Palliative Percutaneous Drainage in Malignant Biliary Obstruction
Part 1: Indications and Preprocedure Evaluation

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Abstract A diagnosis of liver metastasis, periportal adenopathy, or hepatobiliary cancer often is accompanied by findings of biliary obstruction. Malignant biliary obstruction frequently is associated with pruritus, anorexia, cholangitis, or hyperbilirubinemia, which that precludes treatment with chemotherapeutic agents that are excreted or metabolized hepatically. In patients with low biliary obstruction, endoscopic stent placement may accomplish drainage of the entire biliary tree without the need for an external device. Patients with high bile duct obstruction, on the other hand, may need a percutaneous approach to drain the target ducts and avoid draining an atrophic segment or lobe. This first of a series of two articles concerning palliative percutaneous biliary intervention will review the indications for biliary drainage and the preprocedure evaluation of this complicated patient population.

Biliary obstruction is a common source of morbidity in patients with liver metastases, periportal adenopathy, and hepatobiliary cancers. In most cases, these patients have limited life expectancy, and for their physicians, often the challenge is to provide adequate decompression to palliate symptoms or to allow for the administration of chemotherapy that is metabolized by the liver with minimal risk.

Palliation for unresectable pancreatic, liver, and biliary malignancies requires a multidisciplinary approach with input from medical oncologists, radiation oncologists, gastroenterologists, hepatobiliary surgeons, and interventional radiologists alike. In this, the first in a series of two articles pertaining to palliative percutaneous biliary intervention, we will review the indications for biliary drainage and the preprocedure evaluation of this complicated patient population. In the second paper, we will discuss in detail the procedure itself and post-procedure management.

The Basis of the Intervention

The first transhepatic cholangiogram was performed in 1937,[1] but until the 1970s, the relief of obstructive jaundice was largely achieved by surgical bilioenteric bypass. Over the past 30 years, endoscopic and percutaneous biliary drainage have become readily available in most hospital settings, and these minimally invasive techniques have revolutionized the treatment of patients with obstructive jaundice. Previously, a patient with obstructive jaundice who underwent surgery with general anesthesia spent up to 14 days in the hospital[2]; this same patient may now be treated endoscopically as an outpatient or in a short hospital stay after a percutaneous procedure under conscious sedation.

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Indications for Palliative Biliary Drainage

In order to provide effective palliation for this complicated patient population, caregivers must define the goals of intervention before subjecting the patient to a procedure.[3]

JAUNDICE

The most familiar sign of biliary obstruction is jaundice, which is common when the serum bilirubin level is > 3 mg/dL.[4] Unconjugated bilirubin results from either a defect in hepatic bilirubin uptake (eg, Gilbert's syndrome) or excessive heme breakdown (eg, hemolysis). Unconjugated bilirubin forms a complex with serum albumin that does not pass into the urine. Therefore, as opposed to patients with direct (conjugated) hyperbilirubinemia, patients with indirect (unconjugated) hyperbilirubinemia will generally have normal-colored urine.

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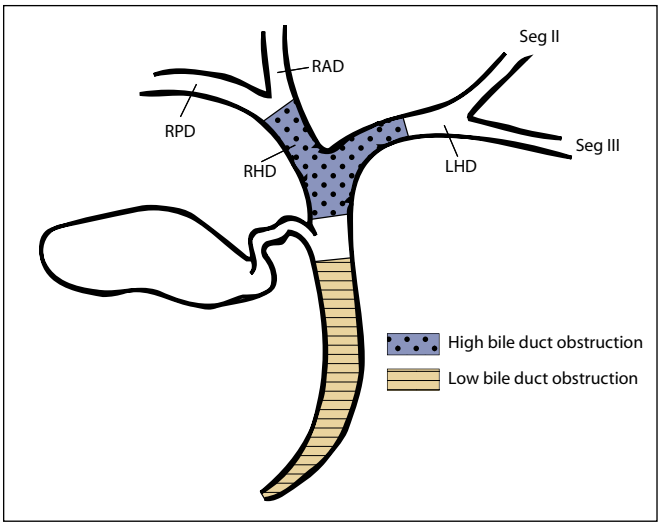

Figure 1 Schematic Representation of High and Low Bile Duct Obstruction

High bile duct obstruction occurs proximal to the cystic duct insertion and is best treated with percutaneous drainage. Abbreviations: RPD = right posterior division; RAD = right anterior division; RHD = right hepatic duct; LHD = left hepatic duct; Seg II = segment II duct; Seg III = segment III duct

Figure 2 Catheter Placement in a Patient With Low Bile Duct Obstruction

A right-sided biliary drainage catheter (arrow) drains the right and left (arrowhead) bile ducts in this patient with low bile duct obstruction from pancreatic carcinoma.

Obstructive jaundice manifests as yellow discoloration of the skin and mucous membranes, light-colored stools, and darkening of the urine due to conjugated biliuria. Jaundice may be easier to detect in areas that are not exposed to the sun, such as mucous membranes of the mouth where the bilirubin is not subject to photodegradation or hidden by skin pigmentation. Patients with obstructive jaundice may also complain of altered taste of food or frank anorexia. These symptoms may be relieved with re-establishment of the normal enterohepatic circulation of bile.[5,6]

Jaundice itself is not an indication for biliary drainage. Any procedure may have complications, and catheters require maintenance and adjustments to lifestyle that may be difficult to justify in an otherwise asymptomatic patient. Some practitioners believe that patients "feel better" when their jaundice is relieved, but this phenomenon has not been documented by quality-of-life studies.

PRURITUS

Pruritus is a common symptom of biliary obstruction. The pathogenesis of pruritus is poorly understood, and the condition is often out of proportion to the patient's serum bilirubin level and bile acid profile[7]; some patients present with severe pruritus and serum bilirubin levels < 3 mg/dL, whereas others remain asymptomatic despite bilirubin levels that are an order of magnitude higher. Pruritus may have a pronounced effect on quality of life and cause dramatic skin changes; not infrequently, patients present with diffuse skin excoriations from scratching. Fortunately, however, pruritus is usually eliminated by drainage of even one single liver segment.[5,8,9]

CHOLANGITIS

Cholangitis almost always occurs in patients with a previously instrumented or manipulated biliary tree resulting from direct or enteric contamination of an obstructed system.[10] Therefore, this not a common initial presentation among cancer patients. Most often, the inciting event is iatrogenic prior to biliary drainage—endoscopic retrograde cholangiopancreatography, sphincterotomy, or surgery. However, cholangitis may also occur due to colonized gallstones or an enteric fistula. Cholestasis itself may affect the function of Kupffer cells, decreasing the effectiveness of bacteria clearance and increasing susceptibility to systemic infection and sepsis.[11–14]

OTHER CONSIDERATIONS

Asymptomatic patients with biliary obstruction may not be able to receive chemotherapy that is metabolized or excreted by the liver. Biliary drainage may be done to lower the bilirubin concentration to an acceptable level (usually < 2 mg/dL) to permit treatment with appropriate agents.

Patients who have had liver surgery or pancreatic surgery may develop postoperative bile leaks requiring biliary drainage for diversion of bile from the leaking site.

Finally, in some cases, patients with unresectable cholangiocarcinoma may require surgical access to the biliary tree to deliver local treatment, such as brachytherapy or photodynamic therapy.[15]

Technique

Biliary obstruction can be divided into "low" and "high" bile duct obstruction. The preprocedure determination of

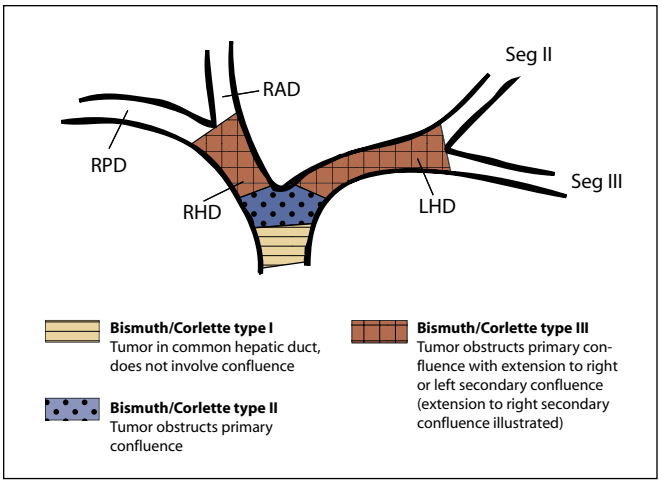

Figure 3 Bismuth/Corlette Classification of High Bile Duct Obstruction

Bismuth/Corlette type IV, referred to by some authors, describes a tumor that involves the secondary confluence on either the right or left side. Abbreviations: RPD = right posterior division; RAD = right anterior division; RHD = right hepatic duct; LHD = left hepatic duct; Seg II = segment II duct; Seg III = segment III duct

whether a patient has low or high bile duct obstruction has significant prognostic implications.

LOW BILE DUCT OBSTRUCTION

Low bile duct obstruction occurs below the usual insertion of the cystic duct (Figure 1). Because the obstruction is below the confluence of the right and left bile ducts, patients with low bile duct obstruction can have complete drainage of the entire biliary system by a single, well-placed catheter or stent (Figure 2). When possible, these patients are best treated endoscopically, because a stent may allow complete drainage without the nuisance of an external catheter.[16] Further, endoscopy does not involve the risks inherent in crossing hepatic parenchyma.

Endoscopic stents used to treat low bile duct obstruction may be crafted of plastic or self-expanding metal. In unresectable malignancies, metallic stents are favored because they offer a longer mean patency, 6–10 months[17,18] versus 3–6 months for plastic stents. The latter require routine exchange every 3 months, and their narrow diameter makes them more likely to occlude.[19]

HIGH BILE DUCT OBSTRUCTION

High bile duct obstruction occurs above the cystic duct insertion. In 1975, Bismuth and Corlette[20] classified carcinomas of the hepatic confluence as type I, type II, and type III (Figure 3). Type I tumors involve the common hepatic duct but not the confluence of the right and left hepatic ducts. Type II tumors feature an obstruction of the primary confluence, whereas type III tumors extend involvement to either the right or left secondary confluence. In addition, some authors have described a type IV tumor that involves the secondary confluence on both the right and left sides.

Figure 4 Isolation of Ducts Due to High Bile Duct Obstruction

Top: Magnetic resonance cholangiography demonstrates a Bismuth/Corlette type II obstruction causing isolation of the right (arrow) and left (arrowhead) ducts. **Bottom:** Right biliary drainage in the same patient fails to opacify or drain the left-sided ducts (complete isolation).

Patients with malignant bile duct obstruction at or above the hepatic hilus are much more difficult to treat than those with low bile duct obstruction.[16] Isolation of the right and left hepatic ducts often occurs when the obstruction lies above the hilus, and this isolation may extend involvement to the secondary ducts as well. In other words, not all of the bile ducts come together, and a single drainage catheter cannot effectively drain all bile segments (Figure 4).

High bile duct obstruction is best treated percutaneously, because a specific duct can be targeted to maximize functional liver drainage based on preprocedure imaging.[21–23] High bile duct isolation is complicated, and a clear understanding of the goal of drainage and the patient's treatment plan and prognosis is critical.

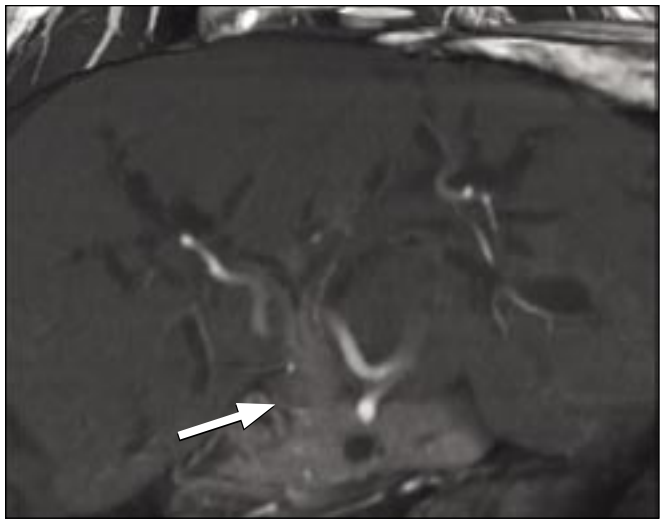

Figure 5 Computed Tomography to Determine the Presence and Level of Biliary Obstruction

Thin-section computed tomography reconstructed in coronal plane demonstrates dilated bile ducts (dark) obstructed by an infiltrating cholangiocarcinoma. Imaging suggests a Bismuth/Corlette type I obstruction (arrow) that was confirmed at drainage.

FUNCTIONAL PARENCHYMA

Just as post-resection patients require a certain volume of hepatic parenchyma to avoid liver failure, patients with obstructive jaundice require a certain volume of "functional" hepatic parenchyma for relief of jaundice. The functional parenchyma is the portion of the liver that has not been replaced by tumor and that has an intact portal venous supply. The portal vein provides 80% of the blood supply to the liver and serves as the trophic blood supply. Portal vein occlusion frequently results in atrophy of the affected segment or segments, particularly when the ipsilateral bile duct is also occluded.[24] Drainage of a portion of the liver that does not have a portal venous blood supply intact will not result in improved liver function, just as placement of a nephrostomy tube into an atrophic kidney or a kidney with an occluded renal artery would not be expected to result in improved kidney function.

In patients who are not cirrhotic and have not received chemotherapy, draining as little as 30% of the functional parenchyma may be adequate; thus, the use of a single catheter to drain only one side of the liver may be sufficient. However, to achieve a serum bilirubin level < 2 mg/dL in patients with underlying liver disease or chemotherapy-associated steatohepatitis, a larger volume of parenchyma may need to be drained. If more than 75% of the hepatic parenchyma has been replaced by tumor, liver function most likely cannot be normalized even with drainage of the entire biliary tree.

Preprocedure Evaluation

IMAGING

High-quality imaging to plan surgery for patients with bile duct obstruction is extremely important. Methods include a contrast-enhanced computed tomography (CT) or magnetic resonance image of the abdomen to determine the presence and level of biliary obstruction and to assess the amount of functional parenchyma that can be drained. Although useful in establishing portal vein patency and the presence of any intraductal tumor, ultrasonography is usually not adequate when used alone to plan biliary drainage.

The level of obstruction is most easily determined by thin section CT or magnetic resonance cholangiopancreatography. The advent of multidetector CT allows for high-resolution images of the entire liver to be obtained in a single-breath hold.[25] Three-dimensional reconstructions make it easier to appreciate the level of bile duct obstruction (Figure 5) and the normal variants of bile duct anatomy that are present in 20%–25% of patients.

The level of obstruction as determined by diagnostic imaging must be well understood to plan biliary drainage and to predict its efficacy. Central tumors frequently obstruct the right and left biliary trees isolating them from one another. Obstruction may extend even higher, isolating the ductal system at the sectoral, segmental, or subsegmental level (Bismuth/Corlette types III, IV).

When drainage is undertaken for relief of pruritus, the drainage of even a segment of the liver often relieves symptoms. However, when drainage is undertaken to lower the serum bilirubin levels and > 30% of normal liver cannot be drained, the likelihood of success is low (A. Covey, unpublished data); the odds are even lower in patients with underlying liver dysfunction or steatohepatitis. To provide maximum drainage, more than one drainage catheter may be needed when high bile duct obstruction causes isolation of the lobes, sectors, or segments. This possibility should be discussed with patients and caregivers before any intervention so that they may make an informed decision as to whether or not to proceed.

Although every effort is made to establish internal drainage with stents, this may not be possible because of extensive isolation (ie, > three ducts or segmental occlusion of multiple ducts) or the presence of intraductal tumor or duodenal obstruction. Because these issues are not always predicted with use of even the best imaging techniques, the physician must prepare the patient for the possibility of a long-term or even lifelong external catheter.

ANTIBIOTICS

Broad-spectrum antibiotic prophylaxis is given to all patients who will undergo biliary drainage, even if they do not have an elevated white blood cell count or fever. Approximately one half of this patient population has positive bile cultures, although some patients may not have relevant signs or symptoms.[26] Patients may become transiently bacteremic during the procedure, even in the absence of signs or symptoms of infection.

Patients with sepsis or a history of cholangitis, biliary enteric bypass, sphincterotomy, or recent instrumentation should re-

ceive prophylactic coverage with an agent such as piperacillin/tazobactam (Zosyn) that is excreted into the bile.[27] Appropriate post-procedure coverage may then be determined based on bile cultures obtained at the time of drainage.

PSYCHOLOGIC CONSIDERATIONS

In patients with low bile duct obstruction, virtually any symptom of obstruction may be ameliorated by placement of a single biliary drainage catheter or stent. High bile duct obstruction, as discussed previously, is more complicated. Therefore, the preprocedure discussion with the patient should include not only the indication for drainage but also the likelihood of achieving the goal.

Even in the presence of isolation, pruritus will almost certainly be eliminated with drainage of a single segment. However, with high bile duct occlusion, patients must understand that it is not always possible to lower their serum bilirubin levels, particularly to levels that would allow for the administration of certain chemotherapeutic agents. A patient with realistic expectations is less likely to become impatient or upset if multiple procedures are needed or if a less-than-ideal outcome is experienced. This is, after all, the basis of informed consent.

Summary

Malignant biliary obstruction is frequently associated with pruritus, anorexia, cholangitis, or hyperbilirubinemia that precludes treatment with chemotherapeutic agents that are excreted or metabolized by the liver. In patients with low biliary obstruction, endoscopic stent placement may accomplish drainage of the entire biliary tree without the need for an external device. Patients with high bile duct obstruction, however, often have isolated segments, and a percutaneous approach is more appropriate to drain the target ducts and avoid draining an atrophic segment or lobe. In cases of high bile duct obstruction, it is critical that the patient and referring physician understand the goal of drainage and the potential need for multiple catheters to treat cholangitis or lower the bilirubin level for chemotherapy.

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