**Management of Bile Duct Problems Treatment Overview**

**Bile Duct Obstruction**

Bile duct (or biliary) obstruction occurs for numerous reasons. Causes can include cancerous and non-cancerous processes as well as injuries from medical procedures or operations. Obstruction can occur at different levels of the bile duct tree (Figure 1a).

Given the many reasons for bile duct obstruction, a multidisciplinary approach is needed to effectively diagnose and treat patients. At the University Medical Center of Southern Nevada, our team of surgeons, radiologists, interventional endoscopists and oncologists offer treatment for a wide variety of biliary obstruction cases.

**Cancerous Lesions**

The presence of a cancerous lesion(s) within the hepatobiliary system can also lead to bile duct obstruction. In these cases, optimal treatment requires a multimodal approach that includes a surgeon, oncologist and interventionalist (endoscopist and radiologist) and radiation oncologists.

**Liver Lesions**

Cancers of the bile ducts within the liver, liver cancers or cancers metastatic to the liver can cause obstruction of the bile duct system. Diagnosis is usually made by radiographic studies (CT or MRI). Prior to treatment of the obstruction, a full work-up of the lesion to determine the extent of disease is necessary. Additionally, a biopsy of the lesion may be needed, which is usually performed with CT or ultrasound guidance. Imaging of the bile ducts within the liver are obtained via radiologic (PTC or percutaneous transhepatic cholangiography) and/or interventional endoscopic (ERCP) procedures.

*Figure 1a. The gallbladder lies on the right of the liver. The biliary tree within the liver is referred to as “intrahepatic” while “extrahepatic” refers to the biliary system outside the liver. A bile duct tumor(s) can occur in any of these locations.*
Treatment depends on the extent, location and type of cancer (Figure 1b). An endoscopic ultrasound (EUS) may be required to determine the extent of disease. Interventional approaches can be used to treat the obstruction if the patient is not a surgical candidate.

**Extrahepatic Bile Duct Cancers**
An extrahepatic bile duct cancer refers to all cancers that arise within the bile duct system below the liver (Figure 1b). Diagnosis is usually made by radiological imaging. Further elucidation with ERCP, PTC and EUS may be required. Brushings and subsequent pathological examination of the bile duct help with the diagnosis. Surgical versus interventional approaches are assessed on a patient-by-patient basis.

**Pancreatic Cancers**
Pancreatic cancers can cause obstruction of the bile duct just as it enters the intestine (Figure 1b). Diagnosis is usually made radiographically. Treatment of this patient requires a multidisciplinary approach encompassing surgeons, oncologists, radiologists and radiation oncologists for an optimal outcome.

**Non-Cancerous Problems**

**Latrogenic**
Biliary strictureing (narrowing) or obstruction may be the result of an injury sustained during a medical procedure. For example, a gallbladder operation or endoscopic procedure can cause a bile duct injury or transection. Surgeons usually treat a bile duct transection at time of injury if noticed.

Bile duct injuries that do not cause bile spillage but cause strictures are usually treated when symptoms arise. Patients often have pain, fever and/or jaundice, as well as elevation in liver laboratory tests. Operative treatment is usually required.
Cholelithiasis (Gallstones) and Biliary Stones

Gallstones or biliary stones can pass from the gallbladder or liver, respectively, into the common bile duct and proceed into the small intestine depending on their size. As they pass through the biliary tree, these stones may cause obstructions if they are lodged in the bile duct. Additionally, strictures may occur due to repeated trauma to the bile duct lining (Figure 2).

Interventional endoscopists can extract lodged stones in the common bile duct tree by performing a procedure called an ERCP (endoscopic retrograde cholangiopancreatography). Similarly, strictures can be treated by an interventional endoscopist or interventional radiologist, depending on the site of the problem and issues related to the patient’s surgical candidacy. After stone removal, further operations may be necessary to remove the source of the stones (gallbladder or part of the liver).

Figure 2b. Image inside bile duct during ERCP shows stones.

Figure 2a. Pre-ERCP

Biliary Leaks

Figure 2c. Post-ERCP with stone extraction

Biliary leaks result when bile extravasates (leaks) through defects in the bile duct wall. This leakage can occur anywhere within the bile duct system. Most commonly, biliary leaks are the result of medical procedures, operations, or traumatic injuries to the biliary system. The end result is bile leakage into the abdomen or surrounding tissues. Interventional approaches (interventional radiologic procedures and interventional endoscopic procedures) are able to treat a majority of the injuries. Surgery may be needed in some situations.
**Biliary Leaks by Location**

**Hepatic**

Bile duct leaks can occur after a liver operation or trauma in which a portion of the liver is removed or injured. The edge of the cut liver can leak bile. If this happens, a collection of bile forms at the edge of the liver. This is called a “biloma”. Individuals will usually present with pain and fever if the biloma is infected. Treatment usually involves placement of a drainage catheter directly into the biloma by the interventional radiologist to drain the collection. The interventional endoscopist then places a stent into the biliary system adjacent to the leaking duct to allow bile to drain via the normal route rather than leak out. Further surgical intervention is needed if the leak remains persistent.

**Common bile duct**

Common bile duct injuries can occur during gallbladder operations or endoscopic interventions of the common bile duct. During a gallbladder operation, the common bile duct can be injured or a clip placed on the cystic duct may fall off at a later time leading to bile leakage. If the injury is noticed during the initial operation, the surgeon will fix the bile duct injury with a Roux-en-Y choledochojunostomy. For leaks that are not noticed at the original operation, treatment is similar to that described above for hepatic injuries. The pancreas is also a site of common bile duct injuries, usually as the result of interventional endoscopy. Surgical intervention with drain placement is required if the patient develops a leak. Sometimes diversion of the bile flow may be needed with a Roux-en-Y choledochojunostomy.

**Bile Duct Treatment**

**Cancerous Lesions**

Individuals with cancerous lesions need a multidisciplinary approach from the onset of their work-up. Interventional approaches are used to help diagnose the lesions. Once diagnosed, optimal management is discussed with surgeons, interventionalists and oncologists.

If the patient is deemed a surgical candidate, physicians pursue resection of the lesion followed by biliary reconstruction. These operations depend on the location of the lesion causing the obstruction (liver, bile duct, and/or pancreas). Interventional approaches are usually used in cases in which the patient is not a surgical candidate and the risk of the operation is outweighed by the benefits afforded by surgical intervention (Figures 3a and 3b).
The mainstay of surgical treatment is to first remove the area of stricture, then reconstruct the biliary system. The most common operation is a Roux-en-Y reconstruction. The Roux limb is connected to the remnant bile duct outside of the liver (Roux-en-Y choledochojunostomy, Figure 4a) or the bile ducts within the liver (Roux-en-Y hepaticojejunostomy, Figure 4b). All procedures require close oncological follow-up.
**Non-Cancerous Lesions**

Initial management of benign biliary strictures usually starts with interventional procedures (either endoscopic or radiologic). The physician places stents across the strictures to relieve the obstruction. A patient is then referred for surgical intervention if restricturing occurs after the stents are removed. Some patients are referred directly for surgical intervention if there is a low likelihood of interventional approaches working.

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**Cholangiocarcinoma (Bile Duct Cancer) Treatment Overview**

**Overview**

Cancer of the biliary system - the gallbladder, the bile ducts within the liver and the bile ducts extending outside of the liver - is relatively uncommon, affecting about 9,000 individuals in the United States annually. Of these 9,000, about 2/3 have cancer limited to the gallbladder, while the remaining 1/3 have cancer of the intrahepatic or extrahepatic biliary tree.

The gallbladder lies on the right of the liver. The biliary tree within the liver is referred to as "intrahepatic" while "extrahepatic" refers to the biliary system outside the liver. A bile duct tumor(s) can occur in any of these locations.

**Risk Factors & Presentation**

Risk factors for biliary cancers include chronic inflammation from infection or autoimmune disease, particularly primary sclerosing cholangitis (PSC). Cholangiocarcinoma typically presents with signs of tumor obstruction of the bile duct. It may be localized (Klatskin’s tumor) versus a diffuse process (cholangiocellular) within the biliary tree.

Early manifestations include pruritis (itchiness) and change in urine and stool color. Blood chemistry tests may reveal elevation of liver enzymes. Clinical jaundice occurs later and may be accompanied by abdominal pain, fever and weight loss.

**Diagnosis**

Distinguishing cholangiocarcinoma from mimicking conditions is imperative in guiding the appropriate treatment. A range of diagnostic tools is available to assess patients with suspected cholangiocarcinoma. These include noninvasive radiological imaging tests such as ultrasound, computed tomography (CT) and magnetic resonance imaging (MRI) or "invasive" tests.
**Non-Invasive**

Ultrasound, CT and MRI

Ultrasound is often the initial study to rule out more common causes of jaundice. For individuals with suspected cholangiocarcinoma, evaluation begins with a computed tomography (CT) scan or magnetic resonance imaging (MRI). Specific CT imaging protocols and MRI sequences optimize visualization of the biliary system and liver. Computer workstations and software-enabled image reconstruction create 3D views of the biliary anatomy and identify the suspected region of the tumor from various angles. Additional information on the local tumor extent (including vascular involvement) and distant metastatic spread is seen on CT or MRI.

**Invasive**

Endoscopic Retrograde Cholangiopancreatography (ERCP)

This diagnostic tool has been the mainstay in evaluating suspected cholangiocarcinoma. ERCP uses an endoscope to gain access to the bile duct from the duodenum. A small catheter inserted into the bile duct with contrast media subsequently injected provides radiographic images of the entire biliary system. ERCP also provides a means for passing tools into the bile duct to assist in diagnosis and/or treatment.

Endoscopic Ultrasound (EUS)

EUS involves two complementary platforms: extraductal and intraductal. Extraductal ultrasound uses an ultrasound probe mounted at the tip of an endoscope to provide detailed, real-time ultrasonic images of the extrahepatic biliary system without instrumenting the bile duct directly. Intraductal ultrasound involves the insertion of a catheter-based ultrasound probe into the bile duct. This probe, which can be advanced into the intrahepatic bile ducts, provides highly detailed images of the bile duct wall lining.

Percutaneous Transhepatic Cholangiography

Occasionally, to characterize the extent of a tumor into the liver, a radiopaque dye is injected into the biliary tree by placing a needle through the abdominal wall into the liver.

**Treatment**

Surgical
For surgical interventions, cholangiocarcinomas are divided into intrahepatic and extrahepatic bile duct cancers. Intrahepatic tumors, when confined to a single lobe or segment of the liver, without evidence of metastasis, are resected with their surrounding liver lobe or segments, much as any primary liver tumor is addressed.

For extrahepatic bile duct cancers, if the lesion by preoperative evaluation appears resectable, the patient is prepared for the operating room and often undergoes a diagnostic laparoscopy immediately prior to the planned surgical resection to rule out unresectable tumor not evident by the preoperative evaluation.

If this laparoscopic evaluation shows extensive disease which cannot be surgically removed, the procedure is stopped without making a large surgical incision. The individual is referred for endoscopic biliary stent decompression and concomitant treatment with radiation and/or chemotherapy.

**Resectable Lesions**
If the initial laparoscopic exploration appears favorable or there is low suspicion of extensive disease, the open surgical procedure ensues with planned removal of the tumor. The primary surgical objectives are to obtain margins free of residual tumor and removal of associated lymph nodes, which may also be involved with the tumor. Surgical resection offers the only opportunity for cure which, unfortunately, remains low with approximately 25-30% five-year survival due to the frequency of recurrent tumor. The surgery itself has a perioperative mortality of 5-10% with major perioperative morbidity of up to 50%.

For tumors high in the biliary tree, the surgical resection involves a partial hepatic resection along with resection of the extra-hepatic biliary tree. The biliary system is then reconstructed as a hepaticojejunostomy to the remaining hepatic lobe.

For tumors low in the biliary tree, a pancreatoduodenectomy is required in addition to the bile duct resection to effect a negative margin. Mid-duct tumors can be primarily resected without the need for either a hepatic resection or pancreatectomy.

In all cases, reconstruction after the resection involves bringing a fashioned limb of intestine up to the residual bile duct to permit biliary
drainage into the intestines. This is often performed over a stent which remains in place for a period of time postoperatively. Postoperative radiation and/or chemotherapy may also be recommended.

**Unresectable Lesions**
For lesions found at surgical laparotomy to be unresectable, the objective changes from removing the entire lesion with negative margins to instead decompressing the obstructed biliary tree. Depending on the type of tumor and its position in the biliary system, the biliary bypass procedure employed would vary. After biliary decompression, the patient, once recovered from surgery, is referred for consideration for radiation and/or chemotherapy. Unfortunately, with unresectable lesions, limited life expectancy with median survivals of two to 10 months is anticipated.

**Stent Therapy**
Endoscopic therapy consists of dilation of the obstructive biliary segment (with rigid or balloon dilation catheters) and metallic biliary stenting. The goal of treatment is to permanently widen the bile duct to a diameter that allows unimpeded bile flow. Endoscopic therapy may require several interval procedural sessions. For unresectable lesions in which endoscopic stenting is not possible, a percutaneous stent placed through the abdominal wall can be an acceptable alternative to effect biliary drainage.

**Medical Treatment**
For unresectable tumors and often as adjunctive therapy for resected tumors, physicians may employ chemotherapy, radiotherapy and/or brachytherapy. Medical therapy is used to palliate symptoms, prolong survival and increase the opportunity for surgical cures.

As only a small percentage of patients are cured with surgery alone, our focus at the UMC Center for Transplantation is to integrate all available treatments.