Aim: To evaluate the effectiveness and safety of percutaneous transhepatic stent placement in management of hepatic venous outflow obstruction after living-donor liver transplantation (LDLT).

Materials and methods: From September 2010 to May 2015 percutaneous transhepatic venography was performed in 30 patients of 489 patients who underwent LDLT with suspected hepatic venous outflow obstruction with stent placement performed in 25 patients. Patient follow-up included clinical and laboratory data collection, Doppler ultrasonography (US), hepatic venography, and computed tomography. Technical success, complications, clinical improvement, and recurrence were evaluated.

Results: Technical success was achieved in all patients. The mean pressure gradients across the stenosis before and after the procedure were 17.8 mmHg ± 6.4 (range, 3–39 mmHg) and 2.4 mmHg ± 2.6 (range, 0–8 mmHg), respectively. Four patients developed recurrent stenosis, and these patients underwent balloon angioplasty and remained with no events until the end of the observation period. During the mean follow-up period of 21 months (range 10–40 months) clinical success was achieved in 24 of 25 patients (96%).

Conclusion: In conclusion, percutaneous transhepatic stenting is safe and effective for venous outflow obstruction after LDLT.

1. Introduction

Hepatic venous outflow obstruction is considered to be one of the observed complications of living donor liver transplantation (LDLT) with a relative rare occurrence of 2–4% [1–3]. The patency of venous outflow is critical to graft survival. Obstruction of the venous outflow causes graft congestion which leads to massive ascites and ultimately graft failure [4,5]. Balloon venoplasty alone seems to be a good management option for hepatic venous outflow obstruction [6–9], yet it is not considered to be an effective treatment for various etiologies of venous outflow abnormalities with high re-stenosis rate [10].

In this article, we describe the efficacy, safety and patency of percutaneous transhepatic venous stenting for post LDLT hepatic outflow obstruction.

2. Patients and methods

2.1. Patients

Between September 2010 and May 2015, 30 patients (27 males and 3 females; median age 51 years) of total...
489 patients with suspected hepatic venous outflow obstruction were subjected to transhepatic percutaneous venography. These patients underwent living donor living transplantation between May 2010 and January 2015.

11 patients (36%) with left lobe grafts and 19 with right lobe grafts were suspected having outflow obstruction due to the presence of intractable ascites, pleural effusion or lower limb edema with abnormal monophasic venous flow patterns at Doppler ultrasonography or unexplained abnormal liver functions.

Hepatic outflow obstruction was diagnosed mainly by Doppler ultrasonography, and multi-slice CT was performed in equivocal cases or for confirmation. Findings to suggest venous outflow obstruction on Doppler were dilated hepatic vein >6 mm at the periphery of the graft, disappearance of triphasic waveform pattern of hepatic veins and/or flat monophasic flow seen in the hepatic vein (Fig. 1).

Common abnormal laboratory data were mainly elevated liver enzymes, high bilirubin and low albumin levels.

All the procedures were done under general anesthesia; an informed consent was taken after explaining the procedure details and possible interventions and risks. In all 30 patients venography was performed via the transhepatic percutaneous approach. The age of the patients ranged from 29 to 57 years (median age 51 years), with the time between transplantation and the venography procedure was 2–10 months (median 4 months).

Venous outflow obstruction was confirmed by venography in 25 patients of the total 30, and significant hepatic vein stenosis was defined with a dilated hepatic vein observed to more than 30% stenosis at the junction with IVC with stasis dye at the anastomosis, with or without the presence of collaterals and/or a more than 5 mmHg pressure gradient across the anastomosis.

2.2. Procedure

Under US guidance, after a small skin snip, the targeted hepatic vein was punctured (11 patients left hepatic vein, 19 patients right hepatic vein). A 16-gauge needle was used for a transhepatic puncture of the vein (rather than transvenous route). The inner stylet of the needle was withdrawn and a successful puncture was confirmed by contrast media injection, a 0.032-in. angled hydrophilic guide wire (Radifocus; Terumo, Tokyo, Japan) was advanced into the hepatic vein, over the guide wire a 7-F interventional sheath introducer was inserted, followed by a control subtracted venogram of the hepatic vein and IVC in direct posteroanterior and oblique projections.

Stenotic segment was identified in 25 patients which was bypassed using the guide wire and a 4 or 5-F catheter with cobra head configuration (Tepo; Cordis, Johnson and Johnson, USA) was inserted across the anastomosis. From this catheter, pressure gradient across the anastomosis (between hepatic vein and IVC or right atrium) was recorded using an invasive monitor. Patients with a pressure gradient of more than 5 mmHg were diagnosed to have significant venous outflow obstruction that requires stent placement.

In all 25 cases a 10 mm bare self-expandable metallic stent (Wallstent, Boston scientific, USA) was placed across the anastomosis, following stent placement, a subtracted post stenting hepatic venography was done with post stenting measurement of pressure gradient across the anastomosis. Further post stenting dilatation with balloons was performed when radiological or manometric results were unsatisfactory.

After completion of the procedure the introducer sheath was then removed, the puncture site was not coiled embolized and post procedural Doppler US was done to confirm stent patency and detect any bleeding (Fig. 2).

2.3. Follow-up evaluation

Doppler US was done every week in the first month, and then every month. Clinical evaluation, liver functions and laboratory tests were performed for all patients every month as well.

Recurrence of symptoms of hepatic outflow obstruction, with or without abnormal laboratory data or Doppler US findings suggesting stent malfunction was an indication for a hepatic venography; balloon venoplasty using a 10 mm balloon with stent reopening was performed when restenosis or stent occlusion was found.
Technical and clinical success, manometric findings, complications, recurrence and outcome of venoplasty, and patency rates were evaluated.

3. Results

3.1. Technical success

Of the 30 patients who underwent venography and manometric measurements, we found 25 patients with pressure gradient more than 5 mmHg between the hepatic vein and IVC with positive venography findings, and 5 patients had a pressure gradient of 3 mmHg or less without venography findings suggesting outflow obstruction. And in the 25 patients with high pressure gradient percutaneous transhepatic stent placement was successfully performed; technical success was 100% in these patients.

3.2. Manometric findings

The mean pressure gradient (venous pressure in the IVC subtracted from that in the liver graft before the anastomosis) was 17.8 mmHg ± 6.4 (ranging from 5 to 39 mmHg) before stenting and 2.4 mmHg (ranging from 0 to 8 mmHg) after stenting. A major difference was found pre and post stenting with statistically significant drop in pressure ($P < 0.01$).

3.3. Clinical success

Clinical success was obtained in 24 out of 25 patients (96%) with resolution of the ascites and normalization of liver enzymes with triphasic waveform pattern of the hepatic vein. One patient showed no clinical improvement however with significant improvement of the hepatic flow but with persistent elevated liver enzymes and ascites and was diagnosed as graft rejection (liver biopsy) and sent for re-transplantation.

3.4. Complications

No major complications were encountered during the course of the study, and no cases of serious post procedural bleeding were recorded. As to minor complication, transient fever and pain were observed in two patients, which were managed conservatively.

3.5. Recurrence

Recurrence of outflow obstruction after the stent placement was observed in 5 patients; follow-up in these
patients ranged from 6 to 20 month, the clinical presenta-
tion was mostly recurrent accumulation of ascites, 4
patients had recurrent outflow obstruction and one patient
suffered from graft rejection with normal flow on Doppler
examination. All four patients underwent hepatic venogra-
phy with balloon venoplasty and reopening of the stent
while the fifth patient was sent for re-transplantation.

3.6. Patency rate

The primary patency rate throughout the follow-up per-
iod was 80% with confidence intervals (CIs) calculated at 6,
12, 14, 16 and 20 months after stenting (Fig. 3) 0.96, 0.92,
0.72, 0.52, and 0.48, respectively. The primary assisted and
secondary patency rates were 1.00 throughout the follow-up
period (Fig. 3).

4. Discussion

Post LDLT hepatic venous outflow obstruction is not
uncommon, and this is likely attributed to the presence
of accessory hepatic veins and the frequent need of more
than one hepatic venous anastomoses. Post LDLT hepatic
venous outflow occlusion was reported to be from 3.9%
to 16.6% [1,7].

Early (<30 days) post LDLT hepatic outflow obstruction
will lead to a congested graft and will induce deterioration
in liver functions, acute graft failure, or even death [1,11]
and this is considered as a surgical emergency, and surgical
correction is mostly the option of choice [12]. While
delayed hepatic venous outflow obstruction usually results
in gradual deterioration of liver function, with ascites and
surgical correction is usually un-preferred due to severe
perianastomotic fibrosis. Thus interventional radiological
procedures are superior to surgical correction in these
cases [13]. So, early and adequate management of post
transplant hepatic venous outflow obstruction is manda-
tory for graft survival.

Balloon venoplasty alone seems to be an effective and
safe for management of post transplant hepatic venous
outflow stenosis [6]; however, there is still a high inci-
dence of restenosis and recurrence of symptoms, and sev-
eral studies showed that there is high rate of restenosis
after venoplasty alone (up to 60%) most of which in the
first 6 months, which needed further stent placement
[3,14].

A transhepatic approach for hepatic vein puncture was
applied in all our cases under real time sonographic guid-
ance. Access to the hepatic vein can be done via both per-
cutaneous transhepatic and transluminal approaches,
weather transjugular or transfemoral with nearly equal
results [3]. However, we believe that dealing with stenosis
via guide wires appears to be much easier with the percu-
taneous transhepatic route because passage through the
stenosis is likely straightforward with this route. This is
resulting in less procedure time, less contrast media and
decreased exposure of the patient to ionizing radiation.
Theoretically the transhepatic approach may be more
liable to serious bleeding. However, in our study, no signif-
ificant bleeding was reported despite we did not embolize
the tract in hepatic parenchyma with colli or gel foam at
the end of the procedure because we succeeded to bypass
the stricture and relive the hepatic congestion in all our
cases.

Although stents may be susceptible to thrombosis and
sometimes could interfere with re-transplantation, our
rate of thrombosis was relatively low 4 over 25 (16%),
and on analysis we found three of these four patients were
diagnosed preoperatively as Budd Chiari disease and
thrombosis was mostly due to uncontrolled thrombophilia,
as recurrence of Budd Chiari Syndrome after transplanta-
tion has been reported to be as high as 27% and may
require re-transplantation [15].

There were no major surgical or technical limitations in
the patient who was sent for re-transplantation as the
position of the stent was not reaching the suprahepatic
part of inferior vena cava, so proper stent placement is
essential to not interfere with further surgical corrections,
and no cases of stent migration were reported in our study.

Regarding stent diameter, we used a standard stent
diameter (10 mm) in all our patients, as that was the mean
vein diameter in the pre procedural duplex US examina-
tion, and a study done by Ko et al. (2008) showed less
restenosis rate in large diameter stents (10 and 12 mm)
compared to smaller stents (6 and 8 mm) [16].

An interesting issue is the high number of left lobe
grafts in our study (36%) despite the low number of left
lobe grafts in the adult LDLT practice in our country,
several data reported increased rate of post LDLT hepatic
outflow obstruction in patients receiving left lobe grafts,
compared with those having right lobe grafts (5.8% vs. 0.8%). This difference is likely due to increased anatomic variation of the left hepatic vein and to the surgical and technical challenges presented by the angle and size of the reconstruction [17,18] (Fig. 4).

A main limitation in our study is the small number of patients, which might not have been enough to evaluate the complications of percutaneous transhepatic approach, and more studies are needed to compare this approach with the transluminal one. Also a comparative study regarding long-term patency between stenting and balloon venoplasty is also needed as the question of whether to treat hepatic venous outflow obstruction in this patient population with venoplasty alone or with metallic stent placement still remains controversial.

5. Conclusion

Percutaneous transhepatic stenting is a safe and effective method for treating hepatic venous outflow obstruction after LDLT with good outcome.

Conflict of interest

The authors declare that they have no conflict of interest.

References


