AN INTRODUCTION TO LIVER TRANSPLANT

Basem Alkurdi, MD, FACP
Medical Director of Liver Transplant
Transplant Institute of Florida at Largo Medical Center
Learning Objectives:

- Recognize the complications of cirrhosis
- Identify the indications for liver transplant
- Understand the use of the MELD score as a continuous disease severity scale of cirrhosis
- Understand the need for a MELD exception
Natural History of Cirrhosis
Cirrhosis is the “End Stage” of Any Chronic Liver Disease

- Alcohol
- Viral (hepatitis C and/or B)
- Non-alcoholic steatohepatitis
- Cholestatic (PBC, PSC)
- Autoimmune hepatitis
- Other*

*eg, hemochromatosis, alpha-1-antitrypsin deficiency; drug-induced liver injury

Survival in Any Chronic Liver Disease Depends on Presence (or Absence) of Cirrhosis

Hepatitis C

Non-alcoholic steatohepatitis


Cirrhosis is Classified into Two Main Prognostic Stages

Chronic liver disease → Compensated cirrhosis → Decompensated cirrhosis → Death
Decompensated Cirrhosis is Defined by the Development of Clinical Complications

- Variceal hemorrhage
- Ascites
- Encephalopathy
- Jaundice

Chronic liver disease → Compensated cirrhosis → Decompensated cirrhosis → Death
Complications of Cirrhosis Result from Portal Hypertension or Liver Insufficiency

- Cirrhosis
- Portal hypertension
  - Variceal hemorrhage
  - Ascites
- Liver insufficiency
  - Encephalopathy
  - Jaundice
There is a Stage of “Further” Decompensation

Acute Liver Injury
- Alcoholic hepatitis
- Acute/flare viral hepatitis
- Drug-induced liver injury
- Liver ischemia

Bacterial Infections

Acute Insult

Compensated cirrhosis
- No varices
- Varices

Decompensated cirrhosis
- VH
- Ascites
- HE

Further decompensation
- Recurrent VH/HE
- Refractory ascites
- Hyponatremia
- HRS
- Coagulopathy
- Jaundice

Death

VH = variceal hemorrhage
HE = hepatic encephalopathy
Survival is Entirely Different Between Compensated and Decompensated Cirrhosis

Median survival >12 yrs

Median survival ~ 2 yrs

D'Amico et. al., J Hepatol 2008;44:217.
CTP (Child-Turcotte-Pugh) is a Prognostic Score in Cirrhosis

<table>
<thead>
<tr>
<th></th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Encephalopathy</td>
<td>None</td>
</tr>
<tr>
<td>Ascites</td>
<td>None</td>
</tr>
<tr>
<td>PT (sec prolonged) or INR</td>
<td>&lt;4</td>
</tr>
<tr>
<td>or INR</td>
<td>&lt;1.7</td>
</tr>
<tr>
<td>Bilirubin</td>
<td>&lt;2</td>
</tr>
<tr>
<td>Albumin</td>
<td>&gt;3.5</td>
</tr>
</tbody>
</table>

Child A: **5-6 pts**  Compensated  
Child B: **7-9 pts**  Start transplant evaluation  
Child C: **10-15 pts**
When to Refer for Liver Transplant

- Diagnosis of cirrhosis does not necessarily imply need for transplant
  - Many patients with cirrhosis remain well-compensated for many years

- Liver transplant needs to be considered once a major complication occurs:
  - Ascites, variceal hemorrhage, hepatic encephalopathy
  - Hepatocellular carcinoma not amenable to resection
  - Worsening hepatocellular function (jaundice, coagulopathy)
Liver Transplant in the United States

- Currently ~6,000 liver transplants are performed in the United States per year
- 16,000 patients on waiting list for transplant
- 1 year recipient survival > 90%, 5 year > 75%
Indications for Liver Transplant

- Decompensated cirrhosis
- Acute liver failure
- Small hepatocellular carcinoma not amenable to resection
- Inherited metabolic liver disease
- No absolute contraindication to liver transplant
Model for End-stage Liver Disease

- Prospectively followed 231 patients at 4 medical centers who underwent elective TIPS
- 70 patients died within 3 months
- Using Cox proportional-hazards regression, 3 factors were identified as predicting mortality
  - Total bilirubin
  - INR
  - Creatinine

Hepatology 2000;31:864.
## MELD Score

### Equation

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Variable</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.78</td>
<td>$\log_e$ [total bilirubin (mg/dL)]</td>
<td>$3.78 \times \log_e [\text{total bilirubin (mg/dL)}]$</td>
</tr>
<tr>
<td>9.57</td>
<td>$\log_e$ [creatinine (mg/dL)]*</td>
<td>$9.57 \times \log_e [\text{creatinine (mg/dL)}]$</td>
</tr>
<tr>
<td>11.2</td>
<td>$\log_e$ [INR]</td>
<td>$11.2 \times \log_e [\text{INR}]$</td>
</tr>
<tr>
<td>6.43</td>
<td></td>
<td>$6.43$</td>
</tr>
</tbody>
</table>

\[\text{MELD Score} = 3.78 \times \log_e [\text{total bilirubin (mg/dL)}] + 9.57 \times \log_e [\text{creatinine (mg/dL)}] + 11.2 \times \log_e [\text{INR}] + 6.43\]

* Maximum value is 4 mg/dL

- Or go to the following website:
  - [www.unos.org/resources/meldpeldcalculator.asp](http://www.unos.org/resources/meldpeldcalculator.asp)
MELD and 3-Month Survival

Cumulative Percent Surviving (%)

92.3%
90.7%
66.0%
33.8%

$P < 0.001$

Months from Listing

Model for End-stage Liver Disease (MELD) Score is a Prognostic Score in Cirrhosis

- Objective formula based on serum creatinine, bilirubin and prothrombin time (INR)
- Accurately predicts 3-month survival in cirrhosis
- Determines organ allocation for liver transplant
- Online calculator available at optn.hrsa.gov

Survival Benefit of Liver Transplant Occurs with MELD score ≥15

Death Hazard Ratio

6-11 12-14 15-17 18-20 21-23 24-26 27-29 30-39 ≥40

MELD Score


risks outweigh benefit of transplant
Liver transplant Listing

I. Acute liver failure

II. Model for End-stage Liver Disease (MELD) - Continuous disease severity scale - Patients with the higher MELD score will get transplanted first

III. Exception MELD Points:
   • HCC, Hilar Cholangiocarcinoma, Hepatopulmonary syndrome, Portopulmonary hypertension, Familial Amyloidotic polyneuropathy, Primary Hyperoxaluria, Cystic fibrosis

IV. Appeal to Regional Review Board
Fulminant liver failure 1A status

Fulminant hepatic failure (UNOS definition)

- Hepatic encepha;opathy onset within 8 weeks of 1\textsuperscript{st} symptom of liver disease
- Absence of pre-existing liver disease
Fulminant liver failure 1A status

- To list, patient must be in the ICU and have 1 of the following 3 criteria
  - Ventilator dependence
  - Hemodialysis or CRT
  - INR more than 2
Limitations of MELD in Liver Transplant

Based on 3 blood tests:
- Creatinine: reflects muscle mass which diminishes in cirrhosis overestimating GFR
- Bilirubin: higher in some liver diseases (e.g., primary biliary cirrhosis) in which it may overestimate risk of death
- INR: variation by laboratory

Does not incorporate major complications of cirrhosis such as ascites, variceal hemorrhage or hepatic encephalopathy

Hepatocellular carcinoma (HCC) often occurs in patients with cirrhosis that are compensated and have a low MELD
Limitations of MELD in Liver Transplant

- Hyponatremia in cirrhosis with ascites reflects impaired circulatory status (worsened vasodilatation)
  - Often occurs with refractory ascites and hepatorenal syndrome

- Incorporation of serum sodium into MELD (“MELD-Na”) increases prognostic accuracy of MELD

- Incorporation of MELD-Na score in the United States is anticipated to decrease deaths on wait list
MELD and MELD-Na Basics

MELD
• Range 6-40
• INR -highest weight
• Creatinine-cap at 4.0
• Hemodialysis twice in 1 week-creatinine imputed to 4
• Lab values less than 1 are set to 1

MELD-Na
• Excludes MELD ≤ 11
• May add up to 11 points for patients with low MELD
• Has very little impact for higher MELD scores
## Serum Sodium Values (mEq / L)

<table>
<thead>
<tr>
<th>MELD Score</th>
<th>&lt;=125</th>
<th>126</th>
<th>127</th>
<th>128</th>
<th>129</th>
<th>130</th>
<th>131</th>
<th>132</th>
<th>133</th>
<th>134</th>
<th>135</th>
<th>136</th>
<th>&gt;=137</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;=11</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>12</td>
<td>11</td>
<td>10</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>13</td>
<td>11</td>
<td>10</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>14</td>
<td>10</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>15</td>
<td>10</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>16</td>
<td>10</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>17</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>18</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>19</td>
<td>8</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>20</td>
<td>8</td>
<td>7</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>21</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>22</td>
<td>7</td>
<td>7</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>23</td>
<td>7</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>24</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>25</td>
<td>6</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>26</td>
<td>6</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>27</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>28</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>29</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>30</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>31</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>32</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>33</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>34</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>35</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>36</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>37</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>38</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>39</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>40</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>41</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>42</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>43</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>44</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>45</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>46</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>47</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>48</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Liver Transplant Cures Early-Stage HCC

- Transplantation cures HCC and eliminates cirrhosis
- Landmark study from Milan in 1996
- Inclusion criteria (N = 48)
  - Unresectable HCC
  - Staging criteria
    - Single lesion < 5 cm or
    - < 3 lesions, each < 3 cm
- Following liver transplantation
  - 4-year survival: 75%
  - 4-year recurrence-free survival: 83%

LIVER TRANSPLANTATION FOR HCC
MILAN CRITERIA

1 lesion ≤ 5 cm
2 to 3 lesions, ≤3 cm +

Absence of Macroscopic Vascular Invasion
Absence of Extra-hepatic Spread

- Lesion must be ≥ 2cm (T2) to receive exception points
- Lesions < 2cm (T1) do not get exception points except in rare instances
- MELD Score begins @ 28 after 6 mo wait & ↑ by 10% q 3 months if within criteria
Pulmonary Vascular Diseases MELD exception

Hepatopulmonary syndrome

- Evidence of portal hypertension ± cirrhosis
- Evidence of shunt:
  Agitated saline echo or macroaggregated albumin scan (MAA)
- PaO2 <60 mmHg on room air

Portopulmonary hypertension

- Portal hypertension ± cirrhosis
- Mean pulmonary artery pressure ≥ 25
- Pulmonary capillary wedge pressure < 15
- Pulmonary vascular resistance > 240 dynes.s.cm
- Post treatment MPAP < 35, PVR <400

MELD starts at 22, increases 10 percent every 3 months
Listing for liver-kidney transplantation

The patient meets any 1 of 3 criteria

- Patient with ESLD and chronic kidney disease with GFR ≤ 30 ml/min
- Patient with AKI including HRS with creatinine ≥ 2.0 mg/dL and dialysis ≥ 8 weeks
- Patient with ESLD and evidence of CKD and kidney biopsy demonstrating > 30% glomerulosclerosis or 30 % fibrosis
Comorbidities and Liver Transplant

- Liver transplant is a major operation and requires long-term immunosuppressive drugs.
- Potential recipients need to be physically robust enough to undergo surgery.
- Severe pulmonary or cardiac disease reduce the likelihood of a successful outcome.
- Severe renal dysfunction may require simultaneous renal transplant.

AASLD Practice Guidelines at www.AASLD.org.
Contraindications to LT: Absolute

- Active alcohol or substance abuse
- Advanced cardiopulmonary disease
- Systemic sepsis, unresponsive to treatment
- Multiorgan failure; multiple pressors
- Extrahepatic malignancy
- Severe pulmonary hypertension
- Severe psychiatric disease likely to affect compliance
Contraindications to LT: Relative

- General debility
- Advanced age
  - No upper age cutoff but careful evaluation of comorbidities in patients >70 years of age
- Extensive portal/mesenteric thrombosis
- Social isolation and limited support
- Cholangiocarcinoma
Alcohol and Substance Use and Liver Transplant

- Alcohol excess is a frequent cause of cirrhosis and HCC
- Patients actively using illicit drugs are not candidates for liver transplant
- Confirmed abstinence $\geq$ 6 months and alcohol/drug rehabilitation is required to reduce likelihood of relapse following transplant
- Transplantation for alcoholic hepatitis remains controversial and is generally not performed in the US

DiMartini AF et al. Liver Transplant 2012;18:1267
Smoking and Liver Transplant

- Tobacco consumption implicated in poorer outcomes following transplant
- ENT malignancies a major concern in smokers following transplant
- Most transplant programs prohibit tobacco use
- Marijuana use is controversial but most programs do not allow it

Vaccination before Liver Transplant

- Vaccination against hepatitis A and B advised because of concern about hepatic decompensation with infection in patients with preexisting liver disease

- Pneumococcal, both pneumococcal conjugate vaccine (PCV13) and polysaccharide vaccine (PPSV23) are recommended

- Influenza, diptheria, pertussis, and tetanus are also advised
Vaccination before Liver Transplant (cont.)

- Vaccination against Human Papilloma Virus advised between 9 and 26 years

- Live vaccines (mumps, measles, rubella, varicella, and herpes zoster) are contraindicated posttransplant and so, if necessary, should be given pre-transplant
Donor Organs

➤ Most commonly from donor with brain death ("deceased donor")
  - Victim of catastrophic event such as head injury or cerebrovascular accident
  - Organs may also be harvested from donors after cardiac death

➤ Live-donor transplant suitable for some recipients, not offered by many programs
  - For pediatric and smaller adult recipients, left lobe is sufficient
  - For most adult recipients, larger right lobe is usually required
Liver Transplant: Summary

- Definitive and lifesaving therapy for advanced liver disease and unresectable hepatocellular carcinoma

- Patients with cirrhosis should be referred for transplant once they have an index complication such as ascites or worsening hepatocellular function with MELD > 15
Liver Transplant: Summary

Indications for liver transplant

- Acute liver failure
- Decompensated cirrhosis with a mELD $\geq$ 15
- Hepatocellular carcinoma within Milan criteria
- Other less common but important indications

Contraindications for liver transplant

- Brainstem herniation, nonreversible brain injury
- Advance cardiopulmonary disease
- Hemodynamic instability requiring high dose or multiple pressors
- Severe portopulmonary hypertension despite treatment