The Nuts and B-OLTS of Liver Transplantation

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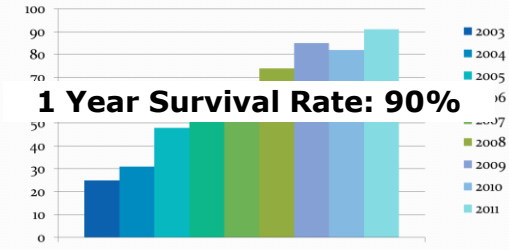
Objectives:

- 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

University of Kansas Hospital:



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
  - Worlds 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 worlds pioneering programs

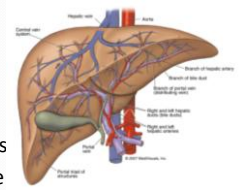
Picture available at: Nature. com

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?

Blood Flow



- 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

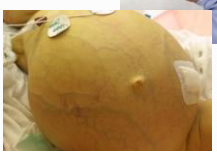
- Liver enzymes are *NOT* liver function tests
  - Enzymes perform functions
  - Elevations are markers of injury
- Liver function tests might be better represented in:
  - Bilirubin
  - INR
  - Albumin
  - Glucose (in acute liver failure)
  - Drug metabolism (certain drugs like lidocaine)

Bile Duct Injury

- Hepatic Excretory System
  - Serum Bilirubin
    - Used to assess the livers 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

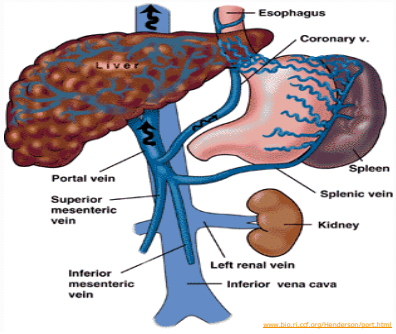
Coagulopathy

- 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 >12mm Hg (normal 5-10mm Hg)
- Caused by Prehepatic, Intrahepatic and Posthepatic obstructions
- The major complications are ascites, splenomegaly and bleeding from esophageal varices.

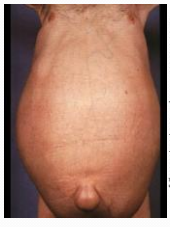
Portal Hypertension



www.nlm.nih.gov/Bioethics/portal.html

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



Picture available at: www.liversurvey.com/ascites.jpg

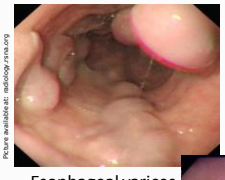
Spontaneous Bacterial Peritonitis

- 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

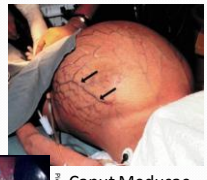
- Caused by portal hypertension
- Compounded by coagulopathy
- Develops in approximately 65% of persons with advanced cirrhosis, causing massive hemorrhage and death in half
- Tx:
  - B-Adrenergic blocking drugs are used to lower portal venous pressure
  - Administration octreotide or vasopressin
  -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

Portosystemic Shunts



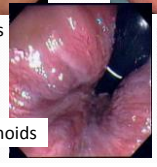
Picture available at: www.ucsf.edu/gi/

Esophageal varices



Picture available at: radiopaedia.org

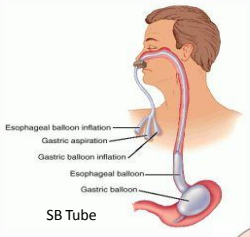
Caput Medusae



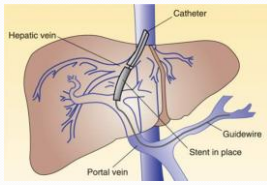
Picture available at: www.uhsch.com

Hemorrhoids

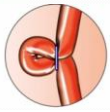
Invasive Treatments:



SB Tube



Transjugular Intrahepatic Portosystemic Shunt



EGD with Banding

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

King's College Criteria for ALF

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

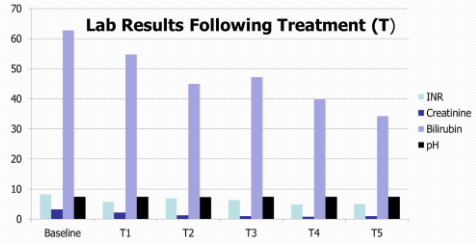
- Factor 5 deficiency
- Hyperphosphatemia
- Lactic acid
- Creatinine (Renal failure)
- Time to encephalopathy

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)

Molecular Adsorbent Recirculating System (MARS)



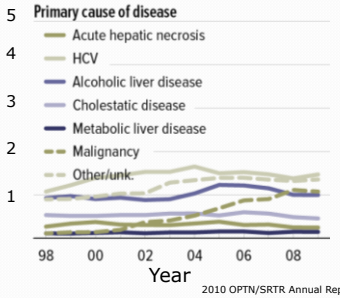
Chronic Liver Failure

Causes of Chronic Liver Disease

- Hepatitis C
- Alcohol Cirrhosis
- Nonalcoholic Steatohepatitis (NASH)
- Hepatitis B
- Autoimmune Hepatitis
- Primary Biliary Cirrhosis (PBC)
- Primary Sclerosing Cholangitis (PSC)

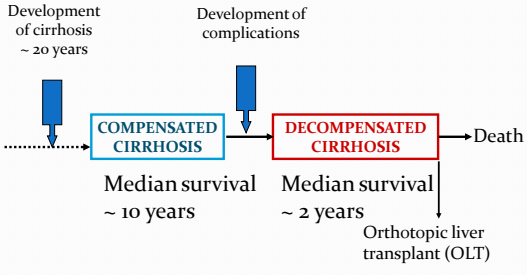
Adult Liver Transplants

(in thousands)



2010 OPTN/SRTR Annual Report, 2011 Table L1 4.2

Timeline to Transplant:



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

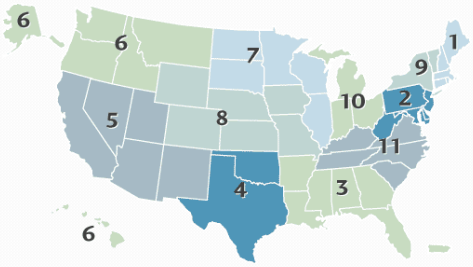
Relative Contraindications

- Extrahepatic sepsis
- Moderate Pulmonary HTN (MPAP 35-50mmHg)
- Lack of psychosocial support
- Advanced cardiopulmonary disease
- Extensive thrombosis to the portal circulation
- HIV (with CD 4+ <100)
- Age > 75 years
- Morbid obesity
- Advanced malnutrition

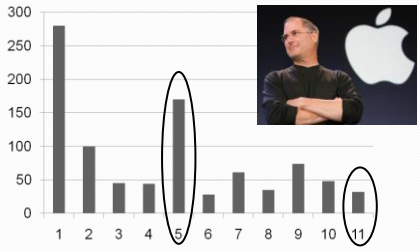
Absolute Contraindications

- Severe Pulmonary HTN (MPAP> 50mmHg)
- Substance abuse
- Extrahepatic malignancy
- Uncontrolled sepsis
- Inability to demonstrate compliance

Organ Procurement Regions:

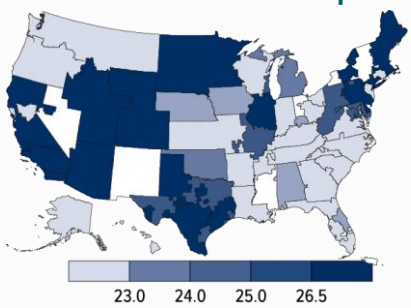


Days to Transplantation by Region



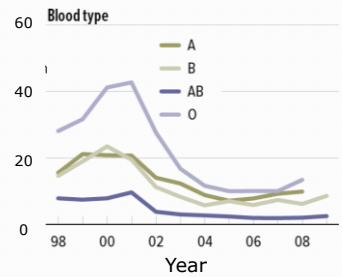
2007, OPTN/SRTR Data, Figure V-13

Median MELD Scores Transplanted:



2009 OPTN/SRTR Annual Report 2011 Table L1.44

Median Months to Transplantation:

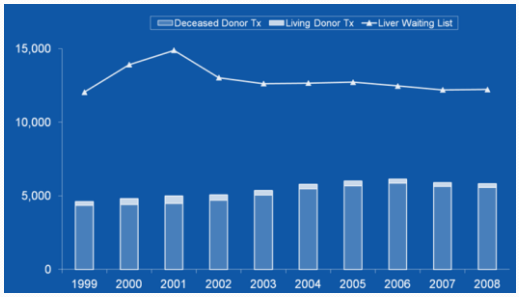


2010 OPTN/SRTR Annual Report 2011 L1 1.9

A National Perspective

So what is the need?

Disparity Between Supply and Demand:



2009, OPTN/SRTR Annual Report 2008 Table 1.7, 9.1a, 9.1b

Death Rates per 1,000 Patient Years

	2003	2004	2005	2006	2007
MELD score, no exceptions					
6 to 10	38	37	36	36	35
11 to 14	72	68	72	66	69
15 to 20	157	166	154	141	125
21 to 30	794	739	721	722	596
31 to 40	4,978	4,969	4,581	3,828	3,758

2008, SRTR Data, Table IV-10

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

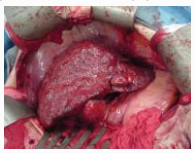
Intra-Operative View:

3 Phases of OLT:

- Pre-Anhepatic Phase
- Anhepatic Phase
- Neohepatic Phase

Pre-Anhepatic Phase:

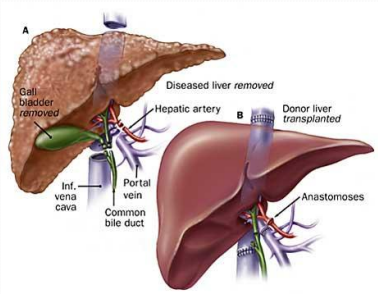
- Mobilization of the native liver
  - Isolation of the supra and infrahepatic vena cava, portal vein, and hepatic artery
  - Division the bile duct
  - Coagulopathy and portal hypertension may yield large blood loss
  - Clamps applied to the remaining vasculature



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:

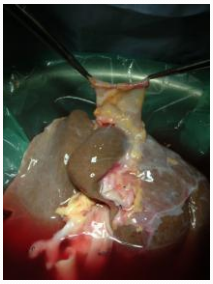


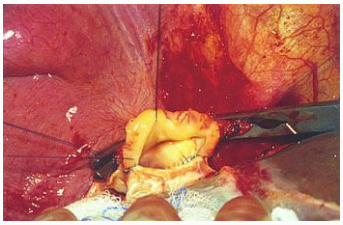
Anhepatic Phase:

- 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

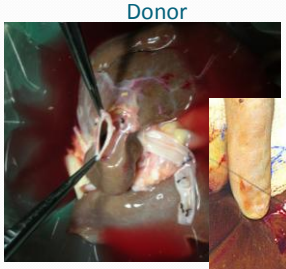
Donor Recipient

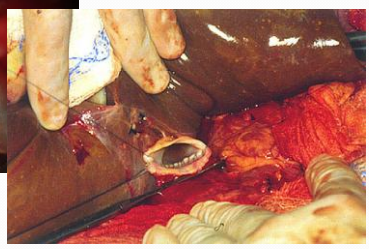




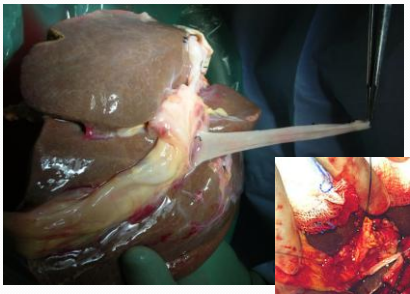
Infrahepatic Cava

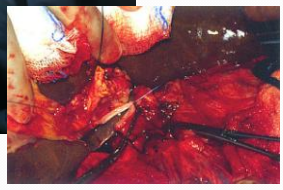
Donor Recipient



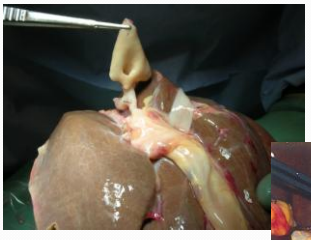


Portal Vein



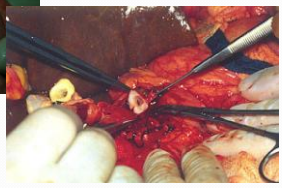


Arterial Anastomosis



Recipient

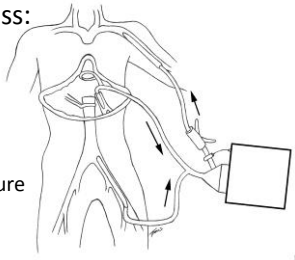
Donor



Anhepatic Phase:

Venovenous Bypass:

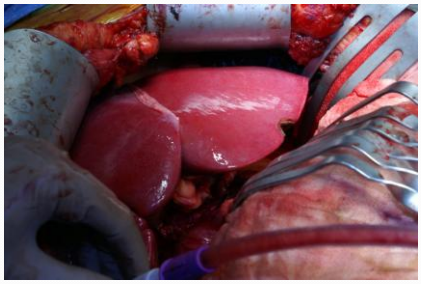
- Air emobolus
- Thromboembolism
- Hypothermia
- Exsanguination
- Trauma to vasculature



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

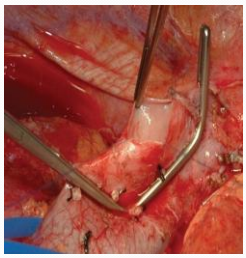


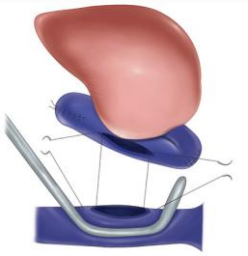
Neohepatic Phase:

- Choledochocholedocostomy
  - Duct-to-duct anastamosis
- Choledochojejunostomy
  - 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)

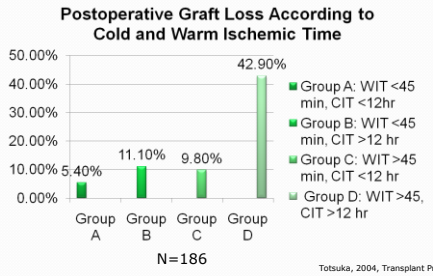
TABLE 1. Multivariate Predictors of Graft and Recipient Survival

Variable	Level	Graft Failure	Mortality Ratio
Donor age (yr)	>55	1.2 (P = 0.20)	1.3 (P = 0.07)
Donor hospital stay (days)	>5	1.3 (0.03)	1.5 (P = 0.002)
Cold ischemia (hr)	>10	1.2 (0.08)	1.4 (P = 0.006)
Warm ischemia (m)	>40	1.8 (<0.0001)	1.7 (P = 0.001)
Recipient age (yr)	>55	1.5 (0.008)	1.5 (P = 0.008)
Recipient urgency	Yes vs. no	1.3 (0.008)	1.5 (P = 0.0006)

N = 1153

Cameron, 2006, Annals of Surgery

Cold vs Warm Ischemic Time



Totsuka, 2004, Transplant Proceedings

Conventional vs Piggyback:

Parameter	Piggyback (n=918)	Conventional (n=149)	p value
Operative time (min)	607.5±177.8	640.6±183.3	0.037761
WIT (min)	34.7±10.7	44.9±12.7	0.000000
Blood requirement (units)	13.4±11.5	17.6±17.8	0.000202
Usage of V-V bypass			
Yes	181 (19.7%)	118 (79.2%)	0.00000
No	737 (80.3%)	31 (20.8%)	

Nishida, 2006, International Hepato-Pancreato-Biliary Association

Post Operative Management

Post Operative Management:

Patient Assessment:

- Vital Signs
- Mental Status
- Urine Output
- Abdominal Drain Fluid (if present)

Ensuring Stability:

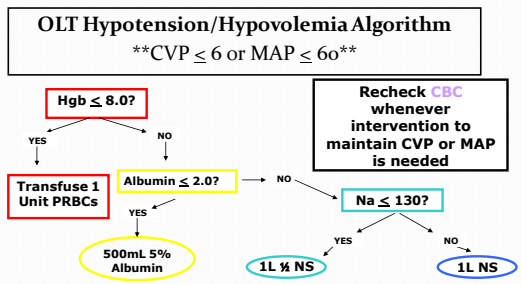
Airway:

- 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:



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

Hepatic Artery Thrombosis (HAT):

- Intervention:
  - Emergent situation requiring transfer to OR for revascularization of liver
- Progression:
  - Parenchymal infarction
  - Necrosis
  - Sepsis
  - Need for retransplantation

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

Primary Non Function (PNF):

- Prevalence:
  - 2-5% with variation between transplant centers
- Treatment:
  - Retransplantation

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

Portal Vein Thrombosis:

- Dx by abdominal US with dopplers
- Interventions:
  - Early - thrombectomy
  - Late – manage complications of portal hypertension
  - Anticoagulation

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 anastamosis
    - 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

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
Coccidiodies immitis
Histoplasma capsulatum
Blastomyces dermatitidis

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
Hirtuism
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:

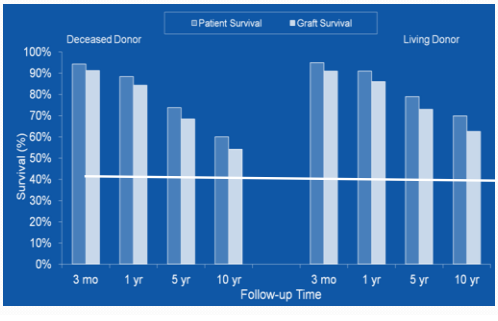
- Typically used in conjunction with CNI
- Side effects include thrombocytopenia
  - Dosage starts low
  - Increase dose as the platelet count begins to recover
- 2 most common:
  - CellCept (mycophenolate mofetil)
  - Azathioprine

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:



2009, SRTR Data, Tables 9.10a, 9.10b, 9.14a, 9.14b

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

Case Review #1

- **As the patient's RN, what 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

Case Review #1

- 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:
ALT/AST:	857/694	1267/1051
Bilirubin:	8	10
INR:	2	3.1
Creatinine:	1.9	2.3

Case Review #2:

- 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:

- Brunicardi FC, Anderson DK, Billiar TR, Dunn DL, Hunter JG, Matthews JB, Pollock RE: *Schwartz's Principals of Surgery,* 9th Edition: http://www.accessmedicine.com
- Bufton, Sally, Karen Emmett, and Anne-Marie Byerly. *Liver Transplantation*. *Core Curriculum for Transplant Nurses*. Philadelphia: Mosby Elsevier, 2008. 423-52. Print.
- Cameron, Andrew M., R. Mark Ghobrial, Hansan Yersiz, Douglas G. Farmer, Gerald S. Lipshutz, Sherilyn A. Gordon, Michael Zimmerman, Johnny Hong, Thomas E. Collins, Jeffery Gornbein, Farin Amersi, Michael Weaver, Carlos Cao, Tony Chen, Jonathan Hiatt, and Ronald W. Busuttil. "Optimal Utilization of Donor Grafts With Extended Criteria." *Annals of Surgery* 243.6 (2006): 748-55. Print.
- Costello, Agnes, and Glen J. Pearson. "Transplant Complications: Infectious Disease." *Core Curriculum for Transplant Nurses*. Philadelphia: Mosby Elsevier, 2008. 143. Print.
- Gilroy, Richard K. "Liver Transplantation." Solid Organ Transplant Lecture Series. University of Kansas Medical Center, Kansas City, Kansas. 24 Mar. 2010. Lecture.
- LaPointe Rudow, Dianne, and Michael J. Goldstein. "Critical Care Management of the Liver Transplant Recipient." *Critical Care Nursing Quarterly* 31.3 (2008): 232-43. Print.
- LaRusso, Nicholas F., Benjamin L. Shneider, Dennis Black, Gregory J. Gores, Stephen P. James, Edward Doo, and Jay H. Hoofnagle. "Primary Sclerosing Cholangitis: Summary of a Workshop." Hepatology 44 (2006): 746+.
- McPhee, S. J., and M. A. Papadakis. "Chapter 16. Liver, Biliary Tract, and Pancreas Disorders." Current Medical Diagnosis and Treatment. 49th ed. The McGraw-Hill Companies, 2010. 1-131.

Bibliography:

- Nishida, Seigo, Noboru Nakamura, Anil Vaidya, David M. Levi, Tomoaki Kato, Jose R. Nery, Juan R. Madariaga, Enrique Molina, Phillip Ruiz, Anthony Gyamfi, and Andreas Tzakis. "Piggyback Technique in Adult Orthotopic Liver Transplantation: an Analysis of 1067 Liver Transplants at a Single Center." *International Hepato-Pancreato-Biliary Association* 8.3 (2006): 182-88. Print.
- Polson, Julie, and William M. Lee. "AASLD Position Paper: The Management of Acute Liver Failure." Hepatology 41 (2005): 1179-197.
- Porth, Carol, and Glenn Matfin, eds. Pathophysiology: Concepts of Altered Health States. 8th ed. Philadelphia, PA: Wolters Kluwer Health/Lippincott Williams & Wilkins, 2009.
- Sass, David A., and A. Obaid Shakil. "Fulminant Hepatic Failure." *Liver Transplantation* 11.6 (2005): 594-605. Print.
- Smith, Susan L., and Maria Ciferni. "Liver Transplantation." *Tissue and Organ Transplantation: Implications for Professional Nursing*. St. Louis: Mosby, 1990. 273. Print.
- Totsuka, E., JJ Fung, K. Hakamada, M. Ohashi, K. Takahashi, M. Nakai, S. Morohashi, H. Morohashi, N. Kimura, A. Nishimura, Y. Ishizawa, H. Ono, S. Narumi, and M. Sasaki. "Synergistic Effect of Cold and Warm Ischemia Time on Postoperative Graft Function and Outcome in Human Liver Transplantation." *Transplant Proceedings* 37.7 (2004): 1955-958. Print.
- Trotter, James F. "Practical Management of Acute Liver Failure in the Intensive Care Unit." *Current Opinion in Critical Care* 15 (2009): 163-67. Print.
- Scientific Registry of Transplant Recipients. www.ustransplant.org
- United Network of Organ Sharing. www.unos.org