Interventional Radiology in the Management of Complications Following Orthotopic Liver Transplantation

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Transplant Patients are Different

• Most patients have benign disease and a potential for long-term survival

• Resources (livers and financial) are limited, so every effort must be made to salvage the allograft

• Immunosuppression alters both response to infection and healing process
Orthotopic Liver Transplantation

**Anastomoses**

- **Systemic venous**
  - Inferior vena caval (whole liver)
  - Hepatic venous (split liver)
- **Hepatic arterial**
- **Portal venous**
- **Biliary**
Orthotopic Liver Transplantation

- All anastomoses are potential sites for stenosis
- If it is a vascular anastomosis it may lead to thrombosis
## Frequency of Anastomotic Complications

<table>
<thead>
<tr>
<th>Site</th>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biliary</td>
<td>20%</td>
</tr>
<tr>
<td>Hepatic arterial</td>
<td>10%</td>
</tr>
<tr>
<td>Portal venous</td>
<td>2%</td>
</tr>
<tr>
<td>Systemic venous</td>
<td>1%</td>
</tr>
</tbody>
</table>
Choledochocholedochostomy

- Preferred anastomosis
  - Anatomic
  - Preserves sphincteric mechanism
  - Allows retrograde access
  - Avoids bowel surgery
Choledochojejunostomy

- CDCD cannot be performed
  - Sclerosing cholangitis
  - Biliary atresia
  - Duct size mismatch
- Repair a problematic CDCD anastomosis
Biliary Complications

Leak

Obstruction
Bile Leaks

1. Biliary anastomosis

2. Cut edge of liver (reduced size or lobar transplantation)
### Incidence of Biliary Complications Post OLT

<table>
<thead>
<tr>
<th>Authors and Reference</th>
<th>Country</th>
<th>Year</th>
<th>n</th>
<th>Follow-up</th>
<th>Graft Right</th>
<th>Graft Left</th>
<th>Technique D-D</th>
<th>Technique Roux-Y</th>
<th>Biliary Complication (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kling et al(^{17})</td>
<td>USA</td>
<td>2004</td>
<td>48</td>
<td>58 mo</td>
<td>1</td>
<td>47</td>
<td>0</td>
<td>48</td>
<td>20.00, 17.00, 33.3</td>
</tr>
<tr>
<td>Dulundu et al(^{18})</td>
<td>Japan</td>
<td>2004</td>
<td>81</td>
<td>664 d</td>
<td>—</td>
<td>—</td>
<td>81</td>
<td>0</td>
<td>14.80, 12.30, 32.0</td>
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<tr>
<td>Gondolesi et al(^{19})</td>
<td>USA</td>
<td>2004</td>
<td>96</td>
<td>—</td>
<td>96</td>
<td>0</td>
<td>39</td>
<td>53</td>
<td>26.00, 27.00, 34.3</td>
</tr>
<tr>
<td>Chang et al(^{20})</td>
<td>Korea</td>
<td>2005</td>
<td>161</td>
<td>—</td>
<td>18(^{†})</td>
<td>6(^{†})</td>
<td>—</td>
<td>—</td>
<td>9.30, 9.30, 16.1</td>
</tr>
<tr>
<td>Giacomini et al(^{21})</td>
<td>Italy</td>
<td>2006</td>
<td>23</td>
<td>644 d</td>
<td>23</td>
<td>0</td>
<td>16(^{‡})</td>
<td>1(^{‡})</td>
<td>21.73, 21.73, 34.8</td>
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<tr>
<td>Ramaciatto et al(^{22})</td>
<td>Italy</td>
<td>2006</td>
<td>27</td>
<td>15.4 mo</td>
<td>27</td>
<td>0</td>
<td>16(^{‡})</td>
<td>9(^{‡})</td>
<td>18.50, 7.40, 25.9</td>
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<tr>
<td>Shah et al(^{23})</td>
<td>Canada</td>
<td>2007</td>
<td>128</td>
<td>23 mo</td>
<td>128</td>
<td>0</td>
<td>64</td>
<td>64</td>
<td>14.80, 17.10, 32.0</td>
</tr>
<tr>
<td>Iwamoto et al(^{24})</td>
<td>Japan</td>
<td>2008</td>
<td>52</td>
<td>565 d</td>
<td>44</td>
<td>8</td>
<td>49</td>
<td>3</td>
<td>11.50, 9.60, 21.6</td>
</tr>
</tbody>
</table>

Average: 17.1, 15.2, 28.7

DD, duct-to-duct anastomosis; Roux-Y, Roux-en-Y hepaticojejunostomy.

Duailibi DF, Ribeiro MAF: *Transpl Proc* 2010;42:517-520
Anastomotic Leaks

CDCD Leak

CDJ Leak
CDCD Anastomotic Leaks

• Drain biloma
• Divert the bile flow
  – Endoscopic stent
  – PTBD if endoscopy fails
  – If T-tube in place:
    • Open T-tube
    • PTBD with external drainage if leak continues with open T-tube

CDCD Leak
CDCD Anastomotic Leaks

- Using this strategy 14/17 (82%) of CDCD anastomotic leaks healed without surgical revision of the anastomosis.

- 3/17 (18%) with complete anastomotic disruption required surgical revision to CDJ.

CDJ Anastomotic Leaks

- Drain biloma
- Divert bile flow (PTBD)
  - Successful treatment less likely (3/9) compared to CDCD leaks
  - Revision of CDJ if leakage continues


CDJ Leak
Cut-Edge Leaks

- Split lobe recipients
- Reduced size transplant
- In the absence of obstruction, most cut-edge leaks will heal with a combination of biloma drainage and biliary drainage
- If leak continues, occlusion with cyanoacrylate glue has been reported to be successful
Anastomotic Strictures

- Most common type of stricture
- Incidence 10%
- Unclear whether more common with CDCD or CDJ
- Likely more technique than site related
CDCD Anastomotic Strictures

• Limited data on the long term results of PTBD with balloon dilatation of CDCD is available
  - Usual approach is endoscopic
  - Early revision to CDJ is successful and durable

• 70% (14/20) patency at mean follow-up of 30.2 months (13-58 mos.) following 1 to 3 transhepatic balloon dilatations of CDCD anastomoses

Righi et al. CVIR 2002;25:30-35
CDCD Anastomotic Strictures

- Long-term (6-months or >) endoscopic stenting successful in 67-75% of patients at 18-month f/u
  
  Rizk et al. *Gastrointest Endo* 1998;47:128

- Surgical repair has one-year patency ranging from 85-90%
  
  Boutttier et al. *J Radiol* 1997;78:485-489
CDCD Anastomotic Strictures

- In first three-months following OLT, stricture may represent edema or inflammation
  - Retrograde stent if possible
  - Transhepatic balloon dilation and internal/external stent if retrograde cannot be achieved, and non-operative tx desired

- If greater than three-months following OLT, surgical revision should be considered
Cutting Balloon

• When standard balloon dilatation is insufficient, cutting balloon should be used.

• Cutting balloon may be undersized, followed by conventional balloon.

• Initial cutting balloon.

• Overall technical success rate 93% c/w 85% for conventional balloons.

• Long-term outcome unknown.

Saad et al. *JVIR* 2006;17:837
CDJ Anastomotic Strictures

- CDJ strictures differ from CDCD strictures as operative repair is less successful and less durable.
- Therefore, CDJ strictures should be approached more aggressively with non-operative therapy.
- Cutting balloons can be safely used in CDJ anastomotic strictures.
CDJ Anastomotic Strictures

- Balloon dilatation followed by internal/external stenting for 4 to 6 weeks
  - 73% success at 2-years
  - 66% success at 6-years

n=47  Zajko et al. JVIR 1995;6:79-83
Anastomotic Strictures

**Metallic Stents**
- Should rarely be used as they may preclude definitive repair

- Anastomotic strictures which fail balloon dilatation
  - Poor surgical candidates
  - Sufficient extra-hepatic bile duct for “rescue” revision
  - Last resort

Living Donor or Split Liver Transplantation

• Biliary complications occur more frequently following LDLT (22% to 64%)
  Giacomoni et al. *Trans Int* 2006;19:466

• Originally most anastomoses were right hepaticojejunosotomies

• Right hepatic to right hepatic or right hepatic to common hepatic ductal anastomoses are becoming much more frequent
Living Donor or Split Liver Transplantation

- If a variant duct (usually the right posterior) is present, it may be intentionally ligated by the transplant surgeon.

- Inadvertent puncture and drainage of a ligated duct is a major medical error.
Major Medical Error

- Drainage of this ligated ductal system should be avoided to prevent long-term external drainage tube
Non-Anastomotic Strictures

- Hepatic artery thrombosis (1/3rd)
- ABO incompatibility
- Prolonged preservation
- Ductopenic Rejection
- Recurrent PSC or tumor
- CMV infection?
Non-Anastomotic Strictures

Balloon dilation results

- 16 patients with non-anastomotic strictures
  - 94% success rate @ two-years
  - 84% success rate @ five-years

Zajko et al. JVIR 1995;6:79-83
Non-Anastomotic Strictures

Reasonable approach

- Patients with minimal symptoms and preserved synthetic function should not be treated.

- Balloon dilatation should be the primary treatment for symptomatic patients.

- Stents should be reserved for failures of dilatation and used as a bridge to retransplantation.
Vascular Complications

Locations
• Hepatic Artery
• Portal Vein
• Hepatic Vein / IVC

Sources
• Intimal hyperplasia
• Torsion
• Technical
Hepatic Arterial Complications: Incidence

- Stenosis (HAS) 12%
- Thrombosis (HAT) 5%
- Pseudoaneurysm < 1%
  - Infected (mycotic)
  - Uninfected (technical)
Hepatic Artery Stenosis

- Cholangiographic abnormalities are present in 60%  
  - Non-anastomotic biliary strictures  
  - Biliary obstruction secondary to sludge and debris
- PTA should be initially attempted
- Arterial stents should be placed for unsuccessful dilatation
- Despite a successful endovascular technique, the majority of patients require retransplantation  
Hepatic Artery Stenosis: PTA
Hepatic Artery Stenosis: PTA
**Results**

- Approximately 50 reported cases
- Technical success  80% to 90%
- Physiologic improvement  40% to 60%
- Retransplantation  Frequent

Hepatic Artery Stenosis: Stent
Hepatic Artery Stenosis: Stent

**Results**

- Significant numbers of patients lacking
- Patency up to 25 months have been reported

Hepatic Artery Pseudoaneurysm - Uninfected
Hepatic Artery Pseudoaneurysm - Uninfected
• Incidence 2%
• If thrombosis occurs within one-month of transplant, hepatic dysfunction and hepatic failure may be observed
• If stenosis or thrombosis occur later, sequelae of portal hypertension (bleeding, ascites and encephalopathy) are usually presenting symptoms
• Diagnosis is usually made by surveillance ultrasound
Portal Venous Stenosis / Thrombosis: Therapy

• Acute thrombosis has been treated with fibrinolytic therapy and mechanical thrombectomy (<20 cases reported- 80% success)


• Symptomatic portal vein stenosis
  – PTV
  – Stent placement
Portal Vein Stenosis
Portal Vein Stenosis: PTV
Systemic Venous Complications

- Incidence: <1%
- Locations:
  - IVC
  - Hepatic venous
  - Combined IVC / HV
- Symptoms:
  - Supra-hepatic or hepatic vein in split liver tx give rise to Budd-Chiari with ascites, portal hypertension and mild hepatic dysfunction
  - Infrahepatic IVC stenoses lead to LE edema
- Treatment: PTV and stent
Systemic Venous PTV
Systemic Venous Complications
Hepatic Venous Stenosis
IVC Stenosis / Occlusion Post OLT
Post-Liver Transplant Interventions

• The overall success rate of a liver transplantation program is strongly correlated with available interventional radiology expertise

• Transplant patients do not have the same immune and healing responses as non-immunosuppressed patients
  – More likely to leak
  – More likely to develop infections

• However, re-operations on this patient population for anastomotic revision is often difficult, therefore an aggressive percutaneous approach is often warranted