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Review Article

Endoscopic ultrasound-guided biliary drainage: Complications and their management

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A B S T R A C T

Endoscopic ultrasound-guided biliary drainage (EUS-BD), EUS-guided choledochoduodenostomy (EUS-CDS), and EUS-guided hepaticogastrostomy (EUS-HGS) can effectively palliate obstructive jaundice, but have not been well established yet. The incidence of complications is about 30% in EUS-BD and higher for EUS-HGS. Several complications have been reported such as bleeding, perforation and peritonitis. Bleeding occurs due to puncture of portal vein, hepatic vein and artery, and we should use color Doppler. When a cautery dilator is used for fistula dilation, burn effects may cause delayed bleeding. Endoscopic hemostasis is only effective for anastomotic bleeding and embolization with interventional radiology technique is required for pseudo aneurysm. There are some types of perforation: failed stent placement after puncture or fistula dilation, double puncture during CDS procedure, and stent migration. Peritonitis with perforation requires surgery and can be fatal. Stent migration before mature fistula formation causes severe peritonitis because EUS-BD makes fistula between two unattached organs. Stents with flaps or long covered self-expandable metallic stents (cSEMSs) are effective to prevent migration. Recent development of lumen apposing stents may reduce early migration in EUS-CDS. Peritonitis without migration can be due to 1) leakage of bile juice or gastric/duodenal contents during EUS-BD or 2) leakage along the placed stent. We should make procedure time as short as possible, and cSEMSs reduce bile leak along the stent by occluding the dilated fistula. In summary, we should understand the mechanism of complications and the technique to prevent and manage complications. Development of dedicated devices to increase the success rate and reduce complications is required.

Keywords: Biliary drainage; Biliary stricture; Endoscopic ultrasound; Endoscopic ultrasound-guided biliary drainage; Endoscopic ultrasound-guided intervention

Introduction

The bile duct can be accessed not only transpapillary but also transmurally due to the development of interventional endoscopic ultrasound (EUS). EUS-guided biliary drainage (EUS-BD) is used as a salvage technique when conventional ERCP fails or is difficult.[1–3] In such situations, percutaneous procedures are necessary. However, percutaneous procedures tend to impair the quality of life (QOL) of patients. EUS-BD is an internal drainage technique and is superior to percutaneous procedures in terms of patient QOL. It is used widely for an ever-expanding range of indications. However, this procedure is not well established, and severe complications can occur.

Several types of EUS-BD are available; these involve the procedures with making of anastomosis between the organs and antegrade approaches. EUS-guided hepaticogastrostomy (EUS-HGS) and EUS-guided choledochoduodenostomy (EUS-CDS) involve placement of a stent between the bile duct and digestive tract and making the anastomosis in the results, and they are associated with a risk of peritonitis, because these organs are not attached. In contrast, the EUS-guided rendezvous (EUS-RV) technique is used to assist transpapillary biliary access, and EUS-guided antegrade stenting (EUS-AGS) does not involve placement of a stent at the anastomotic site.[4–6] These procedures are considered to have a lower risk of severe peritonitis compared with EUS-HGS and CDS. Therefore, a means of reducing complications and troubleshooting techniques for EUS-BD should be established.

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Complications of EUS-BD

Several complications of EUS-BD have been reported, such as bleeding, perforation, mucosal double puncture, peritonitis, cholangitis and abdominal pain. The pathogenesis and methods for prevention and treatment of each complication should be determined. In previous reports of EUS-BD, the incidence of complications was about 30% and was higher for EUS-HGS. The EUS-HGS technique is more difficult compared with EUS-CDS.[3,7] The diameter of the target bile duct in the liver is limited, distance between the puncture point and bile duct was longer, guidewire manipulation was more difficult because of the tortuous duct, and generating an anastomosis was more difficult because of the thicker digestive wall and via liver parenchyma; moreover, the risk of stent migration was greater due to the movement of the gastric wall.

Bleeding

Causes

Bleeding during EUS-BD procedures can have various causes. Most cause was puncture, penetration or injury the vessels along the puncture line when the intra hepatic biliary duct puncture was performed. Bleeding from the portal vein, hepatic vein and artery can occur, and arterial injury may cause pseudo-aneurysm. The portal vein runs alongside the bile duct and can be punctured in error, even using color Doppler guidance (Fig. 1). Other causes of bleeding include burning by the electric cautery dilator, which may occur after the procedure. Bleeding from the puncture site on the digestive mucosa can be seen from an endoscopic view.

Prevention

Color Doppler enables detection of vessels, but avoiding puncturing of small vessels is difficult as they are difficult to detect, even using color Doppler. If an electronic cautery dilator is to be used, puncturing close to small vessels should be avoided. Burning of the vessel can occur near the puncture line. Covered self-expandable metallic stents (cSEMSs) are effective for both prevention and treatment of post-procedural bleeding.[5]

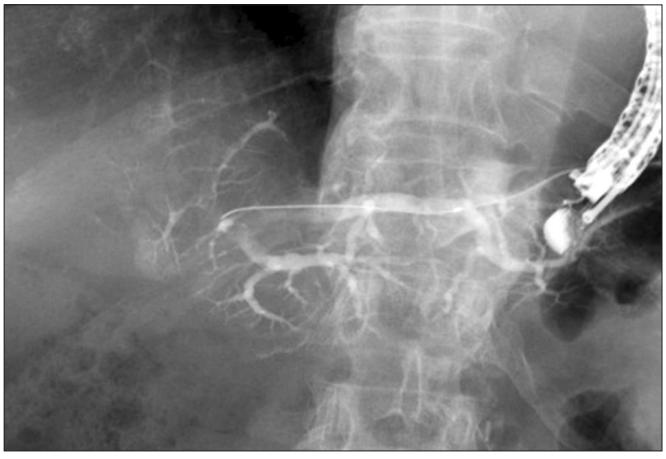

Fig. 1. Endosonography-guided portography. It was obtained by miss-puncturing.

Treatment

Puncture of vessels is indicated by aspiration of blood through the needle. In such cases, we should pull out from the vessel slightly and allow the needle to remain in the liver parenchyma for 1 or 2 minutes to enable coagulation in the puncture tract and needle cavity. Insertion of the stylet to pull out the coagula into the puncture tract will stop the bleeding in most cases. The techniques of making the coagula in the needle and push out it into the puncture tract should be repeated till the bleeding has stopped after withdrawn the stylet. If this procedure is not effective, inserting a gelform is the next step. This technique was developed from the authors' experiences, but the authors thought that it was effective to stop the non-arterial bleeding. To stop bleeding due to arterial injury and pseudo-aneurysm, the angiographic embolization technique using by interventional radiologist is effective.

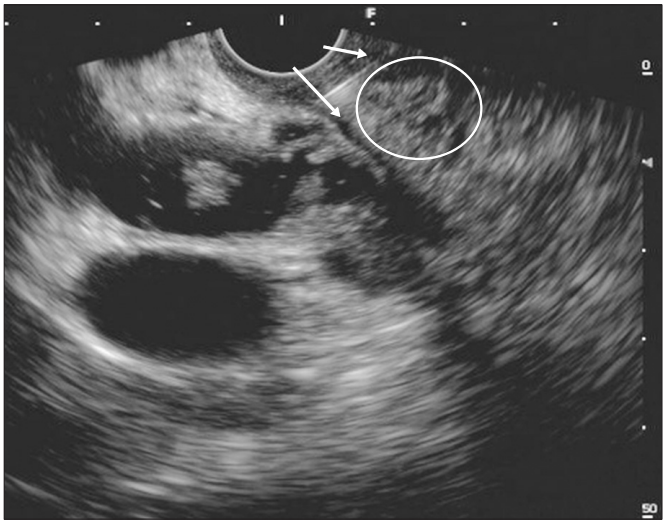

Fig. 2. Endosonographic view of a mucosal double puncture. White arrows indicate the duodenal muscle layers, and other muscle layers are visible (white circle).

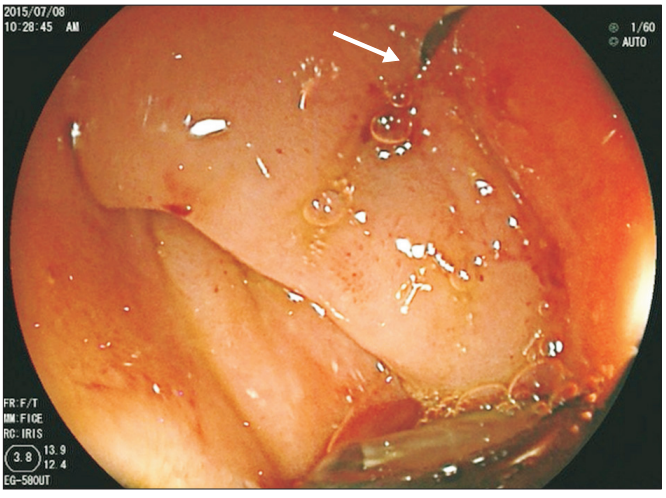

Fig. 3. Endoscopic view of a mucosal double puncture. White arrow indicates the puncture point at the superior duodenal angle (SDA) fold with guide-wire penetration. The duodenal mucosa of the second portion is visible under the SDA fold.

Perforation

Causes

Several types of perforation are related to the EUS-BD technique: puncture without stent placement, mucosal double puncture during the EUS-CDS procedure, and stent migration.

Prevention

If EUS-BD is unsuccessful, another type of drainage must be used. Double mucosal puncture can occur near the superior duodenal angle (SDA) during performance of EUS-CDS.[8] This complication can be detected by EUS imaging (presence of a double mucosa) and from an endoscopic view during guidewire placement (Fig. 2, 3). In such cases, the guidewire should be pulled out immediately. If the stent was placed with unawareness of double mucosal puncture, perforation may be occurred. Prevention of migration is vital for prevention of perforation.

Treatment

Most cases of perforation should be managed surgically. Cases of small perforations or successful closure without fluid collection in the abdominal cavity can be managed conservatively. However, careful follow-up is mandatory, and repeat computed tomography (CT) should be performed.

Stent Migration

Causes

Stent migration before anastomosis creation causes severe peritonitis, because the organs are not attached to each other. Other than the biliary stricture, there is no stricture in the anastomotic tract. Without continuous application of compression to the stent, the likelihood of migration is increased. Another important issue is the lack of a dedicated stent for EUS-BD.

Prevention

Covered SEMS with flaps have been reported to be effective in terms of preventing migration of both EUS-CDS and EUS-HGS.[9] An anchoring system is required to prevent migration. Partially

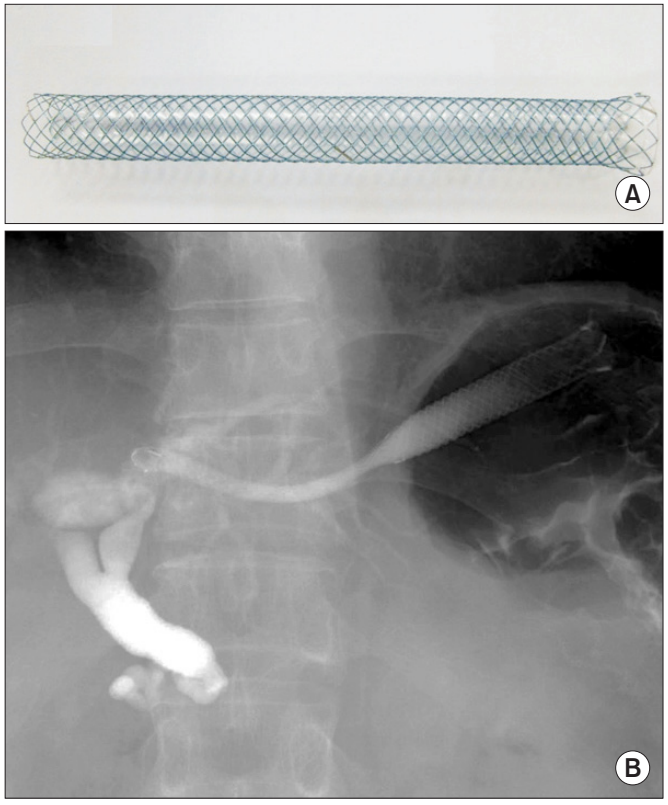

Fig. 4. Endosonography-guided hepaticogastrostomy using a long, partially covered self-expandable metallic stent. (A) A Niti-S Modified GIOBOR stent (Taewoong Medical Co., Ltd., Goyang, Korea). (B) A modified GIOBOR stent (12 cm) placed from B3 to the stomach. The portion protruding into the stomach was > 60 mm in length.

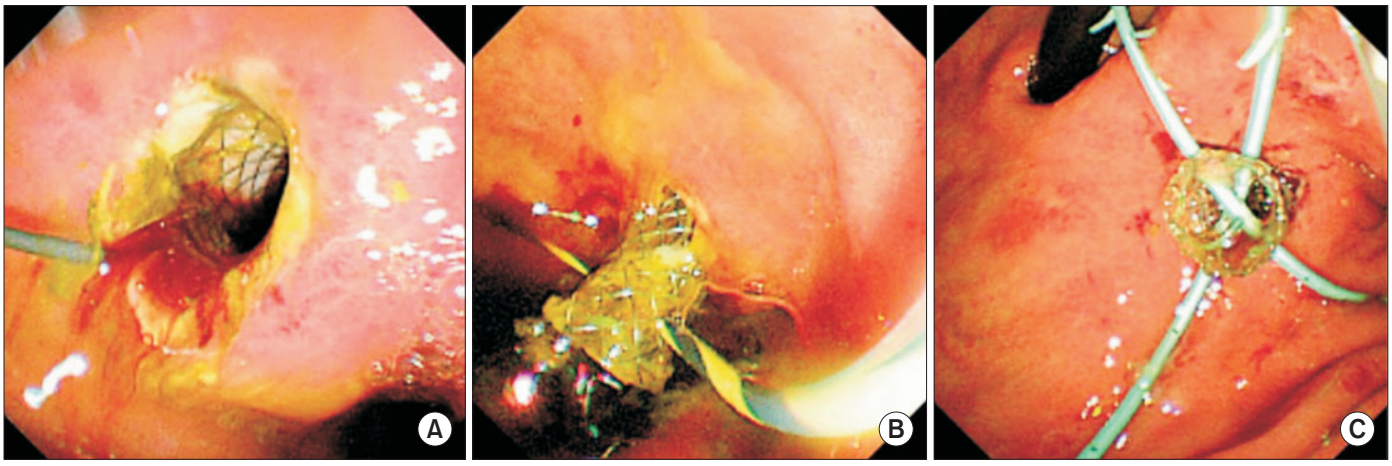

Fig. 5. Crisscross anchor-stent technique. (A) Fully covered self-expandable metallic stent (FCSEMS) was barely dislocated into the gastric wall. (B) Guidewire penetration of the FCSEMS body. (C) Two plastic stents (5 Fr Geenen pancreatic stent; Cook Endoscopy, Winston-Salem, NC, USA) were placed through the mesh in a crisscross shape to prevent migration. Reused from the article of Shima et al (*Endoscopy*. 2014;46 Suppl 1:E563).[12]

covered SEMSs may be anchored in the hepatic parenchyma and hepatic duct; these also prevent segmental cholangitis. Recent progress in lumen-apposing stents may prevent this type of complication. Lumen-apposing stents are commercially available in several countries: Axios (Boston Scientific, Natick, MA, USA) and Niti-S Spaxus (Taewoong Medical Co., Ltd., Goyang, Korea).[10,11] Tubular-type covered SEMSs lacking an effective anchoring system are at risk of migration in the EUS-HGS, as has been reported previously. However, very long cSEMSs (10 or 12 cm, Niti-S Modified GIOBOR; Taewoong Medical Co., Ltd.) containing a long (> 50 mm) portion protruding into the stomach are effective for preventing migration (Fig. 4). Many Japanese endoscopists use this type of SEMS. Some endoscopists fix the covered SEMS using endoscopic clips; attachment endo-loop of SEMS and mucosa, and reduce the size of the anastomotic hall. Shima et al[12] reported a new technique involving fixation of covered SEMS, termed the "crisscross ancho-stents technique", using thin pancreatic stents (Fig. 5). In this technique, two plastic stents penetrate the SEMS vertically in a crisscross shape.

Treatment

We should consider whether the anastomosis was matured or not. Immediately after the procedure before creation of a mature anastomosis, stent may migrated into peritoneal cavity and peritonitis may occur due to non-attachment to the lumen. In such cases, we should refer to the surgeon. In contrast, after anastomosis maturation, cholangitis or cholestasis may occur without peritonitis. If the anastomosis remains in place performance of stent re-insertion is possible.[13] When the perforation site is big and severe peritonitis or migrated stent into the peritoneal cavity, surgical management was mandatory. However, most cases without such situation and with small perforation or successful closure of perforated site were able to be managed conservatively. If the perforation was suspected, we should perform CT scan, and check the fluid collection in the peritoneal cavity. Much amount of fluid collection with clinical signs of peritonitis should be refer to surgeon as soon as possible.

Peritonitis (without Stent Malposition)

Causes

Despite successful stent placement at the anastomosis and lack of stent migration, peritonitis may still occur. Two types of leakage can cause this type of peritonitis: 1) leakage of bile juice or gastric/duodenal contents during the EUS-BD procedure, and 2) leakage along the placed stent.

Prevention

1) Leakage during EUS-BD procedures should be minimized. Reducing the number of procedural steps, shortening the procedural time and use of less dilation before stent insertion result in reduced leakage. 2) Placement of stents of appropriate size for the anastomosis diameter is important. Covered SEMSs are effective in terms of omitting space for leakage to occur.

Treatment

If the stent is placed in an adequate position, antibiotics should be administered with/without aspiration of intra-abdominal fluid. If follow-up CT suggests an increased amount of fluid, the stent should be exchanged for one of a larger diameter. The treatment strategy should be decided according to the patient's status. Watching the patients with surgeon from the beginning of peritonitis was most important, and do not miss the timing for surgical management.

Conclusion

EUS-BD improves patient QOL compared with other techniques but is not yet an established technique. Physicians should be aware of the causes of, and prevention and treatment methods for, complications related to this procedure. Development of dedicated devices to increase the success rate and reduce the incidence of complications is required.

Conflicts of Interest

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