Hepatic vein stenosis as a complication of 'piggyback' liver transplant

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Purpose

The liver transplant procedure is establishing its place as the treatment of choice in irreversible acute or chronic liver dysfunction, like in cirrhotic patients or selected HCC patients.
Survival rates have been continuously improving as a consequence of advances in surgical technique, immunosuppressive agents and interventional techniques. Today, the survival rate at one year is close to 85%.
The piggyback technique offers several benefits over the classical technique, such as shorter surgical procedure and fewer intra-procedure complications. It doesn't imply the need to clamp the recipient's IVC, which in turn avoids a veno-venous bypass, improves hemodynamic stability, and reduces the anhepatic phase, the graft's revascularization time, use of intra-surgery blood-derivates and procedure related complications.
As with the classical technique, common complications can be divided in vascular and non-vascular complications.
Non vascular complications occur in 15 to 20%, most frequently involving the biliary system (e.g. biliary leaks, biloma or biliary stenosis). The biliary tree is very sensitive to ischemia and so these biliary complications are related to stenotic arterial anastomosis or prolonged graft preservation. Up to 60% of patients with hepatic artery stenosis will also show colangiographic anomalies.
Vascular complications involving the hepatic artery, the portal vein or the hepatic veins can present as stenosis, thrombosis, bleeding or a pseudo-aneurysm. Hepatic vein stenosis or thrombosis curses with a typical Budd-Chiari syndrome, presenting as ascites, lower limb swelling and some degree of hepatic dysfunction. Since the syndrome is more prevalent with the 'piggyback' technique it is often referred to as the 'piggyback' syndrome.

Our purpose is to evaluate the endovascular treatment of hepatic vein stenosis as a complication of the 'piggyback' liver transplant technique.
Methods and Materials

From June of 2007 to October of 2010, 12 consecutive patients previously submitted to a single orthotopic liver transplant (OLT) with the 'piggyback' technique were evaluated for suspected hepatic vein obstruction ('piggyback' syndrome) and included in this case series. These patients were evaluated through hepatic venography between 31 days to 10 years after OLT (mean of 19 months). One to three venographies were performed in each patient (mean of 1.5 procedures).

The indication for venography was based on the clinical suspicion of hepatic vein obstruction, with some patients being previously studied with color Doppler ultrasound, contrast enhanced CT or angio-CT. MRI is not available in our institution and was not routinely included in these patients diagnostic work-up.

The procedure is initiated through a trans-jugular approach with jugular puncture guided by ultrasound. A angled sheath is than advanced over a 'J' wire to the level of the piggyback anastomosis. A guide-wire is than advanced through the anastomosis into the hepatic veins and a catheter is used to perform a venography documenting the venous obstruction.

A self-expanding metallic stent (Wallstent, Boston Scientific, Galway, Ireland or a Zilver, Cook, Bloomington, IN) is deployed and a 14mm diameter balloon inflated at the center of the stenosis. A control venography documents the resolution of the venous obstruction. In two cases where the trans-jugular approach was unsuccessful, either by a sharply angled or tight stenosis or due to thrombosis of the hepatic veins, the 'rendez-vous' technique was attempted. In this technique, an anterograde percutaneous approach to the hepatic vein might allow the crossing of the stenosis and the passing of a guide-wire to the IVC, which would then be retrieved through the trans-jugular access. The procedure would then resume through the trans-jugular access as described before.

Pressure gradients were not routinely measured. One patients with refractory ascites and clinical suspicion of 'piggyback' syndrome did not have a venous obstruction confirmed by venography and pressure measurements showed a 5 to 6mmHg gradient across the piggyback venous confluence. This pressure was not considered significant and no further procedure was attempted. A control venography four months later shows stability of the venographic findings and the pressure gradient.
Fig. 3: Angio-CT 59 days after liver transplant showed patent right hepatic vein with reduced caliber (3mm) close to the piggyback anastomosis.

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Fig. 4

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**Fig. 6:** Failed attempt to place a stent in the right hepatic vein. A self-expandable metallic stent was deployed in the middle hepatic vein. The procedure was not clinically effective with persistence of refractory ascites.

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Fig. 7: Six days after the procedure, an angio-CT showed persistence of right hepatic vein thrombosis with a patent middle hepatic vein.

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Fig. 8

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**Fig. 9:** Nine days after, the right hepatic vein was approached through the 'rendez-vous' technique after paracentesis, with deployment of a self-expandable metallic stent in this vein. This last procedure was clinically effective with resolution of the refractory ascites four days later.

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**Fig. 10:** Both stents shown on CT.

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Results

All the 12 patients were evaluated venographically and endovascular treatment was attempted in 11 of them. In one patient, no venous obstruction was identified and no stent was deployed.

In the remaining 11 patients, 14 stenosis were identified at the piggyback confluence. 3 patients presented stenosis at the origin of both the medial and the right hepatic veins, being submitted to two procedures. Technical success was achieved in ten cases (71.4%) and clinical improvement was seen in eight patients (57.1%).

Four procedures were technically unsuccessful (28.5%). In one of them, the procedure was abandoned after a dissection of a small branch of the IVC, with contrast extravasation. This patient died of an unrelated cause.

In two cases were there was technical success, the procedure was not clinically effective, with both patients developing hepatic vein thrombosis at two and 47 days after the procedure and being later on referred to a second liver transplant.

One patient was submitted to three procedures. In the first procedure, a stent was deployed in the right hepatic vein by the 'rendez-vous' technique. Two days later torsion of the stent was confirmed by venography, being this stent dilated by balloon angioplasty. Eleven days after the second procedure, a new stent was deployed in the middle hepatic vein after thrombus aspiration.

Four patients were submitted to two procedures. In one patient, the second procedure was necessary because of lack of the selected stent; another patient repeated the procedure due to a thrombosis of the hepatic vein, probably iatrogenic; in another patient a second procedure was necessary in order to place a stent in the middle hepatic vein after successful stent deployment in the right hepatic vein in the first procedure. In the last patient submitted to two procedures, no stent was deployed and no significant venous obstruction was demonstrated.

We describe as complications in this series two cases of hepatic vein thrombosis (14.3%) and a case of stent torsion (7.1%).

Of the twelve patients included in this case series, six (50%) still remain in follow-up with a medium follow-up period of 472 days (1.29 years). The longest follow-up period is 1213 days (3.31 years) with patency of the stent.
<table>
<thead>
<tr>
<th>Treated stenosis: 14</th>
<th>Clinically effective</th>
<th>Clinically not effective</th>
<th>Sub-total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technically successful</td>
<td>8</td>
<td>2</td>
<td>10 (71.4%)</td>
</tr>
<tr>
<td>Technically unsuccessful</td>
<td>0</td>
<td>4</td>
<td>4 (28.5%)</td>
</tr>
<tr>
<td>Sub-total</td>
<td>8 (57.1%)</td>
<td>6 (42.8%)</td>
<td>14</td>
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</tbody>
</table>

Technical success is defined as the resolution of the venous obstruction after stent placement.
Clinical success is defined as Budd-Chiari’s syndrome resolution.

Fig. 1

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<table>
<thead>
<tr>
<th>Liver disease motivating the transplant</th>
<th>1st endovascular procedure</th>
<th>2nd endovascular procedure</th>
<th>3rd endovascular procedure</th>
<th>2nd liver transplant</th>
<th>3rd liver transplant</th>
<th>Death</th>
<th>Follow-up (days)</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Alcoholic chronic liver disease</td>
<td>4065</td>
<td>1093</td>
<td>1098</td>
<td>1300</td>
<td></td>
<td>77</td>
<td></td>
<td>Cause of death: Respiratory infection</td>
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<tr>
<td>2 Alcoholic chronic liver disease</td>
<td>901</td>
<td>1082</td>
<td></td>
<td></td>
<td></td>
<td>1113</td>
<td></td>
<td>Two hepatic vein stenoses: one successful and one unsuccessful Budd-Chiari syndrome after two days of stent deployment</td>
</tr>
<tr>
<td>3 Polyepicolic hepatic disease</td>
<td>64</td>
<td>70</td>
<td></td>
<td></td>
<td></td>
<td>1233</td>
<td></td>
<td>Two hepatic vein stenoses. Successful stent deployment in the middle hepatic vein did not resolve the piggback syndrome. 2nd stent deployment in the right hepatic vein of clinically effective.</td>
</tr>
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<td>4 Chronic liver disease due to HBV and HCC infection and HCC</td>
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<td>1098</td>
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<td>77</td>
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<td>Cause of death: Respiratory infection</td>
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<tr>
<td>5 Familial Pseudo-Amyloidosis</td>
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<td>568</td>
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<td>268</td>
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<td>2 hepatic vein stenosis</td>
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<tr>
<td>6 Cryoprecipitate coagulopathy and HCC</td>
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<td>568</td>
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<td>2 hepatic vein stenosis</td>
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<tr>
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<td>58</td>
<td>58</td>
<td>58</td>
<td></td>
<td>7</td>
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<td>No stent deployed</td>
</tr>
<tr>
<td>8 Alcoholic chronic liver disease and HCC infection</td>
<td>58</td>
<td>58</td>
<td>58</td>
<td>58</td>
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<td>7</td>
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<td>No stent deployed</td>
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<tr>
<td>9 Alcoholic chronic liver disease and HCC</td>
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<td>No stent deployed</td>
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<td>10 Chronic liver disease due to HCC infection</td>
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<td>7</td>
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<td>Right hepatic vein stenosis and thrombosis diagnosed with doppler ultrasound</td>
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<td>11 Chronic liver disease due to HCC infection</td>
<td>61</td>
<td>61</td>
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<td>61</td>
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<td>7</td>
<td></td>
<td>Right hepatic vein stenosis and thrombosis diagnosed with doppler ultrasound</td>
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<tr>
<td>12 Alcoholic chronic liver disease with refractory anoxia</td>
<td>89</td>
<td>89</td>
<td>89</td>
<td>89</td>
<td></td>
<td>7</td>
<td></td>
<td>Failed trans-jugular approach. ‘Random-ven’ technique was attempted due to large volume anoxia</td>
</tr>
</tbody>
</table>

Fig. 2
Conclusion

The piggyback surgical technique presents several benefits over the classic technique, even thou it is associated with higher rates of long-term complications, such as the piggyback syndrome. Endovascular stent deployment is an effective and safe procedure to treat this syndrome. Technique modifications like the rendez-vous technique allow for successful crossing of the venous confluence stenosis even in patients where the primary trans-jugular approach has failed. Published series on stent deployment to treat piggyback syndrome suffer from low number of cases. Our case series related well with other published series concerning technical success, clinical effectiveness and complication rates of this procedure. In our series, self-expandable stent presents similar good result as reported by other series using balloon expanded stents. The choice of stent usually reflects personal experience and preference. In this setting, a clear advantage of one type of stent over the other still remains to be proven.
References


