The Nuts and B-OLTS of Liver Transplantation

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Medical and Transplant ICU

Objectives:

- Describe the pathophysiology of liver disease
- Identify indications for liver transplantation
- Discuss post-operative management of patients receiving an OLT (orthotopic liver transplant)

University of Kansas Hospital:

- Academic Medical Center
- 596 beds
- Medical and Transplant ICU
  - 14 bed unit
  - 69% of RNs are certified
- Specialties include ALF, ESLD, hepatobiliary operations and OLT
- Hepatology outpatients - 3,100
- Current waitlist ~131 patients

1 Year Survival Rate: 90%

Common Thread?

History of Liver Transplantation
History of Liver Transplantation

- 1958-1960 Northwestern University
  - Dr. Thomas E. Starzl begins liver transplantation in dogs
- 1963 University of Colorado
  - Dr. Starzl first human liver transplant
- 1967 Dr. Starzl first successful liver transplant
  - Short term survival
- 1981 University of Pittsburgh
  - World's largest liver transplant program
- 1984 NIH Consensus Conference
  - Deems liver transplantation accepted treatment for end-stage liver disease
- 1984-90 Pittsburgh performs > 400 transplants per year
  - Trains the leaders of many of the world's pioneering programs

Birth of International Affair

- Living Donor Transplantation
  - Australia: 1988
- Split Liver Transplantation
  - Germany: 1988
  - France: 1988
- Living Donor Right Lobe
  - Hong Kong: 1993
- Domino Liver Transplantation
  - Portugal: 1995

Why is the liver so important?

- Abundant blood supply
  - 1/3 of the cardiac output flows through the liver every minute
- Dual blood supply consisting of a portal vein and hepatic artery
  - 75% of blood supply is from the PV
  - 50-60% of the oxygen supply is from the PV
  - The hepatic artery is the sole oxygen supply of the bile ducts

Liver Functions:

- Functions (>10,000)
  - Metabolic
  - Synthetic (protein, clotting)
  - Immunological (Kupffer cells)
  - Detoxification
  - Drug metabolism
  - Production of bile/clearance of bilirubin
  - Glucose homeostasis
  - Storage

Hepatocyte Injury

- Liver Enzymes:
  - Transaminases:
    - Alanine aminotransferase (ALT) is liver specific
    - Aspartate Aminotransferase (AST) is present in many organs
  - Transaminases mark acute hepatocellular injury
  - Causes of acute rises (>2000) include:
    - Viral hepatitis
    - Hypoxic
    - Ischemic injury
    - Obstruction to blood supply (Budd Chiari)
    - Acute toxic injury (acetaminophen)
Injury vs Function

- Liver enzymes are *NOT* liver function tests
  - Enzymes perform functions
  - Elevations are markers of injury
- Liver function tests might be better represented in:
  - Bilirubin
  - INR
  - Albumin
  - Glucose (in acute liver failure)
  - Drug metabolism (certain drugs like lidocaine)

Bile Duct Injury

- Hepatic Excretory System
  - Serum Bilirubin
    - Used to assess the liver's function
    - Elevation seen later than enzymes
  - Alkaline phosphatase
    - Released during disorders affecting the bile duct
  - γ-glutamyltransferase (GGT)
    - Sensitive indicator of hepatobiliary disease

Physical Signs

- Jaundice
- Edema
- Muscle Wasting
- Gynecomastia, testicular atrophy
- Encephalopathy, asterixis
- Progressive splenic enlargement
- Ascites
- Caput Medusae

What happens when the liver fails?

Common Complications

- Cirrhosis
- Portal Hypertension
- Ascites
- Spontaneous Bacterial Peritonitis
- Gastrointestinal Bleeding
- Renal Dysfunction
- Hepatopulmonary Syndrome
- Portopulmonary Hypertension
- Hepatic Encephalopathy
- Coagulopathy

Coagulopathy

- Synthesis of coagulation factors is decreased
  - Prolongation of INR, indicating hepatic dysfunction
  - Platelet dysfunction
  - Reduced circulating levels of fibrinogen
  - Avoid FFP and Platelets unless:
    - Actively bleeding
    - Invasive intervention is required
Portal Hypertension
- Is characterized by increased resistance to flow in the portal venous system
- Sustained portal vein pressure >12 mm Hg (normal 5-10 mm Hg)
- Caused by Prehepatic, Intrahepatic and Posthepatic obstructions
- The major complications are ascites, splenomegaly and bleeding from esophageal varices.

Ascites
- Fluid in the peritoneal cavity is increased
- Causes
  - Portal hypertension
  - Renal salt and water retention
  - Impaired synthesis of albumin by the liver
- Diagnosis: SAAG
- Treatments:
  - Dietary restriction of sodium
  - Diuretics
  - Water restriction
  - Large volume paracentesis
  - TIPS

Spontaneous Bacterial Peritonitis
- SBP is a bacterial infection that occurs in the peritoneal cavity
- High mortality
- Prevalence:
  - 7% to 17% of patients with cirrhosis
- Diagnosis:
  - Ascitic neutrophils >250/mm³ on diagnostic paracentesis
  - Culture positive for a single organism
- Treatment:
  - Intravenous third-generation cephalosporin

Variceal Bleeding
- Caused by portal hypertension
- Compounded by coagulopathy
- Develops in approximately 65% of persons with advanced cirrhosis, causing massive hemorrhage and death in half
- Tx:
  - B-Adrenergic blocking drugs are used to lower portal venous pressure
  - Administration octreotide or vasopressin
  - Balloon tamponade, endoscopic injection sclerotherapy, vessel ligation or esophageal transection

Portosystemic Shunts
Invasive Treatments:
- SB Tube
- EGD with Banding
- Transjugular Intrahepatic Portosystemic Shunt

Hepatic Encephalopathy
- Neural disturbance
- Causes
  - Blood bypasses the liver
  - Liver is unable to convert ammonia to urea
  - Ammonia moves into general circulation and crosses the blood-brain barrier
- Early sign: asterixis
- Late signs: decerebrate rigidity, deep coma
- Develops in approximately 10% of patients
- Treatment: Lactulose and/or Rifaximin, Neomycin, Flagyl

Grades of Encephalopathy
- **Grade I**: Tremors, slurred speech, impaired decision making
- **Grade II**: Drowsy, asterixis
- **Grade III**: Confusion, somnolence
- **Grade IV**: Comatose

Renal Dysfunction
- **Hepatorenal Syndrome (HRS)** is the development of renal failure with normal renal histology in the absence of nephrotoxic drugs, sepsis, intrinsic renal disease and hypovolemia.
- Occurs in up to 39% of patients within 5 years
- Intense renal vasoconstriction occurs → decreased total renal blood flow
  - An acute decrease in cardiac output is often the precipitating event
- Treatment: Albumin infusion in combination with a vasoconstrictor regimen for 7-14 days
  - Continuous Renal Replacement Therapy (CRRT)

Indications for Transplantation
- Acute & Fulminant Liver Failure
Indications for Liver Transplantation

- **Acute liver failure (ALF):**
  - Defined by several specific features
  - Illness less than 26 weeks duration
  - Absence of chronic liver disease
  - Acute hepatitis (elevation in AST/ALT) accompanied by elevation in INR >1.5

- **Fulminant liver failure:**
  - Far less frequent than ALF
  - Defined by the sudden onset of hepatic encephalopathy developed within 2 weeks of the onset of jaundice

Indications for Liver Transplantation

- **Common Causes of Fulminant & Acute Liver Failure**
  - Infective (Viral: HAV, HBV)
  - Drugs (Acetaminophen, anti-epileptics, etc)
  - Toxins (Mushrooms, ecstasy, etc)
  - Vascular (Budd Chiari Syndrome)
  - Metabolic (Wilson’s Disease)

King’s College Criteria for ALF

- Best known and most utilized system
- Criteria indicates which acute liver failure patients will require transplantation due to increased risk of mortality
- Acetaminophen-Induced ALF:
  - Arterial pH <7.3
  - INR >6.5 (PT >100 seconds)
  - Serum creatinine >3.4 mg/dL
  - Grade III or IV encephalopathy

- Non-acetaminophen-induced ALF:
  - INR >6.5 (PT >100 seconds)
  - OR
  - Any three of the following:
    - Drug toxicity indeterminate cause of ALF
    - Age <10 years or > 40 years
    - Jaundice to coma interval >7 days
    - INR > 3.5 (PT >50 seconds)
    - Serum Bilirubin 17.5 mg/dL

Prognostic Markers ALF

- Factor 5 deficiency
- Hyperphosphatemia
- Lactic acid
- Creatinine (Renal failure)
- Time to encephalopathy

Transplantation Recommended:

- Patient fails to respond to medical management
- Meet King’s Criteria
- Severe synthetic dysfunction develops
- Appropriate psychosocial support structure
- Has not developed irreversible brain injury
Molecular Adsorbent Recirculating System (MARS)

Chronic Liver Failure

Causes of Chronic Liver Disease
- Hepatitis C
- Alcohol Cirrhosis
- Nonalcoholic Steatohepatitis (NASH)
- Hepatitis B
- Autoimmune Hepatitis
- Primary Biliary Cirrhosis (PBC)
- Primary Sclerosing Cholangitis (PSC)

Adult Liver Transplants (in thousands)

Timeline to Transplant:
- Development of cirrhosis ~ 20 years
- Development of complications
- Compensated Cirrhosis
- Decompensated Cirrhosis
- Median survival ~ 10 years
- Median survival ~ 2 years
- Orthotopic liver transplant (OLT)
The List & Organ Allocation System

Model for End-Stage Liver Disease:
- MELD is a mathematical equation used to predict mortality for patients with chronic liver disease
- Scores range from 6-40
- Lab Values Utilized:
  - Creatinine
  - Bilirubin
  - INR
- Three month mortality
  - MELD <9 = 1.9%
  - MELD >40 = 71%

Indications for Liver Transplantation
- MELD greater than 15 or HCC
- With MELD ≤15, mortality risk from transplant is equal to that of liver disease
- Manifestations of Hepatic Decompensation
  - Esophageal or Gastric Variceal Bleeding
  - Hepatic Encephalopathy (severe recurrent)
  - Spontaneous Bacterial Peritonitis
  - Significant Ascites

Contraindications to Transplantation

Organ Procurement Regions:

Days to Transplantation by Region

2007, OPTN/SRTR Data, Figure V-13
A National Perspective

So what is the need?

Death Rates per 1,000 Patient Years

<table>
<thead>
<tr>
<th>MELD score, no exceptions</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
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<tr>
<td>6 to 10</td>
<td>36</td>
<td>37</td>
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<tr>
<td>11 to 14</td>
<td>72</td>
<td>68</td>
<td>72</td>
<td>68</td>
<td>69</td>
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<tr>
<td>15 to 20</td>
<td>157</td>
<td>168</td>
<td>154</td>
<td>141</td>
<td>125</td>
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<tr>
<td>21 to 30</td>
<td>794</td>
<td>739</td>
<td>721</td>
<td>722</td>
<td>956</td>
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<tr>
<td>31 to 40</td>
<td>4.978</td>
<td>4.995</td>
<td>4.981</td>
<td>3.838</td>
<td>3.756</td>
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</table>

Scarce Resource

- Efforts to Decrease Organ Shortage:
  - Increase Donor Rates
  - Increase Awareness
  - 'Opt Out' System
  - Improve Hospital System
  - Use of Extended Criteria Donors (ECD)
  - Domino Liver Transplants
  - Splitting of Organs
  - Living Donors
The Operative Procedure

Intra-Operative View:

3 Phases of OLT:
- Pre-Anhepatic Phase
- Anhepatic Phase
- Neohepatic Phase

Pre-Anhepatic Phase:
- Mobilization of the native liver
- Isolation of the supra and infrahepatic vena cava, portal vein, and hepatic artery
- Division the bile duct
- Coagulopathy and portal hypertension may yield large blood loss
- Clamps applied to the remaining vasculature

Anhepatic Phase:
- Native liver is extracted
- Orthotopic placement of donor organ
- Donor liver is anastamosed
  - Suprahepatic Cava
  - Infrahepatic Cava
  - Portal Vein
  - Hepatic Artery
- Administration of HBIG for HBV patients

Anhepatic Phase:
- Occlusion of IVC
  - Decreased venous return to heart → Decreased cardiac output
  - Increase in bleeding secondary to engorged portal vasculature
  - Increased in renal venous pressure
**Suprahepatic Cava**
- Donor
- Recipient

**Infrahepatic Cava**
- Donor
- Recipient

**Portal Vein**
- Donor
- Recipient

**Arterial Anastomosis**
- Donor
- Recipient

### Anhepatic Phase:
- **Venovenous Bypass:**
  - Air embolus
  - Thromboembolism
  - Hypothermia
  - Exsanguination
  - Trauma to vasculature

### Neohepatic Phase:
- Vascular clamps are removed
- Transplanted liver is reperfused
- Hemodynamic instability may follow
  - Hypotension
  - Cardiac arrhythmias
  - Electrolyte abnormalities, especially hyperkalemia and hypocalcemia
- Biliary anastomosis completed
Neohepatic Phase:

- Choledochocholedocostomy
- Duct-to-duct anastamosis
- Choledochujejunostomy
  - Used when:
    - Native bile duct is diseased
    - Significant duct disparity is noted
    - Remaining bile duct is inadequate
    - Donor bile duct is anastomosed to a portion of the jejunum
    - Roux-en-Y

Roux Limb:

‘Piggyback’ Method:

Warm & Cold Ischemic Time:

Cold Ischemic Time:
- Preservation of the hepatic allograft with concurrent use of Wisconsin solution and hypothermia

Warm Ischemic Time:
- The time between the initiation of vena caval anastamosis and the reperfusion of the portal vein during which rewarming occurs

Warm & Cold Ischemic Time:

- Warm:
  - Largest impact on graft failure
- Cold:
  - Bacterial infection
  - Biliary and hepatic artery complications
  - Primary Non Function (PNF)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Level</th>
<th>Graft Failure</th>
<th>Mortality Rate</th>
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<tr>
<td>Donor age (yrs)</td>
<td>1.2</td>
<td>1.3 (0.79)</td>
<td>1.3 (0.7)</td>
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<tr>
<td>Donor weight (kg)</td>
<td>1.1</td>
<td>1.1 (0.9)</td>
<td>1.1 (0.8)</td>
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<tr>
<td>Warm ischemic time (min)</td>
<td>1.2</td>
<td>1.4 (0.9)</td>
<td>1.4 (0.8)</td>
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N = 1153
Cold vs Warm Ischemic Time

Postoperative Graft Loss According to Cold and Warm Ischemic Time

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<tr>
<th>Group</th>
<th>Cold vs Warm</th>
<th>Cold vs Warm</th>
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<tbody>
<tr>
<td>A</td>
<td>40.0%</td>
<td>42.9%</td>
</tr>
<tr>
<td>B</td>
<td>10.0%</td>
<td>11.1%</td>
</tr>
<tr>
<td>C</td>
<td>0.0%</td>
<td>9.8%</td>
</tr>
<tr>
<td>D</td>
<td>0.0%</td>
<td>0.0%</td>
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</table>

N=186

Conventional vs Piggyback:

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<tr>
<th>Parameter</th>
<th>Piggyback (n=918)</th>
<th>Conventional (n=149)</th>
<th>p value</th>
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<tbody>
<tr>
<td>Operative time (min)</td>
<td>607.5±177.8</td>
<td>640.6±183.3</td>
<td>0.037761</td>
</tr>
<tr>
<td>WIT (min)</td>
<td>34.7±10.7</td>
<td>44.9±12.7</td>
<td>0.000000</td>
</tr>
<tr>
<td>Blood requirement (units)</td>
<td>13±11.5</td>
<td>17±12.7</td>
<td>0.000020</td>
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<tr>
<td>Usage of V-V bypass</td>
<td>Yes</td>
<td>737 (80.3%)</td>
<td>No</td>
</tr>
</tbody>
</table>

Nishida, 2006, International Hepato-Pancreato-Biliary Association

Post Operative Management

Patient Assessment:
- Vital Signs
- Mental Status
- Urinary Output
- Abdominal Drain Fluid (if present)

Ensuring Stability:

Airway:
- Ensure patent airway
- Assess ABGs for acidosis
- Stat CXR
  - Pulmonary status
  - Line and tube placement

Post Operative Hemodynamic Goals:
- CVP > 6mmHg
- MAP > 60mmHg
- Maintain normothermia without correcting hypothermia too quickly

Resuscitation Algorithm:

OLT Hypotension/Hypovolemia Algorithm

**CVP ≤ 6 or MAP ≤ 60**

- Hgb < 8.07
  - Transfuse 1 Unit PRBCs
  - Albumin < 2.07
    - 500mL 5% Albumin
    - 1L 3% NS
- Yes
  - Na < 1307
    - NS
  - 1L NS
  - Recheck CBC whenever intervention to maintain CVP or MAP is needed

- No
  - No

Post Operative Hemodynamic Goals:
- CVP > 6mmHg
- MAP > 60mmHg
- Maintain normothermia without correcting hypothermia too quickly
Lab Interpretation:
Liver Enzyme Trends:
- ALT/AST peak
- Steady decline
Assessment of Synthetic Function:
- INR
- Bilirubin
Renal Function:
- Creatinine
Abdominal Ultrasound

Complications:
Hepatic Artery Thrombosis
Hemorrhage
Primary Non Function (PNF)
Portal Vein Thrombosis
Biliary Complications
Infection
Graft Versus Host Disease (GVHD)
Organ Rejection

Hepatic Artery Thrombosis:
- Thrombosis occurs yielding loss of approximately 50% of the liver’s oxygenation
- S/Sx
  - Elevation in ALT/AST, bilirubin & INR
  - ALT/AST lack downward trend
  - Change in clinical picture of patient
- Dx
  - STAT Abd US with dopplers

Hemorrhage:
- First 48 hours
- Causes:
  - Coagulopathy
  - Technical problem
- Interventions:
  - Blood product administration
  - Frequent H&H monitoring
  - Assessment of drain fluid
  - Possible abdominal re-exploration

Primary Non Function (PNF):
- Early Indicators of PNF:
  - Organ:
    - Quantity and quality of bile production
    - Increased edema of the organ
    - Abnormal color or mottling of the organ
  - Patient
    - Prolonged hypothermia
    - Decrease in urine output
    - Hemodynamic instability
  - Lab abnormalities
    - Elevated: ALT, AST, bilirubin, INR, lactate, creatinine, potassium, phosphorus
    - Decreased: glucose
Primary Non Function (PNF):
- Possible Contributing Factors:
  - Donor Quality
    - Steatosis
    - Increased donor age
    - Prolonged hospital stay
    - Prolonged CIT
  - Operative Complications
    - Prolonged WIT
    - Substantial blood loss

Portal Vein Thrombosis:
- Less common than HAT
- In the immediate postoperative phase, it is usually secondary to technical problems
- S/Sx:
  - Mild elevation ALT/AST
  - Possible intestinal ischemia
  - Portal hypertension

Biliary Complications:
- May occur at any stage following transplantation
- S/Sx:
  - Jaundice
  - Fever
  - Pruritus
- Labs:
  - Elevated alkaline phosphatase
  - Rise in bilirubin
  - Increase in gamma glutamyltransferase (GGT)

Biliary Leaks:
- Leak Sites:
  - At the biliary anastomosis
    - Bile may be seen in drains or seeping through surgical incision
    - Within the liver (thrombosis)
  - Patient may present with peritonitis and sepsis
- Treatment for Anastomotic Leaks:
  - Percutaneous stent placement
  - Stent placement via endoscopic retrograde cholangiopancreatography (ERCP)
  - Severe leaks may require Roux-en-Y

Primary Non Function (PNF):
- Prevalence:
  - 2-5% with variation between transplant centers
- Treatment:
  - Retransplantation
Biliary Obstructions:
- Usually associated with technical complications or ischemia
- Dx:
  - US or MRCP may depict biliary dilation
  - Cholangiogram is often required to display obstruction site
- Treatment typically requires stent placement or occasional biliary revision

Infection:
- Increased risk due to immunosuppression
- In the immediate post-operative phase, infections commonly gram negative and nosocomial
- Fungal infections more common in:
  - Patients transplanted for ALF
  - Patients admitted to ICU prior to transplant
  - Patients receiving renal support pre-transplant
  - Retransplantation
  - Patients receiving high dose immunosuppression

Infection:
- Bacterial
  - Enteric gram negative bacteria
  - Pseudomonas aeruginosa
  - Legionella species
  - Listeria monocytogenes
  - Salmonella species
  - Mycobacterium tuberculosis
  - Nontuberculous mycobacteria

- Viral
  - Cytomegalovirus
  - Epstein-Barr virus
  - Herpes simplex virus
  - Varicella zoster virus
  - Human herpesvirus-6
  - Papillomavirus
  - Adenoviruses
  - Respiratory syncytial virus
  - Influenza virus
  - Enterovirus
  - Parvovirus

Infection:
- Fungal:
  - Candida species
  - Aspergillus species
  - Cryptococcus neoformans
  - Pneumocystis carinii
  - Coccidioides immitis
  - Histoplasma capsulatum
  - Blastomyces dermatitidis

Infection:
- Parasitic:
  - Toxoplasma gondii
  - Cryptosporidium
  - Strongyloides stercoralis

Organ Rejection:
- Hyperacute
  - Within minutes to days of transplantation
  - Extremely rare

- Acute
  - Most commonly seen in the first 7-14 days following transplant but may occur as far out as 1 year
  - Seen in 20-40% of patients, especially during immunosuppression taper

- Chronic
  - Less frequent and occurs over prolonged period
  - Seen in 5-15% of patients
  - Uncommonly requires retransplantation

Organ Rejection:
- Acute
  - Diagnosed based on clinical picture with confirmation by liver biopsy

- Labs
  - Elevated ALT/AST, bilirubin and INR

- Treatment
  - High dose, intravenous glucocorticosteroid x3 days
  - Followed by rapid steroid taper
  - 90% will respond to steroid treatment
  - Non-responders must be treated with Thymoglobulin
Calcineurin Inhibitors:

- Cyclosporine (Neoral, Gengraf)
  - First CNI used in transplant
- Tacrolimus (Prograf):
  - Approximately 100 times more potent than CSA
  - Administered q12 hours
  - Serum trough drawn daily
  - Ideal serum level varies patient to patient depending on clinical picture and co-administration of other immunosuppressive agents

Calcineurin Inhibitors:

- Side Effects:
  - 3 Ns:
    - Neurotoxicity
    - Nephrotoxicity
    - Neoplasm
  - 5 Hs:
    - Hypertension
    - Hyperglycemia
    - Hyperkalemia
    - Hirsutism
    - Hyperplasia (gingival)

Immunosuppression:

Induction Agents:

- Used when patient has creatinine greater than 1.6
- Allows delay of CNI administration and chance for renal recovery
- 3 most commonly used drugs
  - Simulect (basiliximab)
  - Thymoglobulin (anti-thymocyte globulin)
  - Methylprednisolone

Antiproliferatives:

- Typically used in conjunction with CNI
- Side effects include thrombocytopenia
  - Dosage starts low
  - Increase dose as the platelet count begins to recover
- 2 most common:
  - CellCept (mycophenolate mofetil)
  - Azathioprine

Others:

Rapamycin (Sirolimus, Rapamune):

- Decreases T cell proliferation
- May be used in place of CNI
- Used in the HCC population due to its prophylactic effect on cancer cells
- Side Effects
  - Hyperlipidemia
  - Proteinuria
  - Severe, non-healing wounds
  - Cannot be used until 3 months post OLT
  - Initiate alternate IS prior to elective surgery

Patient and Graft Survival:

(Humanism)
Case Review #1

- ML is 24 year old female admitted with ALF secondary to unintentional acetaminophen toxicity.
- Clinical Picture:
  - Grade IV encephalopathy
  - Intubated to protect airway
  - CRRT initiated for renal failure
- Labs 36 hours post ingestion:
  - pH 7.21
  - INR 7.2 and rising
  - Bilirubin 3.8 and climbing
  - ALT/AST 12971/9135

As the patient’s RN, what are your main objectives?

- Maintain adequate serum glucose levels
- Ensure airway is patent
- Correct coagulopathy prior to placing HD catheter
- Start CRRT in a timely manner to correct acidosis in conjunction with mechanical ventilation
- Administer NAC (N-acetylcysteine) IV as ordered

Does ML meet King’s Criteria to be evaluated? **Yes**

An OLT workup is completed and she is listed

26 hours following listing the liver transplant coordinator on-call receives an offer, which is accepted by the physician

What medication, other than immunosuppression, should the nurse expect, knowing she was listed for ALF and in the ICU before transplantation? **Antifungal**

Case Review #2

- JB is a 47 year old male transplanted for HCV acquired in the ’80s following a blood transfusion
- He has been out of the OR for 6 hours, remains intubated with periodic hypotension noted.

**Post-Op Labs: 6 Hours Post OLT:**

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<tr>
<th></th>
<th>6 Hours Post OLT</th>
<th>1267/1051</th>
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<tr>
<td>ALT/AST</td>
<td>857/694</td>
<td>1267/1051</td>
</tr>
<tr>
<td>Bilirubin</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>INR</td>
<td>2</td>
<td>3.1</td>
</tr>
<tr>
<td>Creatinine</td>
<td>1.9</td>
<td>2.3</td>
</tr>
</tbody>
</table>

What are some possible concerns with the patient’s lab results? **PNF or HAT**

What do you request from the physician? **Abdominal US with Dopplers**

The ultrasound is completed with no hepatic artery visible. The patient is taken to the OR and the thrombus is removed.

Current Supply and Demand:

- 89,000 people in the USA awaiting organ transplants
- 17,000 on liver list alone
- Every 13 minutes a new name is added to the waiting list
- 7,000 people die annually on waiting list
- Register as an organ donor
Transplant Questions:

Bibliography:

- Scientific Registry of Transplant Recipients. www.ustransplant.org