Magnetic compression anastomosis for treatment of post-transplant biliary stricture: A case report with dual-graft living donor liver transplantation

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Received October 22, 2021
Revised November 4, 2021
Accepted November 9, 2021
Published online November 11, 2021

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Radiological intervention via percutaneous transhepatic biliary drainage and endoscopic intervention via endoscopic retrograde cholangiopancreatography are the preferred methods to treat liver transplantation (LT)-associated benign biliary stricture (BBS). Magnetic compression anastomosis (MCA) can be applied to reconstruct a refractory or completely obstructing BBS that cannot be resolved with conventional methods. The MCA procedure is divided into four steps: tract formation for magnet delivery, approximation of magnets, removal of the approximated magnets, and maintenance and removal of the internal catheter. We present a patient with BBS, following dual-graft living-donor LT, which was successfully recanalized via MCA with detailed review of technical procedures. In the present case, MCA facilitated the passing of the guidewire through the completely occluded BBS for conventional treatment via long-term endobiliary stenting. MCA is a nonsurgical alternative for treating severe or completely obstructing BBSs that are refractory to conventional endoscopic or percutaneous treatment methods.

Keywords: Liver transplantation; Biliary complication; Duct-to-duct anastomosis; Anastomotic stenosis; Endobiliary stent

INTRODUCTION

Benign biliary stricture (BBS) occurs in 15%–20% of patients undergoing deceased donor liver transplantation and in 19%–40% of those undergoing living donor liver transplantation (LDLT) [1]. The underlying etiology of BBS following liver transplantation (LT) includes local ischemia due to intraoperative damage to the blood vessels supplying the bile duct and hypertrophic changes at the anastomotic site.

BBS is one of the most common complications following LT, but no standardized treatment has been established for its management [2-5].

Radiological intervention with percutaneous transhepatic biliary drainage (PTBD) and endoscopic intervention with endoscopic retrograde cholangiopancreatography (ERCP) are the preferred methods used to treat LT-associated BBS. Currently, such nonsurgical treatments are regarded as safer and more effective than surgical treatment [4,6]. How-

ever, such endoscopic or percutaneous treatments cannot be successful when it is impossible to place a guidewire percutaneously or endoscopically through the completely occluded BBS.

Magnetic compression anastomosis (MCA) has been used as a nonsurgical technique for reconstructing a refractory or completely obstructing BBS that cannot be resolved with conventional methods [7-15]. MCA entails recanalizing the obstructed bile duct by inserting magnets at both ends of the stenosis, inducing necrosis of the stenotic lesion based on the pulling force of magnets. We present a patient with BBS following dual-graft LDLT, which was successfully recanalized via MCA. The technical procedures of MCA are reviewed.

MCA PROCEDURES

The MCA procedure is divided into four steps: formation of the tract for magnet delivery, approximation of magnets, removal of the approximated magnets, and maintenance and removal of the internal catheter [16,17]. The common routes of magnet delivery are percutaneous and peroral. The percutaneous tract for delivery of magnets is formed via the PTBD tract, which is sequentially dilated to 16 Fr, and the PTBD catheter is changed to an 18 Fr sheath for

MCA approximation. This process allows the insertion of magnets without difficulty or duct injury through the sheath during the movement of the magnets. The peroral route for magnet approximation is performed via ERCP. A retrievable fully covered self-expandable metal stent (FCSEMS) is inserted into the common bile duct (CBD) to deliver the magnet via the oral route after endoscopic sphincterotomy.

A silk thread attached to one magnet is fixed to a polypectomy snare, and the magnet is moved to the stricture site through the PTBD tract. Another polypectomy snare is passed through the channel of an ERCP scope, and the other magnet is fixed at the snare in front of the scope. The magnet is relocated to the anastomotic site. After one magnet is moved to the stricture via the 18-Fr sheath, the other magnet is applied to the stricture site in the CBD. Following the placement of the two magnets, they are approximated via attraction to each other. The distance between the two magnets is reduced by pushing them using a balloon catheter through the PTBD and ERCP tracts. Radiological cholangiography is performed to confirm the approximation of the two magnets. After confirming the approximation, the 18-Fr sheath is replaced with an indwelling 16-Fr PTBD catheter and the FCSEMS placed in the CBD is removed. After the approximation, the two magnets compress the stricture tissue, leading to its ischemic ne-

Fig. 1. Peritransplant images of the recipient. (A) Pretransplant dynamic computed tomography (CT) findings show liver cirrhosis with ascites. (B) The photograph of the explant liver shows overt alcoholic liver cirrhosis. (C) CT taken at 1 month after transplantation indicates delayed recovery of graft function following dual-graft implantation. (D) CT taken at 3 months after transplantation shows intrahepatic duct dilatation (arrow).

crisis. As the magnets gradually draw closer to each other, the ischemic necrosis process results in the formation of a new fistula. The magnets after full approximation migrate spontaneously into the CBD through the new fistula. A plain abdominal radiograph is obtained at 2-week intervals for 6–8 weeks after the successful approximation of magnets to confirm the migration of the magnets through the fistula tract. Magnets remaining in the stricture site with close approximation after 10 weeks can be removed via percutaneous transhepatic cholangioscopy (PTCS). The mean duration for successful magnet removal after magnet approximation was reported to be 53.3 days (range, 9–181 days) for duct-to-duct strictures and 7–40 days for hepaticocenteric strictures [18,19]. Recanalized fistula is confirmed endoscopically under fluoroscopy after magnet removal. The mean indwelling duration of the PTCS catheter to maintain the new fistula tract is 4–6 months. The PTCS catheter and FCSEMS exhibit similar safety and efficacy in fistula maintenance [20]. However, the FCSEMS is more convenient for patients because the PTCS catheter has a longer indwelling duration and requires higher number of tube replacement.

CASE PRESENTATION

A 44-year-old male patient diagnosed with alcoholic liver cirrhosis was admitted to our institution for LT (Fig. 1A, B). The model for end-stage liver disease score was 37, but the possibility of allocation to deceased donor LT was low due to scarcity of the deceased donors. Dual-graft LDLT was performed because of gradual deterioration in the general condition of the patient (Fig. 1C).

The first donor was the 46-year-old sister of the patient and a modified right liver graft from this donor weighed 560 g. The second donor was the 43-year-old wife of the patient and a left live graft from this donor weighed 300 g.

The sum of these two grafts showed a graft-to-recipient weight ratio of 1.12%. These donors recovered uneventfully from the donor operation and were discharged 8 days after the operation.

Recipient operation was performed using standard procedures of dual-graft LDLT (Fig. 1C). Biliary reconstruction was performed with dual duct-to-duct anastomoses to the right and left grafts (Fig. 2). The patient recovered slowly from the LDLT operation.

Intrahepatic duct dilatation at the left liver graft was detected at 3 months after LT (Fig. 1D). Both ERCP and PTBD failed to penetrate the occluded left hepatic duct (Fig. 3). We decided to perform MCA at 6 months after LT. A magnet was placed at the proximal end of the PTBD tract (Fig. 4A, B). Another magnet was placed at the proximal end of

Fig. 2. Intraoperative cholangiography showing dual duct-to-duct anastomoses to the right and left grafts.

Fig. 3. Images of left hepatic duct obstruction taken at 3 months after transplantation. (A–C) Endoscopic approach failed to penetrate the occluded left hepatic duct. (D) Percutaneous transhepatic biliary drainage to the dilated segment II duct was performed.

Fig. 4. Procedure of magnetic compression anastomosis performed at 6 months after transplantation. (A, B) A magnet is placed at the proximal end of the percutaneous transhepatic biliary drainage. (C, D) Another magnet is placed at the proximal end of the proximal bile duct through endoscopic approach.

Fig. 5. Removal of magnets at 8 months after transplantation. (A-C) The approximated magnets are removed through the common bile duct. (D) Plastic internal stents are inserted through the passage in the stenotic portion.

Fig. 6. Endobiliary stenting of residual anastomotic stenosis at 15 months (A) and 18 months (B) after transplantation.

the proximal bile duct through ERCP (Fig. 4C, D). After 4 weeks, two magnets were approximated. After 6 weeks after installation of magnets, the magnets were removed (Fig. 5A-C), and plastic internal stents were placed through the passage of the stenosis (Fig. 5D). The biliary stenosis was not resolved easily (Fig. 6A), and thus three plastic internal stents were repeatedly placed every 3 months (Fig. 6B). This patient has been doing well for 19 months after LT,

with repetitive endoscopic treatment of biliary anastomotic stenosis.

DISCUSSION

BBS is a common complication following LT. Transection of the CBD with interruption of blood flow induces ischemic injury and hypertrophic changes also promote duct-to-duct anastomotic stricture [21,22]. Although the optimal therapeutic strategy for BBS has yet to be determined, nonsurgical approaches have been performed more frequently than surgical treatment. We have performed endoscopic and percutaneous treatments for BBS [23-25]. If conventional treatment is failed due to failure of passage through the stricture site, MCA can be considered.

Appropriate and careful selection of indications for MCA is essential for successful outcome. A comprehensive assessment is necessary to plan the approximation of magnets and to predict outcomes. Factors affecting the success of MCA include the length of the stricture, shape of the bile duct, power of the magnets, and axis of the bile duct [15,16]. The longer the stricture, the weaker the attractive power between the two magnets, suggesting the need

for accurate evaluation of the length of the stricture for successful approximation of magnets before MCA.

The overall clinical success rate of MCA for duct-to-duct biliary strictures was reported to be 87.5%, and the recurrence rate was 7.1% [7]. The clinical success rates of MCA differ according to the etiology of the stricture and the treatment method used in duct-to-duct biliary strictures [26-30]. As MCA is used in BBS refractory to conventional methods, it is difficult to compare its advantages and disadvantages and cannot replace the conventional methods. Currently, MCA is not widely used because the magnets and equipment used are not commercially available, and the indications of MCA are relatively rare. MCA has been recently introduced in our LT program to manage the substantial caseload of BBS that was not amendable to conventional treatment modalities. In the present case, MCA enabled the passage of the guidewire through the completely occluded BBS, which facilitated conventional treatment via long-term endobiliary stenting.

In conclusion, MCA is a nonsurgical alternative for treating severe or completely obstructing BBSs that are refractory to conventional endoscopic or percutaneous treatment methods.

FUNDING

There was no funding related to this study.

CONFLICT OF INTEREST

All authors have no conflicts of interest to declare.

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AUTHORS' CONTRIBUTIONS

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