OPERATIVE TECHNIQUES AND HAZARDS

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CAVAL RECONSTRUCTION IN ORTHOTOPIC LIVER TRANSPLANTATION

- RESECTION OF THE RECIPIENT IVC: STANDARD TECHNIQUE
- PRESERVATION OF THE RECIPIENT IVC: PIGGY-BACK TECHNIQUE
  MODIFIED PIGGY-BACK TECHNIQUE
STANDARD TECHNIQUE
CAVAL RECONSTRUCTION IN ORTHOTOPIC LIVER TRANSPLANTATION
STANDARD TECHNIQUE
CAVAL RECONSTRUCTION IN ORTHOTOPIC LIVER TRANSPLANTATION
STANDARD TECHNIQUE
CAVAL RECONSTRUCTION IN ORTHOTOPIC LIVER TRANSPLANTATION

IVC CLAMPING
↓ filling pressure
↓ cardiac output
↓ renal perfusion pressure
↓ arterial pressure
↑ infrahepatic caval pressure
VENO-VENOUS BYPASS
CAVAL RECONSTRUCTION IN ORTHOTOPIC LIVER TRANSPLANTATION

Starzl 1963 systemic anticoagulation
Shaw 1984 heparin-bonded tubing
VENO-VENOUS BYPASS
CAVAL RECONSTRUCTION IN ORTHOTOPIC LIVER TRANSPLANTATION

ADVOCATE
A) Stabilizes intraoperative haemodynamics
B) Reduces PRC requirements
C) Minimises renal/splanchnic congestion/function

CRITICS
A) Hypothermia
B) Coagulopathies
C) Vein thrombosis
D) Air embolism
E) Capillary injury/3rd space losses
F) Wound seromas/infections
G) Prolongs operating time
H) Increase cost
**VENO-VENOUS BYPASS**
**CAVAL RECONSTRUCTION IN ORTHOTOTPIC LIVER TRANSPLANTATION**

- Decreased PRC requirements intraoperatively
- Improved post-operative renal function
- Improved 30 day mortality

  *Shaw et al 1984*

- Stabilising effect during anhepatic phase
- No guarantee of adequate perfusion or maintenance of blood volume

  *Paulsen et al 1989*

- Improved cardiovascular and renal haemodynamics and renal perfusion
- Did not translate into better renal function or decreased PRC requirements

  *Veroli et al 1992*
It is difficult to draw definite conclusions about the comparative outcomes of patients undergoing OLTx with and without VVB because of the inherent biases associated with using VVB selectively on those patients who do not tolerate IVC cross-clamping.

There is limited data to substantiate any significant improvement in short- or long-term benefit in routine use of VVB and excellent results have been reported without its use.
VENO-VENOUS BYPASS
CAVAL RECONSTRUCTION IN ORTHOTOPIC LIVER TRANSPLANTATION

91% routinely used VVB 1987
42% routinely used VVB 1997
58% selective use VVB

Chari 1998
PIGGY-BACK TECHNIQUE
CAVAL RECONSTRUCTION IN ORTHOTOPIC LIVER TRANSPLANTATION

Preservation of the recipient IVC during OLTx
Calne 1968
24 cases described in both adults and children
Tzakis 1989
PIGGY-BACK TECHNIQUE
CAVAL RECONSTRUCTION IN ORTHOTOPIC LIVER TRANSPLANTATION

Reterohepatic dissection
PIGGY-BACK TECHNIQUE
CAVAL RECONSTRUCTION IN ORTHOTOPIC LIVER TRANSPLANTATION

Controlling Right Hepatic Vein
PIGGY-BACK TECHNIQUE
CAVAL RECONSTRUCTION IN ORTHOTOPIC LIVER TRANSPLANTATION

Clamping the Hepatic Veins
PIGGY-BACK TECHNIQUE
CAVAL RECONSTRUCTION IN ORTHOTOPIC LIVER TRANSPLANTATION

Middle and Left Hepatic veins as outflow channel

Right, Middle and Left Hepatic veins as outflow channel
PIGGY-BACK TECHNIQUE
CAVAL RECONSTRUCTION IN ORTHOTOPIC LIVER TRANSPLANTATION
PIGGY-BACK TECHNIQUE
CAVAL RECONSTRUCTION IN ORTHOTOPIC LIVER TRANSPLANTATION
Advantages:

a) Systemic venous return maintained during anhepatic phase
b) Preservation of renal perfusion pressure
c) No retrocaval/adrenal dissection
d) Shorter warm ischaemic time (only one caval anastomosis)
e) 50% shorter anhepatic phase
f) Better maintenance of core body temperature
g) Less intraoperative coagulopathy and 3rd space fluid loss
h) Can be performed without IVC clamping and VVB
PIGGY-BACK TECHNIQUE
CAVAL RECONSTRUCTION IN ORTHOTOPIC LIVER TRANSPLANTATION

‘Reserved’ for favorable anatomical conditions

*Is feasible in almost all patients (Budd-Chiari, Polycystic, retransplantation)*  
*Belghiti et al Liver Transplantation 2001*

Routinely used with transient cross-clamping of IVC or in case of difficulty in disconnecting the liver from IVC or to perform the upper caval anastomosis
As a consequence it has been routinely performed with VVB

*Is feasible to perform in almost all cases without VVB*  
*Margerit et al Transpl Int 1998*
**PIGGY-BACK TECHNIQUE**

CAVAL RECONSTRUCTION IN ORTHOTOPIC LIVER TRANSPLANTATION

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**Table 4. Recent literature review in relation to VVB use and IVC-preserving adult liver transplantation techniques**

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Center</th>
<th>n</th>
<th>IVC preservation (%)</th>
<th>VVB use (%)</th>
<th>Implantation technique (%)</th>
<th>Venous complications (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cherqui D*</td>
<td>1994</td>
<td>Paris</td>
<td>62</td>
<td>100</td>
<td>0</td>
<td>Modified CC</td>
<td></td>
</tr>
<tr>
<td>Fleitas MG*</td>
<td>1994</td>
<td>Santander</td>
<td>44</td>
<td>100</td>
<td>0</td>
<td>100 (PB)</td>
<td></td>
</tr>
<tr>
<td>Lovice E*</td>
<td>1997</td>
<td>Bologna</td>
<td>20</td>
<td>90</td>
<td>10</td>
<td>PB</td>
<td></td>
</tr>
<tr>
<td>Busque S*</td>
<td>1998</td>
<td>Stanford</td>
<td>131</td>
<td>75</td>
<td>15</td>
<td>PB</td>
<td></td>
</tr>
<tr>
<td>Chairi R*</td>
<td>1998</td>
<td>Duke</td>
<td>215</td>
<td>NA</td>
<td>10.2</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Toronto</td>
<td>117</td>
<td>NA</td>
<td>8.5</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Parilla I</td>
<td>1999</td>
<td>Spanish survey</td>
<td>1674</td>
<td>66.4</td>
<td>NA</td>
<td>PB</td>
<td>2.5</td>
</tr>
<tr>
<td>Navarro F</td>
<td>1999</td>
<td>French survey</td>
<td>1681</td>
<td>81</td>
<td>NA</td>
<td>42.7 (PB)</td>
<td>2.4</td>
</tr>
<tr>
<td>Reddy K*</td>
<td>2000</td>
<td>Kentucky</td>
<td>36</td>
<td>94</td>
<td>22</td>
<td>PB</td>
<td></td>
</tr>
<tr>
<td>Shokouh-Amiri MH</td>
<td>2000</td>
<td>Tennessee</td>
<td>34</td>
<td>87</td>
<td>13</td>
<td>PB</td>
<td></td>
</tr>
<tr>
<td>Gerunda G</td>
<td>2001</td>
<td>Padova</td>
<td>150</td>
<td>95</td>
<td>10</td>
<td>29 (PB)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>32 (PCSh)</td>
<td>65 (CC)</td>
<td></td>
</tr>
<tr>
<td>Bolghiti J</td>
<td>2001</td>
<td>Paris</td>
<td>275</td>
<td>100</td>
<td>0 (PCSh)</td>
<td>CC</td>
<td>1.8 (4 deaths)</td>
</tr>
<tr>
<td>Figueras J</td>
<td>2002</td>
<td>Barcelona</td>
<td>95</td>
<td>84.2</td>
<td>0</td>
<td>PB</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>50 (PCSh, study design)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Present study*</td>
<td>2002</td>
<td>Brussels, UCL</td>
<td>202</td>
<td>98</td>
<td>1.5</td>
<td>99.5 CC</td>
<td>2.5</td>
</tr>
</tbody>
</table>

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*a Prospective studies.

CC, cavocaval implantation; PB, piggy-back implantation on hepatic vein cuff; PCSh, portocaval shunt; IVC, inferior vena cava; VVB, venovenous bypass; NA, not applicable.
MODIFIED PIGGY-BACK TECHNIQUE
CAVAL RECONSTRUCTION IN ORTHOTOPIC LIVER TRANSPLANTATION

Latero-lateral cavocaval (face-to-face) anastomosis  Belghiti 1992
MODIFIED PIGGY-BACK TECHNIQUE
CAVAL RECONSTRUCTION IN ORTHOTOPIC LIVER TRANSPLANTATION

Temporary Porto-Caval Shunt  Belghiti 1995
PIGGY-BACK TECHNIQUE
CAVAL RECONSTRUCTION IN ORTHOTOPIC LIVER TRANSPLANTATION

Is temporal porto-caval bypass necessary or advantageous during hepatectomy?
# PIGGY-BACK TECHNIQUE
## CAVAL RECONSTRUCTION IN ORTHOTOPIC LIVER TRANSPLANTATION

![Image](image_url)

## Table 3. Intraoperative data in cavocaval adult liver transplantation (LT)

<table>
<thead>
<tr>
<th></th>
<th>Primary LT (%) (n=183)</th>
<th>Re-LT (%) (n=19)</th>
<th>Total (%) (n=202)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IVC preservation</td>
<td>181 (98.9)</td>
<td>17 (89.5)</td>
<td>98</td>
</tr>
<tr>
<td>IVC cross clamping absent</td>
<td>170 (93)</td>
<td>16 (84.2)</td>
<td>92</td>
</tr>
<tr>
<td>Non use of VVB</td>
<td>182 (99.5)</td>
<td>17 (89.5)</td>
<td>98.5</td>
</tr>
<tr>
<td>Portacaval shunting</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Cavocaval anastomosis</td>
<td>180° (98.4)</td>
<td>17 (89.5)</td>
<td>97.5</td>
</tr>
</tbody>
</table>

* One patient died before implantation of the graft.

IVC, inferior vena cava; VVB, venovenous bypass.

202 consecutive grafts in 188 adults 1993-2000
PIGGY-BACK TECHNIQUE
CAVAL RECONSTRUCTION IN ORTHOTOPIC LIVER TRANSPLANTATION

a) Decreases volume of large liver, easier to mobilise large livers
b) Less portal hypertension, less blood loss (previous surgery)
c) Haemodynamic stability (fulminant patient)

Several studies have failed to show any benefit to temporary porto-caval shunting during the anhepatic phase in patients with cirrhosis

Cherqui et al Transplantation 1994,
Steib et al Liver Transpl Surg 1997,
Hesse et al Transplant Proc 1997
PIGGY-BACK TECHNIQUE
CAVAL RECONSTRUCTION IN ORTHOTOTPIC LIVER TRANSPLANTATION

Use of temporary PCS
a) improves haemodynamic status
b) reduces intraoperative transfusion requirements
c) preserves renal function during and after OLTx

Clinical benefit more apparent in patients with
a baseline flow of 1000 ml/min or greater
those with severe portal hypertension
portocaval gradient of > 16mm Hg or greater

Prospective Randomised Trial of temporary portocaval shunting
during the anhepatic phase of the piggy-back technique.

Figueras et al Liver Transplantation 2001
Disadvantages:
High incidence of caval outflow obstruction, leading to a Budd Chiari syndrome and when recognised late has a 60% mortality.

Technical Reasons:

a) Small orifice fashioned between the middle and left hepatic veins/failure to use all three hepatic veins as outflow orifice

b) Rotation of the graft either because the graft is small for size and falls into the right subdiaphragmatic space narrowing the outflow or because the cuff of hepatic veins has been left too long and kinks
PIGGY-BACK TECHNIQUE
CAVAL RECONSTRUCTION IN ORTHOTOPIC LIVER TRANSPLANTATION

In a series of 1000 OLTx using the standard technique the incidence of
Postoperative caval obstruction was 6 patients
Postoperative caval stenosis was 11 patients \[1.7\%\]

\[Neuhaus World Journal Surgery 2002\]

Postoperative caval stenosis after side-to-side cavocavostomy 14.2\%

\[Hesse Transpl Internat 1996\]

Postoperative caval stenosis/obstruction after piggy-back OLTx 7.8\%
Postoperative caval stenosis after side-to-side cavocavostomy 5.2\%

\[Lerut Transpl Internat 1997\]
PIGGY-BACK TECHNIQUE
CAVAL RECONSTRUCTION IN ORTHOTOPIC LIVER TRANSPLANTATION

Analysis of complications of the Piggy-Back Technique in 1,112 patients

Parrilla Transplantation 2003

Intraoperatively

28 patients intraoperative complications related to piggy-back technique and treated intraoperatively

- 2 major tear of IVC
- 26 congestion of graft after reperfusion (22 of these patients had middle and left hepatic vein orifice)

5/26 had side-to-side cavocavostomy
2/26 resection and reanastomosis
19/26 procedure to prevent rotation
PIGGY-BACK TECHNIQUE
CAVAL RECONSTRUCTION IN ORTHOTOPIC LIVER TRANSPLANTATION

Analysis of complications of the Piggy-Back Technique in 1,112 patients
*Parrilla Transplantation 2003*

Early Postoperative complications (within first week)

11 patients (1%) had complications

- 9/11 Budd Chiari within 48 hrs
  1/9 had caval thrombosis treated with streptokinase
  7/9 underwent retransplantation
- 2/11 reoperation for haemorrhage, one retransplanted
PIGGY-BACK TECHNIQUE
CAVAL RECONSTRUCTION IN ORTHOTOPIC LIVER TRANSPLANTATION

Analysis of complications of the Piggy-Back Technique in 1,112 patients
*Parrilla Transplantation 2003*

Late Post Operative Complications

3 patients developed symptoms of massive ascites 2-3 months after OLTx
  • 3/3 controlled with diuretics
**PIGGY-BACK TECHNIQUE**  
**CAVAL RECONSTRUCTION IN ORTHOTOPIC LIVER TRANSPLANTATION**

Analysis of complications of the Piggy-Back Technique in 1,112 patients  
*Parrilla Transplantation 2003*

<table>
<thead>
<tr>
<th>Cases</th>
<th>Treatment</th>
<th>Outcome</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intraabdominal bleeding</td>
<td>Surgical hemostasis (1st day)</td>
<td>Exitus (7th day)</td>
<td>Multiorganic failure</td>
</tr>
<tr>
<td>(collateral cava vein)</td>
<td>Retransplant for primary failure (4th day)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intraabdominal bleeding</td>
<td>Surgical hemostasis (1st day)</td>
<td>Alive-19 mo</td>
<td></td>
</tr>
<tr>
<td>(collateral cava vein)</td>
<td>Retransplant (7th day)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acute Budd-Chiari</td>
<td>Retransplant (2nd day)</td>
<td>Exitus (6th day)</td>
<td>Multiorganic failure</td>
</tr>
<tr>
<td>Acute Budd-Chiari</td>
<td>Cavocava laterolateral (2nd day)</td>
<td>Alive-19 mo</td>
<td></td>
</tr>
<tr>
<td>Acute Budd-Chiari</td>
<td>Retransplant (7th day)</td>
<td>Exitus (17th day)</td>
<td>Multiorganic failure</td>
</tr>
<tr>
<td>Acute Budd-Chiari</td>
<td>Retransplant (2nd day)</td>
<td>Alive-25 mo</td>
<td></td>
</tr>
<tr>
<td>Acute Budd-Chiari</td>
<td>Retransplant (2nd day)</td>
<td>Intraoperative exitus</td>
<td>Cardiogenic shock</td>
</tr>
<tr>
<td>Acute Budd-Chiari</td>
<td>Estreptokinase</td>
<td>Exitus (1 mo)</td>
<td>Multiorganic failure</td>
</tr>
<tr>
<td>Acute Budd-Chiari and cava thrombosis</td>
<td>Retransplant (2nd day)</td>
<td>Exitus (2 mo)</td>
<td>Multiorganic failure</td>
</tr>
<tr>
<td>Acute Budd-Chiari</td>
<td>Retransplant (2nd day)</td>
<td>Alive-4 mo</td>
<td></td>
</tr>
<tr>
<td>Acute Budd-Chiari</td>
<td>Retransplant (2nd day)</td>
<td>Alive-3 mo</td>
<td></td>
</tr>
<tr>
<td>Chronic Budd-Chiari</td>
<td>Conservative-diuretics</td>
<td>Alive-47 mo</td>
<td></td>
</tr>
<tr>
<td>Chronic Budd-Chiari</td>
<td>Conservative-diuretics</td>
<td>Alive-11 mo</td>
<td></td>
</tr>
<tr>
<td>Chronic Budd-Chiari</td>
<td>Conservative-diuretics</td>
<td>Alive-6 mo</td>
<td></td>
</tr>
</tbody>
</table>
## PIGGY-BACK TECHNIQUE
### CAVAL RECONSTRUCTION IN ORTHOTOPIC LIVER TRANSPLANTATION

Analysis of complications of the Piggy-Back Technique in 1,112 patients

*Parrilla Transplantation 2003*

<table>
<thead>
<tr>
<th></th>
<th>Liver transplant with vena cava preservation (N=1112)</th>
<th>Two veins (N=440)</th>
<th>Three veins (n=672)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technique-related</td>
<td>38 (3.4%)</td>
<td>32 (7.3%)</td>
<td>6 (0.9%)</td>
</tr>
<tr>
<td>complications</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intraoperative</td>
<td>26 (2.3%)</td>
<td>22 (5%)</td>
<td>4 (0.6%)</td>
</tr>
<tr>
<td>congestion of liver</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acute Budd-Chiari</td>
<td>9 (0.8%)</td>
<td>7 (1.6%)</td>
<td>2 (0.3%)</td>
</tr>
<tr>
<td>syndrome</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chronic Budd-Chiari</td>
<td>3 (0.3%)</td>
<td>3 (0.7%)</td>
<td>0</td>
</tr>
<tr>
<td>syndrome</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

*α Two veins versus three veins (P<0.001).*
PIGGY-BACK TECHNIQUE
CAVAL RECONSTRUCTION IN ORTHOTOPIC LIVER TRANSPLANTATION
HEPATIC ARTERY

Arterial blood supply to the graft is critical in the early post-operative period because although the native liver is in most cases adequately perfused by the portal vein and from collaterals from the reteroperitoneum this potential collateral supply is cut at the time of hepatectomy.

Main blood supply to the biliary tree.
HEPATIC ARTERY
HEPATIC ARTERY THROMBOSIS (HAT)

HAT cause of morbidity and graft loss in approximately 7% (4-25%) of adults undergoing OLTx

Incidence is 10-40% of paediatric transplants
• Smaller caliber donor/recipient arteries
• Greater fluctuations in haemocrit and coagulation factor concentrations
HEPATIC ARTERY
HEPATIC ARTERY THROMBOSIS (HAT)

RISK FACTORS FOR HAT

- Most cases of HAT don’t have a ‘clear cause’
- Intraoperative arterial flow of < 350 ml/min higher incidence of HAT
- Poor inflow from the native artery
- Acute cellular rejection
- Prolonged cold ischaemic time
- Multiple donor arteries, problematic arterial reconstruction
- Small arterial diameter
- External compression (haematomas)
- Abdominal compartment syndrome
- High central venous pressure with hepatic oedema
HEPATIC ARTERY
HEPATIC ARTERY THROMBOSIS (HAT)

Clinical Presentation

- Clinical spectrum from acute fulminant hepatic necrosis to mild elevation of liver function tests which is to a large degree time dependent

- In the early postoperative period acute HAT generally presents with massive injury to hepatocytes and biliary epithelium resulting in graft failure, sepsis (gas gangrene), biliary leaks.

- Later (4 weeks after OLTx) HAT presents with elevated transaminases, recurring cholangitis, biliomas, biliary strictures
**HEPATIC ARTERY**

**HEPATIC ARTERY THROMBOSIS (HAT)**

**CLINICAL PRESENTATION:**

<table>
<thead>
<tr>
<th>680 consecutive primary OLTx 1989 to 1993 UCLA</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 patients symptomatic HAT</td>
</tr>
<tr>
<td>4/11 presented within 4 weeks of OLTx</td>
</tr>
<tr>
<td>7/11 presented from 30 days to 1 year after OLTx</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>10/11 had elevated LFTs</th>
<th>(3 early and 6 late)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6/11 had sepsis and recurrent cholangitis</td>
<td>(2 early and 4 late)</td>
</tr>
<tr>
<td>4/11 had gas gangrene</td>
<td>(4 late)</td>
</tr>
<tr>
<td>11/11 had abdominal pain</td>
<td></td>
</tr>
</tbody>
</table>

**LICAGE**

**NEWCASTLE**

**MAY ’05**
HEPATIC ARTERY

HEPATIC ARTERY THROMBOSIS (HAT)

Immediate re-OLTx 2/11 (2 early)
Resection of primary graft 3/11 (3 late)
Delayed re-OLTx 3/11 (3 late)

One third of HAT episodes are asymptomatic
One third not immediately life-threatening, biliary complications
One third cause aprenchymal necrosis and rapid if not transplanted

Pinna et al Transplantation 1996

Early detection of patients with normal graft function can in selected cases be treated with thrombectomy however revision of the arterial anastomosis is inappropriate in the presence of extensive hepatocyte or biliary epithelial damage

Up to 70 % of patients with HAT will come to retransplantation
Arterial Reconstruction is dependent on

- Anatomy and size of the donor and recipient arteries
- Recognition of anatomical variants
- Consideration to the inflow through the recipient coeliac artery
End to end anastomosis of the recipients common hepatic artery with the donor coeliac trunk is the most commonly used technique for arterial reconstruction.

A variation of this is to anastomosis the donor coeliac trunk with an aortic patch to the recipient’s common hepatic artery at the division of the hepatic artery and gastroduodenal artery. Allows for a wide anastomosis and a double inflow via the CHA as well as the mesenteric artery.
Only 55% of the population have conventional anatomy.

Accessory donor hepatic arteries are often reconstructed by re-plantation at the origin of the splenic or gastroduodenal artery on the back-table.

There does not appear to be an increased rate of complications (occlusions, stenoses) following simple reconstruction.
Success of the reconstructed artery does not only depend on the quality of the arterial anastomosis but also on the inflow in the pre-anastomotic arterial segment.

12% adults and 50% of children the CHA is not suitable for anastomosis.

Arterial conduits have provided an effective and reliable method of revascularisation in patients at higher risk of arterial thrombosis, particularly small children, and retransplantation patients.
Arterial Conduits should be considered:

- Doubt about quality of inflow provided by native hepatic artery due to coeliac artery stenosis, hypersplenism

- Small, multiple or anomalous recipient hepatic arteries

- Friable, or attenuated native hepatic arteries ie at retransplantation

- Small recipients in whom the recipient artery is < 3mm in diameter

- More complex procedures including reduced, split, living related, or auxiliary liver transplantation
HEPATIC ARTERY
ARTERIAL RECONSTRUCTION: CONDUITS

Infrarenal site is safe and access is usually good
HEPATIC ARTERY
ARTERIAL RECONSTRUCTION: CONDUITS

Supracoeliac aortic conduit site
HEPATIC ARTERY
ARTERIAL RECONSTRUCTION: CONDUITS

The incidence of HAT when iliac arteries are used as conduits is similar to that in the standard direct arterial anastomosis with 1-year and 5-year patency rates of 88% and 85% respectively.

Cadaveric arteries can be stored up to 14 days in lymphocyte culture medium without increased risk of HAT.

Cryopreserved grafts associated with aneurysmal dilatation and stenoses
THE BILE DUCT

‘Achilles Heel’ of transplantation complications 8-15%, mortality 10%

Causes of Biliary Complications

a) Majority related to surgical technique
b) Hepatic artery thrombosis
c) Extended cold ischaemic time
d) Chronic rejection
Technique has become standardised

- cholecystectomy routinely performed

- cholecystojejunostomy or cholecystoduodenostomy abandoned

- Biliary reconstruction is either by end-to-end choledocho-choledochostomy or by choledochojejunostomy
BILE DUCT
ANASTOMOTIC TECHNIQUES CHOLEDCHO-CHOLEDCHOSTOMY

Biliary complications in Pittsburg, 1,792 cases

<table>
<thead>
<tr>
<th>Year</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1983</td>
<td>19%</td>
</tr>
<tr>
<td>1987</td>
<td>13%</td>
</tr>
<tr>
<td>1994</td>
<td>11.5%</td>
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</tbody>
</table>

*Starzl Ann Surg 1994*
BILE DUCT
ANASTOMOTIC TECHNIQUES CHOLEDOCHO-CHOLEDOSCHOSTOMY
Side-to-side choledocho-choledochostomy is particularly useful in smaller size bile ducts without the danger of developing stenosis.

Mechanical trauma to the edges and traction on the suture are more likely to cause necrosis and leakage in an end-to-end than in a side-to-side Anastomosis.

300 side-to-side choledocho-choledochostomies 7 (2.3%) and only one early biliary leak (0.3%) complications.
BILE DUCT
ANASTOMOTIC TECHNIQUES CHOLEDOCHO-JEJUNOSTOMY

INDICATIONS
• PRE-EXISTING BILIARY TRACT DISEASE
• PREVIOUS TRACT SURGERY

- Pre-existing biliary tract disease
- Previous tract surgery
Three randomised trials showing no benefit with T-Tube placement

- Scatton et al Annals of Surgery 2001
- Davidson et al Br J Surgery 1999
- Vougas et al Transplant International 1996
Most biliary complications occur within the first 3 months after transplantation. 38% first 30 days and 66% within the first 3 months.

Biliary leaks and strictures represent 70% of all biliary complications after OLTx.

50% of leaks occur at the anastomosis, most leaks occur within the first month.

In almost 90% of cases biliary obstruction/strictures occur at the anastomosis.

Leaks account for 75% of all biliary tract related deaths.

The incidence of leakage is similar in CC and CDJ however the leak-related mortality is considerably higher in CRY.
Small leaks can be managed endoscopically or radiologically by placing a temporary stent.

Larger leaks or disruption of the anastomosis should be dealt with surgically by revision from a choledocho-choledochostomy to a choledochojejunostomy.

In the case of CJ, failed anastomosis is taken down, the jejunal defect sutured or preferably excised and the bile duct cleared of devitalised tissue and the anastomosis refashioned, with a New enterotomy fashioned in the Roux loop.
Early strictures usually occur at the anastomotic site and a temporising stent is usually placed at the time of radiological diagnosis.

Tight strictures require early surgical intervention with excision of the stricture and generally formation of a CJ.

Low grade-moderate strictures can be treated with repeated balloon dilatation and repeated stenting. Several studies have shown excellent results at long-term follow-up.
In patients presenting with anastomotic bile duct strictures within 2 years of OLTx surgical reconstruction successfully restores graft function in the majority.

In patients with biliary strictures late after transplantation surgery should be reserved for selected patients who do not have histological evidence of graft fibrosis (moderate-severe) or significant non-biliary pathology.

Patients with in particular non-anastomotic strictures presenting long after OLTx, allograft dysfunction is due to the presence of co-existing diseases (ie rejection)