

**Wake Forest School of Medicine
Department of General Surgery**

TRANSPLANT SURGERY RESIDENT CURRICULUM (PGY-3)

OVERVIEW

This curriculum has largely been adapted from the curriculum for transplant surgery residents designed by the American Society of Transplant Surgeons (ASTS). The ASTS curriculum is available as a PDF file on the ASTS website. Modifications of the ASTS curriculum were made to conform to the actual clinical (kidney and kidney pancreas transplantation) and didactic experience available during a 1-2 month clinical rotation on the Abdominal Organ Transplant service at WFSOM.

The modified ASTS curriculum contains discrete units, each containing 4 parts:

1. **Unit Objectives:** Broad summary topics which define key curriculum components
2. **Learner Objectives:** The specific knowledge to be acquired by the resident
3. **Content:** Outlines the study areas necessary to achieve the unit objectives; provides guidance to residents by identifying appropriate learning resources
4. **Clinical Skills:** Describes the clinical activities and technical tasks required of residents rotating on the transplant surgery service.

Numbers 1 and 2 roughly correspond to Medical Knowledge and number 4 to Patient Care of the components of surgical residency education. An additional summary of Patient Care, as well as expectations for Practice Based Learning, Interpersonal and Communication Skills, Professionalism, and Systems-Based Practice follow the unit based ASTS modified curriculum.

UNIT 1

PHARMACOLOGY AND IMMUNOSUPPRESSION

Unit Objectives

- I. Explain the basic pharmacology (mechanisms of action, metabolism, adverse effects, potential interactions, dosing strategies, and target levels) for all immunosuppressive agents in current clinical use.
- II. Outline potential complications and clinical and laboratory markers of over- and under-immunosuppression.
- III. Define the donor and recipient factors which impact the use of immunosuppressive agents including the risk of rejection, infection, and malignancy.
- IV. Identify the clinical and pathologic features of acute and chronic cellular and humoral rejection and implement appropriate pharmacologic therapy; identify short and long term ramifications of rejection episodes.

Learner Objectives

I. Explain the basic pharmacology (mechanisms of action, metabolism, adverse effects, potential interactions, dosing strategies, and target levels) for all immunosuppressive agents in current clinical use.

A. Calcineurin-Inhibitors

1. Explain the mechanism of action of CsA and tacrolimus.
2. What is calcineurin?
3. List commonly used drugs that interfere with CsA/tacrolimus metabolism by acting as substrates, inhibitors, and, inducers of the cytochrome P450 enzyme CYP3A4.
4. List the most common side effects of CsA and tacrolimus?

B. Sirolimus

1. Explain the mechanism of action of this agent.
2. What is mTOR?
3. List the common side effects of this drug.

C. Antiproliferative Agents (mycophenolate mofetil, mycophenolic acid, and azathioprine)

1. Explain the mechanism of action of these agents.
2. What is a prodrug?
3. Describe the side effect profiles for these agents.

D. Monoclonal Antibodies (basiliximab, daclizumab, muromonab CD3)

1. Describe the difference between a depleting vs. non-depleting and a monoclonal vs. a polyclonal antibody preparation.
2. Explain the difference between a chimeric and a humanized monoclonal antibody.
3. Describe the mechanism of action, side effect profile, and appropriate dosing strategies for all 3 antibodies.

E. Polyclonal Antibodies (rabbit ATG, equine ATG)

1. Explain the basic steps in the preparation of xenogenic polyclonal anti-human lymphocyte sera. By what mechanisms do polyclonal antibodies deplete peripheral lymphocytes?

F. Steroids

1. Describe several possible mechanisms of action of prednisone.
2. Discuss the importance of steroids in the treatment of rejection and for maintenance immunotherapy.
3. Compare the advantages and disadvantages of steroid-free immunosuppressive protocols in renal, pancreas, and liver transplantation.
4. Describe the side effect profile and dosing strategy for prednisone.

II. Outline potential complications and clinical and laboratory markers of over- and under-immunosuppression.

A. Opportunistic Infections

1. List typical opportunistic infections associated with transplantation.
2. At what time points post-transplantation are opportunistic infections usually observed?
3. Describe the association between CMV infection, acute rejection, and long-term graft outcomes.

B. Malignancy

1. List the most common malignancies associated with transplantation.
2. At what percent greater risk of malignancy are transplant recipients compared with the general population?
3. Explain the association between EBV infection and PTLD.

III. Define the donor and recipient factors that impact the use of immunosuppressive agents, including the risk of rejection, infection, and malignancy.

A. Acute Rejection

1. Identify recipient groups that would generally be considered at high vs. low risk for acute rejection.
2. Describe induction protocols for management of recipients at high vs. low risk for acute rejection.

B. Infection/Malignancy

3. List the recipient groups at greater risk of infection posttransplantation.
4. List the recipient groups are at greater risk of PTLD.
5. Recommend strategies that could be used to reduce the risk of infection/PTLD for the above noted groups.

IV. Identify the clinical and pathologic features of acute and chronic cellular and antibody-mediated rejection and implement appropriate pharmacologic therapy; identify short and long-term ramifications of rejection episodes.

A. Describe clinical findings associated with antibody-mediated, cellular, and chronic rejection in renal, pancreas, and/or liver transplantation.

B. Describe management strategies for treatment of:

1. Antibody mediated rejection
2. Mild acute cellular rejection
3. Moderate to severe acute cellular rejection
4. Chronic rejection

C. Identify the early and late adverse events associated with the treatment of rejection episodes.

UNIT 2

ORGAN PROCUREMENT

Unit Objectives

I. Understand the moral, ethical and legal issues and steps involved in determining brain death.

II. Understand the moral, ethical and legal issues and steps involved in live organ donation.

III. Describe the basic assessment of the medical, laboratory, and anatomic characteristics of a potential organ donor (live or deceased), the quality of a donor organ, and its suitability for a given recipient.

IV. Outline in detail the procedure to safely recover abdominal organs from deceased donors, including those for donation after cardiac death (DCD).

V. Understand the recovery processes for living donor organs and describe the steps necessary to perform relevant organ specific recovery (liver, kidney, or pancreas).

VI. Outline the basic principles and limits of organ preservation and be familiar with organ preservation techniques, including pulsatile perfusion.

Learner Objectives

I. Understand the moral, ethical and legal issues and steps involved in determining brain death.

A. Be familiar with the historical development and evolution of brain death criteria in the United States.

B. Understand the moral, ethical and legal basis for declaration of brain death and the standard medical and radiologic criteria used to make this decision.

II. Understand the moral, ethical and legal issues and steps involved in live organ donation.

A. Be familiar with the historical development and evolution of live donor organ donation in the United States.

B. Understand the ethical, moral and legal basis for live donor organ donation.

III. Describe the basic assessment of medical, laboratory, and anatomic characteristics of a potential organ donor (live or deceased), the quality of a donor organ, and its suitability for a given recipient.

A. Understand the medical and surgical issues involved with determining the suitability of an organ from a deceased donor and its suitability for a given recipient.

B. Understand the psychosocial, medical, and surgical short-term and longterm issues involved with determining the suitability of an organ from a live donor and its suitability for a given recipient.

C. Understand the medical and surgical issues involved with determining the suitability of an organ from a donor after cardiac death (DCD) retrieval and an extended criteria donor (ECD) and its suitability for a given recipient.

IV. Outline in detail the procedure to safely recover abdominal organs from deceased donors, including those for donation after cardiac death (DCD).

A. Understand and be able to perform safe recovery of abdominal organs from deceased donors.

B. Understand and be able to perform safe recovery of abdominal organs from deceased donors who are DCD donors. (Basic fellowship is not assumed to include competence in DCD donor organ recovery.)

C. Be familiar with appropriate courtesy and etiquette to organ procurement personnel, operative staff and other organ procurement teams during single and multi-organ procurement.

V. Understand the recovery procedures for living donor organs and describe the steps necessary to perform relevant organ specific recovery (liver, kidney)

A. Understand the steps required to perform open and laparoscopic donor nephrectomy for the purposes of organ donation.

VI. Outline the basic principles and limits of organ preservation and be familiar with organ preservation techniques, including pulsatile perfusion.

A. Be familiar with basic principles of organ preservation and organ preservation fluids.

B. Understand the limits of organ preservation for each organ and the attendant risk of organ dysfunction over time.

C. Understand the basic principles of pulsatile kidney perfusion. (Basic fellowship is not assumed to include competence in pulsatile organ preservation.)

UNIT 3

KIDNEY AND KIDNEY PANCREAS TRANSPLANTATION

Unit Objectives

- I.
 - a. List the indications for kidney transplantation, explain the different disease processes resulting in end-stage renal disease, and describe the treatment options.
 - b. List the indications for pancreas transplantation, explain the different disease processes resulting in diabetes, and describe the treatment options.
- II. Outline the basic of principles of donor and recipient selection and deceased donor organ allocation.
- III. Describe and perform living and deceased donor kidney transplant procedures;
- IV. Explain the basic immunosuppressive strategies used in kidney and kidney pancreas transplantation, including induction and maintenance therapy.
- V. Recognize and diagnose renal and or pancreas transplant rejection, identify basic pathologic findings of rejection, and describe treatment strategies for rejection.
- VI. Describe appropriate long term follow-up and be able to identify and treat short and long term complications of kidney and kidney pancreas transplantation.
- VII. Describe the short and long term outcomes of kidney and kidney pancreas transplantation.
- VIII. Outline the basic principles of renal replacement therapy; identify indications for and surgical techniques necessary to place hemo- and peritoneal dialysis access.

Learner Objectives

- I. List the indications for kidney and kidney pancreas transplantation, explain the different disease processes resulting in end-stage renal disease and diabetes, and describe the treatment options for end-stage renal disease.
 - A. Understand the processes that result in end stage kidney disease in adults and children including the pathophysiology, rate of progression, incidence of recurrent disease, and impact on transplantation for the following diseases:
 1. Hypertensive nephropathy
 2. Diabetic nephropathy
 3. Glomerulonephritis
 4. Reflux disease
 5. Autoimmune kidney disease (e.g. Lupus, Wegners)
 6. Inherited cystic diseases
 - B. Define the evaluation process for patients considering kidney transplantation including the following components
 1. Minimal pre-operative testing
 2. Cancer screening and period of waiting following diagnosis
 3. Cardiac evaluation
 4. Serologic evaluation and importance of viral testing (CMV, EBV, Hep B+C, HIV)
 - C. Understand when patients should be listed for transplant
 1. Minimal listing criteria (CrCl < 20)

2. Pre-emptive vs. following the initiation of dialysis

D. Properly and completely consent the patient and family and explain the risks and benefits of renal transplantation compared with dialysis

1. Compare life expectancy on dialysis vs. transplant for a variety of patient populations
2. Understand basic peri-operative complications.

II. Outline the basic principles of donor and recipient selection and deceased donor organ allocation.

A. Describe criteria used to assess the suitability of a deceased donor for organ transplant

1. Demographic factors (age, race, sex)
2. Cause of death
3. High risk behaviors
4. Presence of malignancy (CNS vs. others)
5. Viral status (Hep C, Hep B, HTLV-1)
6. Infection in donor
7. Hemodynamic status, vasopressor requirements
8. Length of cold ischemic time in all donors and warm ischemic time for DCDs
9. Anatomic considerations (multiple arteries, ureters, surgical damage)

B. Describe criteria used to assess the suitability of a living donor for kidney transplant

1. Demographic factors (age, size, gender)
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2. Evaluation of renal function including protein excretion
3. Presence of illnesses that may predispose the donor to renal insufficiency
4. Anatomic evaluation and considerations
 - a. Multiple arteries
 - b. Duplicated collecting systems
 - c. Left vs. right kidney
5. Crossmatching
6. Psychological and psychosocial evaluation
7. Understand and perform the consent process for living donation including risks and benefits of laparoscopic and open nephrectomy, risk of short and long term complications, potential for transplant failure.
8. Appreciate the ethical issues involved in living donor transplantation, the role of independent donor advocates, and the potential for

coercion.

III. Describe and perform living and deceased donor kidney transplant procedures; pancreas transplants.

A. Prepare the kidney (or pancreas) for transplantation

1. Strategies to deal with common anatomic features including multiple arteries and veins and other non-ideal graft anatomy

B. Understand possible surgical approaches for kidney transplant including extraperitoneal and intraperitoneal location; understand the surgical approaches for pancreas transplantation, including methods for venous and exocrine drainage.

C. Describe the technique for isolating the iliac vessels and performing vascular Anastomoses

D. Detail the procedure for implanting the ureter and importance of the blood supply to the ureter

1. Creation of anti-reflux tunnel
2. Indications for stent placement

E. Use of intra-operative adjunctive medications

F. Detail the post-operative care of renal transplant patients including:

1. Fluid and electrolyte management
2. Recognition and treatment of cardiac complications

G. Identify and treat surgical complications

1. Bleeding
2. Ureteral leak
3. Lymphocele
4. Vascular thrombosis
5. Wound complications
6. Pancreas graft enteric leak

H. Describe and interpret relevant radiological evaluations

1. Ultrasound
2. CT scanning
3. Lasix-renogram
4. Interventional diagnostics (angiogram, percutaneous nephrostogram)

I. Identify and manage delayed graft function

1. Determine the need for post-operative dialysis
2. When should a biopsy be performed?

IV. Explain the rationale for immunosuppressive strategies used in kidney transplantation, including induction therapy.

A. Induction immunosuppression

1. Understand the basics of induction immunosuppression

a. Steroids

b. Antibody preparations

B. Determine appropriate maintenance immunosuppressive regimen

1. Rationale for choice of CNI, anti-proliferative, and/or steroids

2. Appreciate issues of timing (e.g. delayed CNI for DGF)

C. Counsel patients regarding the need for compliance, potential side effects and important drug interactions, and strategies to minimize side effects.

V. Recognize and diagnose renal transplant rejection including performing diagnostic biopsy and interpreting basic pathological findings

A. Participate in the care of post-transplant patients

B. Review and evaluate pertinent laboratory data to identify potential for rejection or other etiologies of graft dysfunction

C. Determine the need for a percutaneous biopsy, ultrasound examination, or other diagnostic procedure

D. Renal biopsy

1. Provide appropriate consent discussion for patients

2. In cooperation with renal pathologist, review biopsy results and identify the basic pathologic features of rejection of renal allografts

E. Describe the treatment approaches for acute allograft rejection

1. Understand the difference in treatment for cellular and humoral Rejection

F. Understand the impact on long term outcome from acute rejection episodes

VI. Describe appropriate long term follow-up and be able to identify and treat short and long term complications of kidney transplantation.

A. Participate in and understand the process of long term follow-up of transplant Patients

B. Appreciate the health maintenance needs of transplant patients

C. Describe techniques to preserve long term graft function

D. Understand the impact of cardiac disease on the long term outcome of renal and pancreas transplant patients

VII. Describe the short and long term outcomes of kidney and kidney pancreas transplantation.

A. Appreciate short and long term outcome of kidney and pancreas recipients

VIII. Outline the basic principles of renal replacement therapy; identify indications for and surgical techniques necessary to place hemo- and peritoneal dialysis access.

A. Describe the pre-operative evaluation of patients considering vascular access

B. Independently consent patients for vascular access and explain the risks, benefits, and options

C. Perform vascular access procedures including

1. Arm fistulas
2. Arm grafts
3. Place percutaneous lines for dialysis

D. Describe techniques for complicated access (leg fistula, chest grafts, leg grafts).

E. Identify and design treatment strategies for complications of access procedures

1. Stenosis/thrombosis
2. Steal syndrome
3. Poor maturation of fistula

F. Evaluate patients for peritoneal catheter placement

1. Describe surgical technique
2. Determine need for surgical removal in case of infection, malfunction

Patient Care

A. IMMUNOLOGY

1. Participate in the perioperative management of immunosuppressive agents in chronically-medicated patients undergoing general surgery.
2. Plan and perform elective surgery in immunosuppressed patients with attention to minimizing infectious risks; perform emergent surgical intervention (treatment of perforated viscus) in similar high-risk patients.
3. Optimize patients' immune state secondary to systemic compromise following major surgery, burns, trauma, and malnutrition.
4. Diagnose acute and chronic organ rejection using clinical signs and symptoms as well as serum chemistries and radiologic studies.
5. Recognize and treat wound infections and other complex disorders in chronically immunosuppressed patients undergoing elective and emergent surgery.
6. Monitor drug levels and side effects in immunosuppressants.
7. Participate in the care of patients receiving immunostimulatory medications (e.g., IV immunoglobulin [IVIG], and granulocyte stimulating factor).

B. TRANSPLANTATION

1. Evaluate potential candidates for living-related and cadaveric vascularized organ transplantation, including:
 - a. Clinical suitability
 - b. Strength of social support
 - c. Expected graft and patient survival
2. Participate in the pre- and post- operative surgical management of patients after vascularized organ transplant.
3. Assist/perform kidney and pancreas transplantation.
4. Participate in the perioperative management of immunosuppressive drug therapy, including monitoring drug levels and treating potential toxicities.

5. Participate in the evaluation of patients suspected of organ rejection to include:
 - a. Laboratory and radiologic testing
 - b. Administration of immunosuppressive (IS) agents
 - c. Following patients for potential acute and chronic side effects
6. Participate in the preparation and surgical recovery of multiple organs from the brain dead donors.
7. Define suitability characteristics of organs for transplantation.
8. Manage postoperative surgical complications, including wound infection, anastomotic stenoses and leaks, vascular thrombosis, and lymphocele formation.
9. Understand and describe the indications for dialysis and the various dialysis modalities, and participate in planning and performance of dialysis access procedures.

Practice Based Learning

Familiarity with the literature regarding surgical management of conditions afflicting the transplant surgery population including areas of controversy is also expected.

Interpersonal and Communication Skills

1. The PGY 3 residents should instruct students about the preoperative and postoperative care of surgical patients and the principles of surgery.
2. Residents should develop good interpersonal skills with nurses, patients, and families.

Professionalism

1. Demonstrate commitment to patient care and acquiring the necessary knowledge to successfully carry out the duties of a PGY 3 resident.
2. They are expected to attend transplant surgery clinics as assigned the equivalent of at least one full day a week.

3. Develop a working relationship with members of the transplant surgery team in managing postoperative patients.

Systems-Based Practice

1. Develop an appreciation of multi-disciplinary approaches to transplant surgery patients by participating in multi-disciplinary outpatient and inpatient activities.
2. Presentation of transplant surgery patients in multidisciplinary patient management conferences.