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Clinical Investigations

Stenosis of the Inferior Vena Cava After Liver Transplantation: Treatment with Gianturco Expandable Metallic Stents

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Abstract

Purpose: Evaluate the efficacy of double Gianturco expandable metallic stents for stenosis of the inferior vena cava (IVC) after orthotopic liver transplantation (OLT).
Methods: Three patients developed severe Budd-Chiari syndrome secondary to suprahepatic caval stenosis after OLT. Percutaneous angioplasty (PTA) of the stenoses was unsuccessful. Therefore double Gianturco expandable metallic stents, connected in tandem, were deployed at the site of the stenoses.
Results: One double stent was successfully and definitively deployed in patient 1. Partial dislocation of the upper and lower stents comprising the double stent occurred in patient 2. The double stent initially implanted across the stenosis became displaced in patient 3. The Budd-Chiari syndrome resolved in all three patients who remained asymptomatic during follow-up from 3 to 32 months.
Conclusions: Double Gianturco stent deployment is a viable option in patients with anastomotic stenosis of the IVC secondary to OLT when initial treatment with PTA fails. Certain modifications of the stents employed are suggested for the purpose of avoiding technical complications.

Key words: Vena cava—Stenosis—Transluminal angioplasty—Liver transplantation—Stents—Grafts and prostheses

Technical complications after orthotopic liver transplantation (OLT) are related to arterial, biliary, or venous anastomoses [1, 2]. Stenosis of the suprahepatic inferior vena cava (IVC) after OLT is a rare but serious complication that has traditionally been managed surgically [2]. In recent years, treatment of this unusual vascular complication has included percutaneous transluminal angioplasty (PTA) in a few cases [3–5] and percutaneous deployment of stents [6]. Both of these interventional procedures are low-risk therapeutic alternatives to surgical revision or retransplantation [5, 6]. We report our experience in three patients using double Gianturco expandable metallic stents to treat IVC anastomotic stenoses complicating OLT.

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Materials and Methods

Three patients with stenosis of the suprahepatic IVC following OLT were treated by percutaneous implantation of double Gianturco expandable metallic stents consisting of an upper stent and a lower stent connected by a single strut. Patient 3 also suffered from a stenosis of the infrahepatic IVC at the site of the distal graft anastomosis. The patients were two men, both age 50, and one woman age 38 (Table 1). All three patients underwent OLT in response to cirrhosis of the liver with esophageal varices, ascites, and malnutrition. A surgical portocaval shunt had been placed in two patients before OLT. Budd-Chiari syndrome and edema in the lower limbs developed after OLT.

To demonstrate the location, length, and severity of the stenosis, a cavogram was performed via a right transjugular approach in one case and a right transfemoral approach in the other two cases. A 7 Fr angiographic catheter was used to determine the venous pressure gradient across the stenosis before percutaneous treatment and after PTA and stent deployment. In patient 1, a 5 Fr 8-mm-diameter balloon catheter (Schneider Europe, Buelach, Switzerland) was introduced via the right femoral vein, while another balloon catheter of the same type was introduced via the right jugular vein. The balloons were placed across the stenosis and inflated simultaneously three times for 60 sec each time. In the other two patients, PTA was attempted by introducing a 9 Fr 18-mm-diameter balloon catheter (Meditech, Watertown, MA, USA) via the right femoral vein. PTA failed to improve the pressure gradient and symptoms in any of the three patients. A 30-mm-diameter x 5-cm-long double Gianturco expandable metallic stent (William Cook Europe, Bjaeverskov, Denmark) was implanted via a right femoral vein approach 9 days (patient 1), 2 days (patient

Table 1. Summary of patients

Patient	Age and sex	Class of cirrhosis	Symptoms after OLT	Days from OLT to cavogram	BPG across IVC stenosis (mmHg)
1	50, M	Child's C	BCS, LLE	11	18
2	50, M	Child's C	BCS, LLE	2	16
3	38, F	Child's C	BCS, LLE	18	17

OLT = orthotopic liver transplantation; BCS = Budd-Chiari syndrome; BPG = blood pressure gradient; LLE = lower-limb edema

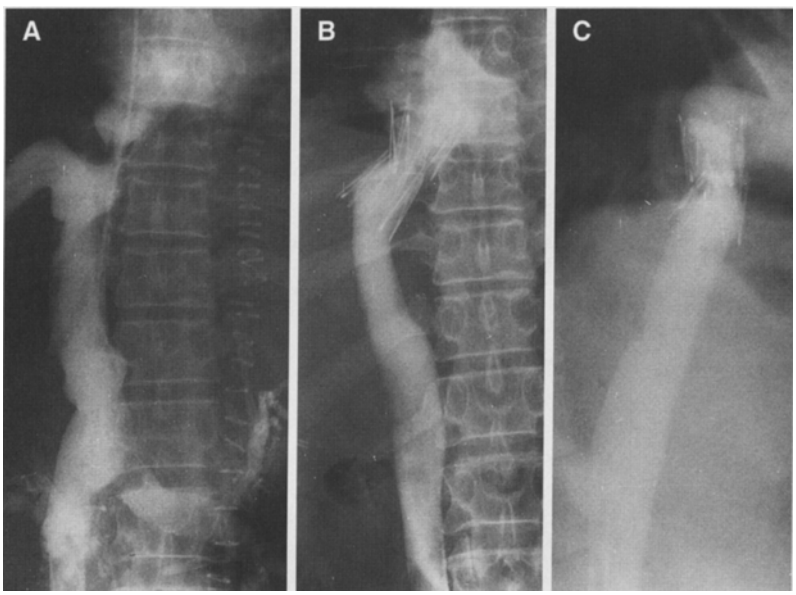

Fig. 1. A Transjugular cavography shows severe stenosis of the suprahepatic caval vein anastomosis. Note retrograde flow into the left renal vein. A-P (**B**) and lateral (**C**) cavograms showing the stenosis to be widely patent following placement of the double Gianturco stent without retrograde flow.

2), and 18 days (patient 3) after PTA. A guidewire and angiographic catheter were inserted across the stenosis. A 12 Fr Teflon sheath mounted on a dilator was then exchanged over the wire. The stent was loaded into the sheath and then advanced to the site of the stenosis, where it was held in place by the pusher while the sheath was retracted. After insertion of the stent, cavography was performed and the pressure gradient across the stented stricture was measured.

Results

One double stent was successfully and definitively implanted in patient 1 (Fig. 1). Partial dislocation of the upper and lower stents occurred in patient 2 (Fig. 2). Patient 3 required the deployment of two double Gianturco stents across the suprahepatic stenosis (Fig. 3A, B). The venous pressure gradient improved immediately upon deployment of the stents (Table 2), and the Budd-Chiari syndrome resolved in patients 1 and 2 within a few days.

Cavography was repeated in patient 3 five days after implantation of the two double Gianturco prostheses, because the ascites and lower-limb edema did not resolve completely. No changes in pressure were observed and the prosthesis had not migrated, but a pressure gradient of 8 mmHg was found at the infrahepatic caval stenosis. As symptoms did not fully subside, it was decided to insert a third double Gianturco stent across the infrahepatic stenosis. The lower of the double stents was initially positioned at the stricture, but slipped upwards slightly when the prosthesis was fully released (Fig. 3C). Nevertheless, the pressure gradient fell to 3 mmHg, and ascites as well as lower-limb edema resolved within a few days.

Patients 1, 2, and 3 remained asymptomatic over follow-up of 3, 32, and 24 months, respectively. Patient 1 died of acute myocardial infarction 3 months after implantation of the stent. The other two patients lead normal, active lives.

Discussion

Budd-Chiari syndrome is a rare disorder consisting of hepatomegaly, ascites, and abdominal pain secondary to hepatic vein or IVC occlusion [3, 7]. This syndrome may be classified as primary (congenital obstruction of the hepatic veins or the hepatic portion of the vena cava by webs or diaphragms) or secondary (acquired ob-

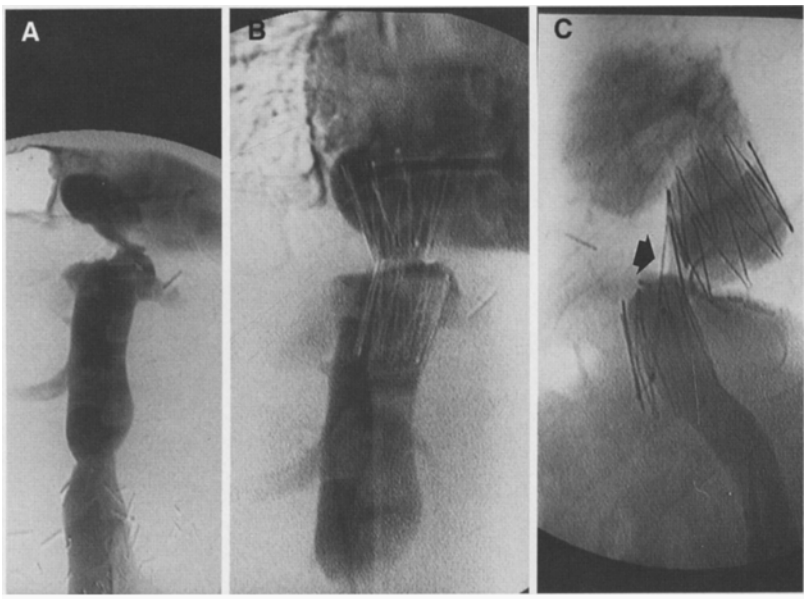

Fig. 2. A A-P cavogram showing severe stenosis of the suprahepatic caval anastomosis. **B** A-P view showing improvement of the stenosis after deployment of the prosthesis. **C** Lateral view demonstrates partial dislocation of the upper and lower stents. Only the connecting strut (arrow) still holds the two stents together.

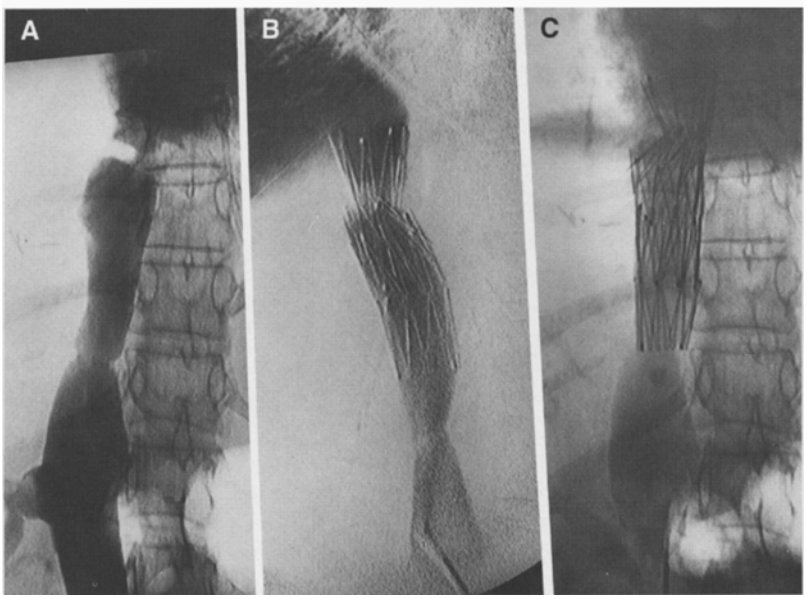

Fig. 3. A A-P cavography shows high-grade stenosis of the suprahepatic caval anastomosis and a more moderate stenosis of the infrahepatic IVC at the distal anastomosis. **B** Lateral cavogram after placement of two prostheses within the suprahepatic stenosis; the first slipped downwards, lodging below the stenosis; the second dilated the stenosis, which had been positioned between the upper and lower stents. **C** A-P cavogram after deployment of a double Gianturco stent at the distal anastomotic stenosis; the prosthesis slipped upwards slightly on release, lodging then partially within the proximal stents, with its lower level at the stenosis.

struction of the hepatic veins or IVC by tumor, thrombosis, or trauma) [7]. In each of our three patients the Budd-Chiari syndrome was caused by a severe stenosis of the suprahepatic IVC anastomosis after OLT obstructing hepatic venous drainage.

Ultrasonography, pulsed Doppler, computed tomography, nuclear medicine, and magnetic resonance imaging can provide important and sometimes definitive data for the diagnosis of Budd-Chiari syndrome [7, 8]. Transfemoral or transjugular cavograms, as in our three patients, can demonstrate the location, length, and severity of the anastomotic lesion. Both these venous routes allow measurement of the pressure gradient across the anastomosis and evaluation of the results after PTA and/or deployment of stents [9–11].

Anastomotic stenoses in OLT may be due to fibrosis, reactive edema, organized thrombus, or neointimal hyperplastic fibrosis [3, 5, 6]. In our three patients early onset of lower-limb edema and Budd-Chiari symptoms suggested a very tight anastomosis or kinking of the vessel, as previously described in the literature [5, 6]. To our knowledge treatment of anastomotic stenosis of the IVC after OLT by means of PTA has been reported in just a few cases [3–5], only one of which involved stent (Palmaz) placement [6]. PTA may have been unsuccessful in our three patients because of the elastic

Table 2. Summary of results

Patient	BPG after insertion of DGS (mmHg)	Symptoms after DGS	Technical complications	Clinical follow-up
1	5	Asymptomatic	None	Normal at 3 months
2	7	Asymptomatic	Partial dislocation of DGS	Normal at 32 months
3	7	Asymptomatic	Displacement of DGS (first and third stents)	Normal at 24 months

BPG = blood pressure gradient; DGS = double Gianturco stent

nature of the stenoses. Surgical correction of the suprahepatic anastomotic stenoses was considered extremely difficult in all three cases, and it was therefore decided to treat the stenoses percutaneously.

Double Gianturco stents were preferred to other stents, because more results have been published for this type of stent in the venous system than for others [12]. The diameter of the prosthesis was chosen according to the normal concentric lumen diameter. A stent 25%–50% larger than the normal lumen diameter was used, as it had been reported to provide a stronger radial force [13].

Deployment of Gianturco stents is simple and effective in patients with stenosis or venous thrombosis of varying location and etiology [12–15]. Still, certain aspects need to be considered when using these stents in the treatment of anastomotic caval stenosis. In all three patients, the upper stent of the double stent was positioned across the stenosis. The entire double stent slipped upwards until the stenosis was situated between the two stents, except in patient 3, where the stent migrated downwards. To prevent such displacement, certain authors have recommended positioning the upper stent above the stenosis and the lower stent at the site of the lesion for short stenoses [12]. However, based on our results, slippage of the lower stent may occur in short stenoses, as in the distal anastomotic stenosis in patient 3. Such slippage may pose a serious threat at the proximal anastomotic stenosis because of its proximity to the right atrium. In addition to slippage, partial dislocation of the prosthesis occurred in patient 2, probably as a result of severe asymmetry and elasticity of the stenosis. Retrospectively, this problem could perhaps have been avoided by using double Gianturco stents connected by at least two struts, as has been recommended previously [16]. Another alternative might have been connection of the two stents by sutures [17]. In fact, joining the stents by means of sutures instead of a metallic strut would prevent any weak points and partial dislocation.

While in all three cases the stents were placed so that the suprahepatic caval stenoses were at the weakest point along the double stents and partial dislocation occurred in one case, the hemodynamic and clinical results can be considered satisfactory. The initial pressure gradients decreased considerably and symptomatic relief was obtained in all three patients. Clinical follow-up did not demonstrate symptoms of recurrent stenoses.

We conclude that Gianturco stent implantation is a viable option in patients with anastomotic stenosis of the IVC secondary to liver transplantation when prior treatment with PTA has been unsuccessful. The suggested modifications to the double Gianturco stents may lessen or eliminate the technical complications described.

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