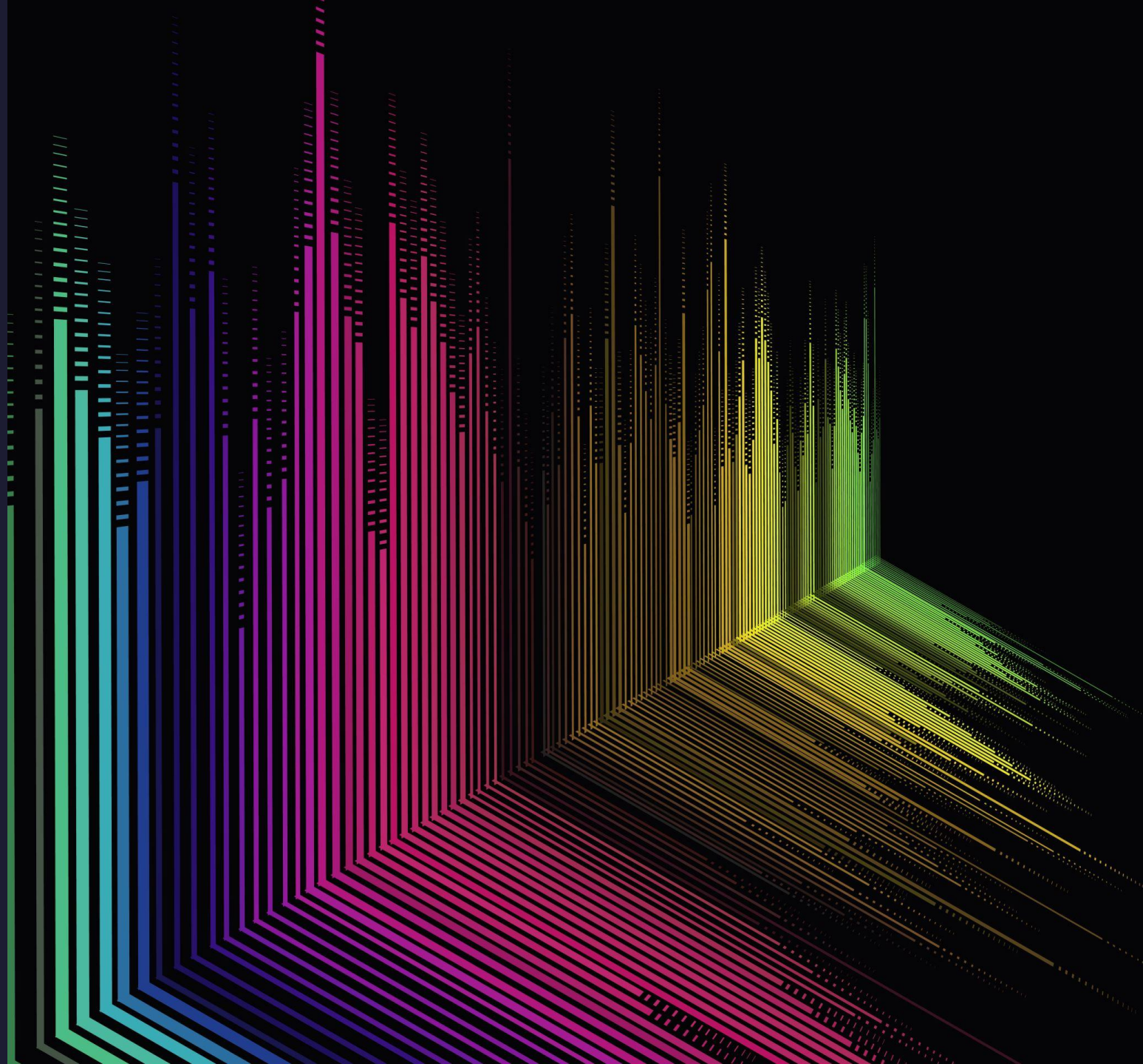


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# EMBRACING FOREIGN ORGANS: MANAGING TRANSPLANT PATIENTS IN THE EMERGENCY DEPARTMENT

Rosny Daniel, MD



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# CASES

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65-year-old man, h/o ESRD s/p renal transplant presents with decreased urine output

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22-year-old woman, h/o toxin mediated liver failure s/p liver transplant presents with fever and fatigue

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26-year-old transwoman, h/o ALL s/p stem cell transplant presents with fever, rash, and diarrhea

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# OBJECTIVES

## Discuss

Discuss the epidemiology of transplants in United States

## Review

Review basic principles of solid organ and hematopoietic transplant

## Categorize

Categorize common transplant complications

## Formulate

Formulate an initial approach to evaluation, work up, and treatment of transplant complications

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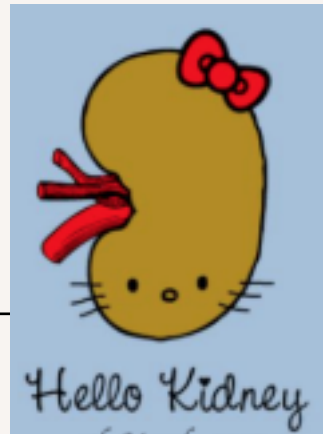
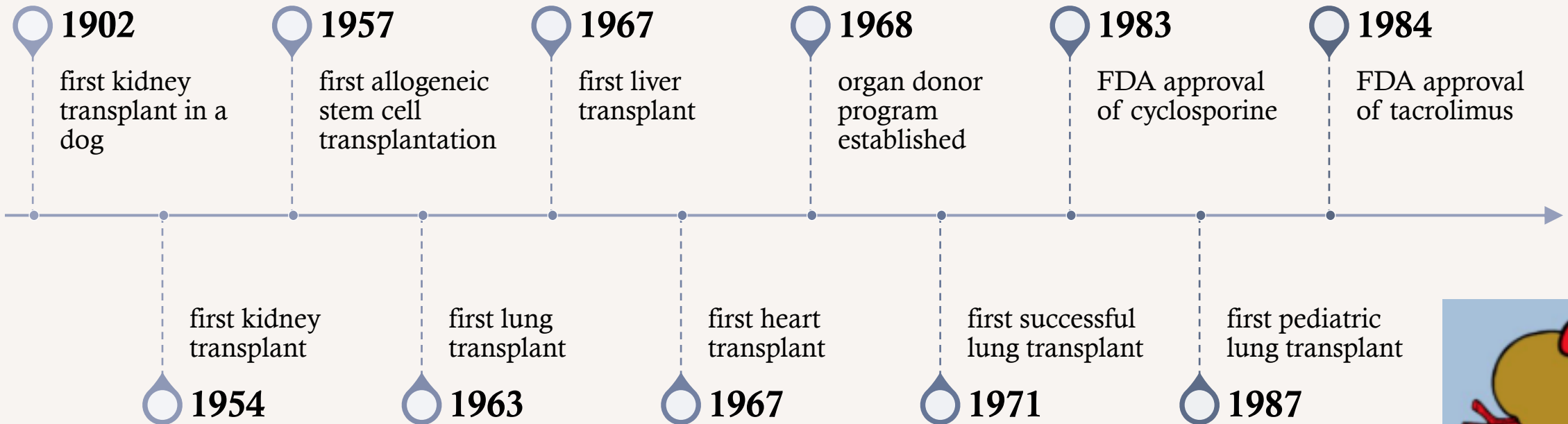
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# REFERENCES AND HIGH YIELD FIGURES

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# TRANSPLANT TIMELINE



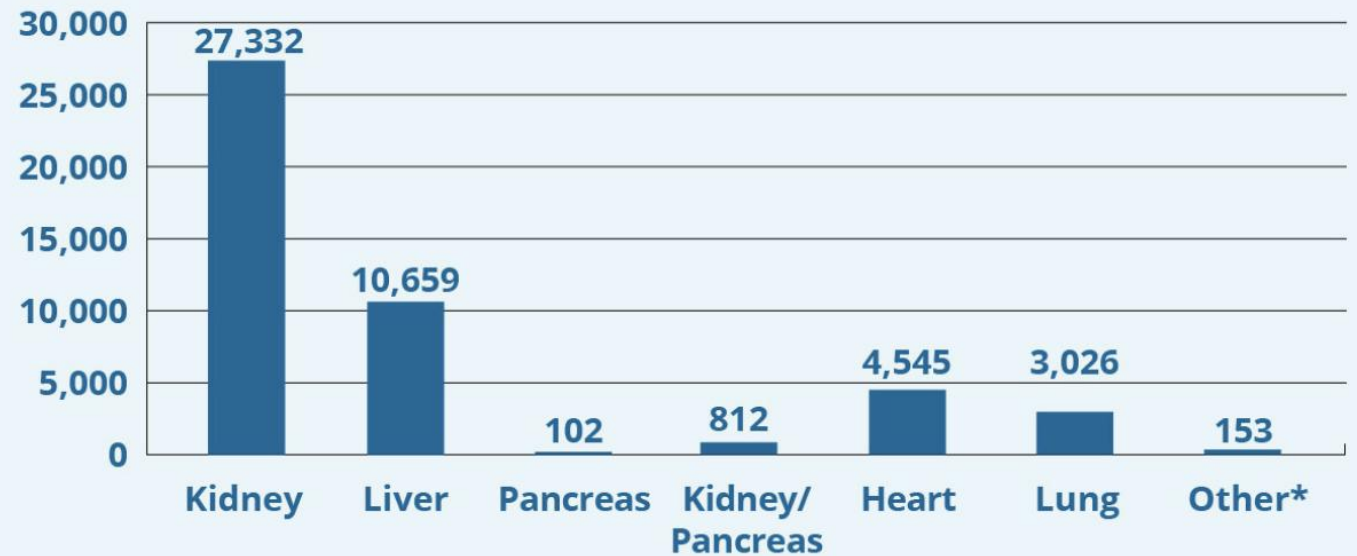
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# EPIDEMIOLOGY

- Kidney > Liver > Lung > Heart > Pancreas
- 245k living kidney transplant patients
- 100k living liver transplant patients
- 110k living hematopoietic cell transplant patients
- 230+ Transplant centers in the US

## Transplants Performed by Organ

In 2023

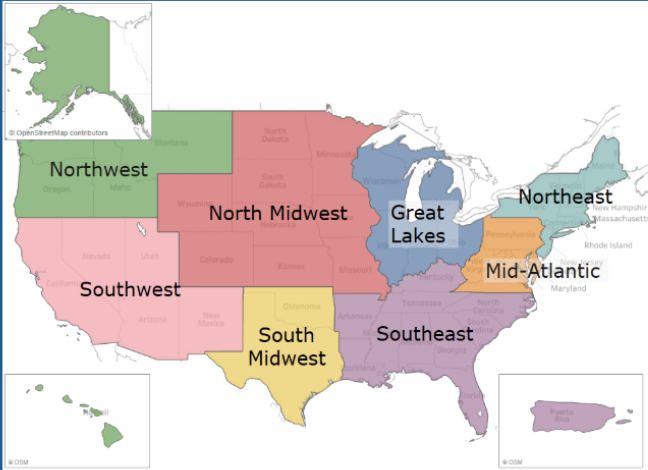


\*Other includes allograft transplants like face, hands, and abdominal wall.

*Based on OPTN data as of September 15, 2024. Data subject to change based on future data submission or correction. Totals may be less than the sums due to patients included in multiple categories.*

---

# Current state of organ donation and transplantation: Transplant trends



## About the dashboard

This dashboard can be used to explore transplant and donor trends and key statistics. This data visualization shows high-level data on transplants, deceased donors recovered, patients added to the waitlist and patients

## Transplants and waitlist

## Donors recovered

Select a visualization

Transplants to date

Transplants by week

Waitlist

Waitlist snapshot

## Number of transplants in the US to date

Select region

Southwest

Select organ

Kidney

Select age group

Adult (18 years and older)

Select race/ethnicity

(All)

Select status

Active

Select month

December

2025

2024

2023

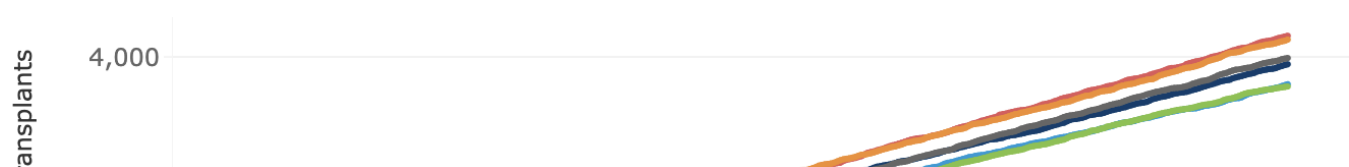
2022

2021

2020

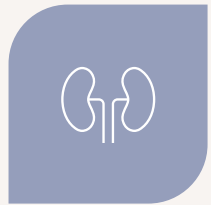
2019

## Year-to-date adult transplants in the southwestern US



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# INDICATIONS FOR TRANSPLANTS



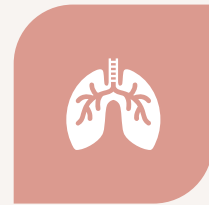
KIDNEY  
FAILURE



LIVER  
FAILURE



HEART  
FAILURE



LUNG  
FAILURE



PANCREAS  
FAILURE



LIQUID  
TUMORS

---



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# SIMPLIFIED REQUIREMENTS FOR TRANSPLANT PATIENTS



Medical adherence



Lifestyle modifications



Sobriety



Support system



Commitment to the process

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# TRANSPLANT COMPLICATIONS

Organ specific

Mechanical and anatomic issues

Rejection

Medication side effects

Infections

Contacting the transplant team

Acute <1 month

Intermediate 1-6 months

Chronic >6 months

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# TRANSPLANT HISTORY

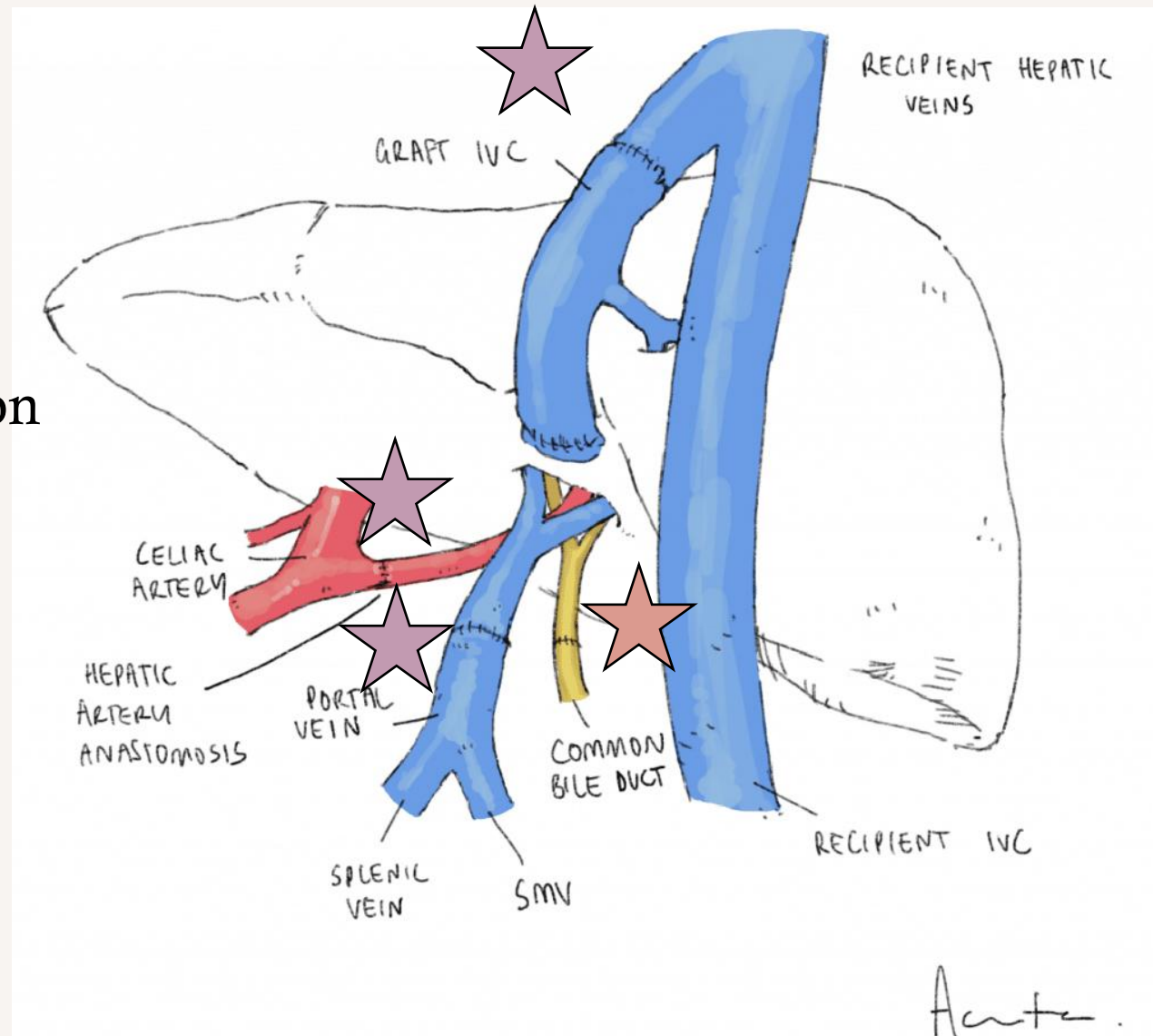
- When was their transplant?
- Where is their transplant?
- Where was their transplant?
- Who did their transplant?
- Current medications?



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# MECHANICAL COMPLICATIONS

- Blood supply
- Organ specific function
- Denervation



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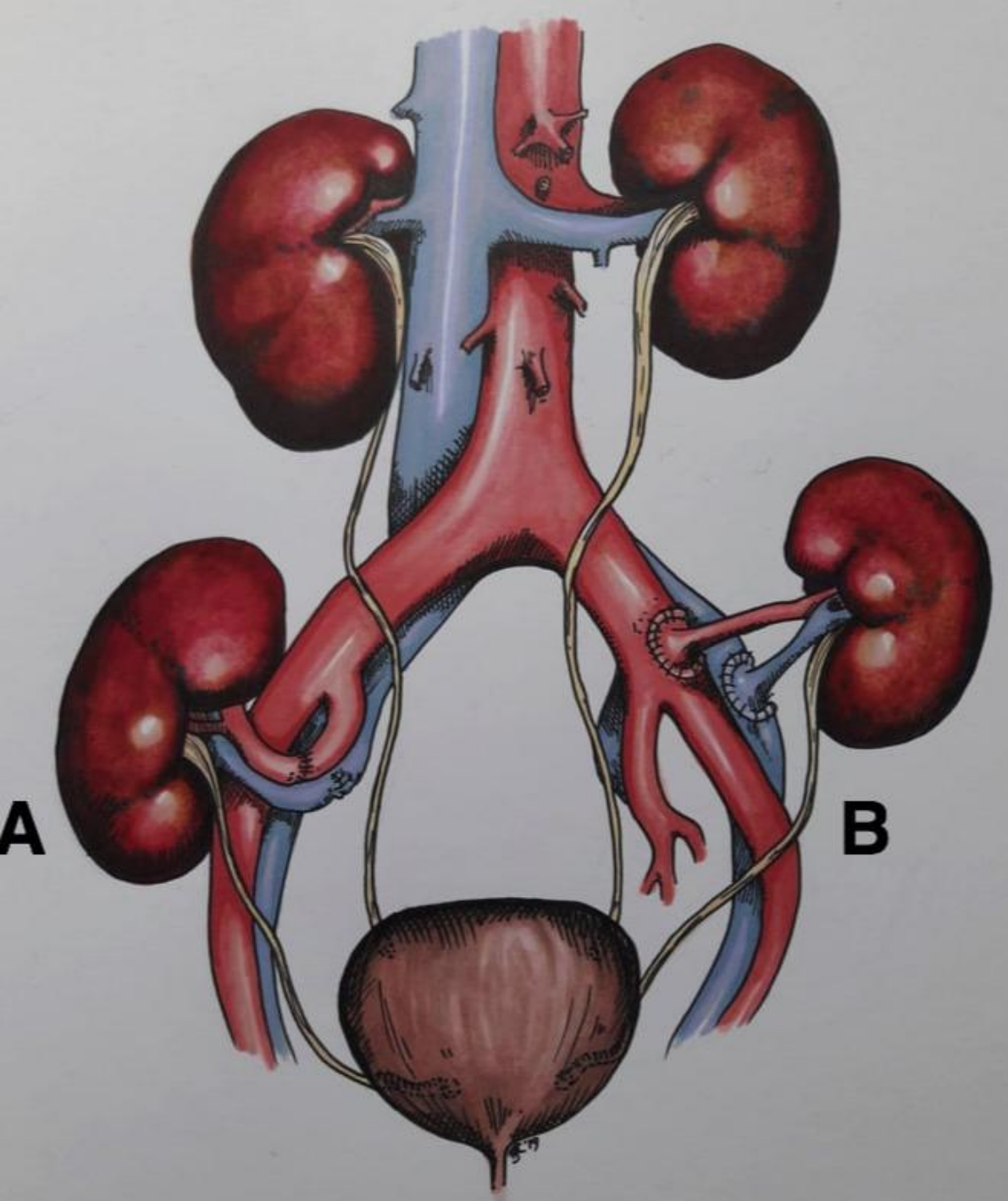
# NOMENCLATURE

Orthotopic  
vs  
heterotopic

Allograft vs  
autograft

Deceased  
donor vs  
living donor

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## MECHANICAL COMPLICATIONS: KIDNEY TRANSPLANTS

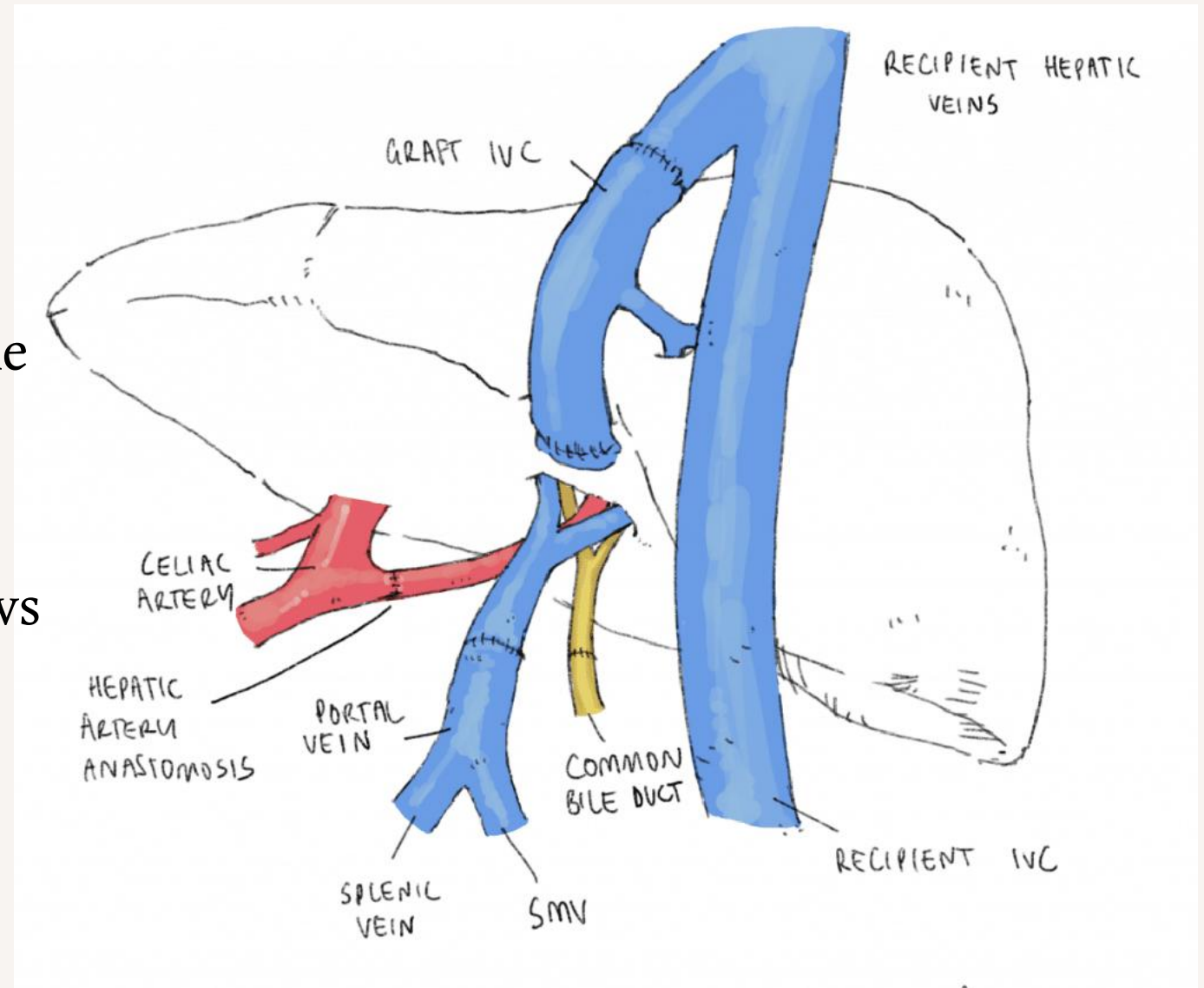
- Renal artery stenosis and thrombosis
  - 10% rate
- Peri-transplant hematoma
  - 2-3% rate
- Ureteral obstruction
  - 3-6%
- Lymphocele
  - 5-15%



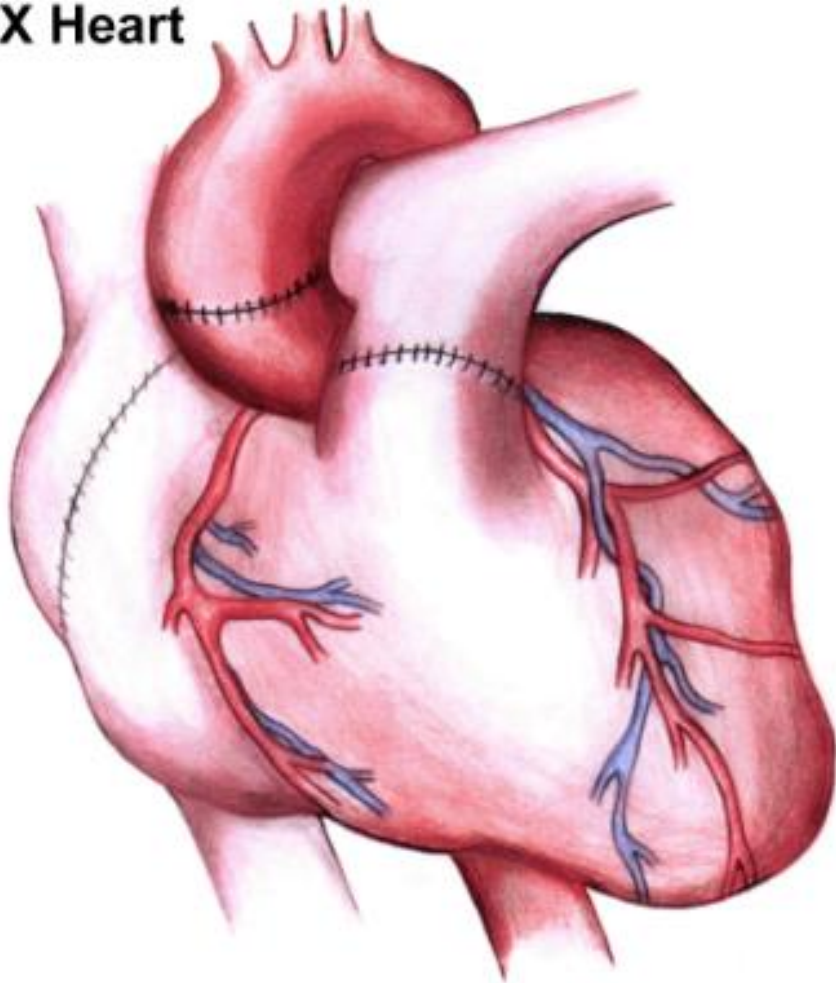
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## MECHANICAL COMPLICATIONS: LIVER TRANSPLANTS

- Thrombosis and stenosis of the hepatic artery
  - 4-12% rate
- Biliary strictures anastamotic vs non anastamotic
  - 4-20% rate
- Biliary leaks and bilomas
  - 2-25% rate



TX Heart



Completed operation. Note suture lines on now-implanted heart.

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## MECHANICAL COMPLICATIONS: HEART TRANSPLANTS

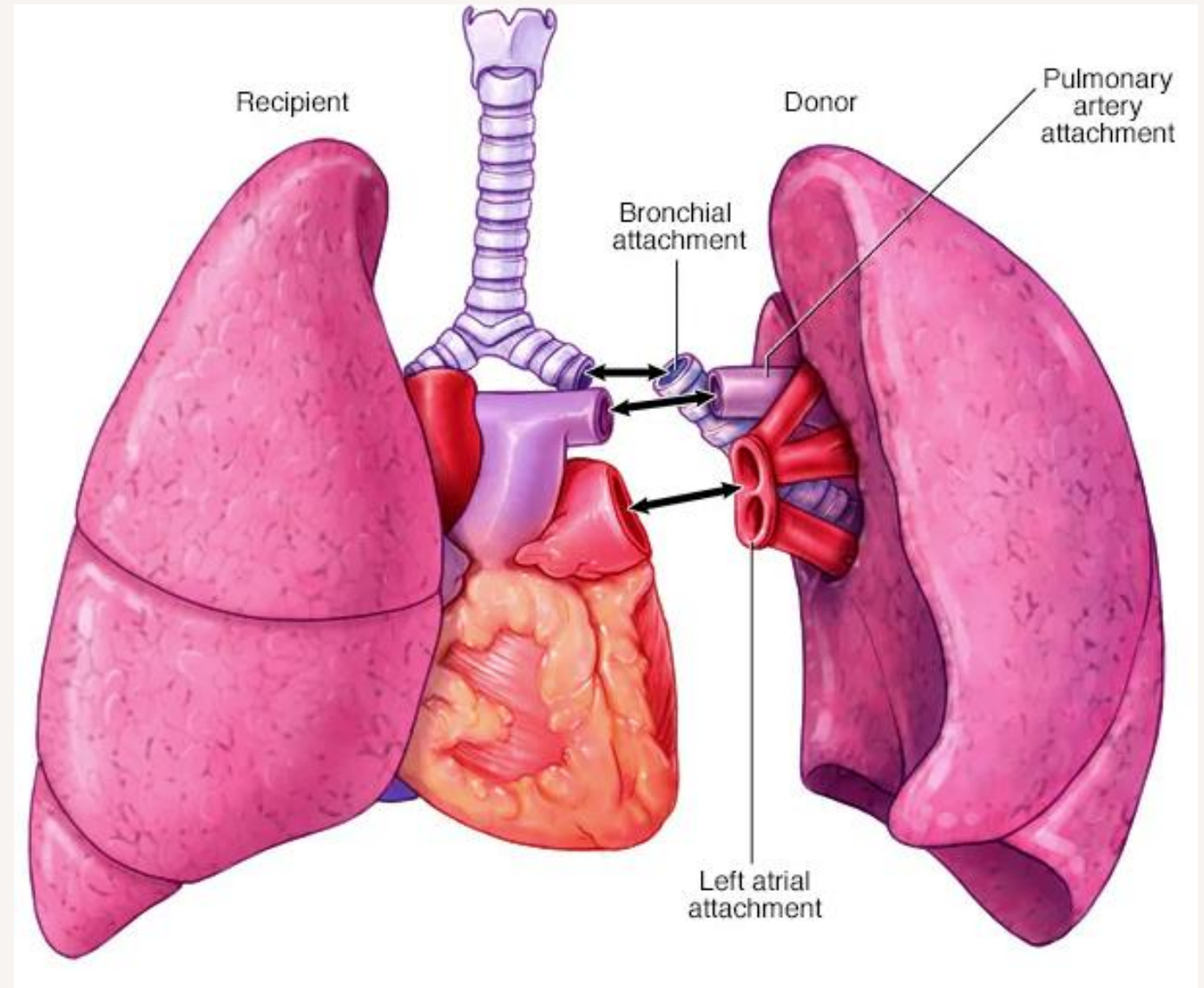
- Allograft vasculopathy
  - 30-70% of patients
- Denervation
  - Decreased vagal tone
  - Bradycardia (no atropine)
  - Decreased sensation
- Tachyarrhythmia
  - >20% of patients
  - Beware CCBs



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# MECHANICAL COMPLICATIONS: LUNG TRANSPLANTS

- Airway anastomosis
  - 30-70% rate
- Arterial/Venous stenosis and thrombosis
  - Rare but morbid
- Phrenic nerve dysfunction
  - 3-10% rate
- Pneumothorax, hemothorax, chylothorax

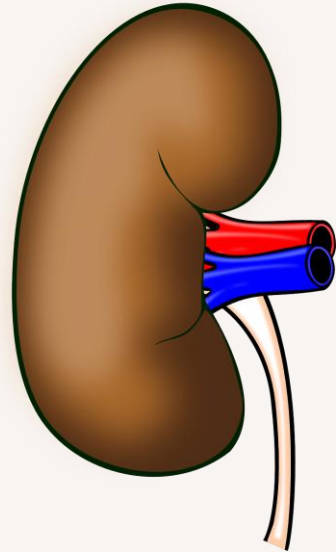


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# ANATOMIC COMPLICATIONS EXAM & IMAGING

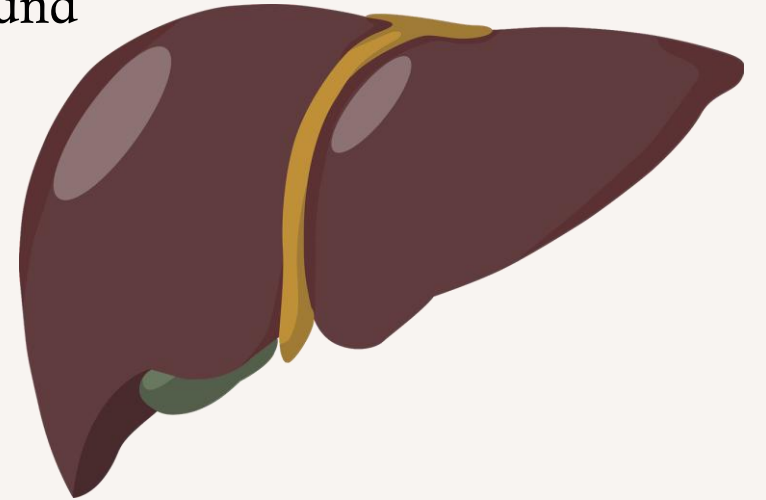
## Transplanted Kidney

- Usually heterotopic
- Bedside ultrasound
- Doppler ultrasound
- CT angiogram



## Transplanted Liver

- Usually orthotopic
- Bedside ultrasound
- Doppler ultrasound
- CT angiogram
- MRCP
- ERCP

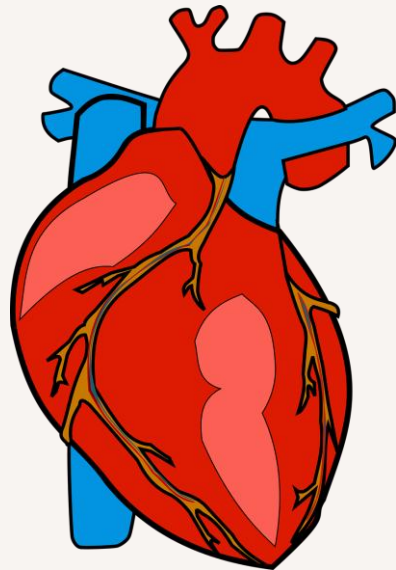


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# ANATOMIC COMPLICATIONS EXAM & IMAGING

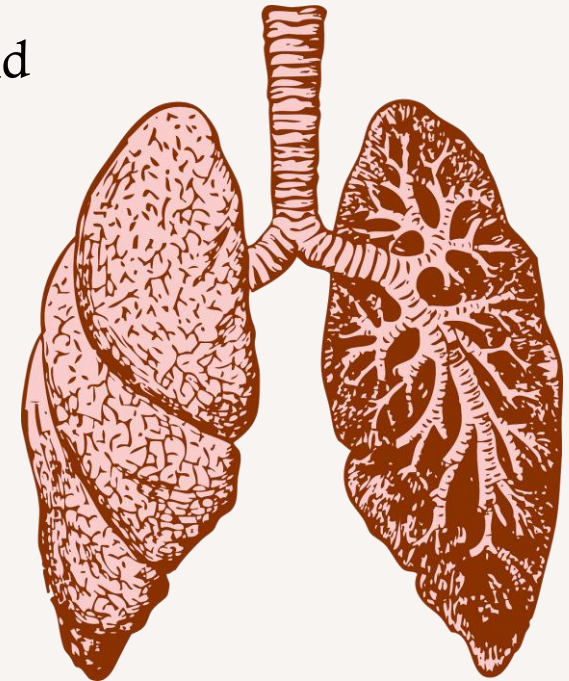
## Transplanted Heart

- Orthotopic
- Bedside ultrasound
- ECHO
- CT angiogram



## Transplanted Lung

- Orthotopic
- Bedside ultrasound
- Chest X-ray
- CT angiogram



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# REJECTION

Hyperacute

This happens in the operating room

Acute

First months to weeks

Looks like native organ failure

Chronic

Can look like native organ failure

Often a much slower burn

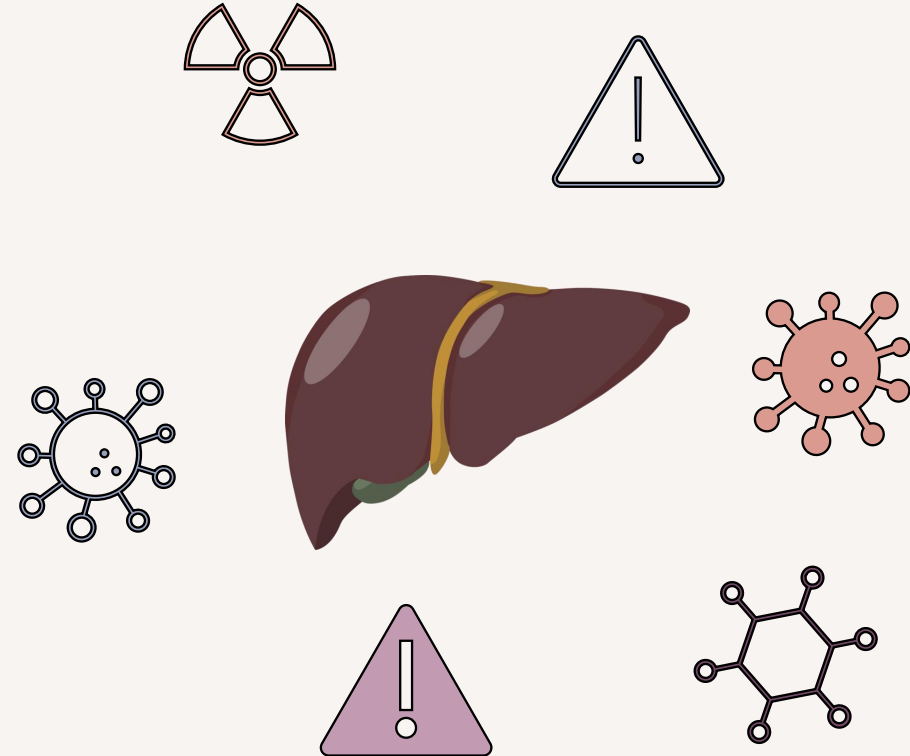
Graft versus host disease

By far most common in hematopoietic

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# GRAFT VS HOST DISEASE

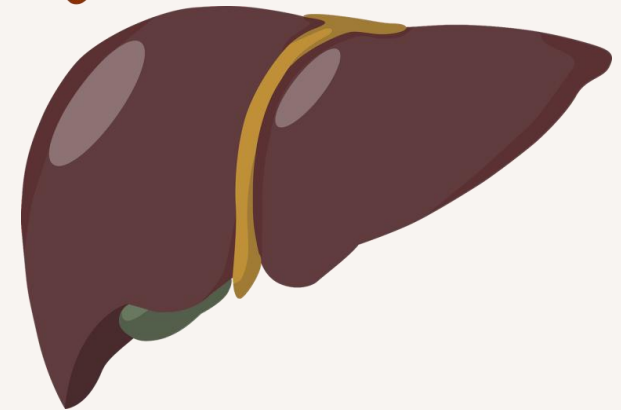
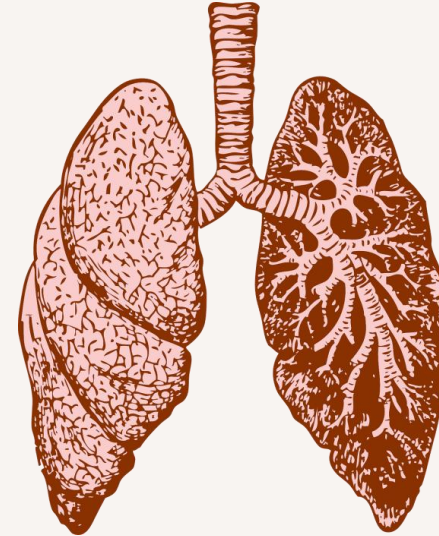
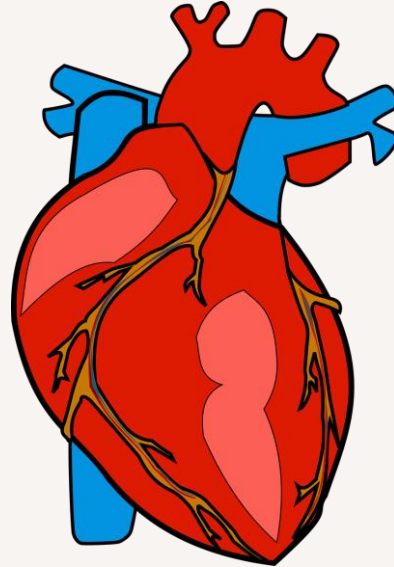
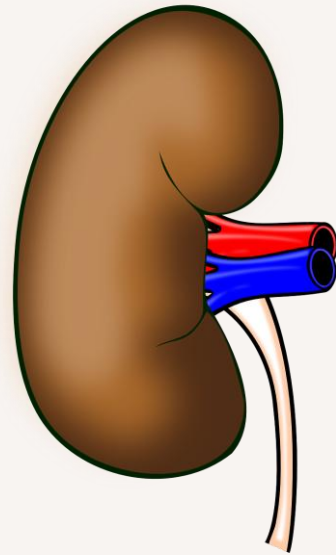
- T cells in the donor graft are activated
- Recognize the donor recipient as foreign and attack
- Skin symptoms – rash, desquamation
- Liver injury – pain, decreased function
- Gastrointestinal tract – diarrhea, vomiting



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# EVALUATING FOR REJECTION

- CBC, CMP, Lipase
- INR
- CRP, ESR
- Troponin, BNP
- ULS, CT
- Biopsy





# EVALUATING FOR REJECTION

Transplant organ	Symptoms/signs	Management
Renal [46]	<ul style="list-style-type: none"> <li>- Many asymptomatic</li> <li>- Fever, malaise, oliguria, graft pain, and tenderness over site</li> <li>- Hypertension</li> <li>- Worsening renal function with decreased urine output and rising serum creatinine</li> </ul>	<ul style="list-style-type: none"> <li>- Acute rise in serum creatinine common</li> <li>- Electrolyte abnormalities may be present</li> <li>- Ultrasonography (US) typically demonstrates increased graft size, loss of corticomedullary junction, prominent hypoechoic pyramids</li> <li>- Renal Doppler studies may demonstrate elevated vascular resistance indices</li> <li>- Biopsy typically needed during admission</li> </ul>
Liver	<ul style="list-style-type: none"> <li>- Fever, malaise, abdominal pain, hepatosplenomegaly, ascites</li> </ul>	<ul style="list-style-type: none"> <li>- Laboratory abnormalities common: elevated liver function tests and bilirubin</li> <li>- US of graft and vasculature may find focal lesion or vascular abnormality</li> <li>- Biopsy is required during admission</li> </ul>
Cardiac	<ul style="list-style-type: none"> <li>- Dyspnea at rest/exertion, orthopnea, palpitations, near-syncope/syncope, peripheral edema, or gastrointestinal symptoms with right heart involvement</li> <li>- Chest pain is absent due to denervation during surgery</li> <li>- Dysrhythmias common</li> </ul>	<ul style="list-style-type: none"> <li>- Cardiac troponin and BNP often elevated</li> <li>- ECG may demonstrate T-wave/ST-segment changes</li> <li>- Echocardiogram often demonstrates systolic/diastolic dysfunction</li> <li>- Chest radiograph may demonstrate findings of congestive heart failure</li> <li>- Biopsy often needed during admission</li> </ul>
Lung [47]	<ul style="list-style-type: none"> <li>- Shortness of breath and cough most common</li> <li>- Lung examination variable: clear lung fields, crackles, or decreased breath sounds</li> <li>- May demonstrate stridor or wheezes</li> <li>- May present with respiratory distress or failure</li> </ul>	<ul style="list-style-type: none"> <li>- Eosinophilia suggestive on CBC with differential</li> <li>- Pulmonary function testing not helpful in differentiating infection and rejection</li> <li>- Normal chest radiograph is not reliable to rule out disease</li> <li>- Chest CT often required</li> <li>- Effusion requires thoracentesis</li> <li>- Bronchoscopy and biopsy needed during admission</li> </ul>

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# TREATMENT OF REJECTION

- Treat any organ failure emergencies
- Contact the transplant team
- High dose steroids
  - 500-1000 methylprednisolone
- Immunosuppressants
  - Mycophenolate, tacrolimus, sirolimus, thymoglobulin, or antibody-mediated treatment



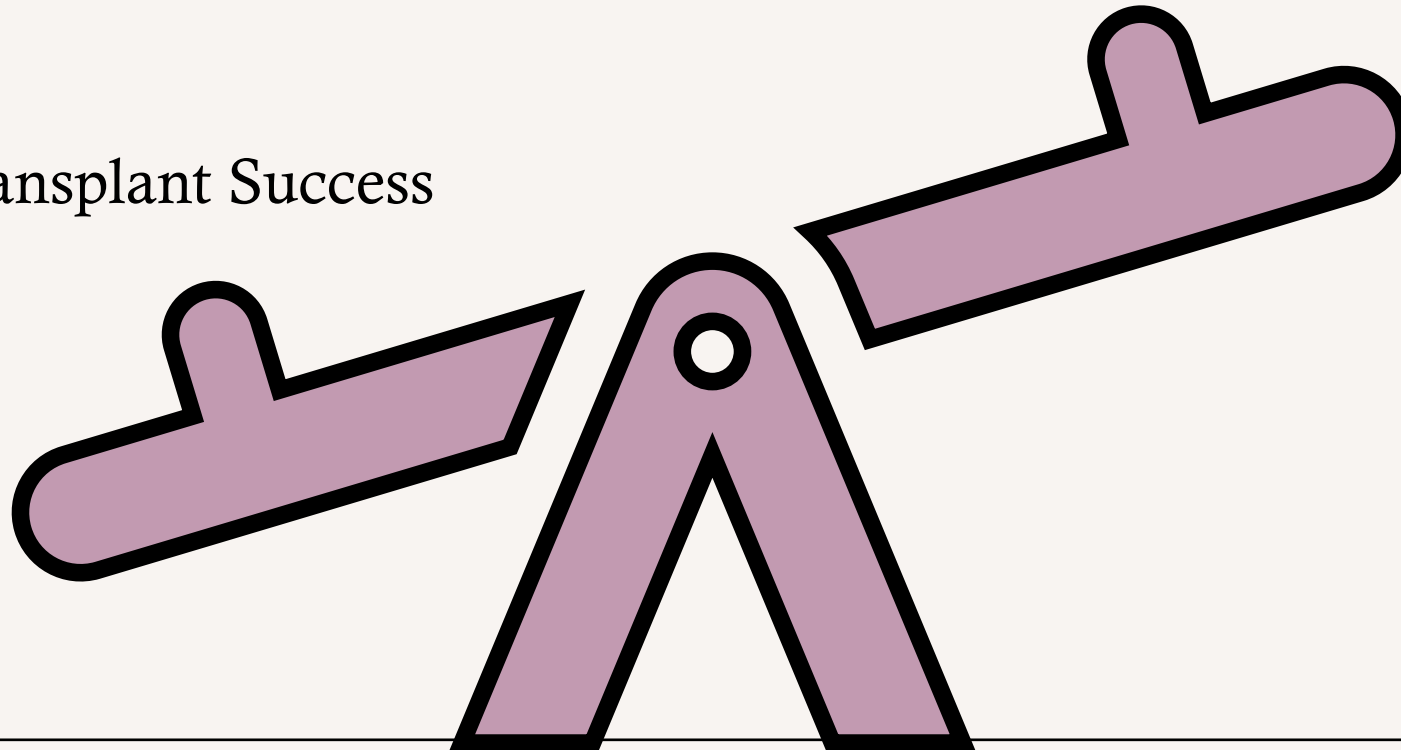


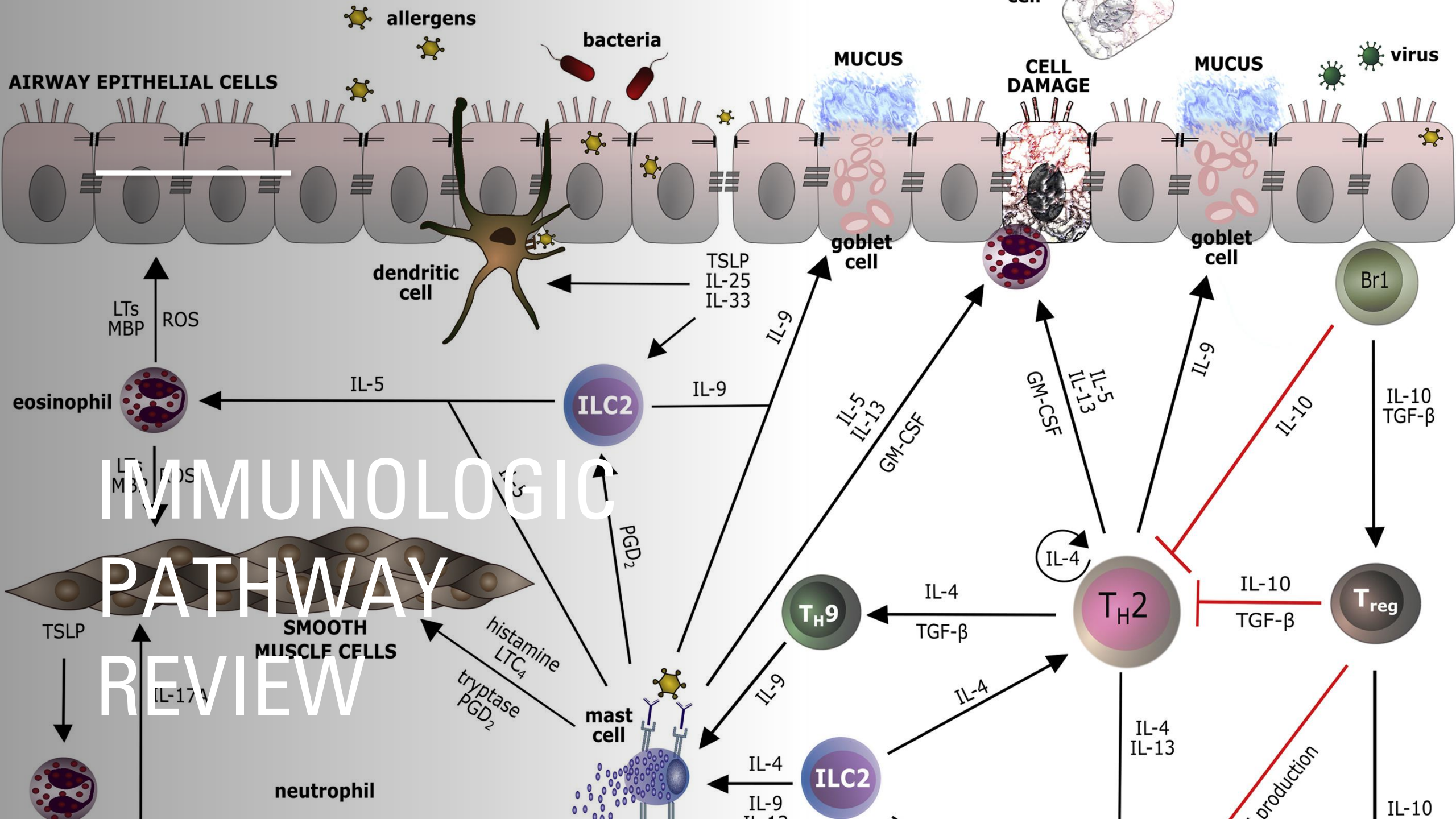
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# MEDICATIONS

Infection  
Side effects


Transplant Success





# MEDICATIONS

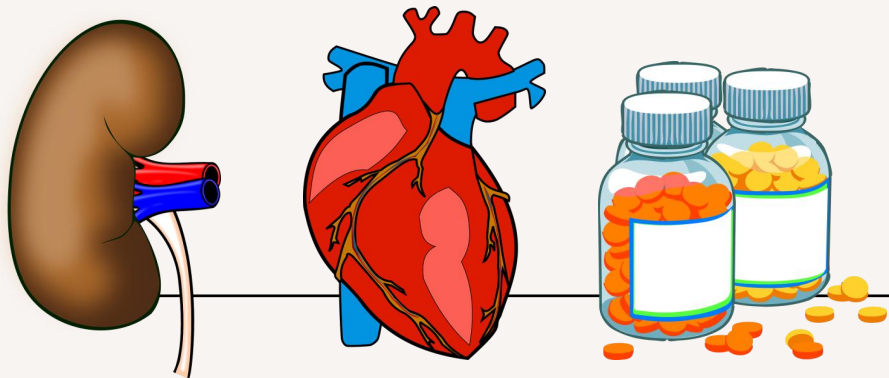
- Induction phase is 3-12 months
  - Typically, triple therapy
- Maintenance phase
  - Goal of 1-2 meds alone
- Many transplant services have their own pharmacist because of the complexity of these medications

	Induction (I)			
	Basiliximab (Simulect)	Alemtuzumab (Campath)	Rituximab	Anti-Thymocyte Globulin (ATG)
Class	Chimeric murine mAb	Humanized mAB	mAB	Polyclonal igG (from rabbit/horse)
How It Works	IL-2 receptor antagonist .	Anti-CD52	Anti-CD20, B-cell depleting	Anti-thymocyte, T-cell depleting
Timing	Non T-Cell depleting lasts 4-6 weeks	T cell depleting with 50% recovery at 3 yrs. B-cell recovery by 1 yr	lasts 12 mo (also used for AMR, DS)	lasts 3-6 months
The Bad	Rare infusion reactions	Cytokine release syndrome (CRS); cytopenias	Infusion reactions	CRS, serum sickness, PTLD

	I/M		Maintenance (M)				
	Belatacept	Glucocorticoid	Tacrolimus (Prograf, Envarsus, Astagraf)	Cyclosporine (Neoral, Gengraf, Sandimmune)	Mycophenolic Acid (Cellcept, Myfortic)	Azathioprine	mTORi
Class	CTLA4-Ig	Steroids	Calcineurin inhibitor (CNI)	Calcineurin Inhibitor	Anti-metabolite (AM)	AM	mTORi
How It Works	Binds CD80/86 receptor on APC and blocks interaction with CD28 (co-stim)	Inhibits cytokine production	Binds FKBP, inhibits nuclear translocation of nuclear factor of activated T- cells (NFAT)	Binds cyclophilin and inhibits nuclear translocation of NFAT	Reversible inhibitor of IMPDH and blocks de novo purine synthesis	Disrupts salvage and de-novo purine synthesis .	Arrests cell cycle in G1-S phase
Timing	I: dosed 10 mg/kg POD 0,4 week 2,4,8,12 M: 5 mg/kg monthly	I: Dosed with IV methylpred M: PO prednisone 5 mg daily	t ½ 9-18 hr, trough check 10-12 hours	t ½ Neoral/Gengraf: 5-18 hr t ½ 10-27 hours	t ½ Cellcept: 18 hr Myfortic: 15 hr Troughs not useful	t ½ 5 hr TPMT involved in metabolism	t ½ Sirolimus 62 hr Everolimus 30 hr
The Bad	PML; PTLD (recipient must be EBV IgG+); cytopenias	HTN; Bone dz,, HLD; Cushings; Weight gain	Alopecia; tremors; neurotoxicity. acute and chronic nephrotox	HTN; HLD; DM; Hyperkalemia; Gingival hyperplasia; Hirsutism; Acute and chronic nephrotoxicity	Contraindicated in pregnancy; GI upset, cytopenias	Hepatotoxic cytopenias (safe in pregnancy however)	Proteinuria Oral ulcers; ILD; cytopenias. Need 4 hours between Siro and CsA



- Renal effects
- Metabolic syndrome
- Malignancy
- Bone, joint, and tendon disease
- Med med interactions
  - CCBs, Amiodarone, Statins
  - Macrolides/ Aminoglycosides
  - AEDs, phenobarbital, phenytoin, carbamazepine



<b>Immunosuppressive agent</b>	<b>Mechanism of action</b>	<b>Adverse side effects</b>
Cyclosporine	calcineurin inhibitor	Hypertension, renal insufficiency, hyperlipidemia, insulin resistance
Tacrolimus	calcineurin inhibitor	Hypertension, renal insufficiency, hyperlipidemia, insulin resistance
Mycophenolate	Inhibits IMPDH	Leukopenia, anemia, thrombocytopenia, GI side effects
Azathioprine	Inhibits adenosine/guanine production	Leukopenia, anemia, thrombocytopenia, pancreatitis
Sirolimus	mTOR inhibitor	Leukopenia, anemia, thrombocytopenia, Hepatic artery thrombosis, pulmonary toxicity
Prednisone	Suppresses cytokines, prostaglandins, leukotrienes	Hypertension, psychiatric disorders, hyperglycemia, hyperlipidemia, peptic ulcers, osteoporosis



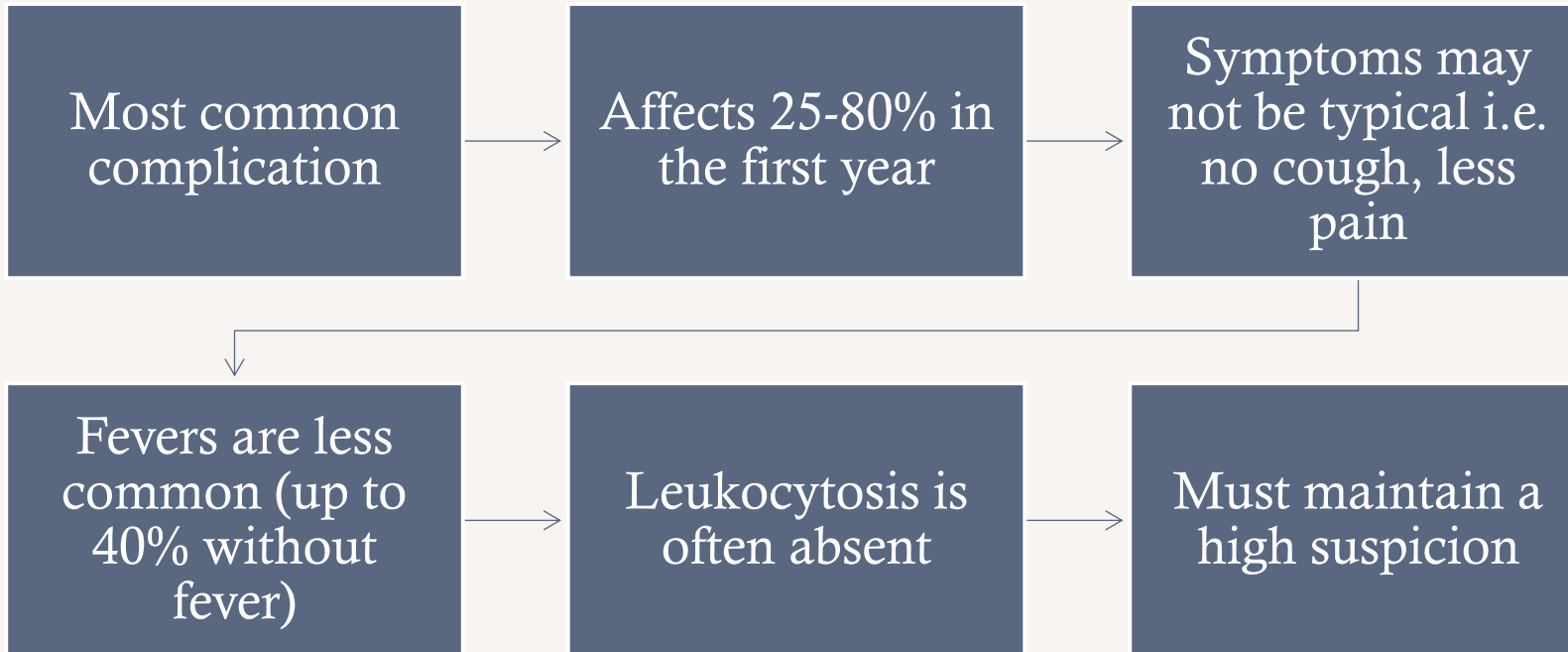
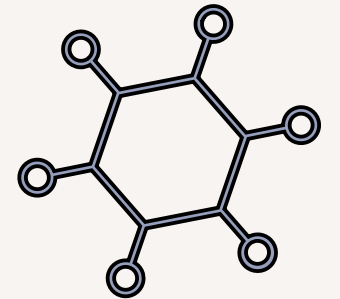
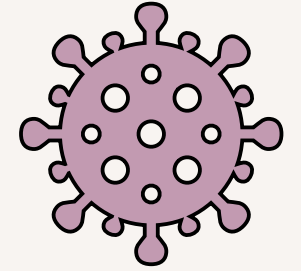
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# NEW ONSET DIABETES AFTER TRANSPLANT (NODAT)

- Common, happens in 5-40% of patients
    - Kidney, liver, lung, up to 30%
    - Heart up to 40%
  - Mostly related to rejection medications
    - Decreased secretion of insulin
    - Increased insulin resistance
  - Similar mechanism to Type 2 DM
  - Hyperglycemic emergencies in the early post transplant phase
-

---

# INFECTIONS



# INFECTIONS



## Infection based on transplant period

Transplant period	Infection
Early: first month after transplantation	<ul style="list-style-type: none"><li>- Donor-derived: donor-derived bacteria (MRSA, VRE, tuberculosis), fungi (<i>Candida</i>), and parasite (toxoplasmosis, Chagas disease)</li><li>- Nosocomial/surgery-related: aspiration pneumonia, surgical site infection, urinary tract infection, superinfection of graft tissue, vascular access infection, <i>Clostridium difficile</i> colitis</li></ul>
Intermediate: 1-6 mo after transplantation	<ul style="list-style-type: none"><li>- Most at risk for opportunistic infection: <i>Pneumocystis jirovecii</i>, <i>Histoplasma</i>, <i>Coccidioides</i>, <i>Cryptococcus</i>, hepatitis B/C, BK polyomavirus, Kaposi sarcoma, cytomegalovirus, tuberculosis, Epstein-Barr virus (EBV)</li><li>- Surgical site infections may arise in this period.</li><li>- Reactivation of dormant host infection (CMV, HZV, HSV, EBV)</li></ul>
Late: >6 mo after transplantation	<ul style="list-style-type: none"><li>- Community-acquired infection: respiratory viruses, <i>Pneumococcus</i>, <i>Legionella</i>, <i>Listeria</i>, <i>Influenza</i>, EBV</li></ul>

MRSA, Methicillin-resistant *Staphylococcus aureus*; VRE, Vancomycin-resistant Enterococci.





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# DIAGNOSING INFECTIONS

- All the basic labs you would already send
  - Attention to the neutrophil count
- CXR, Urinalysis, viral panel
- Blood and urine cultures
- Consider LP if any meningitic symptoms
- Extended viral testing CMV, HZV, HSV, EBV
- Stool testing
- Other causes of fever
  - Rejection, thrombus, meds, malignancy

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# TREATING INFECTIONS

- Late period are more likely to be typical infections
- Early/Intermediate period
  - Low threshold for broad spectrum antibiotics
  - Consider treatment for fungal/viral disease
  - Low threshold for admission
- Resuscitate as you already would





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# CONSULTATION

- Contact the transplant team early
- Discuss testing & imaging options
- Assist with medication decisions
- Help with disposition and follow up planning
- Low threshold to transfer if needed



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# IN SUMMARY

- Each transplanted organ brings unique anatomic and function specific complications, and you already know how to evaluate and treat most of these
  - We tend to see acute, intermediate, and chronic phases of complications
  - Maintain high suspicion for rejection and infection
  - Symptoms may be muted because of anatomic, immunologic, and medication related issues
  - Test broadly and consult early, especially if you are worried
  - Transplant meds can cause renal, metabolic, malignancy, soft tissue, and med med interactions
-

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# CASES

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65-year-old man, h/o ESRD s/p renal transplant presents with decreased urine output

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22-year-old woman, h/o toxin mediated liver failure s/p liver transplant presents with fever and fatigue

---

26-year-old transwoman, h/o ALL s/p stem cell transplant presents with fever, rash, and diarrhea

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# THANK YOU & REFERENCES

