ORIGINAL ARTICLE

Percutaneous intervention strategies for the management of dysfunctioning biliary plastic endoprostheses in patients with malignant biliary obstruction

Burçak Gümüş

PURPOSE
To present our clinical experience and to suggest different strategies in the management of dysfunctioning plastic biliary stents in patients with malignant biliary obstruction.

MATERIALS AND METHODS
Twenty females and 23 males with a mean age of 64.8 years (range, 30–89 years) with malignant obstructive jaundice were referred to the interventional radiology department due to previously inserted dysfunctioning plastic endoprostheses. Pancreatic carcinoma (n=12), duodenal carcinoma (n=5), cholangiocarcinoma (n=16), gallbladder cancer (n=4), and metastatic disease (n=6) had been previously stented endoscopically. Nine of the patients had two plastic endoprostheses in the biliary tree. Forty-nine endoprostheses were straight polyethylene stents, and three were double-J type plastic stents (52 endoprostheses in total).

RESULTS
Forty-nine of the dysfunctioning plastic stents were cleared from the biliary tree. Of these, 31 were dislodged into the bowel with the help of a balloon catheter. Threading with an over-the-wire diagnostic and percutaneous biliary drainage catheter was performed in 12 of the plastic stents. Six dysfunctioning endoprostheses were removed by transhepatic access. Three plastic endoprostheses could not be removed or dislodged. No complication occurred due to intervention. The mean follow-up time was nine months (range, 1–19 months). All of the patients were evaluated in the first month, and then at three-month intervals. Percutaneous metallic stenting was performed on 29 patients.

CONCLUSION
Percutaneous intervention should be considered as an alternative treatment when a need for eliminating the dysfunctioning plastic stent arises. Both removal of the dysfunctioning stent and dislodgement into the bowel are safe and efficient strategies in the management of malignant biliary obstructions.

Key words: • interventional radiology • stent • bile duct obstruction

From the Department of Interventional Radiology (✉ burcakgumus73@yahoo.com), Başkent University İstanbul Hospital, İstanbul, Turkey.

E ndoscopic retrograde cholangiopancreatography is accepted as the first-line diagnosis and treatment modality in patients with jaundice secondary to malignant biliary obstruction. Palliation of these patients is achieved by insertion of plastic stents during the same session (1). Failure of the plastic biliary stents may be due to migration, occlusion, or malposition. A dysfunctioning plastic stent left in the biliary tract may act as a nidus and cause recurrent and persistent cholangitis. They may also lead to additional vascular complications such as pseudoaneurysm formation or bleeding. Additionally, they may perforate the hepatic capsule, causing biloma or abscess, or rarely, they may cause bowel obstruction and/or perforation with delayed migration (2). Failure of endoscopic intervention can be managed by replacing the occluded or malfunctioning endoprosthesis or inserting an additional plastic biliary stent during an endoscopic reintervention session. Endoscopy has a high success rate in removing the dysfunctioning stent with a complication rate of 0%–2% (3).

If endoscopic reintervention fails or cannot be performed, the patient is then usually referred for percutaneous transhepatic intervention before open surgical extraction (4). Percutaneous intervention generally includes biliary drainage followed by insertion of a metallic self-expandable stent. A relative limiting point of this intervention is the presence of a dysfunctioning plastic stent in the biliary tree. Percutaneous removal of the dysfunctioning plastic stent or dislodgement into the bowel are the main options to manage this problem (5, 6).

The present study describes our clinical experience and several different interventional techniques in the management of dysfunctioning plastic biliary endoprostheses in patients with malignant obstructive biliary disease.

Materials and methods

The study was conducted with the approval of our institutional review board, which gave a waiver of informed consent. The data from 43 consecutive patients who underwent percutaneous management of dysfunctioning biliary endoprostheses at a single university hospital between March 2008 and February 2011, were retrospectively evaluated.

Twenty females and 23 males with a mean age of 64.8 years (range, 30–89 years) with malignant obstructive jaundice were referred to interventional radiology department due to previously inserted dysfunctioning plastic endoprostheses. All subjects were outpatients referred from other hospitals except two. Pancreatic carcinoma (n=12), duodenal carcinoma (n=5), cholangiocarcinoma (n=16), gallbladder cancer (n=4), and metastatic disease (n=6) had been previously stented endoscopically. The metastatic diseases were gastric carcinoma (n=3) and breast carcinoma (n=3). Twenty-three of the patients were referred to the interventional radiology department after the failure of an endoscopic reintervention session.
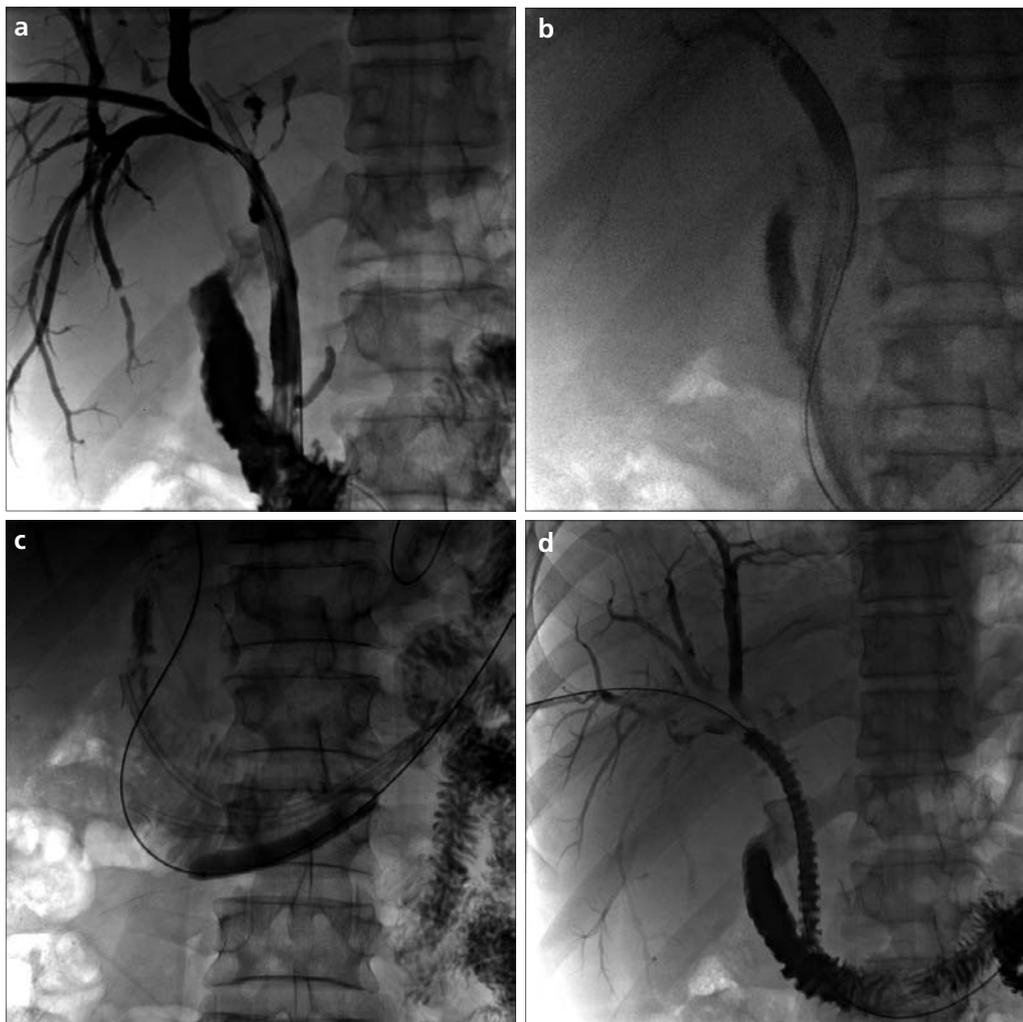
Figure 1. a–d. A 34-year-old patient with metastatic gastric carcinoma having two plastic stents in the common bile duct. A superstiff guidewire is seen in the duodenum, and an introducer sheath was placed through the right hepatic ductus **(a)**. Inflation of the balloon catheter at the proximal part of the common bile duct **(b)** is seen. Both dysfunctioning endoprostheses were dislodged into the duodenum by friction of the balloon **(c)**. Percutaneous metallic stenting was performed in the same session **(d)**.

The mean interval time between plastic stent insertion and percutaneous biliary drainage was 27 days (range, 8–92 days; n=24). However, the interval time could not be determined in 19 patients. Nine of the patients had two plastic endoprostheses in the biliary tree. Forty-nine endoprostheses were straight polyethylene stents and three were double-J type plastic stents (52 endoprostheses in total). The plastic endoprostheses ranged in diameter from 7 to 10 F (n=25). No data were available for 18 patients regarding the diameter of the plastic stents inserted.

The main indications for biliary drainage were cholangitis (n=26), sepsis (n=7), pruritis (n=4), and jaundice (n=6). A multistep procedure was applied, including observation of percutaneous biliary drainage, followed by cholangiography and dislodgement or removal of dysfunctioning stent and finally performance of metallic biliary stenting. The levels of the biliary obstruction determined during cholangiography were distal (n=19), proximal (n=10), mid (n=5), and multilevel (n=9).

Blood cell counts, coagulation parameters, and liver function tests were performed immediately before the intervention. The mean serum bilirubin level was 5.3 mg/dL (range, 2.1–22.4 mg/dL). All patients were administered an intravenous (IV) antibiotic prophylaxis (ceftazidime, 1 g) prior to the procedure. Biliary drainage was performed under conscious sedation with IV midazolam and fentanyl. Access to the biliary tree was gained using standard interventional techniques under ultrasonographic and fluoroscopic guidance. Percutaneous access to the biliary tree was obtained via the right hepatic approach (n=23), left hepatic approach (n=7), and bilateral approach (n=13).

Thirty-one of the plastic stents were dislodged into the bowel with the help of a balloon catheter. An 8 F introducer sheath (Avanti sheath, Cordis, Miami Lakes, Florida, USA) was placed in the biliary tract. A 5 F, 40-cm angled tip catheter (Kumpe, Cook, Bjaeverskov, Denmark) was used with a 0.035-inch hydrophilic guidewire (Radiofocus M, Terumo, Tokyo, Japan) to pass alongside the stent into the duodenum without threading if passage into the duodenum could not be performed at the initial drainage session. The hydrophilic guidewire was exchanged for a 0.035-inch stiff guidewire (Amplatz Super Stiff, Boston Scientific, Natick, Massachusetts, USA). A 7- or 8-mm×4-cm balloon (Symmetry, Boston Scientific) was inflated parallel to the plastic stent and the endoprosthesis was dislodged by friction (Fig. 1). This was the main interventional method applied for the percutaneous management of the 25 dysfunctioning plastic stents. In the other six stents, after failure of the friction technique, threading of the endoprosthesis with a wire entering from the proximal or
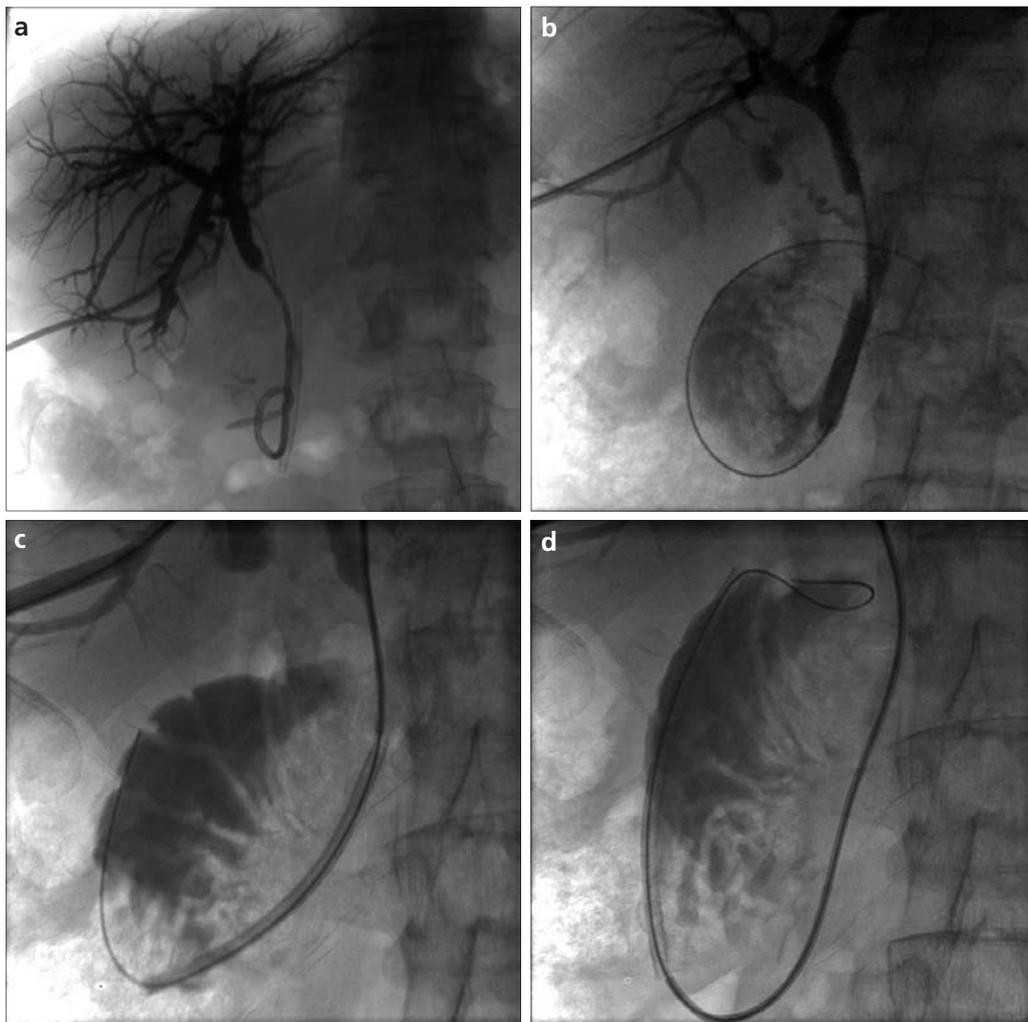
Figure 2. a–d. A 60-year-old man with pancreatic carcinoma. Right-sided percutaneous biliary drainage with a dysfunctioning plastic stent is seen in the common bile duct **(a)**. The balloon catheter was inflated in the proximal part of the dysfunctioning stent **(b)**. The proximal hole of the plastic stent was catheterized after failure of the balloon catheter **(c)**. The plastic stent was dislodged with the help of a 5 F diagnostic catheter using the over-the-wire technique **(d)**.

side hole and exiting from the distal hole, and then passing a 5-mm×4-cm balloon (Ultra-thin Diamond, Boston Scientific) over the wire, and dislodgement of the endoprosthesis into the duodenum were performed.

Threading of the endoprosthesis with an over-the-wire diagnostic catheter or percutaneous biliary drainage catheter was performed on 12 of the plastic stents. The dysfunctioning stent was threaded with a hydrophilic guidewire entering from the proximal or a side hole and exiting from the end hole, and then it was exchanged for a stiff guidewire. The endoprosthesis was dislodged into the duodenum with the help of a 5 F diagnostic catheter (Fig. 2). This method was succesful in eight of the stents. If this method failed, dislodgement of the endoprosthesis had been managed with the help of an 8 F biliary internal-external drainage catheter (Flexima, Boston Scientific). Dislodgement into the duodenum was

realized with the help of a biliary drainage catheter in four of the stents.

Six dysfunctioning endoprostheses were removed by transhepatic access. Percutaneous transhepatic removal of the endoprosthesis was never applied before three weeks following the initial biliary drainage due to lack of mature tract formation. A 10 or 12 F introducer sheath was placed in the biliary tract. A goose-neck snare (EN Snare System, Medical Device Technologies, Inc., Gainesville, Florida, USA) was passed over the proximal or distal end of the plastic endoprosthesis. It was pulled out through a fully mature transhepatic tract via the introducer sheath once it was grasped (Fig. 3).

Results

Forty-nine of the dysfunctioning plastic stents were cleared from the biliary tree. Three plastic endoprostheses could not be removed or dislodged. Two of these stents had been referred for the

percutaneous approach because of endoscopic failure of the reintervention session. These plastic endoprostheses had been inserted too high in the biliary system during the initial endoscopic intervention session. Dislodgement into the duodenum and snaring were both attempted, but the endoprostheses were so deeply impacted that none of these methods could manage the problem.

Forty-three of the plastic stents were dislodged into the duodenum with the help of balloon catheters using the friction method or over-the-wire technique. No radiological or clinical signs of bowel perforation was detected. Eleven patients suffered from cholangitis, probably due to manipulations during the dislodgement of the plastic endoprostheses. These patients were managed by conservative medical therapy. Seven patients complained of severe abdominal pain and were consulted by abdominal surgeons. However, these patients recovered well during
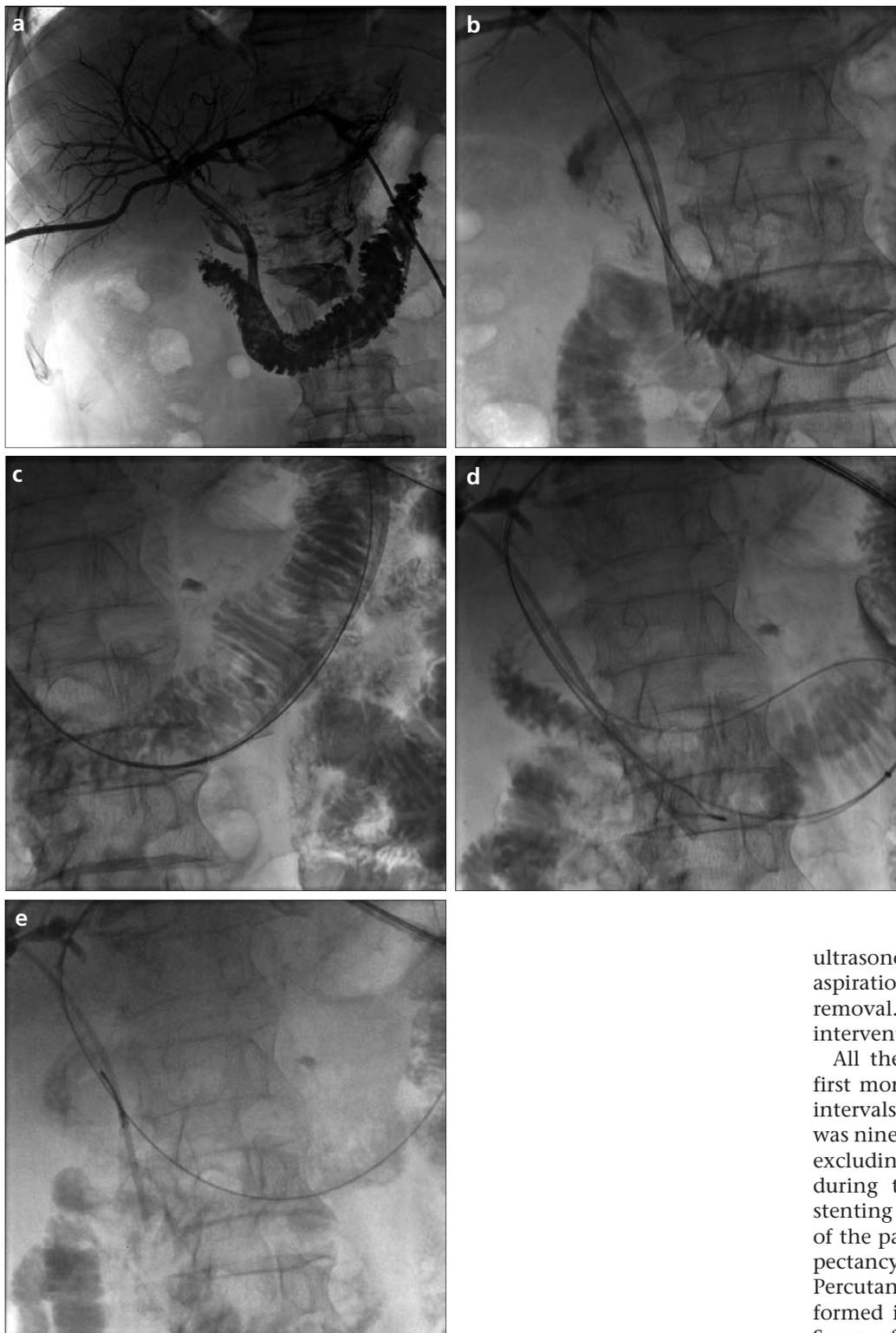
Figure 3. a–e. A 72-year-old man with cholangiocarcinoma. A right-sided drainage catheter in the proximal part of the common hepatic duct and a left-sided drainage catheter in the duodenum with two plastic stents in the common hepatic duct are seen (a). The proximal hole of the dysfunctioning stent was catheterized by the left hepatic tract (b). The exit of the guidewire from a side hole and dislodgement of the stent with the help of a 5 F diagnostic catheter over the superstiff wire are seen (c). The second dysfunctioning stent was snaring (d). The dysfunctioning stent was removed percutaneously via the introducer sheath (e).

the follow-up with medical therapy alone. These complications only prolonged the recovery room follow-up. Other patients were followed up for three hours in the recovery room and discharged. No mechanical obstruction was detected during the passage of the dysfunctioning endoprostheses in the follow-up period. No patient required surgical intervention. A small subcutaneous collection was detected in one of the patients in whom a plastic stent had been removed by transhepatic access. It was drained under ultrasonographic guidance by needle aspiration at the second week of the removal. He recovered well after the intervention.

All the cases were evaluated in the first month, and then at three-month intervals. The mean follow-up period was nine months (range, 1–17 months) excluding five patients who were lost during the follow-up period. Biliary stenting was not performed in nine of the patients because of poor life expectancy and the patient's preference. Percutaneous metallic stenting was performed in the remaining 29 patients. Seven of these patients underwent bilateral kissing stenting. Twenty-one of the patients were lost (n=5) or had died (n=16) at the time of writing.

Metallic stent obstruction due to tumor in- or out-growth was detected in 17 of the cases during the follow-up period. Another percutaneous biliary drainage session was performed for these cases. Percutaneous biliary drainage was

carried out, and a further metallic stent was inserted in 11 of these cases.

Discussion

Dysfunctioning biliary stents can be managed by replacing the occluded or malfunctioning plastic stent or inserting an additional biliary stent during an endoscopic reintervention (2, 3). Replacement of the plastic stent with a metallic stent that can expand to a diameter of 8–10 cm, which is three times greater than that of plastic stents in common use, may be a good option to overcome this problem (2). The percutaneous transhepatic approach may be an alternative option when endoscopic intervention or reintervention fails. The first step is to perform percutaneous biliary drainage, and then evaluate the steps for dislodgement or removal of the dysfunctioning stent before insertion of a metallic stent (4–6).

Many alternative techniques have been described in the literature for dislodging the dysfunctioning plastic stent into the bowel. Dislodgement by inflating a balloon catheter is a well-known technique (7). Diagnostic catheters or biliary drainage catheters can also be applied for the dislodgement (5, 8). It can be safely performed over a super-stiff wire and the dysfunctioning stent can be left in the bowel. The endoprosthesis usually passes through the bowel with no symptoms, although many complications have been described (9, 10). We completely dislodged 43 of the dysfunctioning stents into the bowel using different techniques without radiological or clinical signs of perforation or mechanical obstruction. Dislodgement into the bowel is quite safe and effective in the management of dysfunctioning biliary stents. We observed no complications due to passage of the plastic stent in our patient population. We dislodged plastic stents using the diagnostic angiographic catheters and biliary drainage catheters in some cases without a need for balloon inflation. It is also an effective method for dislodgement and saves the additional cost of a balloon catheter. However, threading of the dysfunctioning stent may be a time-consuming procedure and may increase radiation exposure of the patient and radiologist, while dislodgement by friction is not a very complex procedure.

Percutaneous transhepatic removal of the plastic stent can be applied using a goose-neck snare (5). The intervention can be performed in the biliary system or in the duodenum after dislodgement of the stent using a long introducer sheath or guiding catheter (11–13). Some of the studies have concluded that performing the manipulations in the duodenum after dislodgement is relatively safer than performing them in the biliary tree (5, 11). We removed six of the biliary endoprostheses via the transhepatic tract from the biliary tree. In our patient population, we observed none of the complications described in the literature except for a small subcutaneous fluid collection that had been managed by simple drainage. The critical point of the percutaneous transhepatic removal is to wait for the tract maturation. No intervention should be attempted before mature tract formation to avoid complications. Snaring is also an effective strategy for removing the dysfunctioning stent, but the additional cost of the device should be re-evaluated before the intervention.

The percutaneous approach may be a life-saving procedure in the management of dysfunctioning biliary endoprostheses. Several different techniques have been described in the literature regarding management of the dysfunctioning stents. No clear data exist concerning the superiority of one technique over others. Our study demonstrates many different techniques for palliation of this patient population. Although many complications were described in the literature, we have observed no major complication due to the technique performed. Minor complications commonly foreseen in any biliary intervention were encountered in our patient population. These complications can be easily managed by conservative medical therapy. The only result of these complications is a prolonged recovery room stay. Both percutaneous transhepatic removal and dislodgement into the duodenum are safe and effective techniques in the management of dysfunctioning biliary stents. As in other interventional procedures, the ability to perform different techniques helps the interventional radiologist to improve several treatment strategies for managing the problem.

The percutaneous approach should come into consideration if endoscopic intervention or reintervention fails.

Note that many different options exist for management of the dysfunctioning plastic endoprostheses. The interventional radiologist should be familiar with different techniques and know that all these techniques can be performed with high success and very low complication rates.

Conflict of interest disclosure

The authors declared no conflicts of interest.

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