Bile Leak after Laparoscopic Cholecystectomy

Sybile Val MD Long Island College Hospital September 22, 2006

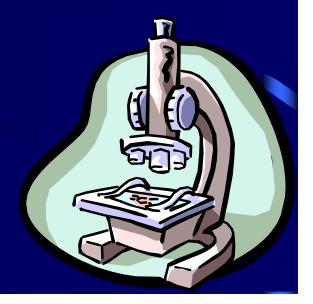
- Chief Complaint: "Severe abdominal pain x one day"
- HPI: Patient is a xx year old female, 5 months post partum who presented to LICH ED with one day history of abdominal pain mainly in the right upper quadrant. Patient reported crampy intermittent pain, 8/10 in terms of severity associated with nausea, but no vomiting. She also reported one episode of diarrhea but denied any fever, chills or urinary symptoms. No alleviating or aggrevating factors. LMP 5/05/05

- HPI continued: Reports similar pain off and on over past four months for which she was seen by PCP 2 weeks prior to presentation who recommended dietary changes and obtained RUQ sono as outpatient which demonstrated cholelithiasis.
- PMH: Cholelithiasis
- PSH: C-section x 2
- Meds: Oral contraceptive
- Allergies: NKDA

- Soc: Denies tobacco or alcohol use, no IVDA, currently breast feeding
- ROS: Negative except as per HPI

- Vitals: 98.2 139/88 80 18
- Gen: AAO x 3 in NAD, no scleral icterus
- Cardio: S1S2 RRR
- Chest: Clear, no wheezing, rales or rhochi
- Abdomen: Soft, non-distended, right upper quadrant tenderness with voluntary guarding, positive Murphy's sign, no rebound
- Back: Negative costavertebral tenderness
- Rectal: No masses, guiac negative
- Ext: warm with normal turgor and pulses, no jaundice appreciated

- Labs:
 - CBC: 10/11/33/321 no shift
 - Chem: 143/3.8/103/28/10/0.6/112
 - LFTs: AST/ALT 35/33 Ap/Tbili 95/0.3
 - UA: Moderate leukoesterase, trace blood, 20-30
 WBCs



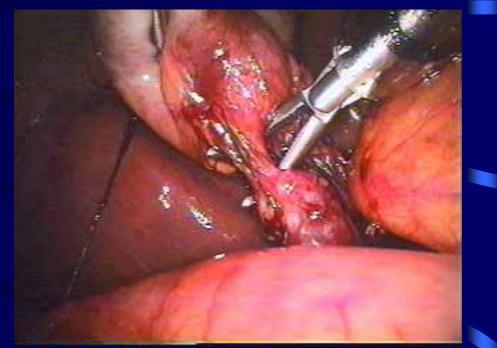


- Sludge
- No gallstones identified
- Minimal gallbladder wall thickening, no distention
- No intra or extrahepatic duct dilatation
- Positive sonographic Murphy's sign
- Stone noted on previous U/S (7/12) no longer identified

- Patient was made NPO with IVF, given IV antibiotics and admitted to the surgical service with the diagnosis of acute cholecystitis and urinary tract infection
- HD #1 patient was taken to the operating room where she underwent an uneventful laparoscopic cholecystectomy

Intra-operatively

- Cystic duct-gallbladder junction was clearly identified
- Once adequate visualization of the cystic duct and artery was confirmed cystic duct then artery was divided between Ligaclips
- Hydrops of gallbladder was noted after inadvertent opening of the gallbladder
- Purulent drainage was noted from gallbladder which was copiously irrigated
- Dissesction was otherwise straight forward with removal of gallbladder without incident
- Hemostasis was confirmed prior to termination of procedure



– Pathology: Acute on chronic cholecystitis

- 8x3x1.5cm gallbladder with mucosal surface demonstrating moderate cholesterolosis
- Gallbladder wall 0.4 cm
- No stones identified
- Reactive hyperplastic lymph node

Post-operative Course

- POD # 0
 - C/O incisional pain relieved with narcotics
 - Started on clears sin nausea or vomiting
- POD #1
 - Tmax 100.2 *
 - Complained of some mild "soreness"
 - Advanced to regular diet, tolerated sin nausea or vomiting, encouraged to ambulate and use incentive spirometer
- POD #2

- Discharged home with surgical follow up

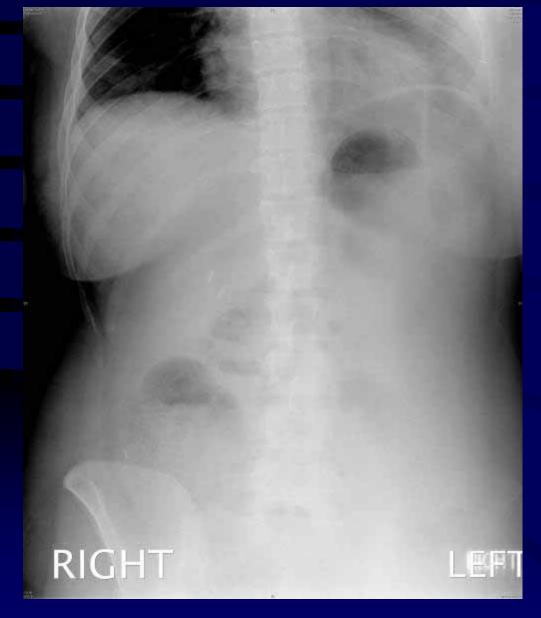
Post-operative Course

• POD # 3 (7/30)

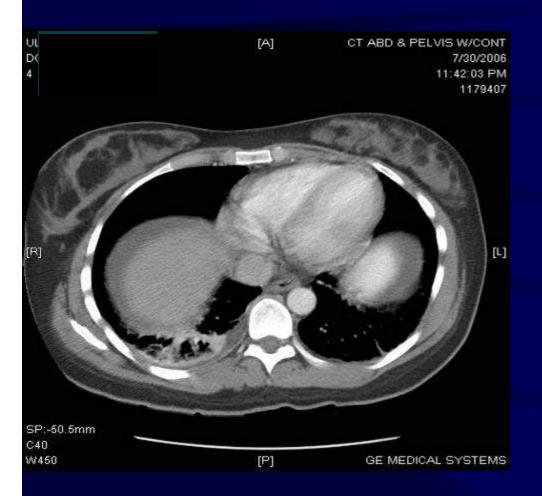
 Presented to LICH ED complaining of abdominal distention and persistent RUQ pain. Denied fever, chills, nausea or vomiting. Denies recent BM or passing flatus. Reported decrease appetite

– Afebrile 97.3 135/85 75 20

- Abd exam: +tenderness in RUQ + rebound tenderness, no erythema appreciated, port sites with intact without any drainage
- Labs
 - CBC : 9.6/13/38/345
 - Chem: 140/4.0/102/28/5/0.6/113
 - LFTs: AST/ALT 92/376 AP/Tbili 286/2.1*



- Air filled loops of normal caliber colon
- CT scan recommended for further evaluation



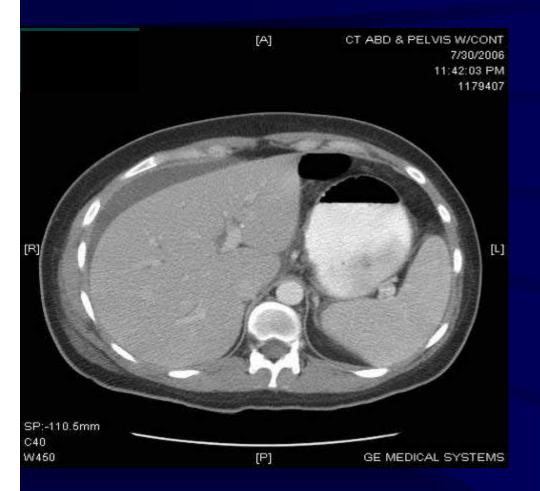
- Bibasilar atelectasis and small right pleural effusion
- Extensive infiltrative changes in right chest and abdominal wall c/w hemorrhage into soft tissue
- Moderate perihepatic and pelvic ascities
- Mild dilatation of CBD
- s/p cholecystectomy, bile leak cannot be excluded, rec HIDA



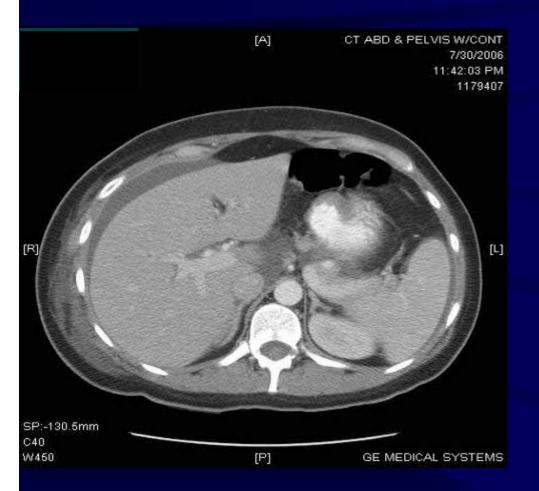
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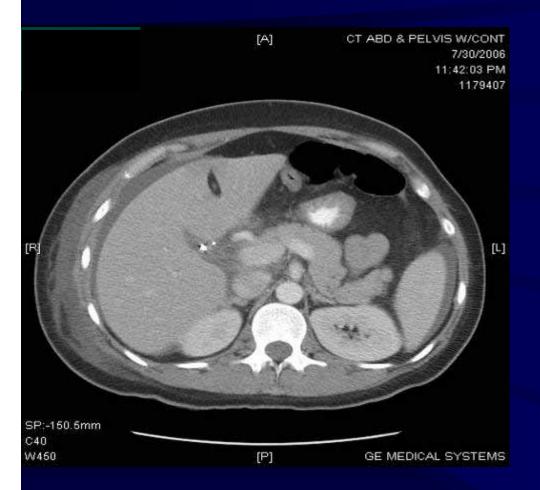
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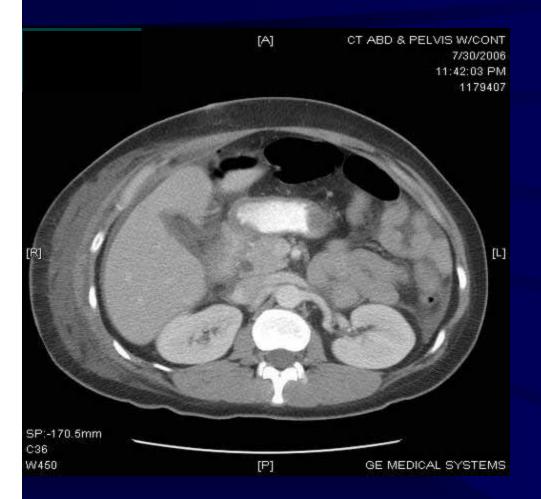
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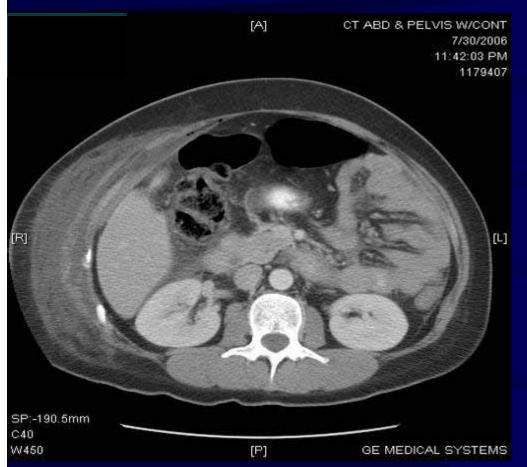
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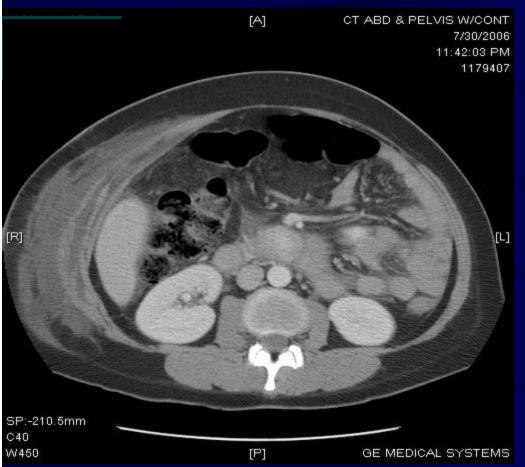
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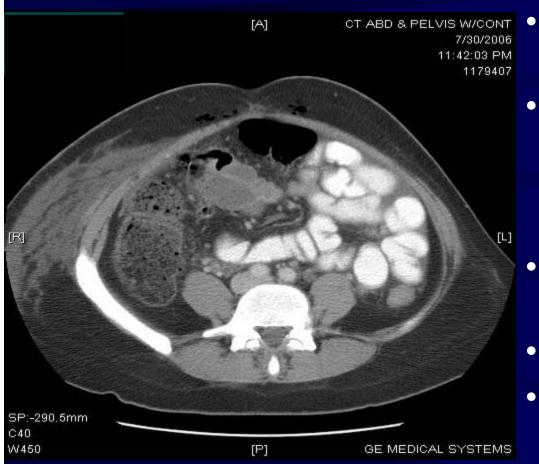
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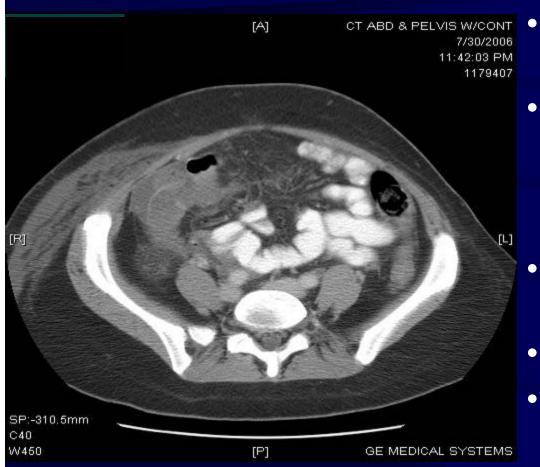
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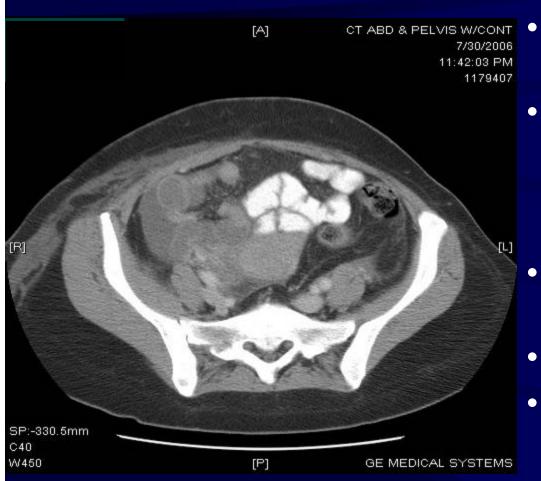
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Post-operative Course

- Admitted to the surgical service with diagnosis of biloma, made NPO with IVF, given IV antibiotics
- POD # 4 she had a HIDA scan

HIDA Scan

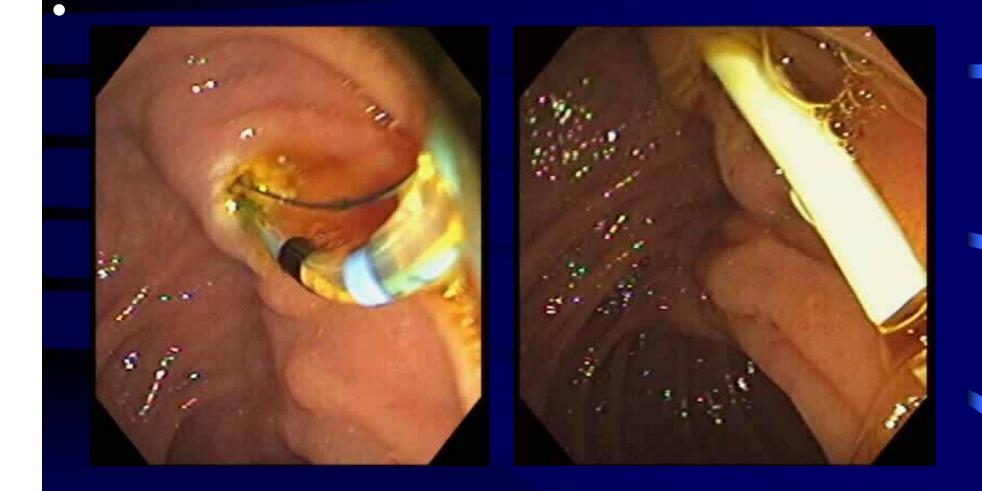
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- Proximal cystic remnant seen
- Bile extravasation along the inferior margin or the liver into the left paracolic region
- Minimal radiotracer transit into duodenum
- Ant oblique images at 70 minutes show bile extravasation
- Findings consistent with bile leak at cystic duct remnant

Post-operative Course

- GI was consulted and an ERCP was performed which demonstrated:
 - Contrast material within the proximal biliary collecting system
 - Collection of contrast adjacent to apparent cystic stump
 - Cystic duct stump leak
 - Normal cholangiogram without any filling defects
 - Sphincterotomy was performed and 10 inch 10
 French stent was placed

ERCP



Post-operative Course

• POD # 5

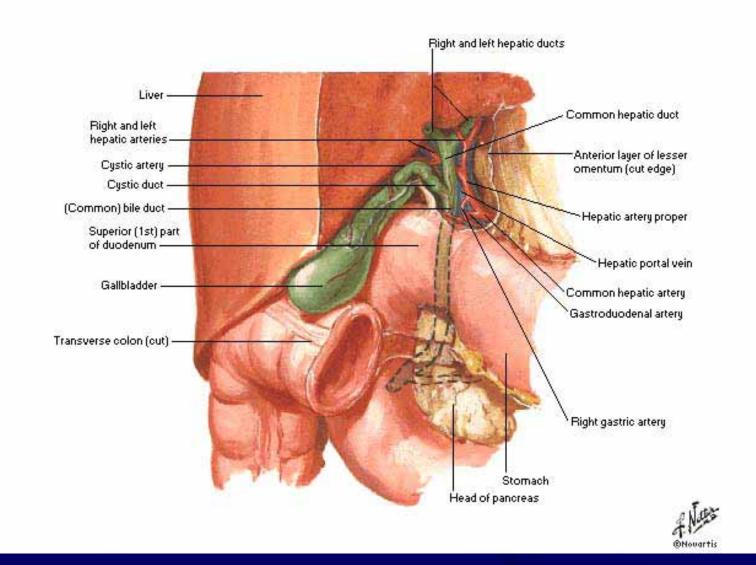
Discharged home on PO flagy and cipro with f/u with GI for stent removal and surgery

• POD #55 (9/20/06):

 Repeat ERCP demonstrated complete resolution of bile leak and biliary stent removed without incident www.downstatesurgery.org

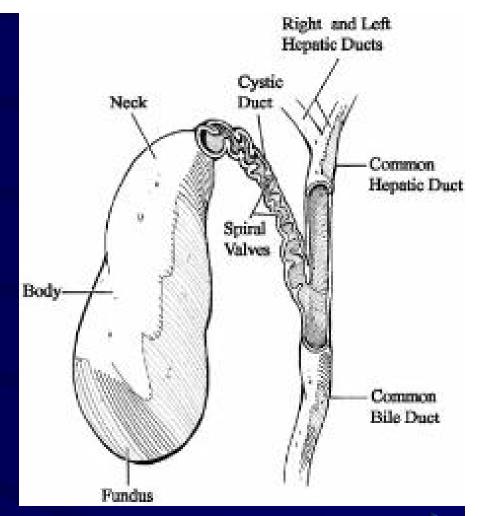
Bile Leak post Laparoscopic Cholecystectomy

The Gallbladder



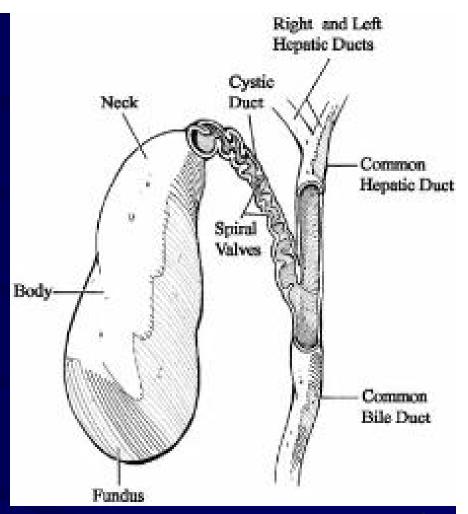
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- Sac-like hollow organ, approximately 10cm
- Location defines the anatomic boundary between the right and left lobes of the liver
- Attached to liver by loose areolar tissue
- The extrahepatic portion is covered by peritoneum
- It lies in close proximity to the duodenum, pylorus, hepatic flexure, right colon and right kidney
- The four parts of the gallbladder are:
 - Fundus
 - Rounded blind portion the extends beyond the liver edge
 - The least well-vascularized portion of the GB thus most susceptible to ischemic changes and most common site of perforation
 - Body
 - Makes up the majority of the gallbladder
 - Makes contact with the liver, duodenum, hepatic flexure and colon



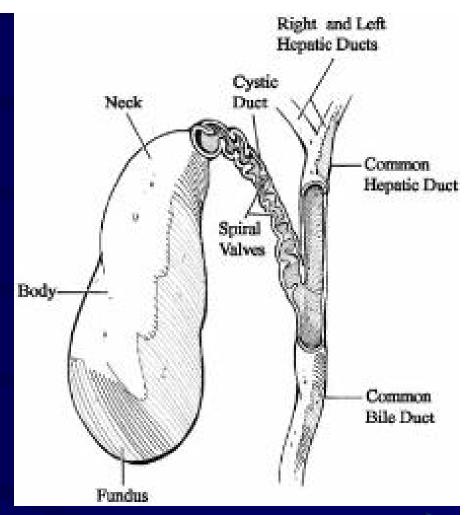
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- Infundibulum
 - Diverticulum on the inferior portion of the GB aka Hartmann's pouch
 - Clinically significant because of proximity to duodenum
 - Stones may become impacted in this region and lead to obstruction of the cystic duct
- Neck
 - The narrowest part of the GB, lies between the body and cystic duct
- Cystic duct
 - connects the GB to the CBD
 - spiral valves of Heister allow passage of bile into and out of the gallbladder
- Blood supply
 - cystic artery (branch of right hepatic) is the major blood supply
 - In 20% of cases, origin of cystic artery may be from the celiac axis, SMA or an aberrant hepatic artery



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- Primary function is to concentrate bile by absorption of water and sodium
- Bile flow occurs in a continuous fashion with sone gallbladder emptying occuring constantly
- Stimulated by:
 - Ingestion of food
 - Release of CCK (duodenum)
 - Vagus
 - Fat is most potent inducer of CCK
- Factors the lead to GB filling:
 - Hormonal
 - Motilin
 - Secretin
 - Histamine
 - Prostaglandins
 - Mechanical



- Gallbladder disease is a common disease affecting 10 20% of the population
- Affects more than 30 million Americans with more than 750,000 cholecystectomies performed every year
- Up to 50% of all patients with gallstones are asymptomatic with 1-2% chance of developing symptoms annually
- Predisposing factors include:
 - Female gender
 - Obesity
 - Increasing age
 - Family history
 - H/o ileal resection
 - Total parenteral nutrition

- There are two main types of stones:
 - Cholesterol stones
 - 70% of all cases



- Described by Admirand and Small in 1968 as a result of imbalance between cholesterol, phospholipids and bile salts
- Nucleation specific proteins within cholesterol-saturated bile induce aggregation and ultimately promote stone formation
- Pigmented stones
 - Most common type of stones worldwide
 - Classified as either brown or black stones
 - Brown stones are typically found in Asia and are associated with infection
 - Black stones are mainly found in patients with hemolytic disorders or cirrhosis
 - Altered solubilization of unconjugated bilirubin with precipitation of calcium bilirubinate and insoluble salts is the common pathway to the formation of pigmented stones

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- Clinical manifestations of gallstones include:
 - Biliary colic
 - Most common presentation for patient with symptomatic gallstones
 - Postprandial RUQ pain
 - Precipitated by fatty or protein-rich meal
 - Occurs 30 60 minutes after eating and then resolves
 - May be associated with nausea and emesis
 - Due to transient impaction of a stone in the cystic duct
 - Acute cholecystitis
 - Most common complication of gallbladder disease
 - Due to obstruction of the cystic duct by and impacted stone or by local edema and inflammation

- Acute cholecystitis (continued)
 - Obstruction leads to:
 - gallbladder distention
 - subserosal edema
 - mucosal sloughing
 - venous/lymphatic congestion
 - localized ischemia
 - Infiltration of the gallbladder wall may lead to :
 - emphysematous cholecystitis
 - gangrenous cholecystitis
 - Diagnosis is based on:
 - Physical exam findings: RUQ pain
 - » Murphy's sign
 - 97% sensitive
 - Laboratory data
 - Radiographic imaging

- Acute cholecystitis (continued)

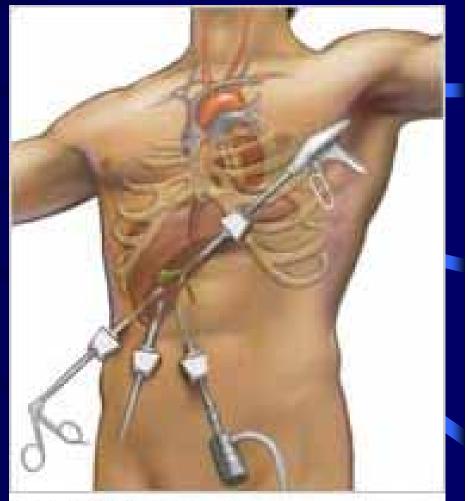
• Ultrasound

- most commonly used to assess the patency of the biliary tree identify calculi or sludge in the gallbladder. Findings include:
 - » Pericholecystic fluid
 - » Impacted stone
 - » gallbladder wall thickening (> 4 mm)
 - » biliary sludge
 - » gallbladder distention
- Hepatobiliary iminodiacetic acid scan (HIDA)
 - assess patency of cystic duct
 - positive with non-visualization of the gallbladder
 - 100% sensitive, 95% specific

- Choledocholithiasis
- Obstructive Jaundice
 - Mirrizzi's syndrome
- Pancreatitis
- Cholangitis
- Differential Diagnosis for gallstones and gallstone associated conditions include:
 - Bowel obstruction
 - Regional enteritis
 - Hepatitis
 - Urinary tract infection/Pyleonephritis
 - Myocardial infarction
 - Right sided heart failure with hepatic congestion

Laparoscopic Cholecystectomy

- 1987 Philipe Mouret performed the first lap chole in Lyon, France
- 1988 the first lap chole was performed in the United states
- By 1990 10% of all cholecystectomies were performed laparoscopically
- By 1992, 90% of cholecystectomies were done laparoscopically
- Today Laparoscopic cholecystectomy is the standard of care for the management of gallstone disease



Cholocystectomy

Laparoscopic Cholecystectomy

- Advantages:
 - Less pain
 - Rapid recovery
- Disadvantages:
 - Increased incidence of biliary injury postcholecystectomy
 - Common Bile Duct injuries rose from 0.1-0.2% to 0.4-0.6% between the era of open cholecystectomy and the age of laparoscopic cholecystectomy

Laparoscopic Cholecystectomy Contraindications

Absolute

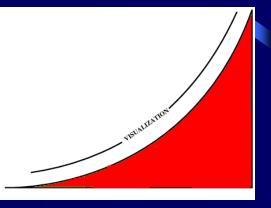
- Inability to tolerate general anesthesia
- Severe cardiac or pulmonary disease
- Peritonitis with bowel distention
- Multiple previous abdominal surgeries
- Gallbladder Cancer

<u>Relative</u>

- Extreme obesity
- Large diaphragmatic hernia
- Acute pancreatitis
- Ascities
- Cirrhosis/portal hypertension

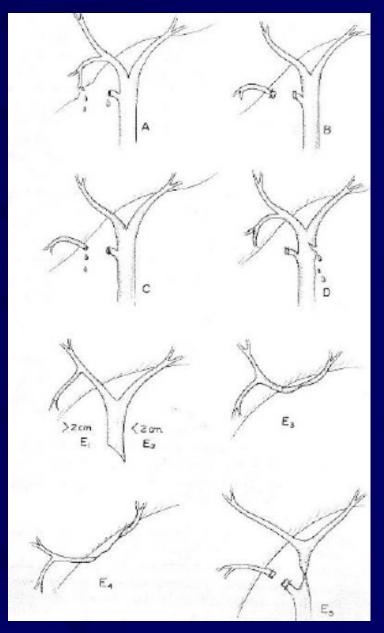
Biliary Tract Injuries

- In the 1990's rate of biliary injury was due in part to inexperience
 - "the learning curve"
 - Rates have appeared to reach a plateau at 0.5% but are documented to range between 0.2 - 2%
 - Incidence of injury 3xs greater when lap chole is performed for acute chole versus elective lap chole
 - Cystic duct stump leaks comprise majority of all biliary tract injuries after LC
- Clinically significant bile leaks after LC is infrequent but constitutes a serious complication and poses difficulties in management
- Bile injuries are due mainly to technical problems and problems with misidentification
- Etiology of bile leak: *latrogenic* Sandha et al (207 pts)
 - Cystic duct 78%
 - Subvesicle bile duct (Luschka's ducts) 26%
 - Major bile duct injury 9%



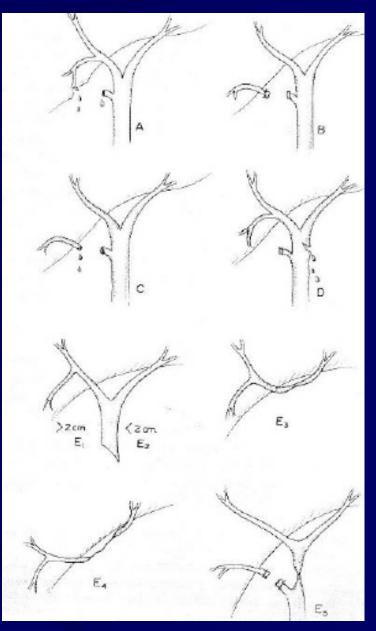
Bismuth Classification

- Type A
 - Bile leak from a minor duct still in continuity with the CBD
 - Occur at cystic duct or from the liver bed
- Type B
 - Occlusion of part of the biliary tree
 - Usually the result of an injury to the aberrant right hepatic duct*
 - In 2% of cases the cystic duct enters a right hepatic duct rather than the common bile duct-common hepatic duct junction



Bismuth Classification

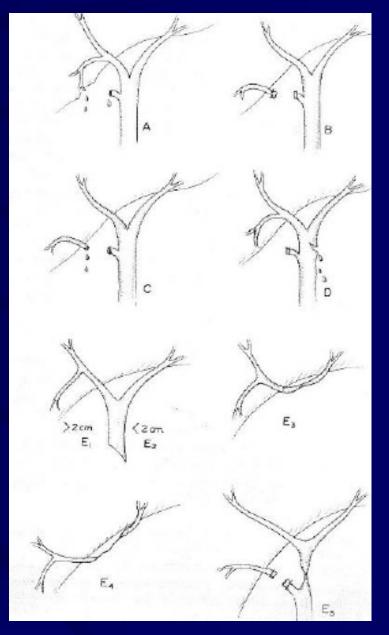
- Type C
 - Bile leak from duct not in communication with CBD
 - Diagnosed early in postop period as an intraperitoneal bile collection
- Type D
 - Lateral injury to extrahepatic bile ducts
 - May involve CBD, CHD, or right or left bile duct



Bismuth Classification

- Type E
 - Circumferential injury of major bile duct
 - Causes separation of parenchyma from the lower ducts and duodendum

Treatment: Type A, C and D Type New Classifications Large versus Small Leaks Low grade versus High Grade



New Classifications

- Ryan et al classified bile leaks as large or small based on amount of contrast observed fluoroscopically to extravasate from the ductal disruption
- Sa et al defined a two category grading system based on severity of leak
 - Low-grade
 - Leak identified only after opacification of the intrahepatic biliary radicals with contrast
 - Indicates a small defect thus biliary sphincterotomy alone is adequate for decompression and subsequent leak closure
 - High-grade
 - Leak observed flouroscopically before intrahepatic opacification
 - Means that defect is large enough that even partial filling of the bile duct results in extravasation of contrst
 - Should be treated by stent placement
 - Concluded that the decision for stent placement should be based on severity of leak not location

- Risk factors for biliary injury include:
 - Training and experience
 - Surgeon experience is a predictor of the safe and efficient performance of laparoscopic cholecystectomies
 - Achieving conclusive identification of cystic structure
 - 1. The Critical View of Safety
 - » Complete dissection
 - of Triangle of Calot
 - 2. Cholangiography



- Fletcher et al found that intra-operative cholangiography had a protective effect
- Operative cholangiography is best at detecting misidentification of the CBD as the CD
- Prevents excisional injuries when correctly identified
- 3. The Infundibular technique
- 4. Identification of junction of CBD,CHD & CD

- Risk factors for biliary injury include:
 - Training and experience
 - Kauver et al looked at influence of resident seniority and complication rate during lap chole
 - 270 cases, 143 performed by junior residents
 - Higher complication rate in junior residents compared to senior resident (5.6% versus 0.78%)
 - Most common complication was *cystic duct* leak
 - Ferzli et al looked at resident competence in both open and laparoscopic cholecystectomy (1997)
 - Concluded that 5 years exposure to laparoscopic cholecystectomy adequately prepared chief residents to perform the procedure with complication rates no greater than that sited in the literature
 - Supported concept of learning curve as 75% of complications occurred during the first 30 cases

- Local risk factors

- chronic inflammation
- Dense scarring
- Operative bleeding

- <u>Technical problems</u>

- Failure to properly occlude cystic duct (Type A)
 - Clips not as reliable as ligatures or suture ligature
 - » Rohatgi examined clip failure rate
 - Simple clips (titanium)– higher incidence of cyst duct stump leak (0.11 2% compared to 0 in pts with locking clips)
 - » Locking absorbable clips more secure, easier to apply and associated with fewer cystic duct leaks
 - Crossing of clip tips (scissor) or inability or tips to join (sec to thick, rigid or dilated cystic duct)
 - Retained stones in CBD may increase intraductal pressure thus leading to clip failure
 - Prevention
 - » Tip of clips should be seen projecting beyond the duct
 - » Clips should not be manipulated in subsequent dissection
 - » Ligature Loops should be used for cystic duct occlusion whenever the cystic duct cannot be completely encased within clip
 - -Pre-tied ligature applied after CD transection
 - -Intracorporeal CD ligation
 - -Endocorporeal CD ligation

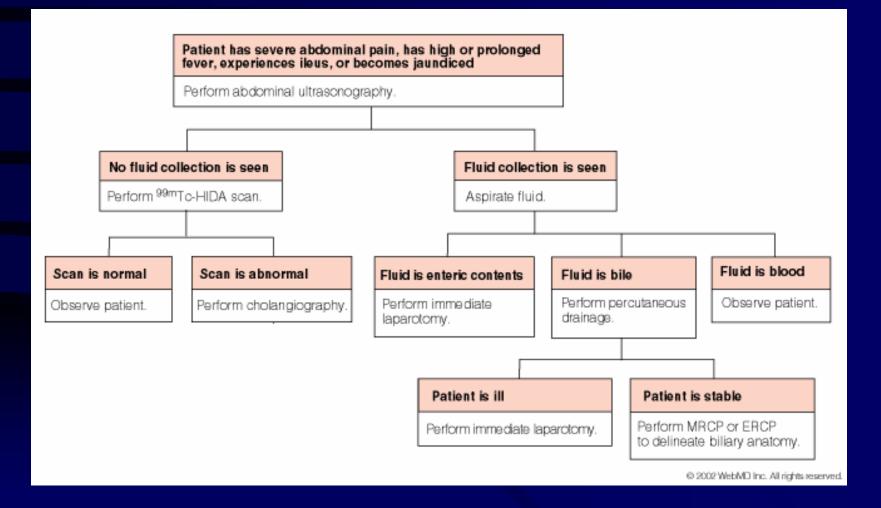
<u>Technical problems</u>

- Improper plane of dissection
 - Entering plane deep to gallbladder plate results in injury to ducts in liver bed
 - Occurs with difficult dissections in cases of severe inflammation or when GB is intrahepatic
 - Prevent
 - » Meticulous dissecting in correct plane
 - » Use spatula and irrigation to ensure clear field
- Thermal Injuries
- Tenting Injuries
 - Caused by forceful pulling on the gallbladder
 - Occlusion of the junction between the common bile duct and hepatic bile duct
 - Prevent
 - » Don't pull!
 - » Be certain that a length of CD remains below the clip by CBD

Diagnosing post-LC bile leak

- Should be suspected in any post LC patient with prolonged recovery period
- Usually present within first week
- Commonly complain of:
 - Abdominal pain /distention
 - Generalized malaise and anorexia
 - Bilious drainage from drain placed at initial operation or from incision
- Imaging
 - Essential to define biloma that may require percutaneous or surgical intervention
 - HIDA may show presence of an active bile leak
 - MRCP may show dilatation, stenosis or retained stone
 - ERCP for diagnostic and therapeutic intervention

Algorithm for suspected Bile Leak after Laparoscopic cholecystectomy



- Goal is to re-establish a pressure gradient that will favor the flow of bile into the duodenum as opposed to the leak site
 - This often requires removal of any physiologic or pathologic obstruction such as the normal sphincter of Oddi pressure or a retained bile duct stone

- Surgical management of biliary leak is associated with high morbidity (22-37%) and mortality (3-18%)
- Percutanous transhepatic biliary drainage, previously common treatment option provides allows for the decompression of the biliary tree
 - Complications include:
 - Fistula formation/recurrence
 - Stricture formation
 - Hemorrhage
 - Bile leak secondary to liver puncture
 - Technical difficulty
 - » Non-dilated biliary system

 Biliary endoscopic procedures have become the treatment of choice for the management of biliary leaks with literature demonstrating 96% efficacy

– Sphincterotomy:

- reduce the bile duct-duodenal pressure gradient maintained by an intact sphincter of Oddi
- divert bile away from the site of the leak
- Nasobiliary drainage (NBD):
 - bridge the defect at the site of the leak physically occluding it while providing a conduit for bile to flow
 - Also prevent stricture formation during healing
 - Advantages
 - » Provide visual confirmation of biliary decompression
 - » Facilitate repeat cholangiography
 - » Allow gravity assisted drainage of bile from buct
 - Disadvantages
 - » Uncomfortable
 - » High risk of displacement
 - » Deprive patient of large amount of

- Stenting:

- Similar to NBD +
- Eliminates outflow resistance offered by basal sphincter of Oddi pressure
- Results in preferential draining of bile into the duodenum
- Disadvantages
 - Associated with biliary obstruction, cholangitis
 - Stent migration
 - Requires second endoscopy for stent removal

- Agarwal et al (2006) compared sphicterotomy with stent versus stenting alone
- 90 patients with post LCBL
- Leaks: 72 at CD stump (with 24 with retained CBD stones), 30 at CBD, 4 at RHD
- Therapeutic modalities used: sphincterotomy, biliary stenting and nasobiliary drainage
- Conclusions:
 - Post-cholecystectomy bile leaks occur most commonly at the cystic duct and are frequently associated with BD stone
 - Sphincterotomy with endoprosthesis or endoprosthesis alone is equally effective in the management of post-cholecystectomy bile leak

Sandha et al evaluated need for sphincterotomy and stent

- Conclusion
 - Low grade leaks close with sphincteromony alone
 - High grade leaks require stent placement for effective closure

New Techniques

- Poly-N-Acetyl glucosamine
 - Biodegradable gel derived from marine diatom
 - Solidifies at basic PH
 - Safely plugs cystic duct stump leaks in animal studies
 - May be performed endoscopically
 - Human trials scheduled to start
- Botulinum toxin
 - Derived from C. botulinum, an anaerobic GPR
 - Paralyzes muscle via irreversible inhibition of Ach release at NM junction
 - Induces relaxation of sphincter of Oddi thereby decompressing the biliary tree
 - Lasts 3 6 months
 - Compared to stenting in animal studies and found to be
- Preventive Measures
 - Fluorescent cholangiography
 - Mouse study for improved laparoscopic identification of the biliary anatomy
 - Real time technique involving exogenously fluorescein-based bile acids or indocyanine green

Conclusion

- Biliary injuries have increased since the introduction of laparoscopic cholecystectomy for the treatment of gallbladder disease
- Although the learning curve plays major role in occurance of complications, the incidence has reached a plateau but continues to be greater than that seen in the era of open cholecystectomies
- New techniques are currently being investigated in an attempt to lower incidence of bile leaks after laparoscopic cholecystectomies

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Thank You's

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