Surgical Aspects of Kidney and Pancreas Transplant

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Kidney transplantation

- Indications
  - ESRD or advancing CKD with GFR less than 20 mL/min
  - Projected survival of > 5 years irrespective of kidney disease
Contraindications to Kidney Transplant

- Active or recent malignancy
- Reversible renal disease
- Severe irreversible extra-renal disease
- Severe functional disability with limited rehabilitation potential
- Active or recent untreated infection
- Unmodifiable nonadherence to treatment
- Psychiatric illness: not remitting with treatment and could affect consent and/or adherence
Referral for renal transplant evaluation

No

Prior substance abuse?

Yes

Drug screens

No

Morbid obesity

Yes

Weight loss

No

Compliance issues?

Yes

Contract

No

High risk for heart disease?

Yes

Evaluate

Low risk

OK?

Yes

No

*Problem list
*Medication list
*Medical history
Immunization history
*Physical exam
Stool occult blood
Pap smear (women)
Chest x-ray
Tuberculin test

*EKG
*Abdominal ultrasound
CBC
*Chem screen
INR, APTT
Infectious serologies
*PSA (men ≥40)
*Urine analysis ± culture

Mammogram (women ≥40 years)
Eye exam (≥50 diabetics)
Dental exam
Social service consult
Dietary consult
Patient and family education
Financial counseling
Histocompatibility testing

*Special studies and specialty consults as indicated

*Active infection?
*Active malignancy?
High probability of perioperative mortality?
*Unsuitable conditions for technical success?
Noncompliance?

No

Yes

Corrected

Acceptable for transplantation

Unacceptable for transplantation
Pre-transplant evaluation

- **History**
  - Cause of renal disease and pre-ESRD treatment
    - Steroids, cytotoxics, immunosuppression
  - Dialysis
    - Duration, modality, access
  - Previous transplants
    - If yes- Induction, complications, compliance, rejection
  - Sensitization
    - Pregnancies, blood transfusions, previous transplants
  - Complete medical history
  - Travel history
    - Exposures to infections, pets/animals
  - Previous surgeries
    - Previous urologic history
Pre-transplant evaluation

- **History**
  - Medications
    - Anticoagulants, potential interactions with immunosuppressants
  - Allergies
  - Functional status
    - Occupation, exercise tolerance, hobbies
  - Social
    - Smoking, alcohol, drugs, social support
  - Family medical history
    - ESRD, malignancies, CAD
Pre-transplant evaluation

- Physical examination
  - BMI
    - > 40 morbidly obese (Can consider pre-operative bariatric surgery)
  - Vitals
  - Visual and auditory deficits
    - Evaluate for any physical deficits that can impair ability to take medications
  - Heart: murmurs, evidence of heart failure
  - Lungs: Signs of COPD, fluid overload
Pre-transplant evaluation

- Physical examination
  - Abdomen
    - Hepatomegaly, ascites, hernias, bruits, previous incisions
  - Vascular
    - Peripheral pulses, bruits
  - Neurologic
    - Cognitive deficits, sequela of CVA’s
  - Cutaneous
    - Skin cancers, infections
  - Musculoskeletal
    - Gait, ability to ambulate, strength, fall risk
Pre-transplant evaluation

- **Age and gender appropriate cancer screening**
  - Colonoscopy, mammogram, pap smear, PSA

- **Labs**
  - CBC, coags, chemistries, LFT’s, calcium, phosphorous, PTH
  - UA
  - **Infectious disease panel**
    - CMV, EBV, VZV, Hepatitis B and C, HIV, PPD (TB Gold), RPR
  - **Immunologic profile**
    - ABO, HLA typing, PRA

- **Imaging**
  - CXR, CT of the abdomen and pelvis or abdominal ultrasound, any additional imaging studies based on patient examination or history
Malignancy

- **Recommended wait times**
  - **Renal cell**
    - Incidental: None
    - <5cm: 0-2 years
    - > 5cm: 5 years
  - **Prostate**: 0-2 years
  - **Bladder**: 2 years
  - **Colorectal/Breast/Uterus/Lung**
    - Clinically guided, 2-5 years
  - **Melanoma**: 5 years
Indications for native nephrectomy

- ADPKD
  - Extending into the pelvis prohibitive of transplant
  - Anorexia/nausea and vomiting/weight loss/recurrent infections or hematuria/pain
- Suspicious renal mass
- Obstructing/infected kidney stones
- Recurrent pyelonephritis
- Malignant HTN
- Severe nephrotic syndrome
- Severe vesicoureteral reflux or hydronephrosis
Polycystic kidney disease
Polycystic kidney disease
Transplant operative technique

- Backbench preparation of the donor kidney
  - Identification of Renal vein/artery, multiple vessels
  - Reconstruction of the right renal vein to add length using IVC in the setting of a right deceased donor kidney
  - Dissection of the renal artery and vein towards the hilum for mobilization and increased length
  - Ligation of perforating venous branches with silk ties
  - Identification of the ureter
  - Removal of perinephric fat
Backbench preparation
Backbench preparation
Operative technique
Operative technique

- Gibson (or modified) incision
  - 2cm superior to the pubic symphysis, 2cm medial to the ASIS
  - Retroperitoneal exposure
  - Bookwalter retractor to expose the iliac fossa
  - Dissection of the common/external/internal iliac arteries and vein, depending on the amount of vessel dissection required
  - Vessel loops placed to facilitate clamp placement
Operative technique

- **Vascular anastomosis - Venous**
  - Typically the vein is performed first -unless the internal iliac artery is used for end to end anastomosis
  - Generally anastomosed end to side to the common, external iliac vein, or IVC
    - Side-biting clamp (Satinsky) placed on the vein
    - Venotomy made with an 11 blade
    - Vessel is irrigated with heparinized saline and venotomy is extended with Potts scissors
    - Running or interrupted, permanent suture (most often 5-0 or 6-0 Prolene)
    - Can apply bulldog clamp but not necessary
Operative technique

- **Vascular anastomosis- Arterial**
  - Can be performed end to end to the internal iliac artery, or end to side to the common or external iliac artery
    - Proximal and distal clamps applied or may use side-biting arterial clamp
    - Must avoid areas of calcification for clamp placement to avoid lower extremity embolic events
    - Interrupted or running anastomosis with permanent suture, most commonly 5-0 or 6-0 Prolene
Operative technique

- **Accessory arteries**
  - Upper pole - can ligate if very small, will lose this portion of kidney perfusion, generally a small defect
  - Lower pole - **MUST preserve** as provides blood supply to the ureter

- **Multiple main renal arteries**
  - Can anastomose together on the back table
    - End to side (spatulate smaller artery and anastomose to side of larger artery)
    - Side to side (spatulate both arteries and anastomose together)
  - Can anastomose separately to the iliac
    - Can keep kidney iced through both anastomoses or can reperfuse the kidney and then anastomose a smaller lower artery
  - Can also anastomose lower artery end to end to inferior epigastric artery
Operative technique

- Reperfusion of the kidney
  - Venous clamp removed first, then the arterial
  - Must inspect perfusion of the kidney, evaluate the venous outflow, inspect for bleeding, and confirm distal arterial pulses
  - May use papaverine externally
  - May inject intra-arterial verapamil
Reperfusion
Multiple arteries
Operative technique

- Ensure appropriate and adequate flow to the kidney with no immediate vascular complications

- Ureter is then trimmed and spatulated

- Bladder is filled with solution, may use methylene blue to aid in identification of the bladder (vs peritoneum)
Operative technique

- **Ureteral anastomosis**
  - Can be performed in many ways
  - Single layer onlay (running, interrupted)
  - Tunneled with two layers (mucosal followed by second layer of detrusor to tunnel the ureter)
  - Ureteroureterostomy to native ureter only if necessary

- **Stent vs no stent**
- **Drain vs no drain**
- **Foley left in place for 3-5 days, may require longer duration of foley catheter for more complex anatomy**
Vascular Complications

- Kidney
  - Arterial inflow compromise
    - Malpositioning, improper technique, accidental narrowing with anastomosis, inadvertent ligation of multiple vessels
  - Venous outflow compromise
    - Narrowing at the level of the anastomosis, malpositioning of the anastomoses or the kidney → renal vein thrombosis

- Recipient
  - LE compromise from embolic event
    - Clamping calcified artery
  - LE compromise from dissection
    - Clamping calcified artery, dissection at the time of opening the vessel, not including all layers of the arterial wall in the anastomosis
  - Bleeding
  - DVT related to the venous anastomosis
Renal vein thrombosis
Pancreas Transplantation
Indications

- DM I
- Very rarely DM II (low insulin requirement, low BMI)
- Level of renal function determines type of pancreas transplant
- ESRD main determinant of patient longevity
Indications

- Simultaneous Kidney and Pancreas Transplant (SPK)
  - Approximately 80% of pancreas transplants
  - DM 1 with ESRD or GFR<20
  - Lifelong immunosuppression for the kidney transplant—only adding surgical risk with pancreas
  - Lower immunologic graft loss than Pancreas After Kidney (PAK)
  - Benefit of concordant nature of rejection (60-70% simultaneous)
  - One operation
  - Shorter wait time than kidney alone
    - Median time to transplant for SPK (SRTR 2016) 16.6 months
Indications

- Pancreas After Kidney (PAK)
  - Approximately 12% of pancreas transplants
  - Patients with labile BG control, previous well-functioning kidney transplant
  - Risk of kidney allograft loss as result of pancreas transplant complications (3-5%)
  - Pancreas transplant can be performed ~3 months after kidney
  - Kidney can be placed on the left if planned previously
    - Median wait time for PAK (SRTR 2016) 18.2 months
Indications

- Isolated pancreas
  - Approximately 8% of all pancreas transplants
  - Brittle DM1 without uremia
  - Uncontrolled, hypoglycemic unawareness, DKA, frequent hospitalizations
  - Adds both surgical risk and risk of lifelong immunosuppression
Recipient Evaluation

- No absolute age (majority <50)
- Cardiac assessment critical
- CV disease-majority of waitlist deaths, 30% of recipient deaths
- Significant lesions present in ~1/3 of patients presenting for pancreas evaluation
Recipient Evaluation

- History and Physical
  - Other complications of DM: limb, vision, GI
  - BMI, hypercoaguable state, anticoagulation
  - Evaluation of vasculature +/- imaging

- Cancer screening

- Infectious risk

- Psychosocial-support, substance abuse history, compliance, financial
Donor Evaluation

- Primary:
  - Age
  - BMI
  - Cause of death
  - Appearance at the time of organ procurement

- Other factors:
  - Med/Soc history, hemodynamics and lab values, anticipated preservation time
Donor Evaluation

- Donor age—important determinant of graft survival
  - Age thresholds vary
  - <1 % from donors >50

- Donor BMI
  - Very few >30-35 used
  - Higher rate of graft failure in overweight donors with death from CVA

- Death from CVA
  - Worse graft survival
Donor Evaluation

- DMII, pancreatitis, alcoholism, splenectomy not necessarily contraindications
- Amylase/lipase, insulin administration - minor role
- Abnormal HbA1c - relative contraindication
- Trauma to other intra-abdominal organs
- Social history - risk of transmission of infectious diseases (risk/benefit)
Donor Evaluation

- Intraoperative evaluation-single most important determinant of donor selection
  - Inflammation/fibrosis (firm pancreas) is a contraindication
  - Fatty infiltration
  - Edema
  - Trauma
  - Shorter cold times preferred (>50% of transplants performed in the country with <12 hour CIT)
Inspection performed through the lesser sac

Majority of the dissection performed “in the warm,” using the spleen as a handle to minimize manipulation of the pancreas

Infrarenal, supraceliac aorta controlled for flushing/crossclamping

 +/- portal flush via IMV

Limit aortic flush

Duodenum stapled at the pylorus, then again at the 4th portion or proximal jejunum
Organ Procurement

- CBD, GDA ligated
- Portal vein divided halfway between the pancreas and liver (at least 1cm above pancreatic border)
- Divide splenic artery close to the celiac origin, do not dissect into the pancreas
- Divide SMA at the aorta. If liver is not being procured, leave SMA and celiac on common aortic cuff
- Root of the small bowel mesentery stapled >3cm away from head of the pancreas to avoid injury to inferior pancreaticoduodenal arcade
- Full length of iliac artery (common, internal, external), Iliac vein (in the event of need for portal vein extension)
Organ Procurement
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Organ Procurement
Surgical Techniques

- Exocrine drainage (Donor duodenum)
  - Enteric drainage
    - >80% of all pancreas transplants in the US
    - Donor duodenum anastomosed to recipient jejunum or duodenum
    - More physiologic than bladder drainage
    - Risk of leak
    - Less ability to monitor for rejection
  - Bladder drainage
    - Donor duodenum anastomosed to bladder
    - Allows for better monitoring for rejection
    - No risk of enteric leak/peritonitis
    - Risk of metabolic abnormalities—hyperchloremic metabolic acidosis due to bicarbonate loss in the urine, recurrent UTI, dehydration, cystitis, graft pancreatitis
Surgical Techniques

- Venous drainage (Portal vein)
  - Portal vs systemic
    - >90% of pancreas transplants in the US utilize systemic drainage
    - Peripheral hyperinsulinemia with systemic- minimal clinical adverse effects
    - No difference in risk of technical complications or rejection
    - For systemic drainage, the portal vein is typically anastomosed to iliac veins or IVC
Surgical Techniques

- Arterial supply (SMA, Splenic artery)
  - Most commonly Iliac Y-graft anastomosed end to end on the backtable (External iliac to SMA, Internal Iliac to Splenic)
  - Y-graft typically anastomosed to the right common or external iliac
Surgical Techniques

PANCREAS TRANSPLANT WITH ENTERIC DRAINAGE IN SITU
Surgical Techniques

PANCREAS TRANSPLANT WITH ENTERIC DRAINAGE
Surgical Techniques

PANCREAS TRANSPLANT WITH BLADDER DRAINAGE
Postoperative course

- NPO, NGT
- JP drain x 1 or 2
- Foley, stent for SPK
- Prolonged PACU recovery vs ICU
- Q1 hour accuchecks first 12 hours
- NO insulin (BG is evidence of function)
Postoperative course

- Induction with Simulect or Thymoglobulin
- Maintenance with Prograf, MMF, Prednisone (rapid taper)
- Length of stay typically dependent upon return of bowel function, average 4-7 days
- Length of JP drainage dependent upon presence of leak
- Occasionally require oral hypoglycemics if type II picture
Complications

- Bleeding
- Enteric complications-bowel leak/intra-abdominal sepsis
- Ileus/gastroparesis/SBO
- Pancreatitis
- Thrombosis
Transplant outcomes

- Significant variation in reporting of graft survival (insulin independence vs continued c peptide production)
  - Early reported pancreas graft losses (SRTR)
    - 8.3% PAK, 9.4 % PTA, 8% SPK

- Past decade 1, 5 year graft survival
  - SPK 89%, 71%
  - PAK 86%, 65%
  - PA 84%, 58%

- Estimated half life (50% function)
  - SPK 14 years
  - PAK 7 years
  - PA 7 years

- 5-year patient survival for pancreas transplants 2009-2011 similar between SPK, PAK, PA -82-91%
Benefits

- Stabilization/improvement in complications of DM (retinopathy, neuropathy, nephropathy, CAD)
- Restores normal glucagon response from islet alpha cells and symptom recognition of hypoglycemia
- >50% report significant improvement in quality of life
- Adding a pancreas transplant to a kidney in a diabetic patient improves survival
Survival Benefits

- SPK - Patient survival significantly higher at 10 years post-transplant compared to deceased donor kidney recipients. SPK with greatest longevity.

- PAK - evidence suggests that pancreas transplant improves long-term patient and kidney graft survival rates.