Clin J Gastroenterol (2014) 7:361–364
DOI 10.1007/s12328-014-0507-1

CASE REPORT

Magnetic compression anastomosis for the stricture of the choledochocholedochostomy after ABO-incompatible living donor liver transplantation

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Received: 9 April 2014 / Accepted: 9 June 2014 / Published online: 28 June 2014

Abstract Biliary complications, such as stricture or obstruction after living donor liver transplantation (LDLT), are still major problems. Magnetic compression anastomosis (MCA) is a minimally invasive and nonsurgical procedure in patients with biliary structure or obstruction. A 49-year-old woman who had had ABO-incompatible LDLT 16 months previously presented with obstructive jaundice. After sufficient improvement of obstructive jaundice by percutaneous transhepatic cholangiodrainage (PTCD), the rendezvous technique between PTCD and endoscopic retrograde cholangiopancreatography was attempted in order to break through the stricture, but this was not successful. Therefore, MCA was performed. A parent magnet was endoscopically placed at the common bile duct side of the stricture, and the daughter magnet, attached to a guidewire, was also inserted to the intrahepatic bile duct. Both magnets were advanced to positions immediately prior to the biliary obstruction, and it was confirmed that the two magnets attracted each other magnetically, sandwiching the stricture. Twenty-four days after MCA, as recanalization could be achieved without any adverse events, the magnets were removed via the PTCD fistula. MCA enabled us to create a fistula without complications. In conclusion, when a conventional endoscopic or percutaneous approach, including the rendezvous technique, has failed, MCA is a novel method for patients with the stricture of the choledochocholedochostomy after LDLT.

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Keywords Magnetic compression anastomosis · Choledochocholedochostomy · Biliary tract stenosis · Liver transplantation

Introduction

Biliary complications after liver transplantation are relatively common and remain an important cause of morbidity, in spite of various advances in surgical techniques [1]. The incidence of such complications is reportedly higher following living donor liver transplantation (LDLT) than after deceased donor liver transplantation, especially in ABO-incompatible cases, affecting ~20–30 % of recipients [2]. In most cases, this complication involves stricture of the choledochocholedochostomy, along with biliary leakage [3].

The treatment for most biliary complications is considered to be surgical intervention in the early phase of LDLT; in contrast, surgery for late-phase stricture of the choledochocholedochostomy is usually more difficult than that of early phase, because of inflammation due to biliary leakage and repeated cholangitis. Currently, anastomotic strictures are conventionally managed by endoscopic or percutaneous transhepatic dilatation, ballooning, and/or stenting through the use of interventional radiology techniques [4, 5]. On the other hand, magnetic compression anastomosis (MCA) has been developed as a minimally invasive procedure for late-phase stricture of the choledochocholedochostomy [6, 7]. It can create a non-surgical, sutureless anastomosis in conjunction with interventional radiology techniques by using two strong magnets. Herein, we describe a successful case of MCA for late-phase stricture of the choledochocholedochostomy in the patient after ABO-incompatible LDLT (ABO-I-LDLT).

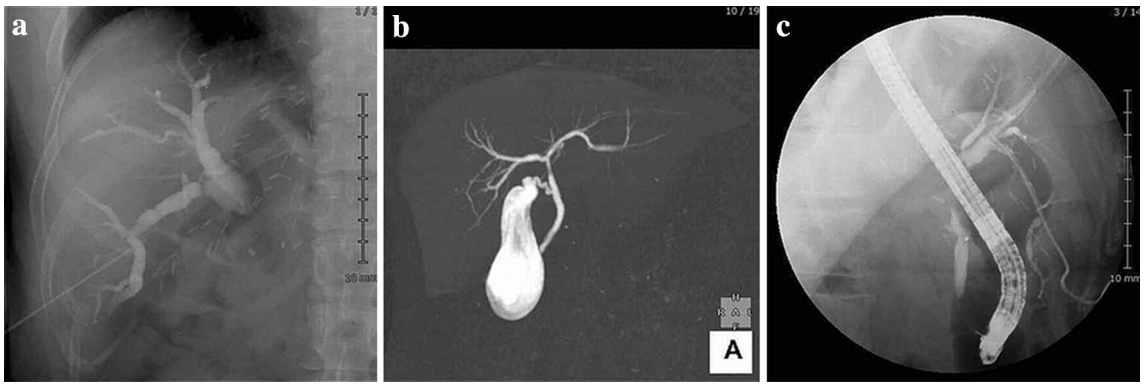

Fig. 1 **a** Percutaneous transhepatic cholangiography showed dilation of the intrahepatic bile duct. **b** The donor's preoperative computed tomography combined with drip infusion cholangiography revealed no anatomical abnormality. **c** The rendezvous technique showed the location of stricture and its distance was 11 mm

Case report

A 49-year-old Japanese woman had undergone ABO-I-LDLT 16 months previously, due to liver cirrhosis by hepatitis C virus. A right lobe from her daughter had been used for the original graft and biliary tract reconstruction had been performed by duct-to-duct anastomosis. She underwent endoscopic sphincterectomy and transpapillary biliary drainage using endoscopic retrograde cholangiography (ERCP) due to late-phase stricture of the choledochocholedochostomy 10 months later; however, acute pancreatitis occurred as a major complication of ERCP. She noticed a skin icterus afterwards and was referred to our clinic. Routine laboratory investigations revealed a cholestatic pattern of liver dysfunction, with a serum total bilirubin of 7.0 mg/dL, aspartate aminotransferase of 79 IU/L, alanine aminotransferase of 70 IU/L, gamma-glutamyltransferase of 358 IU/L, and alkaline phosphatase of 2620 IU/L. In addition, ultrasound examination also showed the dilation of the intrahepatic bile duct. She was admitted and underwent percutaneous transhepatic cholangiodrainage (PTCD) from B5 (Fig. 1a). PTCD showed complete biliary obstruction of the choledochocholedochostomy, and passing an antegrade guidewire via the PTCD route was impossible. The donor's preoperative computed tomography combined with drip infusion cholangiography is also shown in Fig. 1b to compare with the findings from PTCD. After sufficient improvement of obstructive jaundice, the rendezvous technique between PTCD and ERCP was attempted in order to break through the stricture, but was also not successful. The rendezvous technique revealed the location of the stricture and also showed that the distance of the stricture was 11 mm (Fig. 1c). Therefore, MCA was considered, since it is a non-surgical procedure.

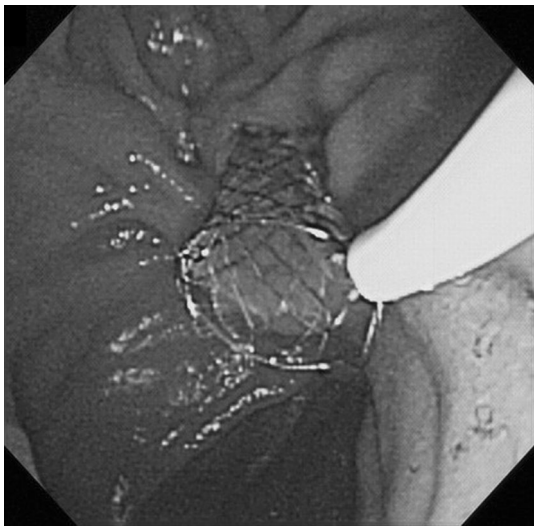

Fig. 2 A EMS was endoscopically inserted into the CBD via the papilla of Vater in order to position the parent magnet appropriately

In preparation for MCA, the PTCD tube was gradually dilated more every week: starting at 8 French, increasing by 2 French weekly, and finishing with 16 French. First, we endoscopically inserted an expandable metallic stent (EMS) (diameter 10 mm, length 40 mm) into the common bile duct (CBD) via the papilla Vater (Fig. 2). A 16 French sheath tube was inserted through the dilated PTCD fistula, and the daughter magnet (diameter 4 mm, length 9 mm), attached to a guidewire, was inserted into the intrahepatic bile duct (Fig. 3a). Then, the parent magnet (diameter 5 mm, length 6 mm), attached to a guidewire, was inserted into the CBD and was placed endoscopically at the CBD side of the stricture through the EMS. Both magnets were advanced to positions immediately prior to the biliary obstruction, and it was confirmed that the two magnets attracted each other magnetically, sandwiching the stricture

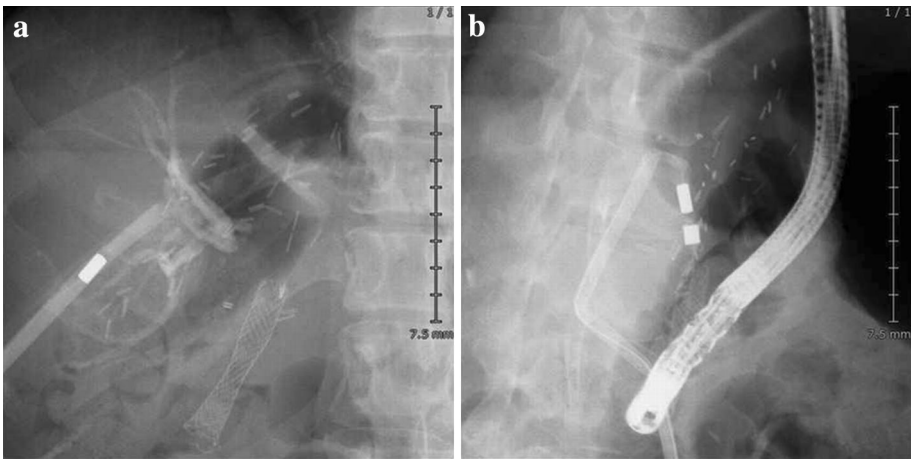

Fig. 3 **a** The daughter magnet was delivered to the stump of the stricture of the choledochocholedochostomy through the sheath tube. **b** The parent magnet was delivered safely through the EMS and attached to the daughter magnet, sandwiching the stricture

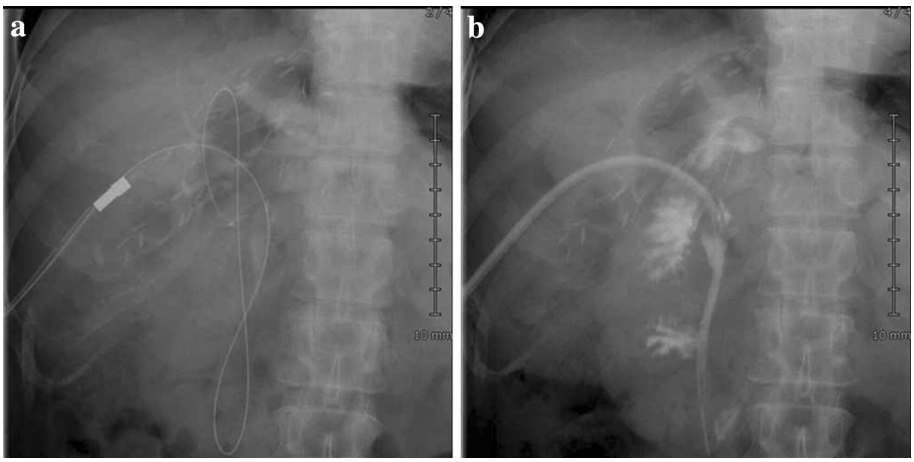

Fig. 4 **a** The magnets were removed via the PTCD fistula after MCA achievement. **b** A 16 French PTCD tube was placed across the created fistula

(Fig. 3b). The EMS was removed at the end of the endoscopic procedure, and a 16 French PTCD tube was replaced. Twenty-four days after MCA, recanalization could be achieved without any adverse events, the magnets were removed via the PTCD fistula (Fig. 4a), and a 16 French PTCD tube was placed across the created fistula (Fig. 4b). One year after creation of the fistula, the PTCD tube was removed. Up to the present, neither has recurrence of the stenosis of the choledochocholedochostomy nor any other complication occurred for 9 months.

Discussion

LDLT is one of the most effective and acceptable surgeries in patients with end-stage liver diseases. However, anastomotic stricture of the choledochocholedochostomy or choledochojejunostomy is the most common and problematic complication in up to 30 % of patients [2, 3]. The conventional sequential approach for late-onset anastomotic stricture of the choledochocholedochostomy is, needless to say, first, ERCP, second, PTCD, and third, the rendezvous technique. In the present case, all the sequential interventions had failed, and MCA was successfully performed without any adverse events. Yamanouchi et al. [8] and Takao et al. [9] reported that MCA was a revolutionary technique for performing alimentary tract anastomosis without surgical intervention. After confirming the safety of the anastomotic techniques and magnets in animal experiments, they eventually succeeded in performing choledochojejunostomy and enteroenterostomy by MCA in numerous clinical patients and reported that the results for anastomotic patency by this method were comparable to those from conventional surgery [10, 11]. However, apart from choledochojejunostomy, MCA for stricture of the choledochocholedochostomy is technically difficult, because positioning a parent magnet in the CBD via the papilla of Vater is cumbersome and occasionally impossible [11]. As the EMS (diameter 10 mm, length 40 mm) can ensure the wide entry for the parent magnet (diameter 5 mm, length 6 mm) compared to endoscopic sphincterotomy or endoscopic papillary balloon dilation, the EMS

may help us to perform MCA safely and smoothly [12]. Therefore we also employed temporal EMS insertion into the CBD.

It is worth nothing that the distance between the two ends of the stricture and the means of magnet delivery are critical factors and create limitations that affect magnet approximation in MCA [11]. A longer distance between the ends of the stricture can weaken the magnetic force, making it impossible to approximate the magnets or, even after approximation, to establish a sufficient attractive force to induce ischemic necrosis of tissue [13]. In the present case, the distance between the ends of the stricture was 11 mm, and MCA was successfully completed. Although the maximum distance between the ends of the stricture is considered to be 15–20 mm [7], there is very little evidence on the length of stricture required for the MCA procedure to succeed and for predicting the outcome, including anastomotic patency.

The length of time required for creating a fistula by the MCA procedure is 7–10 days with choledochojejunostomy, and 10–30 days with choledochocholedochostomy [8–10]. Generally, as biliary stenosis or obstruction is caused by fibrosis and adhesion, creation of the fistula by the MCA procedure depends on the distance and the histological situation around the biliary stenosis or obstruction [11]. In the present case, it needed a relatively long time, 24 days, for creating the fistula; therefore, the strong fibrosis might have occurred due to biliary leakage and repeated cholangitis. Also, the timing of the removal of the tube stent after completing the MCA procedure may be very difficult to judge, because it depends on several factors, such as distance, distortion, and histological situation of the biliary obstruction [11]. On this point, we have little evidence yet; therefore, further study is warranted, especially in cases with long stenosis.

We have herein described a successful application of the MCA procedure for stricture of the choledochocholedochostomy in ABO-I-LDLT. MCA is an outstanding nonsurgical procedure for the patients in whom the conventional endoscopic or percutaneous approach has failed, and its efficacy has been proven. We believe that the MCA procedure is less traumatic, and, more importantly, has a very low recurrence rate compared with other treatments.

Acknowledgments The authors would like to thank Dr. Naoko Ito, Dr. Hidenori Itabashi, Dr. Hirokatsu Katagiri and Dr. Shoji Kanno for helpful discussions. The authors also greatly thank Professor Eigoro Yamanouchi for devoted cooperation for this procedure.

Disclosures

Conflict of Interest: Akira Umemura and co-authors have no conflict of interest.

Human/Animal Rights: All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008(5).

Informed Consent: Informed consent was obtained from all patients for being included in the study.

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