Chapter 8
Management of Concurrent Biliary and Duodenal Obstruction

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Case Presentations

Case 1

A 29-year-old man with history of ataxia-telangiectasia syndrome (*ATM* gene mutation) presented with 2 days of painless jaundice associated with nausea and vomiting. The patient was afebrile, hemodynamically stable, and physical exam revealed conjunctival telangiectasias and scleral icterus. Laboratory studies were remarkable for total bilirubin 11.7 mg/dL, direct bilirubin 9.7 mg/dL, and alkaline phosphatase 398 units/L. An abdominal ultrasound showed a distended gallbladder in addition to intrahepatic and extrahepatic biliary dilatation without identifiable filling defect. Magnetic resonance imaging with cholangiopancreatography (MRI/MRCP) demonstrated a 3.3 by 3.3 cm hypoenhancing mass in the distal duodenal bulb and descending duodenum resulting

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D. K. Mullady (ed.), *Dilemmas in ERCP*,
https://doi.org/10.1007/978-3-030-12741-1_8

in common bile duct (CBD) stricture and dilatation of the pancreatic duct without vascular invasion (Fig. 8.1).

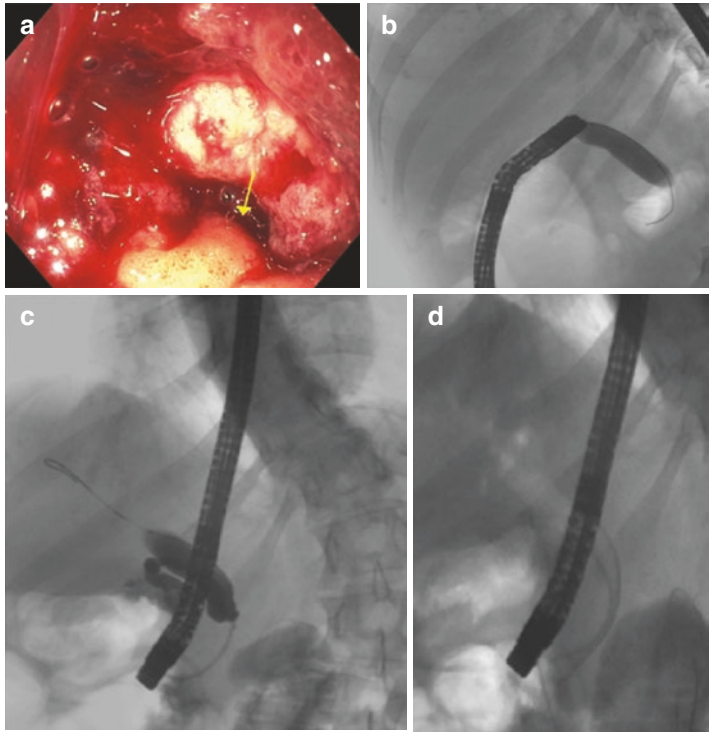


Figure 8.1 A 29-year-old man with history of ataxia-telangiectasia syndrome (ATM gene mutation) presented with a hypoenhancing mass in the distal duodenal bulb and descending duodenum resulting in common bile duct (CBD) stricture and dilatation of the pancreatic duct. Evaluation with upper endoscopy demonstrated a complete obstruction of the duodenal bulb due to a friable mass (**a**) that was successfully dilated under fluoroscopic guidance to 18 mm (**b**). Subsequently, passage of a duodenoscope was possible, and cholangiography demonstrated a severe, malignant-appearing distal bile duct stricture (**c**). An uncovered metallic biliary stent was successfully deployed (**d**, **e**), followed by the successful placement of an uncovered metallic duodenal stent (**f**, **g**) for palliation of the gastric outlet obstruction

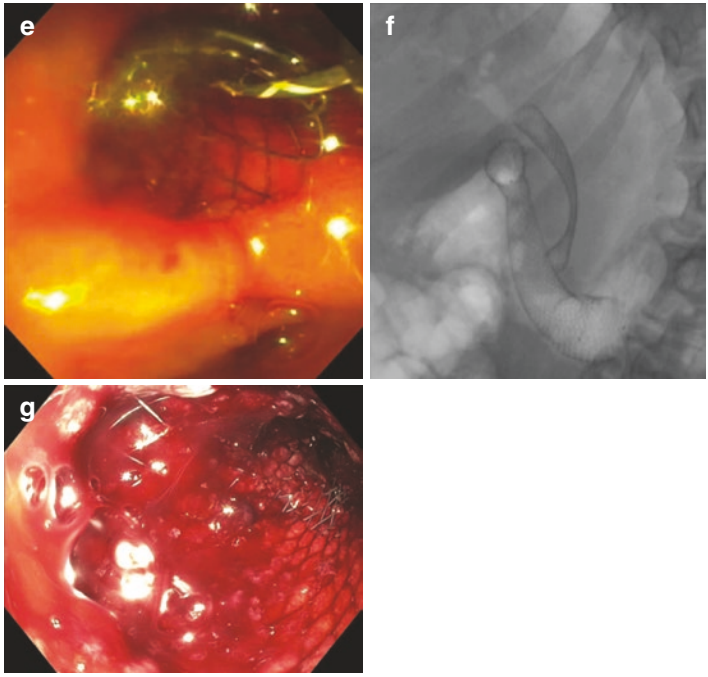


FIGURE 8.1 (continued)

Case 2

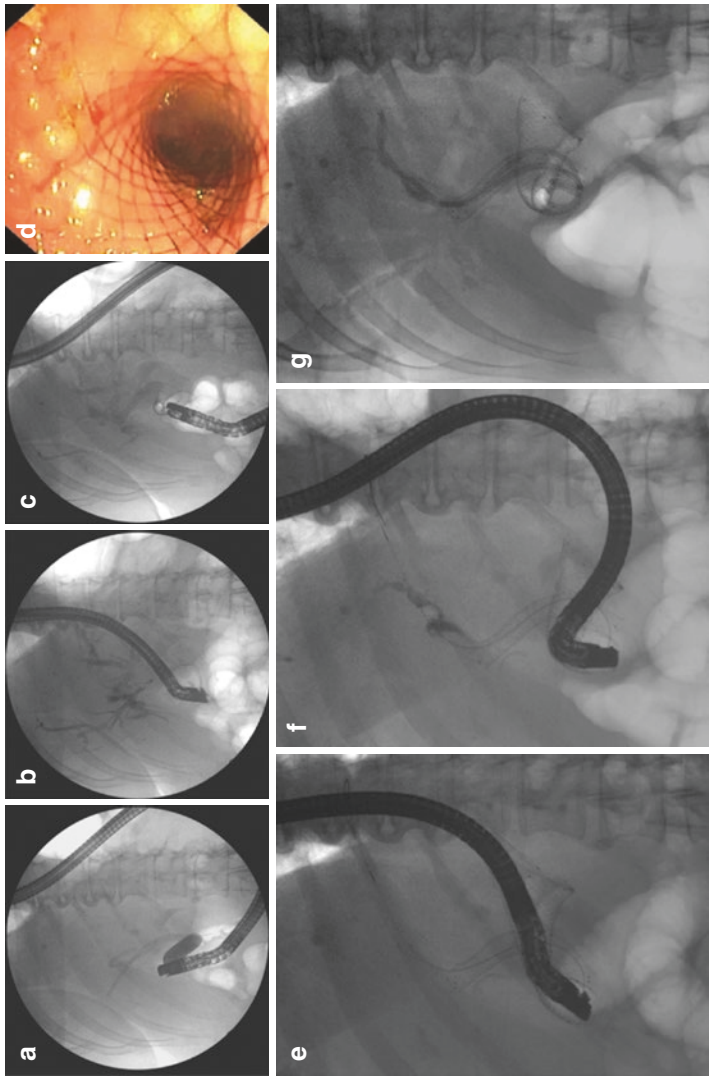
A 57-year-old woman presented with painless jaundice, and MRI/MRCP showed a porcelain gallbladder, Mirizzi's syndrome, and right adnexal cystic mass concerning for primary ovarian malignancy. Mirizzi's syndrome was palliated with ERCP, sphincterotomy, and plastic stent placement. Subsequent exploratory laparotomy, bilateral salpingo-oophorectomy, omentectomy, and subtotal cholecystectomy demonstrated metastatic gallbladder cancer with peritoneal and drop ovarian metastases. Postoperatively, the patient developed a left intrahepatic bile leak that was treated with stent placement. Over the next year, the patient was managed with plastic stent exchanges with a progressive, Bismuth IV

severe hilar stricture involving the upper portion of the CBD in addition to the left main and right main hepatic ducts. Despite bilateral plastic stenting with fenestrated double pig-tail plastic stents, she presented with cholangitis and gastric outlet obstruction (Fig. 8.2).

Case 3

A 59-year-old woman with a history of poorly differentiated duodenal cancer, managed with ERCP and plastic stent placement, underwent attempted Whipple procedure. Intraoperatively, she was found to have multiple liver metastases, so the Whipple operation was aborted. A gastrojejunostomy was performed to alleviate gastric outlet obstruction symptoms. However, postoperatively, the patient

FIGURE 8.2 A 57-year-old woman with a complex history of metastatic gallbladder cancer complicated by Bismuth IV hilar strictures previously managed with bilateral plastic stent placement now presents with septic shock and gastric outlet obstruction. The malignant gastric outlet obstruction was dilated to 18 mm under fluoroscopic guidance (**a**), and an Olympus JF slim duodenoscope was advanced to the major papilla. Limited cholangiography confirmed the persistence of a severe, complex hilar stricture (**b**). Subsequently uncovered metallic stents were placed in a Y-configuration for palliation of the hilar obstruction, and an uncovered duodenal stent was placed for the management of the gastric outlet obstruction (**c**, **d**). The patient returned several months later with recurrent cholangitis. After dilation of the previously place duodenal stent, the JF duodenoscope was advanced to the region of the major papilla (**e**). The uncovered metallic biliary stent was cannulated through the interstices of the duodenal stent with a guidewire, and the orifice was dilated to allow stent passage. Limited cholangiogram demonstrated persistence of a complex stricture of the left intrahepatic duct (**f**). Subsequently to 7 Fr plastic stents were successfully placed into the left intrahepatic duct with subsequent resolution of cholangitis (**g**)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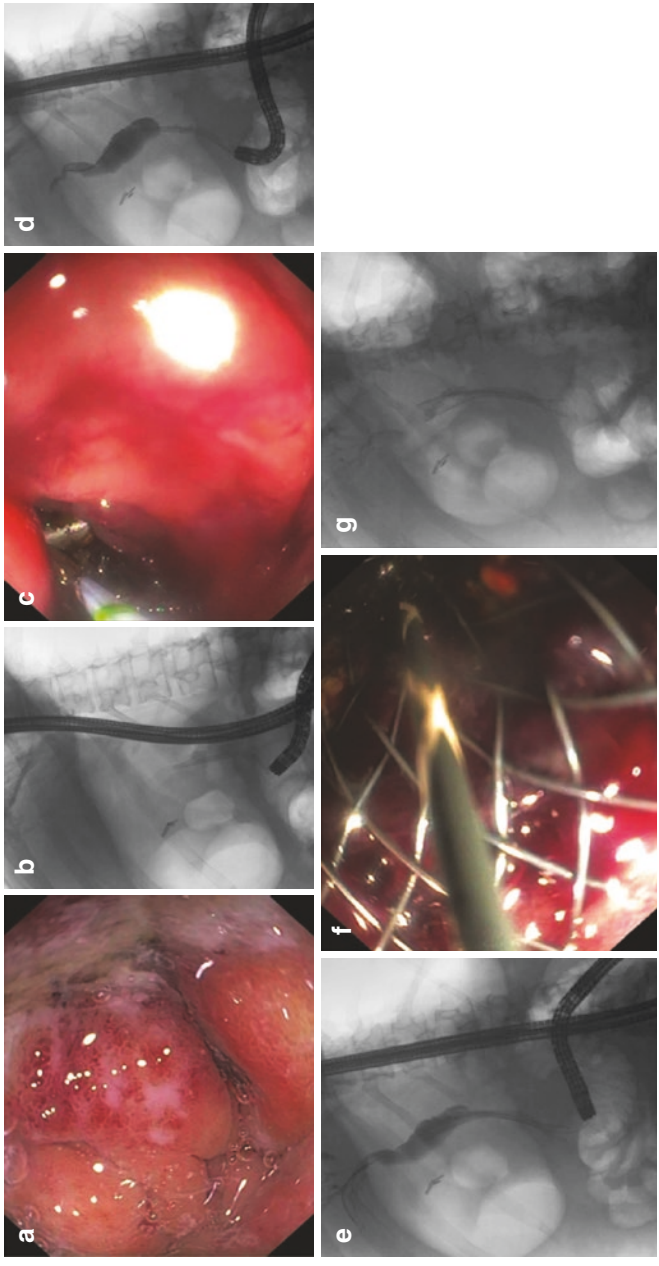
developed fever and obstructive jaundice with a total bilirubin 4.8 mg/dL and alkaline phosphatase 754 units/L (Fig. 8.3).

Assessment and Diagnosis

Concurrent biliary and duodenal obstruction (CBDO) occurs in both malignant and benign diseases. Among malignant etiologies, pancreatic adenocarcinoma is the most common, followed by ampullary cancer, gallbladder cancer, cholangiocarcinoma, gastric cancer, small bowel adenocarcinoma, intestinal and extraintestinal lymphoma, and metastatic diseases. Benign conditions, such as autoimmune pancreatitis, sclerosing mesenteritis, and Bouveret's syndrome, are much less common causes of CBDO [1].

Without therapy, the mean survival for patients presenting with malignant biliary obstruction is less than 200 days. Because most patients have advanced disease at the time of

Figure 8.3 A 59-year-old woman with a history of poorly differentiated duodenal cancer, managed with ERCP and plastic stent placement, underwent an aborted Whipple due to intraoperative identification of diffuse metastatic disease. A palliative surgical gastrojejunostomy was surgically created but the patient developed cholangitis and biliary obstruction postoperatively. Endoscopy demonstrated complete and untraversable obstruction at the level of the pylorus due to malignant infiltration (**a**). Subsequently the Olympus 1 T upper endoscope was able to be advanced retrograde through the gastrojejunostomy to the second portion of the duodenum (**b**, **c**). There was malignant infiltration of the duodenum distal to the papilla. Utilizing a sphincterotome with fluoroscopic guidance, a guidewire was able to be advanced adjacent to the previously placed plastic stent into the bile duct. Cholangiography confirmed a severe 2 cm distal biliary stricture with upstream dilation (**d**). Subsequently, an uncovered metallic biliary stent was deployed under fluoroscopic (**e**) and endoscopic (**f**) guidance, successfully (**g**)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presentation, operative resection with curative intent is only possible in 10–15% of cases [2]. While there are not large series of patients with CBDO, published cohorts suggest that these patients have a worse prognosis, with as little as an 81-day median survival [3]. Given this prognosis, treatment must aim to palliate symptoms of duodenal obstruction, obstructive jaundice, and pain. While there is controversy about the best approach to palliative treatment, options include surgical approaches (biliary and gastric bypass with choledochojejunal and gastrojejunal anastomoses), percutaneous drainage options (percutaneous biliary drainage), and endoscopic approaches (endoscopic biliary and enteral stent placement).

Although the diagnosis of CBDO can be confirmed by endoscopic evaluation, clinical vigilance by incorporating clinical history, physical examination, and biochemical and radiographic findings can prevent unnecessary repeat procedures or delay in care. Patients usually present with symptoms of biliary obstruction including jaundice and pruritus with associated conjugated hyperbilirubinemia and imaging findings of biliary ductal dilatation. The difficulty usually arises in recognizing gastric outlet obstruction (GOO) before proceeding with endoscopic biliary decompression. Patients with GOO usually have nonspecific symptoms that could be explained by the primary disease, and it is important to have a low index of suspicion. Patients could present with nausea, vomiting, abdominal pain, early satiety, weight loss, dehydration, and undernutrition. Imaging might show large volume of gastric contents with or without a dilated stomach or duodenum. Oral and intravenous contrast are key due to their ability to establish the diagnosis, assess the stage of malignant diseases, evaluate the anatomy before procedures, and assess for possible contraindications and the extent and severity of luminal stenoses. The above findings in the right clinical settings should elicit the suspicion for CBDO in the preprocedural setting.

Based on the timing of the development of the biliary obstruction compared to the development of the duodenal obstruction, patients with CBDO can be classified into three

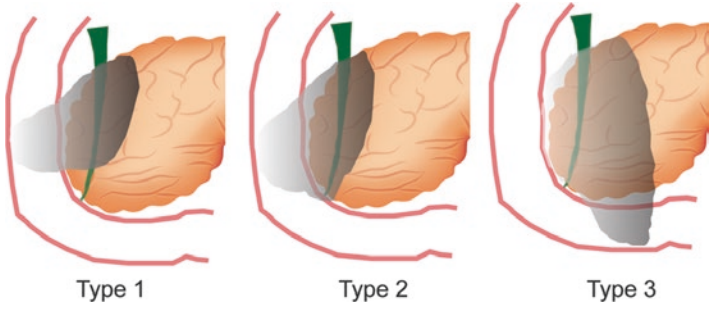

FIGURE 8.4 Anatomic subtypes of combined biliary and duodenal obstruction, as suggested by Mutignani et al. [3]

groups: (1) biliary obstruction followed by duodenal obstruction within weeks to months which is the most common scenario (as in the first and third cases above), (2) simultaneous biliary and duodenal obstruction (as in the second case above), or (3) duodenal obstruction followed by biliary obstruction (least common).

From an anatomic and prognostic standpoint, CBDO can be classified into three types based on the location of the duodenal obstruction in relation to the major papilla, as described by Mutignani et al. (Fig. 8.4) [3, 4]. Type 1 represents duodenal obstruction that occurs at the level of the duodenal bulb or upper genu of the pancreas without involvement of the major papilla as in the first case. Type 2 is duodenal obstruction at the level of the major papilla as in the second case. Type 3 is duodenal obstruction distal to the major papilla. Generally, combined endoscopic approaches are most readily achievable in type 3 and most challenging in type 2 when biliary cannulation is hampered by tumor involvement of the papilla.

The above classifications can affect the clinical approach, treatment strategy, and outcomes for a patient. For example, in the three cases discussed, while all presented with obstructive jaundice, in the first case, the diagnosis of GOO was delayed until the time of endoscopy. In the second case, the

presence of ingrowth into the stents and worsening hilar mass on imaging were clues into the possible concurrent obstruction. While in the third case, the prior knowledge of the presence of the duodenal malignancy and GOO requiring surgical bypass were key in attempting a retrograde approach.

Treatment and Management

The management of benign etiologies of CBDO primarily focuses on the treatment of the underlying process in the cases of sclerosing mesenteritis or AIP or relief of the obstructing stone in the case of Bouveret's syndrome. We will focus here primarily on the management of malignant CBDO, which accounts for the vast majority of presentations in clinical practice.

In early stages, when the malignant disease can be resected, the role of endoscopy is to alleviate the symptoms and achieve biliary drainage while awaiting surgical resection. However, usually the presence of CBDO indicates at least locally advanced disease that is unresectable. Historically, unresectable disease was palliated surgically by performing double-bypass surgery, gastrojejunostomy with hepaticojejunostomy or choledochojejunostomy, at the time of the diagnostic laparotomy. With the advancement of radiographic and endoscopic technologies, surgical palliation is rarely done. From an endoscopic perspective, a common theme is to attempt to treat the biliary obstruction first. This is related to the increased difficulty of accessing the major papilla when it becomes jailed behind an enteric stent. In addition to traditional endoscopic approaches, endoscopic ultrasound-guided biliary access and lumen-apposing metal stents (LAMS) have advanced our ability to perform minimally invasive palliative procedures to alleviate the complications of malignant diseases including CBDO even in patients who are poor surgical candidates. Here we briefly discuss the management of isolated biliary and duodenal obstructions separately first, before discussing the different possible scenarios for CBDO based on the anatomical types described by Mutignani et al. [3].

Management of Malignant Biliary Obstruction

The current standard treatment for unresectable malignant biliary obstructions is transpapillary stenting. This can be achieved using plastic stents (PS) or self-expandable metal stents (SEMS). PS are safe and effective, are less expensive than SEMS, and can be easily replaced if occlusion occurs. SEMS were designed to extend the duration of patency utilizing a larger internal diameter and thereby reducing the frequency of re-intervention. SEMS are associated with lower complications rates, longer stent patency, and fewer re-interventions and lower costs after 1 year in comparison to PS, even in those patients with short survival times (<3 months) [5, 6]. Compared to uncovered SEMS (uSEMS), partially/fully covered SEMS (pc/fcSEMS) were developed to reduce the rate of tumor ingrowth; however there remain concerns of stent migration, sludge formation, stent-induced cholecystitis and pancreatitis, and tumor overgrowth [7]. The utility of covered SEMS is also limited to distal malignant biliary obstructions due to concerns for blocking the contralateral intrahepatic system or ipsilateral intrahepatic branches. A recent meta-analysis [8] and large single-center retrospective study [9] demonstrated no differences in the number of recurrent biliary obstructions or stent patency after 6 or 12 months, overall or median survival, median time to recurrent biliary obstruction, or rate of adverse events. Therefore, our practice is primarily to utilize fcSEMS upfront in palliation of clinically, highly suspicious malignant biliary strictures without an official tissue diagnosis when a patient is post-cholecystectomy [10] or in recanalization and preservation of an occluded indwelling uSEMS.

When the transpapillary approach fails, EUS-guided biliary drainage and percutaneous transhepatic biliary drainage (PTBD) with external or internal biliary drainage are both excellent options. The presence of ascites might limit such approaches due to the risk of infection, leakage, and migration of the drainage catheters.

Management of Malignant Duodenal Obstruction

The current treatment options for unresectable duodenal obstruction or GOO are endoscopic stenting with enteral SEMS, surgical gastrojejunostomy, or venting gastrostomy with or without the placement of a jejunal feeding extension. Regardless of the treatment strategy chosen, it is paramount that when a patient presents with suspected GOO, a nasogastric (NG) tube is placed to suction as soon as possible to reduce the risk of aspiration and facilitate endoscopic intervention as appropriate. We frequently allow 24 hours of drainage with an NG tube prior to attempting endoscopic intervention especially in patients with a distended stomach on imaging. The SUSTENT study demonstrated that enteral stents have no differences in survival or quality of life in comparison with surgical gastrojejunostomy, though surgical intervention was associated with fewer recurrent obstructive symptoms (28% vs 5%) occurring at a longer interval [11]. However, in aggregate, enteral stents are associated with faster resolution of GOO symptoms, shorter hospital stays, reduced cost, and no differences in survival for the management of intrinsic duodenal obstruction [12].

The use of LAMS for EUS-guided gastrojejunostomy is a new approach that may be considered in the hands of high-volume therapeutic endoscopists in patients who are poor surgical candidates and cannot undergo duodenal stenting [13]. In this technique, a small bowel loop is demarcated by placement of wire-guided balloon catheter, injection of contrast using a wire-guided nasobiliary tube or a peroral ultraslim endoscope, or a wire-guided double-balloon tube. Then, an echoendoscope is used to localize the demarcated small bowel loop, and a gastroenterostomy is formed by placement of a LAMS [14]. While the preliminary case series of this approach have been encouraging, further robust clinical experience is required before its routine use in clinical practice.

Management of Combined Biliary and Duodenal Obstruction (CBDO)

In type 1 CBDO (duodenal obstruction is proximal to the major papilla), the goal is to pass the duodenoscope through the stricture to the major papilla, if possible. The initial approach should employ gentle pressure to pass the duodenoscope or the utilization of a slim duodenoscope (i.e., JF) if available through the duodenal stricture. If that fails, a 15–16.5–18 mm TTS balloon dilator can be used to dilate the stricture under fluoroscopic guidance. Alternatively, a balloon-tipped catheter can be passed fluoroscopically to the third portion of the duodenum to anchor and pull the endoscope across the stricture. Once the major papilla is reached, biliary cannulation and SEMS placement are completed per usual fashion. Subsequent to placement of a biliary stent, a guidewire can be passed into the fourth portion of the duodenum, and an enteric stent can be placed under endoscopic and fluoroscopic guidance. The proximal end of the enteric stent should be positioned within the prepyloric area as type 1 duodenal obstruction tends to be in the duodenal bulb. Additionally, care should be taken to use a stent long enough to achieve a margin of 2 cm both proximal and distal to the margins of the duodenal stricture as SEMS tend to shorten by 25% during expansion. Ideally, if possible, the position of the biliary stent on fluoroscopy should be used as a guide to prevent deployment of the duodenal stent across the biliary stent, though this is often unavoidable. If the maneuvers above fail to allow the duodenoscope to traverse the duodenal stricture, the placement of the enteric stent under fluoroscopic guidance prior to achieving biliary drainage becomes necessary. The endoscopist should attempt to position the distal end of the enteric stent proximal to the papilla to facilitate later biliary cannulation, though this is often difficult to gauge on fluoroscopy alone. As biliary obstruction usually develops prior to the development of the duodenal stenosis, many patients have indwelling PS/SEMS in place which can

help in localizing the papilla. Alternatively, it may be possible to advance a standard upper endoscope or ultrathin scope to the level of the papilla and mark this point either with a reference fluoroscopic image or with the placement of an endoscopic hemoclip. Once the duodenal stent is placed, the options are to either wait 1–3 days to allow the enteric stent to expand or to attempt to dilate the freshly deployed stent to 15 mm to allow scope passage in the same session.

Type 2 CBDO represents the most challenging anatomic type of CBDO, as the duodenal obstruction includes the level of the major papilla making biliary access very challenging. Identification of the papillary orifice is often difficult due to extensive tumor infiltration. Furthermore, maneuverability is usually limited, with little room to work between the head of the endoscope and medial/lateral walls of the strictured duodenum. In many cases, the biliary obstruction has developed prior to the duodenal obstruction, and thus patients present having an indwelling PS or occluded SEMS in place. Utilizing endoscopic and/or fluoroscopic cues can be critical in achieving biliary cannulation. If biliary access is gained, the patient can be treated in similar approach to type 1. If the stricture is not traversable, a duodenal stent can be placed across the duodenal stenosis first. However, the placement of this stent will invariably make identification of the major papilla more challenging. In some cases, after stent deployment, the papillary orifice may be identified or intuited based on the presence of bile streaking through the interstices of the duodenal stent, and biliary cannulation may be possible. If wire access can be established into the bile duct, ERCP can be performed through the interstices utilizing balloon dilation and/or argon plasma coagulation (APC) to create an opening in the metallic mesh sufficient to allow passage of the biliary stent. There has been some innovation in this area, with the creation of the Meditek BONASTENT M-Duodenal, which employs a central area of looser cross mesh that makes biliary cannulation potentially easier [15]. If biliary access cannot be achieved through a transpapillary approach after duodenal stent placement, then EUS-guided or percutaneous approaches can be utilized to gain biliary access.

EUS-guided cholangiography utilizes a curved linear echoendoscope to identify the intrahepatic bile ducts using a transgastric approach or the extrahepatic bile ducts using a transgastric or transduodenal approach. When accessing the biliary tree in this fashion, the options are either a rendezvous approach where EUS access is used to pass a wire antegrade to the papilla to facilitate transpapillary drainage or EUS-guided creation of a fistula (hepaticogastrostomy, choledochoduodenostomy, etc.). Under EUS guidance, the bile duct is identified and punctured using a 19-gauge access needle. After aspiration of bile and injection of contrast into the biliary tree to confirm appropriate access, a biliary wire is advanced into the biliary tree under fluoroscopic guidance. In the rendezvous approach, the wire is directed toward the papilla under fluoroscopic guidance. Once the wire is out of the papilla, the echoendoscope is withdrawn, and a duodenoscope is readvanced to the level of the papilla. Through the duodenoscope, the wire is retrieved and backloaded into the duodenoscope using snare or forceps. Over this wire, conventional transpapillary drainage and stent placement can then be performed with the distal end of the biliary stent deployed within the duodenal stent [16]. Alternatively, the EUS-placed wire emerging transpapillary can be used as a guide for traditional transpapillary cannulation if grasping the wire is challenging. We will typically utilize fcSEMS that traverse the point of EUS-guided access to minimize the risk of a leak. In a similar fashion, PTC can be used to perform rendezvous ERCP, in conjunction with interventional radiology. Alternatively, a hepaticogastrostomy (HGS) or choledochoduodenostomy (CDS) could be created with this approach. After the wire is advanced into the biliary tree via either transduodenal or transgastric puncture, verifying that there are no intervening structures or vasculature on EUS, dilation of the tract can be performed with a combination of push catheters and a 4 mm/6 mm balloon. Subsequently, a transmural fcSEMS or LAMS can be advanced in antegrade fashion and deployed to form a hepaticogastrostomy or choledochoduodenostomy [17, 18]. There are lower complica-

tion rates and leak rates associated with transpapillary drainage as opposed to the creation of fistulas. All of these techniques should be employed only in the hands of expertly trained therapeutic endoscopists at high-volume centers, with immediately available hepatobiliary surgery, and interventional radiology consultations given the potential for morbidity or even mortality should misdeployment or perforation occur. If this is not available or the case is not amenable, then percutaneous biliary access with the placement of a biliary stent across the papilla or external percutaneous drainage by an interventional radiologist is an excellent alternative.

In type 3 CBDO, as the duodenal obstruction is distal to the major papilla, endoscopic treatment is generally the most straightforward. These cases are the most uncommon and usually arise from pancreatic uncinate tumors. Although we still prefer achieving biliary drainage first to avoid unplanned jailing of the papilla, the order of which stent to place first is not as pivotal as in type 1 when the distance between the ampulla and the duodenal stricture is not close. It is important to keep in mind that the risk of duodenal reflux after biliary stenting is higher in patients with type 3 CBDO.

Outcomes of the Clinical Cases

Pre-procedural knowledge of the patient's anatomy and preparation for every type of CBDO, or combination therein, is crucial for real-time decision-making. It is also important to discuss and obtain appropriate consent from patients for possible dilation, placement of biliary and enteric stents when GOO is suspected, or even the specific performance of EUS-guided access procedures. As mentioned above, when a patient has suspected GOO, an NG tube must be placed, and the gastric contents should be suctioned for at least 24 hours before the procedure. In our practice, we perform all our procedures with fluoroscopy and with anesthesia support under general endotracheal intubation when GOO is suspected.

In the first case, the patient had type 1 CBDO with simultaneous biliary and duodenal obstruction. On initial attempt at ERCP, an Olympus TJF-160VF (13.2 mm outer diameter) and Olympus JF-140F (11.0 mm outer diameter) could not traverse a stricture at the distal duodenal bulb. The duodenoscope was exchanged for a straight-viewing Olympus GIF-H190 (9.2 mm outer diameter) gastroscope, and there was a large, infiltrating, obstructing mass in the distal portion of the duodenal bulb that was traversed with gentle pressure. The mass extended to 1.5 cm proximal of the ampulla. The stenosis was dilated using a 15–16.5–18 mm through the scope (TTS) balloon dilator to 18 mm. This made it possible for the Olympus TJF-160VF to traverse the stricture. Subsequently, biliary cannulation was achieved and cholangiography demonstrated a single severe stenosis in the distal CBD that was treated successfully with the placement of an uncovered self-expandable metallic stent (uSEMS). Finally, the duodenal stenosis was treated with the placement of a 22 mm × 9 cm enteral stent with the proximal end positioned within the prepyloric antrum and the distal end proximal to the biliary stent (Fig. 8.1). The patient's jaundice resolved, and he was able to advance his diet and receive outpatient neoadjuvant chemotherapy. Duodenal stent patency and biliary drainage were maintained for 6 months. His course was complicated by bleeding which was likely related to the combination of his ataxia-telangiectasia syndrome and the locally advanced tumor. The bleeding episodes were treated conservatively.

In the second case, the patient initially had a type 1 CBDO which was treated in a similar fashion to the first case, although the biliary obstruction was a hilar Bismuth IV lesion. She subsequently presented with a type 2 CBDO with tumor ingrowth through the stent interstices. In this case, ERCP was performed and demonstrated a severe duodenal bulb stenosis which was dilated with a 15–16.5–18 mm TTS balloon dilator to 18 mm under fluoroscopic guidance. She was noted to have occluded plastic stents which were removed, and a Bismuth IV stenosis was noted again. Due to the presence of malignant duodenal obstruction raising concern for possible inability to

access the bile ducts should the plastic stent be replaced, the decision was made to place Y-configuration metallic biliary stents. Subsequently, a 10 mm × 8 cm uncovered metallic stent was placed into the left intrahepatic duct. A wire was advanced through the interstices of the first stent into the right anterior duct, and another 10 mm × 8 cm uncovered metallic stent was placed into the right main duct, extending beyond the papilla. Finally, the duodenal stenosis was managed with a 22 mm × 9 cm uncovered metallic stent with its proximal end in the prepyloric antrum. Two months later, the patient represented with fever, hypotension, bacteremia, and jaundice with total bilirubin 2.4 mg/dL and alkaline phosphatase 1002 units/L. She was found on contrast-enhanced computed tomography (CT) to have tumor ingrowth into the uncovered metallic stents and worsening infiltration of the soft tissue lesion into the hepatic hilum. Repeat ERCP was attempted through the duodenal stent and overlapping Y-configuration biliary stents. The duodenal stent was dilated with a 15–16.5–18 mm TTS balloon dilator to 18 mm under fluoroscopic guidance. The Olympus TJF-160VF duodenoscope was unable to traverse the stenosis, so it was exchanged for an Olympus JF-140F duodenoscope which was able to traverse the luminal stenosis. The biliary orifice was obscured by the overlaying duodenal stent. Utilizing fluoroscopic guidance, the bile duct was cannulated with a short-nosed traction sphincterotome through the interstices of the duodenal stent. The entire biliary tree contained multiple diffuse stenoses, likely due to secondary cholangiopathy from chronic cholangitis and obstruction. The interstices of the duodenal stent and distal CBD were dilated with an 8-mm balloon dilator. Finally, two double pigtail 7 Fr × 10 cm plastic biliary stents were placed 12 cm into the common bile duct extending into the left intrahepatic ducts (Fig. 8.2). Subsequently, the patient's fever, cholangitis, and jaundice rapidly resolved, and she was able to receive further palliative chemotherapy. Her course was complicated by recurrent cholangitis due to her hilar biliary strictures and cholangiopathy. She has been undergoing chemotherapy by her local oncologist and she had her plastic stents exchanged through the

previously placed duodenal and biliary metal stents successfully for an episode of cholangitis 6 months later.

In the third case, the patient had biliary obstruction that was treated with PS initially and subsequently underwent palliative surgical gastrojejunostomy for a type 1 CBDO. She then developed biliary obstruction due to occlusion of the PS. In this case, upper GI endoscopy using Olympus GIF-1TQ160 endoscope demonstrated severe malignant infiltration and obstruction of the duodenum just beyond the level of the duodenal bulb that could not be traversed. Therefore, the afferent limb of the gastrojejunostomy was entered, and the scope was advanced retrograde with some difficulty to the area of the ampulla. There was malignant infiltration of the second portion of the duodenum noted retrograde, with a small portion of the previously placed plastic stent visible endoscopically. There appeared to be a necrotic cavity anatomically proximal to the level of the ampulla. Wire-guided biliary cannulation was achieved with a short-nosed sphincterotome utilizing fluoroscopic visualization to direct the sphincterotome tip in axis with the indwelling biliary stent. Cholangiogram demonstrated the indwelling plastic stent with a 2 cm distal CBD stricture with significant upstream ductal dilation to 18 mm. A 10 mm × 8 cm uSEMS was then successfully placed across the stricture with the distal end of the stent position beyond the ampullary mass in the distal duodenum. Bile and pus flowed through the stent (Fig. 8.3). Jaundice and leukocytosis rapidly resolved after the procedure, and it has been 9 months since without need for re-intervention. She continues to follow up with her oncologist for chemotherapy.

Reported Outcomes and Complications in Patients with CBDO

The evidence evaluating the role of the different endoscopic treatments for CBDO comes mainly from case series of malignant unresectable CBDO [19]. The largest published

case series by Hamada et al. included 110 patients with a functional success rate of 95% including 90 patients who underwent ERCP, 10 who underwent EUS-guided CDS, and 10 who underwent EUS-guided HGS. In terms of the timing of the development of the duodenal obstruction, 61% of the patients developed the duodenal obstruction after the biliary obstruction with a median time of 2 months. In 12.7% of the patients, the duodenal obstruction preceded the biliary obstruction with a median time of 1 month. Survival was the longest in patients who developed simultaneous CBDO and patients who had type 2 CBDO. In terms of achieving biliary drainage, ERCP was successful in most patients who had type 1, type 3, or nonsimultaneous CBDO, while 30% of patients who had type 2 and 42% of the patients who had simultaneous CBDO required EUS-guided transmural drainage. In total, 33% of the patients developed recurrent biliary obstruction. Neither the sequence of the development nor the anatomical type of CBDO predicted the time to recurrent biliary obstruction. On the other hand, different treatment approaches had different rates of recurrence with 50% of EUS-guided CDS, 40% of EUS-guided HGS, and 31% of transpapillary drainage developing recurrent biliary obstruction. Regardless, all the patients underwent successful re-intervention for biliary drainage via ERCP, EUS-guided, and percutaneous approaches [20].

From a safety standpoint, ERCP had the lowest rate of adverse events at 8.9% followed by EUS-guided CDS (20%) and then EUS-guided HGS (50%). Adverse events associated with EUS-guided transmural drainage occurred early, within 30 days, in all the patients. Potential adverse events of the endoscopic interventions that attempt to alleviate CBDO include cholangitis, cholecystitis, pancreatitis, bleeding, perforation, stent migration, and bile leakage [20].

A recently conducted randomized controlled trial has shown no difference in efficacy or safety profile between ERCP or EUS-guided biliary drainage in patients with distal biliary obstruction due to pancreatic cancer [21]. However, one of the exclusion criteria was the presence of altered

anatomy or inability to access the major papilla, which is a uniquely challenging scenario that might have led to higher rates of complications in line with prior CBDO case series [20]. Percutaneous drainage, in comparison to endoscopic intervention, has been associated with higher rate of adverse events and unscheduled re-interventions [22].

Pearls and Pitfalls

- Given the complexity, potential complications, and varied approaches to patients with CBDO, a multidisciplinary team that involves hepatobiliary surgery, oncology, interventional radiology, and interventional gastroenterology should evaluate and discuss each case individually prior to committing a patient to intervention.
- Understanding the anatomy and the different anatomical variations of CBDO is key in approaching the case efficiently. There should be a low index of suspicion for CBDO in patients who may not have classical, overt GOO symptoms, and contrast-enhanced cross-sectional imaging should be reviewed pre-procedure to help in procedure planning. Similarly, patients should be consented for both enteric and biliary stents when there is any suspicion for CBDO.
- Malignancy is the most common cause for unresectable CBDO. Such patients usually have poor performance status, and achieving both biliary drainage and duodenal stenting in one procedure may prevent periprocedural complications.
- It is important to set realistic expectations with the patients and their families that the intention of endoscopic intervention is palliation of symptoms and that the median survival remains modest.
- In general, when double stenting is performed, we recommend securing the biliary stent first when at

all possible before proceeding with enteric stent placement to maximize chances of transpapillary cannulation.

- Based on the results of observational studies, ERCP tends to be associated with the highest success rate, lowest risk of recurrent biliary obstruction, and best safety profile. Hence, we recommend exhausting attempts at biliary decompression via ERCP by a high-volume endoscopist prior to proceeding with EUS-guided or percutaneous approaches.
- EUS-guided biliary access should be performed in well-informed, selected patients, by endoscopists with sufficient experience and multidisciplinary support by interventional radiology and surgery. In particular, EUS-guided access should not be attempted in patients with biliary dilation <1 cm or those who have ascites.

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