Gall bladder and biliary tract motility disorders

Essay

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بسم الله الرحمن الرحيم

وَعَلَّمَكَ مَا لَمْ تَكُنْ تَعْلَمُ وَكَانَ

فَضْلُ اللَّهِ عَلَيْكَ عَظِيماً

صَدَقَ اللهُ العَظِيمُ

(سورة النساء الآية 113)

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AAC	Acute Acalcular cholecystitis
ARP	Acute recurrent pancreatitis
Botox	Botulinum toxin
CAC	Chronic Acalcular Cholecystitis
CAGD	Chronic a calculous gallbladder disease
cAMP	Cyclic adenosine monophosphate
CCK	Cholecystokinin
CT	Computed tomography
DHT	Dihydrotestosterone
DISIDA	Diisopropyliminodiacetic acid
ERCP	Endoscopic retrograde cholangiopancreatography
ES	Endoscopic sphincterotomy
ET-1	Endothelin-1
ETOH	Ethanol
FGF19	Fibroblast Growth Factor 19
FMU	Fatty meal ultrasonography
FXR	Farnesoid X receptor
GB	Gallbladder
GBD	Gallbladder dyskinesia
GBEF	Gallbladder ejection fraction
GERD	Gastroesophageal reflux disease
HIDA	Hepato imino diaceticacid
IBAT	Ileal bile acid transporter
IBS	Irritable bowel syndrome
ICU	Intensive care unit
IDA	Iminodiacetic acid
MMC	Migrating motor complex
NO	Nitric oxide
P	Progesterone
PACAP	Pituitary adenylate cyclase activating polypeptide

PCS	Postcholecystectomy Syndrome
PGE2	Prostaglandin E2
PK	Protein kinase
QHBS	Quantitative hepatobiliary scintigraphy
SO	Sphincter of oddi
SOD	Sphincter of Oddi dysfunction
SOM	SO manometry
T	Testosterone
TCDC	Taurochenodeoxycholic acid
VIP	Vasoactive intestinal polypeptide

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A

INTRODUCTION

Gall bladder diseases account for numerous problems related to digestion, and the discomfort they cause affects people worldwide. (Baldwin SL., 2008). In developed countries, at least 10% of white adults have gallstones, with women having twice the risk, and age further increasing the prevalence in both men and women. Surveys using noninvasive ultrasonography have identified its true prevalence and the associated risk factors. *(Shaffer EA., 2005).*

Biliary dyskinesia is a quite common term, used as a synonym of chronic acalculous Cholecystitis. It describes a group of complex, functional biliary conditions in patients with typical symptoms of biliary tract disease without distinct structural abnormalities and in absence of stones in the gallbladder. (*Pierre-Alain, Clavien, John Baillie., 2006).*

Gallbladder and biliary dyskinesia are motility disorders that affect the gallbladder and sphincter of Oddi (SO), respectively. Gallbladder dyskinesia presents with typical biliary pain in the absence of gallstones. Work-up includes laboratory tests and imaging to rule out gallstones. Further investigation leads to a functional radionuclide study to investigate gallbladder ejection fraction. An ejection fraction of less than 40% is considered abnormal, and patients should be referred for cholecystectomy. Symptom relief after the procedure has been seen in 94% to 98% of patients. The term sphincter of Oddi dysfunction (SOD) describes a collection of pain syndromes that are attributed to a motility disorder of the SO. SOD can be further subdivided into biliary and pancreatic SOD. Patients typically have had a prior cholecystectomy and present with episodic biliary pain. (*George J, Baillie J., 2007).*

The laparoscopic cholecystectomy, with less pain and a shorter length of hospital stay, has resulted in an increased use of cholecystectomy for the treatment of chronic acalculous Cholecystitis. A number of retrospective studies have determined the efficacy of laparoscopic cholecystectomy in acalculous gallbladder disease. Resolution of symptoms after cholecystectomy following chronic acalculous Cholecystitis was reported in 78 to 96% of patients. (*Brosseuk D, Demetrick J. 2003).*

AIM OF WORK

This essay aims for highlighting the biliary motility disorders to assist proper approach to diagnosis and treatment.

Embryology of Biliary Tract

The liver arises from the distal end of the foregut as a solid bud of endodermal cells. The site of origin lies at the apex of the loop of the developing duodenum and corresponds to a point halfway along the second part of the fully formed duodenum. The hepatic bud grows anteriorly into the mass of splanchnic mesoderm called the septum transversum. The end of the bud divides into right and left branches, from which columns of endodermal cells grow into the vascular mesoderm. The main hepatic bud and its right and left terminal branches now become canalized to form the common hepatic duct and the right and left hepatic ducts. The gallbladder develops from the hepatic bud as a solid outgrowth of cells. The end of the outgrowth expands to form the gallbladder, while the narrow stem remains as the cystic duct. Later, the gallbladder and cystic duct become canalized. The cystic duct now opens into the common hepatic duct to form the bile duct. The bile duct and the main pancreatic duct are joined to one another. They pass obliquely through the wall of the second part of the duodenum to open on the summit of the major duodenal papilla, which is surrounded by the sphincter of Oddi. *(Snell R.S., 2008).*

Surgical Anatomy of Gall Bladder

The gallbladder (7-10 cm long) lies in the fossa for the gallbladder on the visceral surface of the liver. This shallow fossa lies at the junction of the right and left (parts of the) liver. The relationship of the gallbladder to the duodenum is so intimate that the superior part of the duodenum is usually stained with bile in the cadaver. Because the liver and gallbladder must be retracted superiorly to expose the gallbladder during an anterior approach , it is easy to forget that in its natural position the body of the gallbladder lies anterior to the duodenum, and its neck and the cystic duct are immediately superior to the duodenum. The pear-shaped gallbladder can hold up to 50 ml of bile. Peritoneum completely surrounds the fundus of the gallbladder and binds its body and neck to the liver. The hepatic surface of the gallbladder attaches to the liver by connective tissue of the fibrous capsule of the liver. The gallbladder has three parts:

Fundus: The wide end of the organ, projects from the inferior border of the liver and is usually located at the tip of the right 9th costal cartilage in the MCL.

Body: Contacts the visceral surface of the liver, the transverse colon, and the superior part of the duodenum.

Neck: Narrow and tapered; directed toward the porta hepatis; it makes an S-shaped bend and joins the cystic duct. *(Moore KL and Dalley AF.,2006).*

Surgical Anatomy of Biliary Tree

Cystic Duct

The cystic duct (3-4 cm long) connects the neck of the gallbladder to the common hepatic duct. The mucosa of the neck spirals into the spiral folds (spiral valves). The spiral folds help keeping the cystic duct open; thus bile can easily be diverted into the gallbladder when the distal end of the bile duct is closed by the sphincter of the bile duct and/or hepatopancreatic sphincter, or bile can pass to the duodenum as the gallbladder contracts. The spiral fold also offers additional resistance to sudden dumping of bile when the sphincters are closed, and intra-abdominal pressure is suddenly increased, as during a sneeze or cough. The cystic duct passes between the layers of the lesser omentum, usually parallel to the common hepatic duct, which it joins to form the bile duct. *(Moore KL and Dalley AF.,2006).*

Hepatic Ducts

The right and left hepatic ducts emerge from the right and left lobes of the liver in the porta hepatis. After a short course, the hepatic ducts unite to form the common hepatic duct. The common hepatic duct is about 1.5 inch (4 cm) long and descends within the free margin of the lesser omentum. It is joined on the right side by the cystic duct from the gallbladder to form the common bile duct.*(Snell RS., 2008).*

Bile Duct

The bile duct (common bile duct) is about 3 inch (8 cm) long. In the first part of its course, it lies in the right free margin of the lesser omentum in front of the opening into the lesser sac. Here, it lies infront of the right margin of the portal vein and on the right of the hepatic artery. In the second part of its course, it is situated behind the first part of the duodenum to the right of the gastroduodenal artery. In the third part of its course, it lies in a groove on the posterior surface of the head of the pancreas. Here, the bile duct comes into contact with the main pancreatic duct.

The bile duct ends below by piercing the medial wall of the second part of the duodenum about halfway down its length. It is usually joined by the main pancreatic duct, and together they open into a small ampulla in the duodenal wall, called the hepatopancreatic ampulla (ampulla of Vater). The ampulla opens into the lumen of the duodenum by means of a small papilla, the major duodenal papilla. The terminal parts of both ducts and the ampulla are surrounded by circular muscle, known as the sphincter of the hepatopancreatic ampulla (sphincter of Oddi). Occasionally, the bile and pancreatic ducts open separately into the duodenum. ***(Snell RS., 2008).***

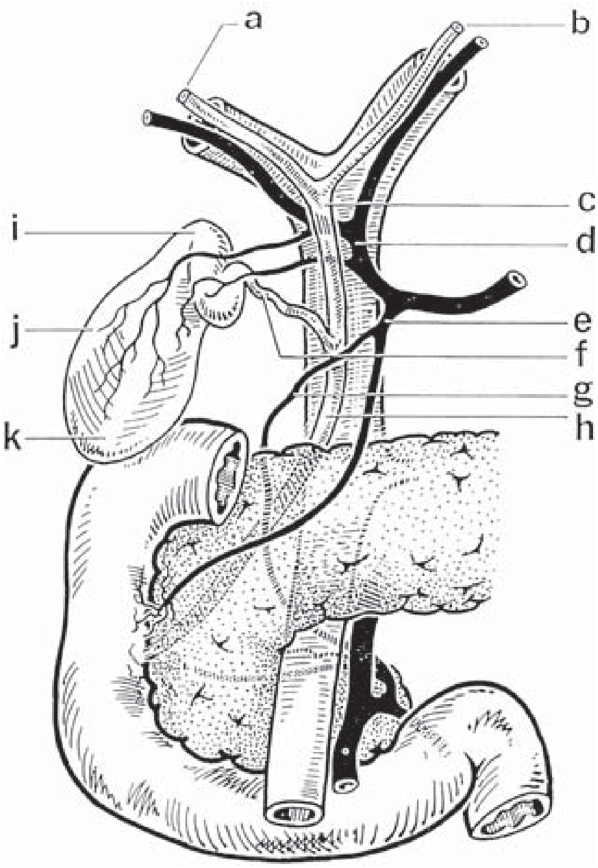

Figure (1): The anatomy of the extrahepatic biliary system: (a) right hepatic duct, (b) left hepatic duct, (c) common hepatic duct, (d) hepatic artery, (e) gastroduodenal artery, (f) cystic duct, (g) retroduodenal artery, (h) common bile duct, (i) neck of the gallbladder, (j) body of the gallbladder, (k) fundus of the gallbladder.

The Sphincter of Oddi

The human sphincter of Oddi is generally a continuous smooth muscle structure that is subdivided into several parts that largely reflect the arrangements found in other animal species:

1. Sphincter choledochus consists of circular muscle that surrounds the common bile duct.

2. Pancreatic sphincter surrounds the intra duodenal portion of the pancreatic duct before its junction with the ampulla.

3. Fasciculi longitudinales are composed of longitudinal muscle fibers between the pancreatic and bile ducts.

4. Sphincter ampulla is composed of longitudinal muscle fibers that surround the papilla. *(Suchy FJ,1998).*

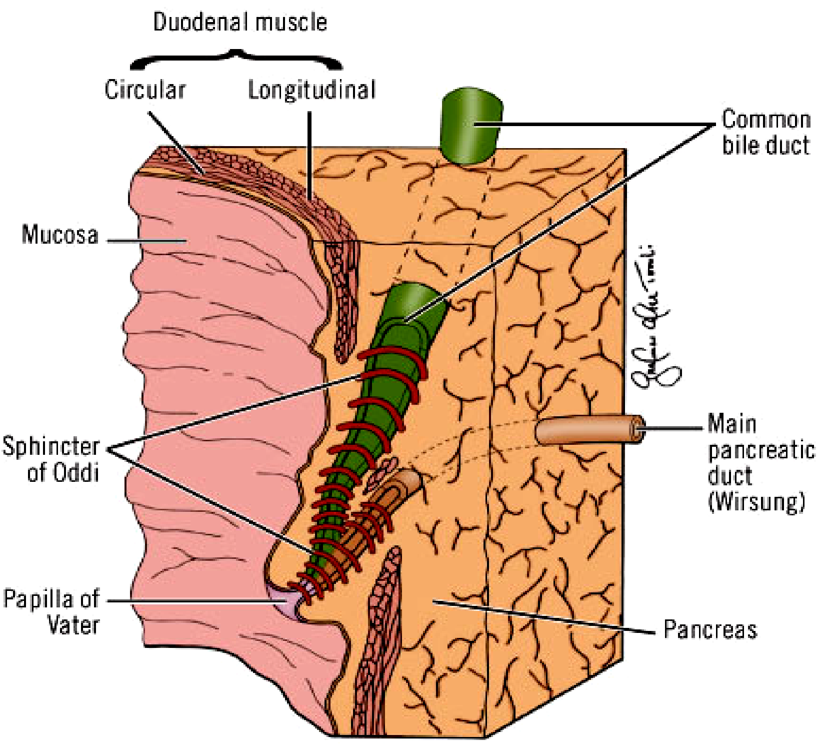

Figure (2) : The choledochoduodenal junction. The sphincter muscle is predominantly circular in orientation, and extends beyond the wall of the duodenum. There is a small extension along the pancreatic duct.

The triangle of Calot (the Cystohepatic triangle):

Calot's triangle is an anatomical region bounded medially by the common hepatic duct, inferiorly by the cystic duct and superiorly by the inferior surface of the liver. The cystic artery runs within this triangle. Two anomalies may be encountered in Calot's triangle. Firstly, an aberrant right hepatic artery which arises from the superior mesenteric artery, it is seen in 16% of individuals. It can be located in the medial border of Calot's triangle in 90% of these patients. Secondly, the right posterior or anterior sectoral ducts may run through Calot's triangle and may be mistaken for the cystic duct. It has been well demonstrated that, during cholecystectomy, the cystic artery can safely and easily be identified at the junction of the gallbladder neck and the cystic duct by defining the cystic lymph node. The node may be swept in the direction of the common bile duct, facilitating the recognition of the cystic duct and the cystic artery.*(Padbury RTA, Toouli J, et al,1994).*

Blood supply of the gall bladder and cystic duct

The cystic artery, supplying the gallbladder and cystic duct, commonly arises from the right hepatic artery in the angle between the common hepatic duct and the cystic duct (Cystohepatic triangle).

The cystic veins, draining the neck of the gallbladder and cystic duct, enter the liver directly or drain through the portal vein to the liver, after joining the veins draining the hepatic ducts and upper bile duct. The veins from the fundus and body of the gallbladder pass directly into the visceral surface of the liver and drain into the hepatic sinusoids. Because this is drainage from one capillary (sinusoidal) bed to another, it constitutes an addition (parallel) portal system.

The lymphatic drainage of the gallbladder is to the hepatic lymph nodes, often through cystic lymph nodes located near the neck of the gallbladder. Efferent lymphatic vessels from these nodes pass to the celiac lymph nodes. *(Moore KL and Dalley AF.,2006).*

Blood supply of the biliary tract

The blood supply to the common bile duct is also divided into three segments:

- The supraduodenal segment of the duct essentially has an axial blood supply. The blood supply originates from the retroduodenal artery, right hepatic artery, cystic artery, gastroduodenal artery and the retroportal artery. On average there are eight small arteries with the main two running along the side of the common bile duct at 3 and 9 o'clock. Sixty percent of the arterial blood supply occurs from the duodenal end of the duct, and 38% is from the hepatic end. Only 2% of the arterial supply is nonaxial, arising directly from the main hepatic trunk.

- The second segment is the retropancreatic part of the duct, which is supplied by the retroduodenal artery. It provides blood to the multiplesmall vessels running around the duct to form a mural plexus.

- The third segment is the hilar duct, which receives its blood supply from the surrounding blood vessels, forming a rich network.

The veins draining the bile duct correspond to the described arteries. They drain into veins at 3 and 9 o'clock on the side of the common bile duct.

The lymph drainage of the extrahepatic biliary system is through two pathways:

- The superior pathway of nodes along the cystic duct, the hepatic duct, the anterior and medial aspect of the portal vein, and the celiac axis.

- The inferior pathway of nodes along the cystic duct, anterior and lateral aspect of the portal vein, the posterior aspect of the pancreas, between the aorta and the inferior vena cava, and the left aspect of the aorta under the left renal vein. Lymph drainage of the common bile duct is by lymph nodes along the duct to both the inferior and superior pathway.*(Toouli J and Bhandari M., 2006)*.