Indigo Thrombectomy System for Hepatic Artery Thrombosis After Liver Transplantation: A Case Report

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ABSTRACT

Introduction. Hepatic artery thrombosis still represents a major complication after liver transplantation responsible for graft failure, possibly resulting in the need for retransplantation.

Case Report. We describe a case of a patient undergoing liver transplant complicated by hepatic artery thrombosis, successfully treated with an endovascular approach using the Indigo System. This new system allows mechanical fragmentation and aspiration of the thrombus, with no injection of any thrombolytic agents, thereby reducing the risk of bleeding. Hepatic artery flow was immediately restored, with no complications for the patient and the graft.

Discussion. The Indigo System appears to be a safe, affordable, and manageable technique for endovascular management of late hepatic artery thrombosis after liver transplant.

LIVER transplantation (LT) is a worldwide accepted treatment and considered as the best option for end-stage liver diseases. Nevertheless, it is still affected by several types of surgical complications, particularly vascular complications, both in the immediate and late period after transplant. Early or late arterial complications represent the second cause of graft failure [1], with hepatic artery thrombosis (HAT) being the most common complication, particularly in pediatric patients [2], with an incidence ranging from 2.5% to 15% [3]. HAT is responsible for high incidence of morbidity and mortality, leading to graft failure and graft loss. This is due to the lack of oxygenated graft inflow that leads to ischemia of the hepatic parenchyma and biliary structures. In cases of HAT, the treatment modality depends on time of onset after transplantation and symptoms. Options include endovascular approach with thrombolysis, surgical intervention with hepatic artery reanastomosis, or retransplantation in case of graft failure. In this paper we present a case of late HAT after transplant treated with the Indigo System (Penumbra Inc, Alameda, Calif, United States), a device that allows for arterial thrombus elimination by means of mechanical aspiration.

CASE REPORT

In November 2016, a 59-year-old white man underwent LT due to hepatocellular carcinoma and alcoholic cirrhosis. The hepatectomy was carried out with vena cava preservation according to the piggyback technique, and the arterial reconstruction was performed through a termino-terminal anastomosis between the donor and recipient common hepatic artery (HA), by a double running suture using polypropylene 6.0. The early posttransplant period was stable with good liver function, and patency of the vascular anastomosis was confirmed by calculating resistance index with Doppler ultrasound (DUS). After the first week, the patient was put on antiaggregation therapy for prophylaxis of HAT. The patient was discharged from the hospital in good condition, and with normal liver function on postoperative day 15.

One month later a follow-up DUS suggested a possible occlusion of the HA. The patient was readmitted to the hospital, and an urgent abdominal computed tomography (CT) scan with contrast showed an irregular and thin graft HA with reduced intrahepatic arterial perfusion and an hypodensity area of 4 cm × 4 cm in the right hepatic lobe. A digital subtraction angiography (DSA) was performed, confirming a patent but thin HA with a reduced parenchymal impregnation. A Hippocampus Stent (Medtronic, Minneapolis, Minn, United States) 5 mm × 15 mm in diameter was positioned in the HA through the anastomosis. Furthermore, suspecting splenic artery steal syndrome, blood flow was increased via

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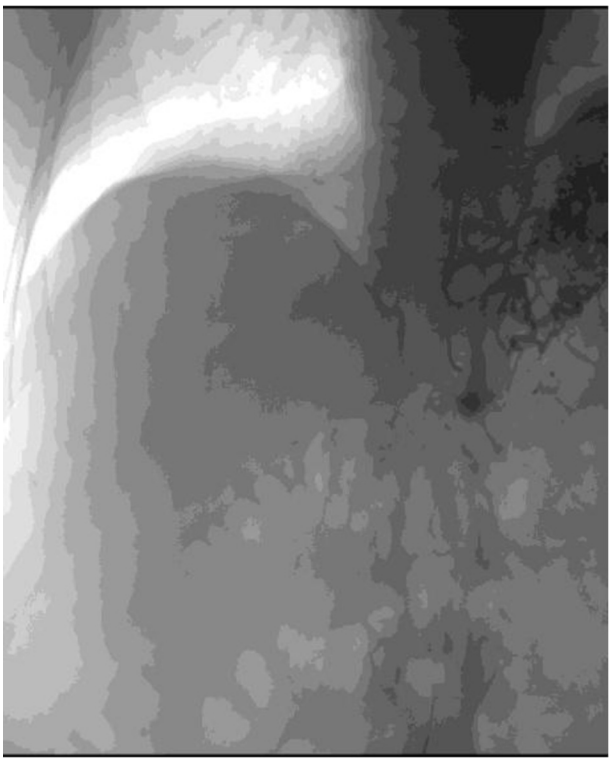

Fig 1. The angiogram shows the lack of hepatic artery opacification. Its origin is not recognizable. The stent previously positioned is visible.

Fig 2. The angiogram shows the patency of intrahepatic arterial tree.

embolization of the splenic artery using the Amplatzer Vascular Plug II (Abbott Laboratories, Chicago, Ill, United States). After the procedure, the liver intraparenchymal contrastography significantly improved. The patient was put on double antiaggregant therapy for 1 month, followed by single therapy. Serial DUS follow-up visits were stable with normal arterial resistance index (0.70) and normal liver function.

Eleven months later, the patient was readmitted to the hospital for fever (>38°C) and altered blood chemistry (white blood cells 28,600/μL; hemoglobin 11.4 g/dL; procalcitonin 158 ng/mL; C-reactive protein 404 mg/L; international normalized ratio 1.6; creatinine 2.8 mg/dL; liver enzymes ast/alt 500/579 IU; total bilirubin 1.29 mg/dL; conjugated bilirubin 1.06 mg/dL; albumin 26.1 g/dL). A contrast abdominal CT scan revealed a region of liver ischemia with abscesses between segments VI and VII. The HA was not recognizable and intrahepatic arterial flow persisted via by small collateral vasculature. The patient underwent repeat DSA for diagnosis and possible therapy.

TECHNICAL PROCEDURE

Preliminary DSA performed through the left humeral artery confirmed the occlusion of HA (Figs 1–3). Recanalization of the HA was obtained by use of a microguide and microcatheter followed by predilatation with a 3-mm × 40-mm Coyote Balloon (Boston Scientific, Marlborough, Mass, United States) dilatation catheter. To resolve the thrombus, we used a new technique consisting of a continuous aspiration mechanical thrombectomy system composed of 4 principal components: a vacuum-assisted pump using the Pump MAX (Penumbra Inc) which can deliver a nearly pure vacuum of 29 mm Hg; an aspiration catheter responsible for continuous aspiration; a separator which facilitates fragmentation of thrombus; and a MAX canister (Penumbra Inc). The aspiration catheters (CAT 3, CAT 5, CAT 6, CAT 8) and the separators (SEP 3, SEP 5, SEP 6, SEP 8) are available in assorted sizes.

The Indigo System aspiration was performed by using CAT 5 (5 F in diameter and 132 cm in length), which appeared to be the most appropriate depending on vessel size. The catheter must be placed at the proximal edge of the thrombus, followed by initiation of aspiration alone or by using the "size-vessels matched" separator. In our case we preferred to use SEP 5 (175 cm in length) which is the device compatible with CAT 5. The thrombus was considered a "late thrombus" and therefore adhered to the vessel wall minimally. The SEP5 allowed for the dislodging of the thrombus, a mechanical thrombolysis, and the aspiration of the thrombus. After the procedure, a further dilatation was performed, followed by positioning of a 7-mm × 30-mm Precise Pro-Rx Carotid Stent (Cordis Corporation, Milpitas, Calif, United States). This was able to reduce the kinking of the artery. At the end of the procedure, DSA revealed the complete recanalization of the HA and

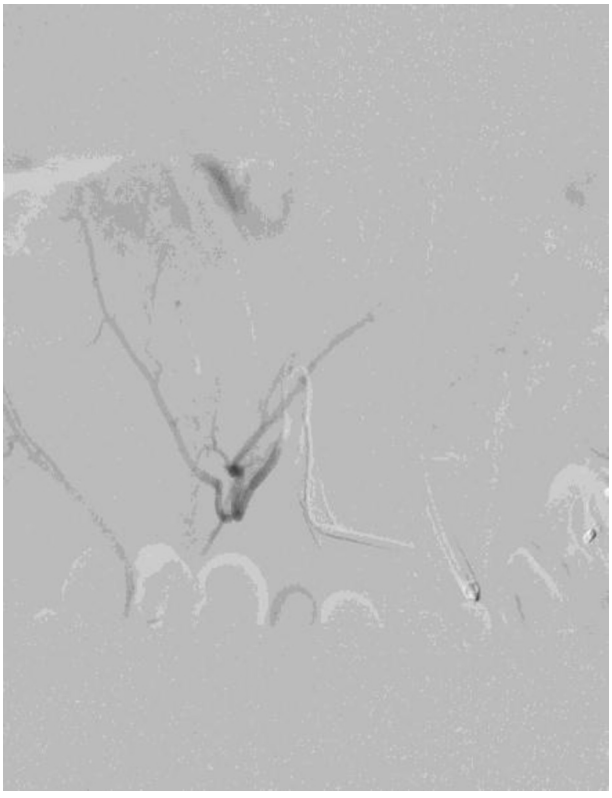

Fig 3. The angiogram shows the patency of intrahepatic arterial tree.

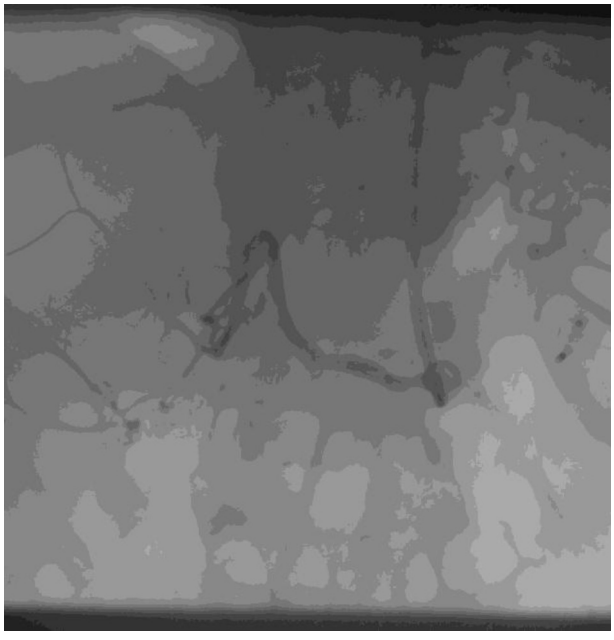

Fig 4. Angiography after aspiration with Penumbra's Indigo System.

restoration of intraparenchymal flow (Figs 4 and 5). The total operative time was 75 minutes.

After the procedure, the patient continued antibiotic therapy for 1 month with piperacillin-tazobactam; repeat DUSs confirmed a good flow restoration with normal resistance in the HA. Furthermore, a CT scan 19 days posttreatment revealed a more increased liver vascularization and perfusion with a significant reduction in diameter of the abscesses.

At 4 months after the procedure, the patient is in stable condition, with normal liver function and no remaining liver abscess evidenced by DUS.

DISCUSSION

HAT represents one of the major causes of liver transplant complications and a frequent indication for retransplantation [4]. The major features associated with HAT are: prolonged cold ischemia time, donor age over 60 years, cytomegalovirus infections or reactivation, multiple episodes of rejection, and hypercoagulable states in the recipients [5].

Other causes are related to surgical techniques, differences in vessel size, quality of donor and recipient arterial vessels (such as presence of arterial abnormalities that require complex reconstructions at back-table or during transplantation), and the patient's features. Moreover, literature reports an increasing risk of HAT in obese patients because of technical problems secondary to narrow and deep spaces with limited visualization of the vasculature [5].

Fig 5. Final result after the procedure. The angiogram demonstrates the complete recanalization of the hepatic artery and the restoration of intrahepatic flow from the celiac tripod.

Prompt diagnosis is directly related to patient and graft survival [6,7]. Early HAT is generally treated by surgical reconstruction of the arterial anastomosis or retransplantation in cases of acute liver failure. In contrast, late HAT may be conservatively managed if sufficient arterial collateralization develops to maintain adequate blood flow to the liver.

In our case, the patient was treated with HA stent positioning and embolization of the splenic artery 1 month after transplant for liver hypoperfusion due to splenic artery steal syndrome and hepatic artery stenosis. Despite restoration of normal flow and anticoagulant therapy, he was newly readmitted for late arterial thrombosis (LAT) 4 months after transplant complicated by hepatic abscess. As reported in the literature, the majority of LAT thromboses that develop ischemic cholangiopathy have an elevated risk of rescue retransplantation [8].

Our patient had no signs of liver failure, therefore, we decided to perform an urgent radiologic treatment to save the graft. Various endovascular treatments have been proposed such as stenting, angioplasty, fibrinolysis, and intra-arterial urokinase infusion. We decided to try the new Indigo System.

To our knowledge, this is the first case of HAT after LT treated with this system. We conducted our search on the PubMed database through January 2018 and we found only 4 articles about the device used for treatment of blood vessel thrombosis. In particular, the situations in which it was utilized were acute renovisceral-occlusive events not transplant-related [9], peripheral acute ischemia [10,11], and pulmonary sub-massive embolism [12]. In our case we judged CAT 5 to be the most appropriate size-matched catheter of the Indigo devices for the procedure. Bisdas et al [9] considered CAT 8 (8 F in size) more appropriate for the superior mesenteric artery and celiac trunk, and CAT 6 for the native renal artery. In our case, CAT 5 allowed us to clear the HA in a very short time, without any procedure-related complications and with early patient recovery. Moreover, as demonstrated in our case, it is possible to integrate such a system to other complementary procedures such as stent positioning and angioplasty and it avoids the use of fibrinolytic agents. In our experience the procedure appears to be safe and it can potentially be repeatable on other occasions such as in the case of persistent or recurrent thrombus, venous thrombus, and in the pediatric population. The Indigo System is a fast and intuitive device which can be used after minimal training of interventional radiologists. On the other hand, it should be abandoned when, after repeated attempts, it's not able to resolve the problem, moreover it is more expensive than other usual modalities such as traditional thrombolysis. Nevertheless, it is a unique device without parallel. Its function and capabilities are not common to the other available techniques.

CONCLUSION

Our experience suggests a possible usefulness and feasibility of Penumbra's Indigo System to treat vascular complications of liver transplant surgery. Surgical revision should be considered when clinical status and laboratory findings appear compromised, either initially or as a last resort should the procedure not resolve the issue.

No problems have been evidenced during the procedure and this approach allowed for an immediate blood flow to be reestablished. Operative times were reduced with demonstrated safety and effectiveness.

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