means that complications are common and potentially serious. Intraoperative complications such as bleeding following reperfusion can lead to the need for blood transfusion and inotropic support. Up to one in three patients require further surgery postoperatively. This may be due to reperfusion pancreatitis or bleeding. Reperfusion pancreatitis (a manifestation of ischaemia-reperfusion-related injury) can result in an amylase-rich transudate around the pancreas and in the abdominal cavity. Drainage may be necessary to aid recovery: in patients with an ongoing inflammatory state clinicians have a low threshold to return to the operating theatre for washout and debridement of peripancreatic necrosis. Thrombosis affects up to 8% of patients and this may result in early graft loss or β -cell dysfunction. Anastomotic leaks, particularly from the duodenum, are rare but difficult to manage; they can be controlled with direct drainage, such as a Foley catheter within the duodenum. However, such complications may necessitate surgical revision or, in extreme cases, graft pancreatectomy. Bladder-drained pancreases can cause cystitis from pancreatic enzyme secretion and electrolyte disturbance, acidosis and dehydration from the loss of bicarbonate. Up to 50% of patients with bladder-drained pancreas transplants require enteric conversion (where the transplant duodenum is surgically detached from the bladder and reconnected to the small bowel) within the first year following transplant. This usually follows recurrent hospital admissions for acidosis and is performed to mitigate the risk of acute kidney injury. Also, the indication for conversion may be driven by patient choice because of symptoms from chemical cystitis, urinary tract infection (UTI) and the need for high-dose oral sodium bicarbonate. Late complications of pancreas transplantation include pseudoaneurysm formation, which may result from fungal infection or a vascular anastomosis, and highlights the importance of culturing the preservation fluid at the time of transplant and treating any cultured microorganisms. A full list of complications following pancreas transplantation is given in Table 90.1

Enteric conversion

Enteric conversion

Bladder drainage of the exocrine secretions is associated with complications that may require conversion to enteric drain - age. Enteric conversion is performed in patients to eliminate these complications of bladder drainage (see Postoperative management, Complications). It is usually delayed until 1 year post transplant but can be performed sooner if indicated. A lower midline laparotomy is performed and the urinary bladder is filled and the transplant duodenum is identified. The transplant duodenum is disconnected from the bladder and the bladder is closed in two layers. An adjacent section of small bowel is identified and a longitudinal enterotomy is performed on the antimesenteric border; the anastomosis to the duodenum is completed in two layers. Surgical drains are - placed adjacent to the anastomoses and a urinary catheter is usually kept in place for 14 days.

IVC Aorta Pancreas (b) Portal vein Y graft External iliac artery External iliac vein Duodenum Donor duodenum Pancreas transplant Common iliac artery (c) (c) Roux loop Donor portal vein Donor duodenum SMA Splenic artery Splenic vein Figure 90.3 Illustration of the organ positions in a simultaneous kidney-pancreas transplant and the options for management of the exocrine secretions. (a) Transplanted pancreas positioned head-down with the duodenum anastomosed to the urinary bladder. positioned head-up with the duodenum anastomosed to the jejunum. construction. IVC, inferior vena cava; SMA, superior mesenteric artery; SMV, superior mesenteric vein. (b) Kidney IVC SMV Recipient jejunum Donor portal vein Aorta Kidney Graft kidney (b) Transplanted pancreas (c) The donor duodenum anastomosed to the Roux limb of the Roux-en-Y

Surgical techniques /uni25CF /uni25CF /uni25CF

Careful inspection and preparation of the pancreas is essential and involves the construction of a Y-graft between donor iliac vessels and the SA and SMA to aid arterial anastomosis The pancreas is usually transplanted intraperitoneally with the PV anastomosed to the IVC and the Y-graft anastomosed to the CIA Drainage of enteric secretions is performed by anastomosis to the bowel, although bladder drainage can also be performed

FURTHER READING

FURTHER READING

Al-Qaoud TM, Kaufman DB, Odorico JS, Friend PJ. Pancreas and kidney transplantation for diabetic nephropathy . In: Knechtle SJ, Marson LP , Morris PJ (eds). *Kidney transplantation, principles and practice* , 8th edn. Philadelphia, PA; Elsevier, 2020: 608-32. Dean PG, Kukla A, Stegall MD, Kudva YC. Pancreas transplantation. *BMJ* 2017; 357 : j1321. White SA, Shaw JA, Sutherland DE. Pancreas transplantation. *Lancet* 2009; 373 (9677): 1808-17.

FUTURE WORK

FUTURE WORK

The major limiting factor in pancreas transplantation is greater morbidity compared with kidney transplantation alone. This is largely a function of the immediate reperfusion pancreatitis that is a common sequel to implantation. A second limitation is the very poor utilisation of donor organs: in the UK, only 25% of organs that are offered are actually transplanted. The risk profile of the organ donor population is increasing (largely because of age) and this increases the need to develop a means of preservation and organ assessment that gives clinicians the confidence that organs are suitable for transplant. Machine perfusion, has been successful in other organs, but there has been no such advance in pancreas transplantation – this is largely a function of the relatively small numbers of patients undergoing this procedure. New methods of graft surveillance to detect rejection or other complications at a much earlier stage are also needed. International collaboration and multicentre clinical trials are needed to advance practice. If it were possible to reduce the morbidity and improve the survival of pancreas transplants to the same level as kidney transplants, the indications for this procedure would expand, possibly allowing patients to benefit before developing kidney failure. Our sincere thanks to Mr James Gilbert for supplying the photographic images.

IMMUNOSUPPRESSION AND FOLLOW-UP Long-term monitoring

IMMUNOSUPPRESSION AND FOLLOW-UP Long-term monitoring

Blood glucose monitoring is reassuring for the patient but, once glucose levels are raised as a result of graft rejection, it is usually too late to reverse. Haemoglobin A1c (HbA1c) levels are an independent predictor of long-term graft function and oral glucose tolerance testing can also be used to assess organ dysfunction and aid management. Fasting C-peptide and insulin levels can also give an idea of pancreatic function. Cellular rejection is difficult to diagnose owing to the absence of a biomarker: in patients who have undergone SPK, serum creatinine can be used as a surrogate marker and renal biopsy performed, although discordant rejection of kidney and pancreas is a well-recognised event. However, if the pancreas rejects but not the kidney, the diagnosis is much more difficult and relies on cross-sectional imaging (to exclude vascular complications) and a high level of clinical suspicion. In PTA, the exocrine secretions can be managed by anastomosis with the urinary bladder, which means that urinary amylase can be measured sequentially and used as a biomarker of pancreatic function and a surrogate for rejection. A reduction in levels of urinary amylase may indicate rejection. Cystoscopic duodenal biopsy can be performed but the histology is often difficult to interpret and the presence of lymphocytes may not necessarily indicate rejection. Computed tomography angiography may show peripancreatic inflammation, which would be consistent with rejection and be an indication for rescue therapy.

transplantation. Generic Enteric drainage Bladder drainage complications Bleeding Anastomotic Loss of sodium leak bicarbonate Reperfusion and acidosis/ pancreatitis Stoma formation extracellular Thrombosis Exacerbation of volume depletion gastropathy and Paralytic ileus malnutrition Rejection Chemical cystitis Infection – e.g. Urethritis CMV, candida Bladder leak Retinal Re /f_ l ux pancreatitis haemorrhage Recurrent UTIs and worsening Bladder stones of vision Urethral strictures Limb ischaemia Urethral irritation Epididymitis Prostatitis and prostatic abscess CMV, cytomegalovirus. a Linked to duration of transplant. b Documented complications but very rare.

Immunosuppression

Immunosuppression

Immunosuppression is split into induction (immediate post transplant) and maintenance (long term) therapy. Induction therapies include non-depleting antilymphocyte antibodies that cause T-cell inactivation, such as basiliximab, which blocks the interleukin-2 receptor and inhibits T-cell expansion. T-cell-depleting antibodies have largely replaced non-depleting therapies as a more effective way of suppressing lymphocytes. These include polyclonal ATG and the monoclonal antibody alemtuzumab (Sanofi). The use of T-cell-depleting antibody therapy has reduced rejection levels but without a corresponding effect on graft or patient survival. Alemtuzumab is easier to administer and is associated with lower rates of viral infection than ATG, so is preferred by some transplant units. Maintenance immunosuppression has evolved from triple therapy with ciclosporin, azathioprine and steroid to current practice with tacrolimus and mycophenolate mofetil. Steroid-free regimes are aimed at minimising insulin resistance and wound infection and are favoured by some centres. Comparison of ciclosporin with tacrolimus in combination with mycophenolate mofetil (MMF) and steroid, plus induction with ATG, in the EUROSPK 001 trial showed a reduction in the rates of severe rejection, with lower rates of pancreas graft loss at 3 years in the tacrolimus combination group. Summary box 90.4 Immunosuppression and follow-up

Pancreas rejection is challenging to diagnose and once glucose levels rise it is usually too late to reverse. Outcomes from SPK and LD kidney transplant are similar and both options offer a survival advantage compared with deceased donor transplant. Induction therapy with lymphocyte-depleting antibodies (alemtuzumab, ATG) has reduced rejection rates without changing graft and patient survival.

Indications

Indications

The indications for pancreas transplant can be split into those for patients with concomitant renal failure and those without. SPK is the most frequently performed procedure for patients with type 1 diabetes and renal failure due to diabetic nephropathy. There is a small population of patients with type 1 diabetes with renal failure due to primary renal disease or non-diabetic causes and they are also included in this group. The organs are almost exclusively from the same deceased donor, although there are rare examples of organs from living donors (LDs); however, LD pancreas transplantation has not been widely accepted and carries significant risk to the donor. In patients with type 1 diabetes and the option of an LD kidney the possibilities are to undergo an LD kidney transplantation followed by either a PAK or an SPK. The decision is not clear-cut: although pancreas graft survival was historically superior in SPK, PAK results have improved over recent years and the outcomes of the two procedures are now similar. If the patient presents late and has already accrued time on dialysis, the high morbidity and mortality associated with dialysis (30% mortality at 5 years) renders LD kidney transplantation followed by PAK somewhat more desirable. The policy regarding SPK or LD kidney transplantation followed by PAK is dependent on many factors, particularly the expected waiting time for an SPK. SPK indications as defined by the NHS Blood and Transplant Pancreatic Advisory Group (NHSBT PAG) Paul Langerhans, 1847–1888, German pathologist, physiologist and biologist credited with the discovery of the 'islets of Langerhans', the cells that secrete insulin in the pancreas. dialysis or dialysis predicted within 6 months (glomerular filtration rate [GFR] <20 mL/min). Patients with type 1 diabetes without renal failure but with life-threatening hypoglycaemic unawareness are potential candidates of solid organ PTA or islet transplantation. The annual mortality rate of patients with insulin-induced hypoglycaemic unawareness is estimated to be between 3% and 6% – a major risk for this group of typically young patients. In patients with early diabetic nephropathy the risk of repeated acute kidney injury (AKI) needs to be considered prior to PTA to minimise the chance of accelerating renal failure, and a baseline GFR of 20–100 mL/min/1.73m² means the patient is unlikely to need a kidney transplant. Patients with type 2 diabetes can also be considered for SPK, although after careful selection: many obese patients with type 2 diabetes are better managed with diet and/or bariatric surgery. Suitable candidates are non-morbidly obese patients, typically with insulin requirements of less than 1 unit/kg body weight in 24 hours (to exclude patients with insulin resistance). When selected in this way, the results of SPK in these patients are similar to those in patients with type 1 diabetes.

Introduction

INTRODUCTION

Current World Health Organization estimates are that about 9% of the global population have diabetes. This translates to over 600 /uni00A0 000 /uni00A0 000 people living with diabetes, with a significant proportion of these patients requiring insulin: approximately 10% of this population has type 1 diabetes. The aims of pancreas transplantation are to restore normoglycaemia, with freedom from insulin therapy , and to limit the progression of complications associated with diabetes. Pancreas transplantation is most commonly (but not exclusively) performed in individuals with type 1 diabetes with end-stage renal disease. In certain diabetic patients without renal insufficiency , pancreas transplantation alone can be performed to avert life-threatening complications of hypoglycaemia and to prevent the progression of diabetic complications. Unlike cardiac, lung and liver transplant, pancreas transplantation is not an immediately life-saving procedure, although it significantly improves not only quality of life but also life expectancy . Despite successful outcomes in the majority of patients following transplant, particularly for combined kidney-pancreas transplant, there is significant morbidity and mortality associated with the procedure. These factors, including the complications of long-term immunosuppression, must be carefully weighed against any potential benefit prior to patient listing. Current data indicate that more than 42 /uni00A0 000 pancreas transplants have been performed world wide, with the majority having been in the USA.

Learning objectives

Learning objectives

To understand: The indications and patient selection for solid organ & pancreas transplant The different types of pancreas transplant and the & respective surgical techniques The principles of immunosuppression &

ORGAN DONATION AND PRESERVATION

Organ retrieval

ORGAN DONATION AND PRESERVATION Organ retrieval

Pancreas organ retrieval is standardised in the UK and is carried out by dedicated abdominal organ retrieval teams. Donation after brain death (DBD) donors constitute 75% of all pancreas donors with donation after circulatory death (DCD) donors making up 25%. The pancreas can be retrieved either alone or en bloc with the liver. If the liver and pancreas are retrieved en bloc the retrieval surgeon separates the organs, ensuring that there is 10 mm of PV and an adequate length of splenic artery (SA) and superior mesenteric artery (SMA) for reconstruction. The bifurcation of the iliac vessels is sent with the pancreas to facilitate a vascular Y-graft construction (Figure 90.1), creating a single arterial inflow . Only around 50% of pancreases that are retrieved with the intention of transplantation are actually transplanted; this is a much higher discard rate than occurs in Folkert O Belzer , 1930–1995, pioneering transplant surgeon who was Chairman of the Department of Surgery , University of Wisconsin, USA, along with Jan Wahlberg (Uppsala, Sweden) and Rutger Ploeg (Leiden, the Netherlands) developed University of Wisconsin solution. James H Southard , contemporary , Emeritus Professor, Department of Surgery , University of Wisconsin, USA, co-inventor of the University of Wisconsin solution with Belzer. condition of the pancreas is frequently suboptimal owing to fatty infiltration or fibrosis, features that are associated with a poorer outcome. Also, injury to the pancreas during retrieval is much more common than in other organs: it is easily damaged and the consequences of even a relatively minor parenchymal injury can be severe, with postoperative leakage of exocrine secretions. Acceptance criteria for pancreases varies between centres and is usually related to donor age, BMI, alcohol intake and lifestyle factors. Other adverse donor and retrieval features that impact acceptance rates include: a prolonged agonal phase in DCD donors, evidence of hepatic or pancreatic ischaemic injury (raised transaminases, amylase and lipase) and complex vascular anatomy .

Internal iliac artery Portal vein anastomosis with Ligated bile duct splenic artery Common iliac artery External iliac anastomosis section of Y-graft with SMA Figure 90.1 The inferior border of the donor pancreas prepared for implantation demonstrating a completed vascular reconstruction. The surgical forceps are holding the cut end of the donor common iliac artery and the completed anastomoses between the donor external iliac artery and the superior mesenteric artery (SMA) and the donor interior iliac artery with the splenic artery are demonstrated (blue vascular suture).

Organ preservation

Organ preservation

Static cold storage (SCS) has remained the gold standard preservation method for the pancreas graft since the first transplantation was performed in 1966. SCS is the most common preservation method for organs after retrieval because of its simplicity, relative effectiveness for many organs and low cost. Hypothermic preservation is based on the principle that cooling an organ reduces the metabolic rate and the demand for adenosine triphosphate (ATP). The pancreas is extremely sensitive to both warm and cold ischaemia, which has a significant impact on preservation. Once retrieved from the donor, the pancreas is inspected for any damage and for adequacy of perfusion and then submerged in preservation solution within an organ bag and placed in an icebox for transport to the transplant centre. Unlike other organs the pancreas is not flushed following retrieval in order to minimise endothelial damage and (supposedly) to reduce the risk of early graft pancreatitis and thrombosis. Early pancreas transplants suffered from a significant thrombosis rate of up to 25%. For this reason, in 1986 Belzer and Southard set out to redefine the needs of pancreas preservation by developing a new preservation solution. This new solution – University of Wisconsin (UW) solution – was first successfully applied in experimental pancreas transplantation; this study was published by Wahlberg, who was a member of the Wisconsin group. The colloid constituent, hydroxyethyl starch (HES), was particularly important in the pancreas, especially in suboptimal organs and those with longer cold ischaemia times. Translation to clinical use of the UW solution led to a significant improvement in the results of pancreas transplantation and a marked reduction in pancreatitis and thrombosis of the grafts. There have been studies in experimental pancreas preservation using hypothermic machine perfusion; in these studies the organ is continuously pumped with a cooled solution, but this has yet to translate into clinical practice, although recent results are promising. Normothermic machine perfusion of pancreases has been performed on animal and discarded human organs but led to organ injury, possibly because of - Normothermic regional perfusion is a technique in which, following cessation of circulation in a DCD organ donor, the donor blood is warmed, oxygenated and then pumped back around the abdominal organs. This appears to be beneficial in the context of the liver, but has yet to show convincing data in pancreas transplantation – the numbers studied are small and the technique is still in its infancy. Summary box 90.2 Organ donation and preservation /uni25CF /uni25CF /uni25CF

The majority of pancreas transplants (75%) are from DBD donors The pancreas is the most frequently damaged organ during retrieval, which can impact on clinical outcomes SCS remains the gold standard of preservation, although research into machine perfusion is gaining momentum

Outcomes

Outcomes

There are no randomised controlled trials that compare the outcome of SPK transplantation with kidney transplantation alone, so best practice has mostly been determined from registry analyses and single-centre experiences. The major limitation of comparing SPK with deceased donor kidney transplantation is the inherent selection bias that patients who are suitable for SPK are fit enough to undergo major abdominal surgery and those undergoing deceased donor kidney transplant may not be. However, registry analyses show a clear survival benefit of SPK compared with deceased donor transplant. Adjusted 10-year patient survival rates were 67% for SPK recipients, 65% for LD kidney recipients and 46% for deceased donor kidney recipients. In the UK, 1- and 5-year pancreas graft survival for patients undergoing their first SPK is 90% and 81%, respectively. Patient survival is 98% and 89% at 1 and 5 years, respectively. PTA has the poorest long-term survival because of high rates of early thrombosis and cellular rejection but provides exogenous insulin production to treat the the outcomes are still inferior with 1- and 5-year pancreas graft survival of 82% and 54%, respectively. In the USA, the data are similar with 5-year pancreas graft survival currently 73% for SPK, 65% for PAK and 53% for PTA; 5-year patient survival rates are 93% for SPK, 91% for PAK and 78% for PTA recipients, respectively.

POSTOPERATIVE MANAGEMENT

Anticoagulation

POSTOPERATIVE MANAGEMENT Anticoagulation

To minimise the risk of graft thrombosis in the early post operative period anticoagulation is indicated for all patients. Every centre has its specific protocol: the exact details are less important than the balance between adequate anticoagulation to minimise thrombosis and over-anticoagulation leading to bleeding and the need for further surgery . Intravenous unfractionated heparin, dextran or epoprostenol are examples of preparations used; monitoring of their effect can be achieved by measuring prothrombin time (PT) and/or thromboelastography (TEG). TEG is a real-time bedside test that gives a numerical value for overall coagulation. The heparin dose or infusion rate of therapy can be amended according to the TEG or PT results. TEG has an advantage over PT as the result is immediate and analysis incorporates the entire clotting cascade and platelet function. Patients usually require 24–48 hours of high-dependency care (high-dependency unit or intensive care unit) and close blood glucose monitoring is essential. Insulin secreted by the transplant pancreas drains directly into the IVC and straight into the systemic circulation without passing through the liver, thereby avoiding first-pass metabolism. This is unlike normal physiology where insulin drains via the portal vein through the liver. As a result of high systemic insulin levels the patient may require intravenous glucose supplementation to maintain blood glucose levels. This phenomenon usually accommodates within 48 hours. If blood glucose levels rise above 8 mmol/L, then cross-sectional imaging with arterial phase contrast is usually performed to assess for thrombosis. The presence of a small volume of thrombus in the distal ligated end of the SMA is considered normal. However, thrombus propagating from the stump into the SMA, SA thrombus or PV thrombus should be treated with full anticoagulation. The indication for surgery is limited to complete thrombosis of the arterial inflow or PV; thrombectomy usually fails, resulting in graft pancreatectomy .

Patient selection

Patient selection

Once the indication for pancreas transplantation is satisfied the patient needs a comprehensive assessment of cardio - vascular and surgical fitness. An anaesthetic review , echo - cardiogram and assessment of inducible cardiac ischaemia using dynamic imaging such as a myocardial perfusion scan or stress echocardiogram should be performed. If cardiac assessment demonstrates occult ischaemic heart disease (IHD) then angiography and revascularisation via angioplasty or bypass surgery may be needed prior to wait-listing. Patients with diabetic nephropathy usually have other manifestations of secondary diabetic complications, including sensory neuropathy , retinopathy , gastropathy , peripheral vascular disease, foot ulcers and autonomic neuropathy leading to postural hypotension. These complications should be sought and discussed prior to listing as they can have an impact on whether a pancreas transplant is appropriate and - may alter the surgical strategy . For example, the significant anticoagulation required post transplant can lead to retinal haemorrhage; in a patient with severe retinopathy , this can lead to a deterioration in vision and even blindness. Patients with severe gastropathy may require a feeding jejunostomy at the time of transplant surgery , as gastropathy and bowel dysfunction are frequently exacerbated by surgery , which can - lead to vomiting, difficulties absorbing immunosuppressants and malnutrition. The overall risks of this major surgery - and immunosuppression in a patient with advanced diabetic complications have to be balanced with the likely benefits in severely overweight patients: most transplant centres have a 2 body mass index (BMI) cut-off (e.g. $<32 \text{ kg/m}^2$). Types of transplant and patient selection

There are three main types of solid organ pancreas transplant: SPK; PTA; PAK The most common indication for pancreas transplant is type 1 diabetes with diabetic nephropathy Hypoglycaemic unawareness and life-limiting complications from insulin therapy are indications for pancreas transplant alone A comprehensive preoperative assessment of surgical fitness and occult cardiac disease is essential prior to wait-listing

SURGICAL TECHNIQUES

Preparation for transplant

SURGICAL TECHNIQUES Preparation for transplant

Once the organ has been inspected and is deemed suitable for transplant it needs to be prepared for implantation. This is a crucial step and meticulous attention to detail and a systematic approach are vital to minimise bleeding and complications after reperfusion. The pancreas is retrieved with the spleen attached, a length of duodenum and the cut ends of the SMA, SA and PV (Figure 90.2). The splenic vessels are ligated and the spleen removed; the duodenum is shortened, stapled and the staple lines buried with a suture. Excess fat and omentum are removed, and the cut end of the inferior mesenteric vein ligated. An arterial Y-graft™ is usually fashioned between the SMA and SA of the pancreas using donor iliac vessels, so that the end of the common iliac artery (CIA) can be used for a single arterial anastomosis (Figure 90.1).

Transplantation procedure

Transplantation procedure

Pancreas transplant can be performed as an intraperitoneal or extraperitoneal procedure and the exocrine drainage of the pancreas can be managed by connection to the small intestine or urinary bladder (Figure 90.3). The majority of surgeons favour an intraperitoneal approach as the peritoneal cavity has an excellent capacity for containing and reabsorbing fluid generated as a result of reperfusion pancreatitis. The steps of the surgical procedure are as follows. A midline laparotomy is performed and the retroperitoneum is exposed. The inferior vena cava (IVC) and CIA are dissected and controlled. In the enteric drainage procedure (donor duodenum anastomosed to recipient jejunum) the organ is positioned with the head of the pancreas towards the liver and the tail towards the pelvis. However, for bladder drainage (donor duodenum anastomosed to recipient urinary bladder) the organ is positioned with the head facing towards the pelvis and tail towards the liver. A side-biting vascular clamp is used to partially occlude the IVC and the PV is anastomosed end to side to the IVC. Whether performing a single arterial anastomosis or separate SMA and SA anastomoses, the right CIA is most frequently used. Heparin is administered prior to clamping the CIA and the arterial anastomosis is performed. The organ is reperfused and haemostasis is ensured before performing the duodenal anastomosis (this renders the organ less mobile and more difficult to access). For enteric drainage, the jejunum is identified as close as convenient to the duodenojejunal flexure and anastomosed side to side to the duodenum in two layers. This can be performed by passing the duodenum through a window in the colonic mesentery, using a Roux-en-Y technique or with the two sections of bowel lying adjacent underneath the colon (Figure 90.3). The Roux-en-Y technique creates a blind-ending loop of bowel; if severe complications develop and the pancreas needs to be removed, then separation from the main enteric flow is straightforward and the need for a defunctioning stoma is avoided. In the bladder drainage technique, the anastomosis to the bladder is also performed in two layers and a urinary catheter is kept in place for 7-10 days to reduce the chance of anastomotic leak.

Duodenum Spleen splenic artery and vein Figure 90.2 A healthy donor pancreas prior to preparation for surgical implantation. The pancreas is lying in its anatomical position with the head of the pancreas beneath omental fat encircled by the duodenum and the tail within the hilum of the spleen.

Types of solid organ pancreas

Types of solid organ pancreas

-

transplant

transplant

1 Simultaneous pancreas-kidney transplant (SPK) . Both organs come from the same deceased donor. - This is the commonest type of pancreas transplant and is indicated in patients with chronic renal failure (on or close to requiring dialysis) secondary to diabetes. 2 Pancreas transplant alone (PTA) . Primarily for patients with type 1 diabetes who have repeated episodes of hypoglycaemia associated with unawareness (i.e. patients develop hypoglycaemic coma without warning). This is a life-threatening situation and such patients are unemployed. 3 Pancreas-after-kidney transplant (PAK) Deceased donor pancreas transplantation is performed after a previous kidney transplant, from either a living or deceased donor. 4 Simultaneous deceased donor pancreas and live donor kidney transplant . This option may shorten waiting times but is logistically very challenging and rarely performed. Transplantation of the islets of Langerhans (islet cell transplant) is an alternative to pancreas transplant alone for patients with hypoglycaemic unawareness. This is not a solid organ transplant and therefore not detailed in this chapter, but a brief description follows. After pancreas retrieval, islets are isolated, prepared and delivered into the portal vein (PV) of the recipient, usually via a percutaneous transhepatic radio logically guided procedure. Early results demonstrated that the presence of functioning islets appeared to protect against refractory hypoglycaemia and improve glycaemic control with a low incidence of insulin independence. However, success rates have improved in the last decade with some series showing 50% of patients remaining insulin independent at 5 years. Immunosuppression is required for islet transplantation and the associated long-term risks need to be balanced with the treatment benefits.