



By Young Choi, M.D. & William B. Silverman, M.D. FACG, Division of Gastroenterology/Hepatology, University of Iowa Hospitals and Clinics, Iowa City, Iowa

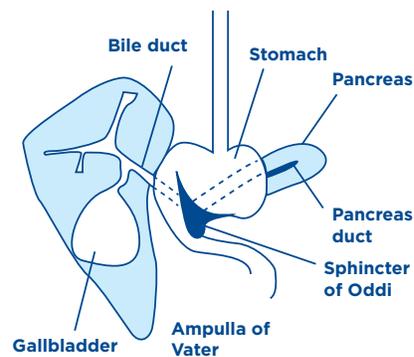
## GALLSTONES AND GALLSTONE DISEASE

### What are Gallstones?

Gallstones are collections of cholesterol, bile pigment or a combination of the two, which can form in the gallbladder or within the bile ducts of the liver. In the United States, the most common type of gallstones is made of cholesterol. Cholesterol stones form due to an imbalance in the production of cholesterol or the secretion of bile. Pigmented stones are primarily composed of bilirubin, which is a chemical produced as a result of the normal breakdown of red blood cells. Bilirubin gallstones are more common in Asia and Africa but are seen in diseases that damage red blood cells such as sickle cell anemia.

### How Do Gallstones Cause Problems?

If gallstones form in the biliary system they can cause blockage of the bile ducts, which normally drain bile from the gallbladder and liver. Occasionally the gallstones can also block the flow of digestive enzymes from the pancreas since both the bile ducts and pancreas ducts drain through the same small opening (called the Ampulla of Vater) which is held tight by a small circular muscle (called the Sphincter of Oddi). [See Figure 1]. This results in inflammation of the pancreas. This is known as gallstone pancreatitis. Blockage of the bile ducts may cause symptoms such as abdominal pain, nausea and vomiting. If the bile duct remains blocked, bile is unable to drain properly. Jaundice (yellow discoloration of the eyes and skin) can develop and an infection known as cholangitis may also develop.



**Figure 1:** Anatomy of liver, bile duct, pancreas duct and sphincter of Oddi. Note that a stone can impact at the sphincter of Oddi and block both the bile duct and pancreas duct.

### Who Is at Risk for Gallstones?

Female gender, older age, obesity, high cholesterol levels, treatment with estrogen containing medications, rapid weight loss, diabetes and pregnancy are all risk factors for developing cholesterol gallstones. Disorders that lead to the destruction of red blood cells such as sickle cell anemia are associated with the development of pigmented or bilirubin stones. The occurrence of gallstones varies widely among different ethnic groups. For example, Pima Indians and Hispanics have high occurrence rates of developing gallstones compared to Asians, who overall, have a very low rate.

### What Are the Symptoms of Gallstones?

Gallstones that are not causing symptoms generally do not cause problems and do not require further evaluation. Many times gallstones are found by chance on an abdominal x-ray or ultrasound done for other reasons. Unless symptoms of pain, nausea, vomiting or fever are present, no additional testing or

intervention may be needed. Symptoms arise when a gallstone blocks the flow of bile out of the gallbladder or through the bile ducts. A gallstone in the common bile duct is called choledocholithiasis and may cause intermittent or constant discomfort. The pain of choledocholithiasis is usually localized in the upper abdomen, and can radiate (be felt in another location) in the right shoulder, may last many minutes to hours, and be associated with sweating, nausea, and vomiting. Gallstone attacks can produce chest pain that may feel like a heart attack. If a pain is new and different than other pains the symptoms should be discussed with a physician.

An inflamed gallbladder (cholecystitis), infected material trapped within the common bile duct (cholangitis), or a stone blocking outflow of pancreatic juice (gallstone pancreatitis) can result in fever, chills, severe abdominal pain or jaundice. Individuals with these complaints should have an urgent evaluation by a physician.

#### **How Are Gallstones Diagnosed?**

The diagnosis of gallstones is suspected when symptoms of right upper quadrant abdominal pain, nausea or vomiting occur. The location, duration and “character” (stabbing, gnawing, cramping) of the pain help to determine the likelihood of gallstone disease. Abdominal tenderness and abnormally high liver function blood tests may be present. An abdominal ultrasound examination is a quick, sensitive, and relatively inexpensive method of detecting gallstones in the gallbladder or common bile duct. This is the test most often used.

#### **What is the Treatment for Gallstones?**

The treatment for gallstones that obstruct the common bile duct is endoscopic retrograde cholangiopancreatography (ERCP) or surgery. ERCP involves passage of a thin flexible scope through the mouth and into the duodenum where it is used to evaluate the common bile duct or pancreatic duct. Tiny tubes and instruments may be used to further evaluate the ducts and remove stones if necessary. Gallbladder surgery may be performed if there are stones found in the gallbladder itself, as these cannot be removed by ERCP. This operation, known as cholecystectomy, is frequently done using a laparoscope, another thin scope that resembles an endoscope, and is inserted into the abdomen through several small incisions under general anesthesia. If a gallbladder operation is not possible, a medicine known as ursodiol, may be used to dissolve cholesterol gallstones. This can take months, and the stones recur in many people once the treatment is stopped.

#### **WHAT IS GALLSTONE PANCREATITIS?**

Gallstone pancreatitis is inflammation of the pancreas that results from blockage of the pancreas duct by a gallstone. This occurs at the level of the sphincter of Oddi, a round muscle located at the opening of the bile duct into the small intestine. If a stone from the gallbladder should travel down the common bile duct and get stuck at the sphincter, it blocks outflow of all material from the liver and pancreas. This results in inflammation of the pancreas that can be quite severe. Gallstone pancreatitis can be a life-threatening disease and evaluation by a physician urgently is needed if someone with gallstones suddenly develops severe abdominal pain.

#### **Who Gets Gallstone Pancreatitis?**

Risk factors for gallstone pancreatitis are similar to those described for gallstone disease.

#### **What Are the Symptoms of Gallstone Pancreatitis?**

Symptoms may be similar to those discussed above in **Gallstones and Gallstone Disease**. Additionally, the pain may be felt in the left upper abdomen or in the back. It is usually sudden in onset, quite severe, frequently sharp or squeezing in character, and often associated with nausea and vomiting.

#### **How Is Gallstone Pancreatitis Diagnosed?**

Blood tests can identify inflammation of the pancreas (amylase and lipase) and evidence of obstructed outflow of bile from the liver (ALT, AST, alkaline phosphatase and bilirubin). Inflammation of the pancreas is best demonstrated by an abdominal CAT scan, which can also determine the severity of the pancreatic inflammation. CT scans are not as sensitive at identifying small gallstones and an abdominal ultrasound may be ordered if this is considered the cause of the pancreatitis.

#### **What is the Treatment of Gallstone Pancreatitis?**

Pancreatitis is best treated initially by avoiding any intake of liquids and solids until the inflammation subsides. Intravenous delivery of fluids is usually all that’s required if the inflammation is modest and symptoms resolve in a few days. Severe inflammation, persistent pain or fevers suggest severe pancreatitis and ongoing inflammation.

Intravenous delivery of nutrients would be started if oral intake cannot be restarted within approximately 5-7 days. Severe nausea and vomiting are treated initially by relieving the stomach of fluid by use of a nasogastric tube and with anti-nausea medications. Pain therapies may be administered by intravenous until oral treatments and food intake can resume.

Sometimes it is important to remove a gallstone causing pancreatitis urgently, and other times it may be appropriate to wait 24-48 hours with regular assessments to assure the individual remains stable. Stones that cause gallstone pancreatitis may pass out of the duct without intervention or may require endoscopic or surgical removal. In cases of infected pancreatic tissue, or a condition called pancreatic necrosis (dead tissue) occurs, antibiotics may be used to control or prevent infection.

## **SPHINCTER OF ODDI DYSFUNCTION (BILIARY DYSKINESIA: POST-CHOLECYSTECTOMY SYNDROME)**

### **What Is Sphincter of Oddi Dysfunction?**

Sphincter of Oddi Dysfunction (SOD) is a symptom complex of intermittent upper abdominal pain that may be accompanied by nausea and vomiting. This disorder is not completely understood. It is thought to be caused by either scarring or spasm of the sphincter of Oddi muscle. The sphincter of Oddi muscle is a small circular muscle approximately 1/2 inch in length, located at the downstream end of the bile duct and pancreas duct. The function of this muscle is to keep the bile duct and pancreatic duct muscles closed, therefore, preventing reflux of intestinal contents into the bile duct and pancreas duct. If this muscle should spasm or scar, drainage of the bile duct and/or pancreas duct may be hindered. Abnormal dilation of the bile duct and/or pancreas duct is often associated with an increase in the products and enzymes made by the liver, gallbladder and pancreas, which can be tested for by blood tests (serum liver tests, amylase, lipase). If the ducts are blocked this may result in pain.

### **Who Gets SOD?**

Biliary dyskinesia may develop after the gallbladder has been removed, hence the name post-cholecystectomy syndrome.

### **What Are the Symptoms of SOD?**

Symptoms may be similar to those for which the gallbladder was initially removed and include abdominal pain, nausea and vomiting. The symptoms may be episodic. They may wax and wane. Subjects may experience weight loss due to poor appetite. Fever, chills and diarrhea are not characteristic of this disease. If symptoms are severe and do not respond to conservative treatment, further investigation may be warranted.

### **What Establishes a Diagnosis of SOD?**

It is important to verify that other, more serious conditions are not being missed prior to embarking on a diagnosis of sphincter of Oddi dysfunction. Therefore, it would be important to verify that the patient does not have stones within the bile ducts, cancer of the pancreas or bile ducts, peptic ulcer disease or heart disease (poor blood flow to the heart, called “ischemia” or “angina” may mimic these symptoms).

The diagnosis of sphincter of Oddi dysfunction can be evaluated and confirmed using a special endoscope that allows the placement of a catheter into the bile and pancreatic ducts. Injection of contrast through the catheter coupled with the use of X-rays can give the physician pictures of the bile and pancreatic ducts. This procedure requires a special scope is known as an endoscopic retrograde cholangiopancreatography (ERCP). It can help determine the presence of gallstones in the gall bladder or bile duct. In the case of bile duct stones, special instruments and procedures (sphincterotomy with stone extraction) (see figure 2, above) can be used at the time of ERCP to remove the vast majority of them. Measurements of the contracting force of the sphincter of Oddi muscle can be made using a special plastic tube inserted into the bile duct or pancreas duct at the level of the sphincter of Oddi muscle. This is called “sphincter of Oddi manometry” and is used to determine if the muscle is “dyskinetic” or contracts abnormally. If it does, a diagnosis of biliary dyskinesia is confirmed.

### **What Is the Treatment of SOD?**

If patients have severe symptoms that cannot be tolerated, the sphincter muscle may be cut open using the ERCP scope, which has a special plastic tube with a small wire attached to the side (called a “sphincterotome”). The sphincterotome is passed through the ERCP scope channel, then into the bile duct and/or pancreas duct at the level of the sphincter muscle. A small electric current is then applied to the wire, which then cuts and cauterizes the open muscle. This is called “sphincterotomy”. This procedure should only be done by highly experienced doctors and only when symptoms are severe and do not resolve. Approximately 5-15% of patients who undergo this therapy may develop inflammation of the pancreas (called “pancreatitis”) as a complication immediately following this procedure.

## Tests Used to Evaluate for Gallstone Disease:

- 1. Ultrasound** — This test uses sound waves to examine the bile ducts, liver and pancreas. It is very safe. Stones may be seen in the gallbladder or bile ducts. Imaging may be hindered in patients who are very obese or have recently eaten food.
- 2. Endoscopic Ultrasound** — This device uses a special scope with an ultrasound probe on the end. The scope is passed down into the intestines where the bile ducts, gallbladder, and pancreas ducts can be examined internally rather than externally. Use of the endoscopic ultrasound device requires special training. It is helpful in locating bile duct stones that may be missed by ordinary ultrasound. It is also helpful in diagnosing cancers within the pancreas and bile ducts.
- 3. CT Scan** — It is helpful in diagnosing cancers within the liver and pancreas. It may identify gallstones but is not as effective in finding them as ultrasound. It is the one of the better tests to assess the severity of pancreatitis.
- 4. ERCP** — ERCP (Endoscopic Retrograde Cholangiopancreatography). This is a special type of endoscope, which allows access to the bile ducts and pancreas ducts. It also allows therapy to be performed such as removing stones from the bile ducts or pancreas ducts. Measurement of pressure within the sphincter of Oddi muscle may be performed by an additional test called sphincter of Oddi manometry (see section on Biliary Dyskinesia). This is done at the time of ERCP. It is a specialized test requiring special training.
- 5. MRCP** — (Magnetic Resonance Cholangiopancreatography). This test uses a machine called MRI (Magnetic Resonance Imaging). It is a noninvasive test that employs special computer software to create images of the bile and pancreatic ducts similar to the ones obtained by ERCP and does not require an endoscopy. Abnormalities found on MRCP would be further evaluated or treated by ERCP or surgery.