Gallbladder Diagnosis and Treatment

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- Nothing to Disclose

Objectives

- **Discuss the pathophysiology of cholelithiasis**
- **Identify and evaluate complications of cholelithiasis**
- **Identify the risk, prevention, identification, and treatment of common bile duct injury**

Gallbladder Outline

- Anatomy
- Prevalence of gallbladder disease in the US and among Native Americans
- Complications of gallstones
- Evaluation
- Management Options
- Special Considerations
- Operative Complications
- Common Bile Duct (CBD) Injury
- Conclusions

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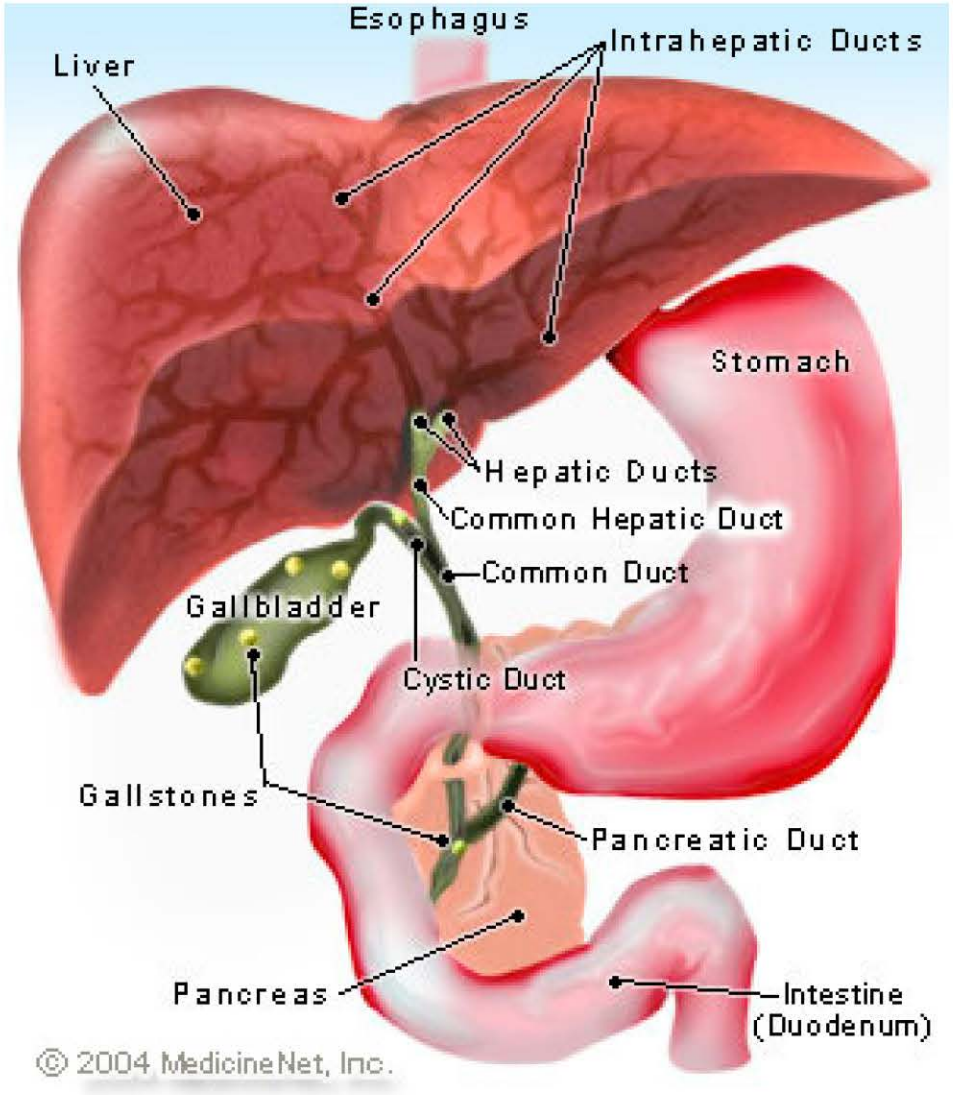
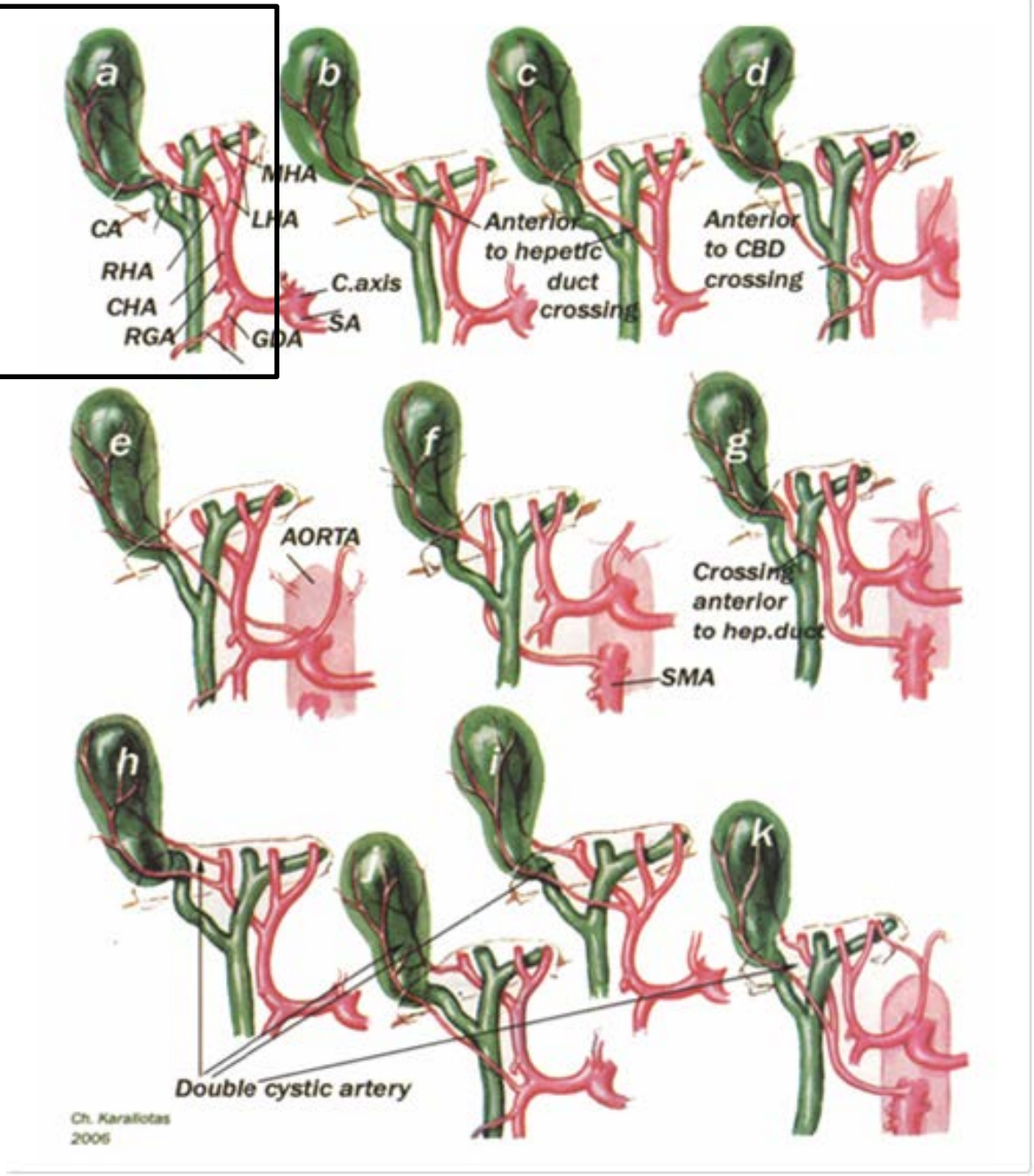
Gallbladder Anatomy



Gallbladder Anatomy

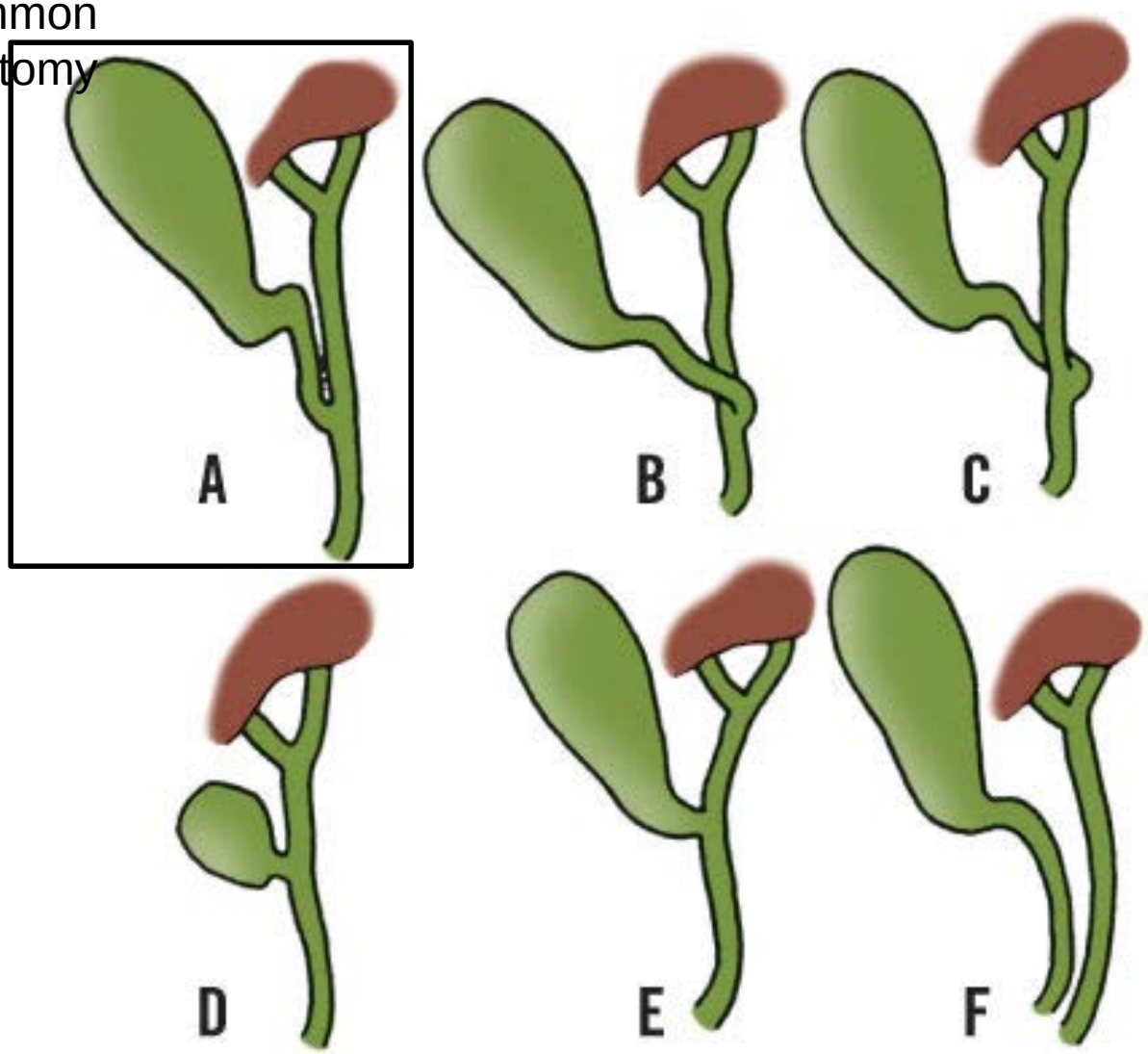
Vascular Variations

Most common anatomy



Cystic Duct Variations

Most common anatomy



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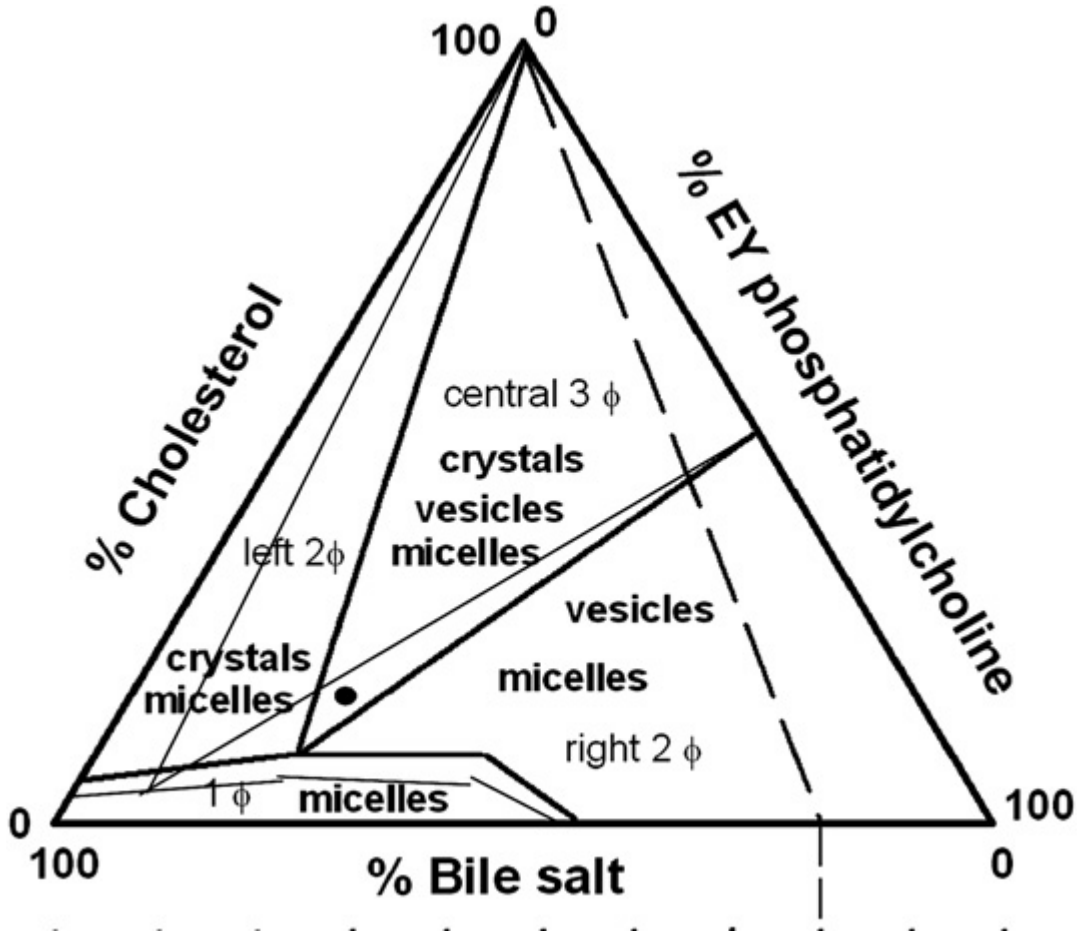
Pathophysiology



Prevalence of Gallbladder Disease in the US

- US National Health and Nutrition Examination Survey
- 1988 – 1994
- 14,228 participants underwent gallbladder ultrasound
- ages 20 – 74 years

- All comers = 12.4%
    - prevalence of gallstones = 7.1%
    - prevalence of previous cholecystectomy = 5.3%

Ruhl and Everhart. Gallstone disease is associated with increased mortality in the United States. Gastroenterology. 2011;140(2): 508-516.

Prevalence of Gallbladder Disease among Native Americans

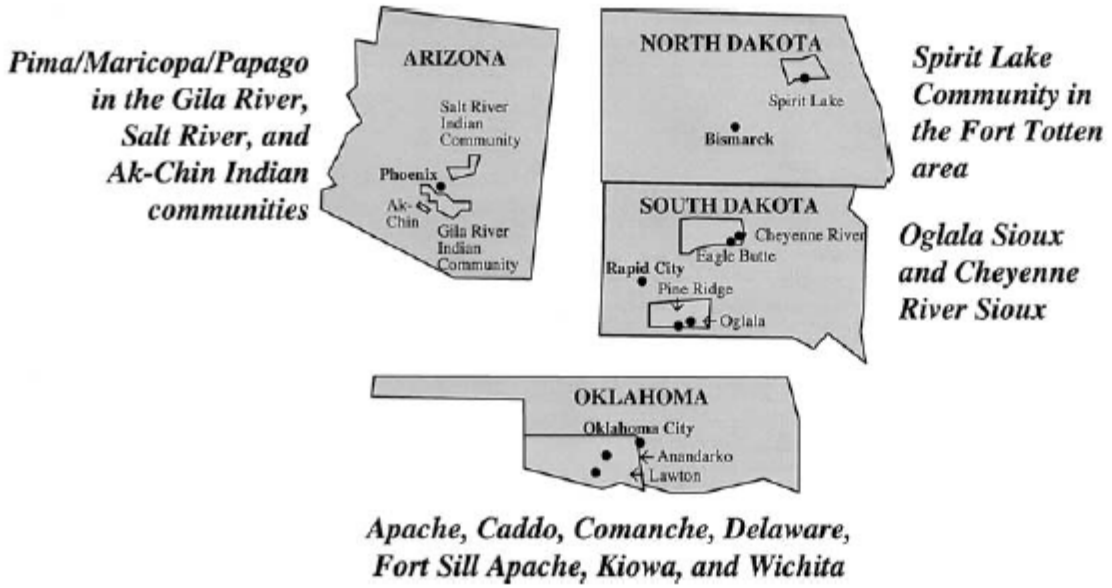


Fig. 1. Participating American Indian communities in the Strong Heart Study.

Everhart et al. Prevalence of gallbladder disease in American Indian populations: Findings from the strong heart study. Hepatology. 2002;35:1507-12

Prevalence of Gallbladder Disease among Native Americans

Table 2. Prevalence (%) of Gallstones, Cholecystectomies, and Gallbladder Disease by Sex and Examination Site Among American Indians

	Dakotas	Arizona	Oklahoma	All Sites
Women				
Gallstones	19.1	18.0	16.5	17.8
Cholecystectomy	40.4	50.2	47.6	46.3
Gallbladder disease	59.5	68.2	64.0	64.1
95% Confidence interval	55.6-63.3	64.7-71.6	60.5-67.6	62.0-66.1
Men				
Gallstones	15.1	19.7	17.9	17.4
Cholecystectomy	10.3	11.3	14.3	12.1
Gallbladder disease	25.5	30.9	32.2	29.5
95% Confidence interval	21.4-29.5	26.1-35.8	28.0-36.4	27.0-32.0

vs. 12.4% for general US population

Everhart et al. Prevalence of gallbladder disease in American Indian populations: Findings from the strong heart study. Hepatology. 2002;35:1507-12.

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Gallstones

Natural History of Gallstones

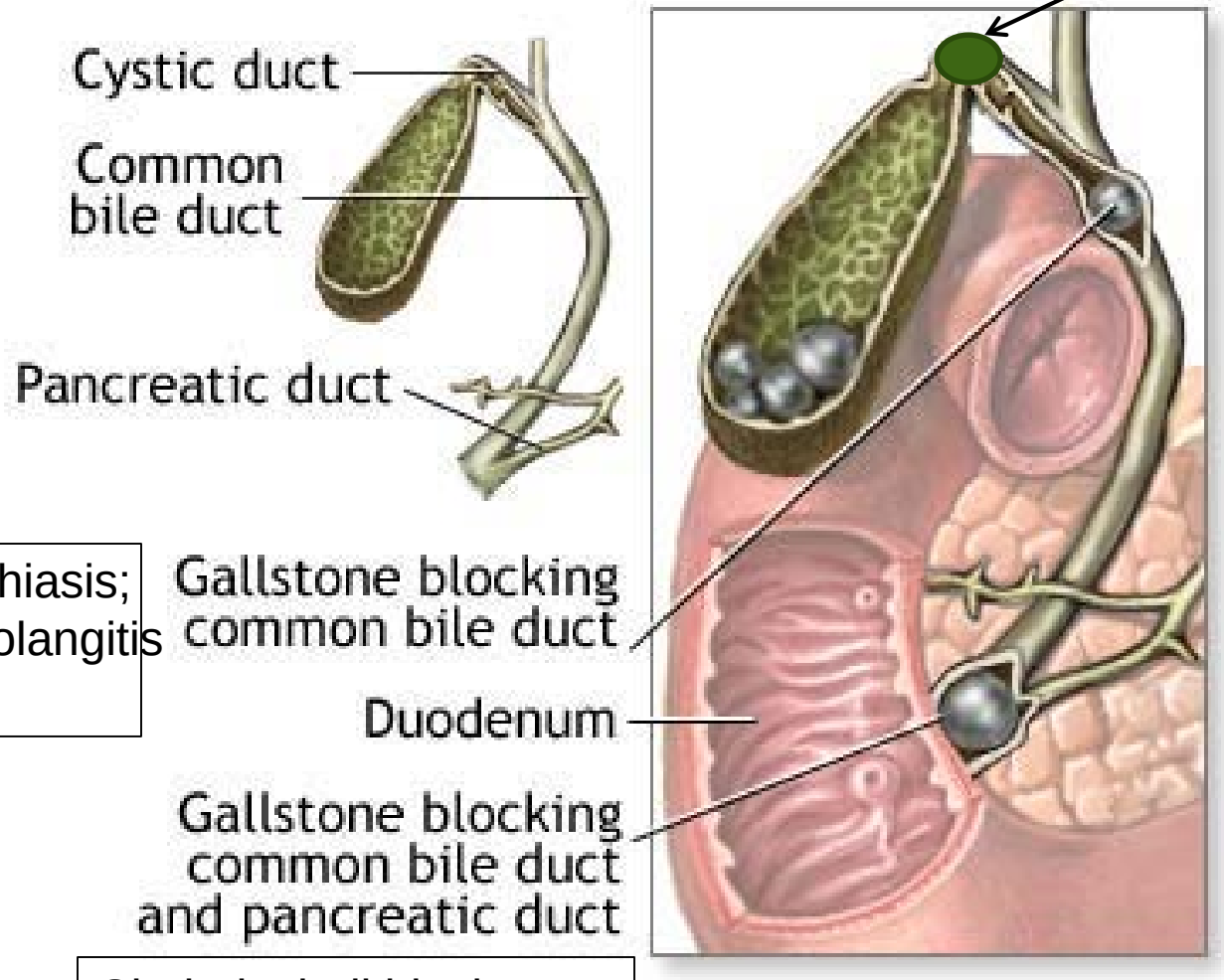
- Nearly 80% of patients with gallstones are asymptomatic

- Multiple studies have shown
    - ~10% of patients with asymptomatic gallstones will develop symptoms within 5 years
    - 20% at 10 years

- Special considerations
    - gallstones > 2.5 cm can cause higher rates of cholecystitis and gallbladder cancer
    - gallbladder polyps > 10 mm can harbor cancer

Consequences of Gallstones

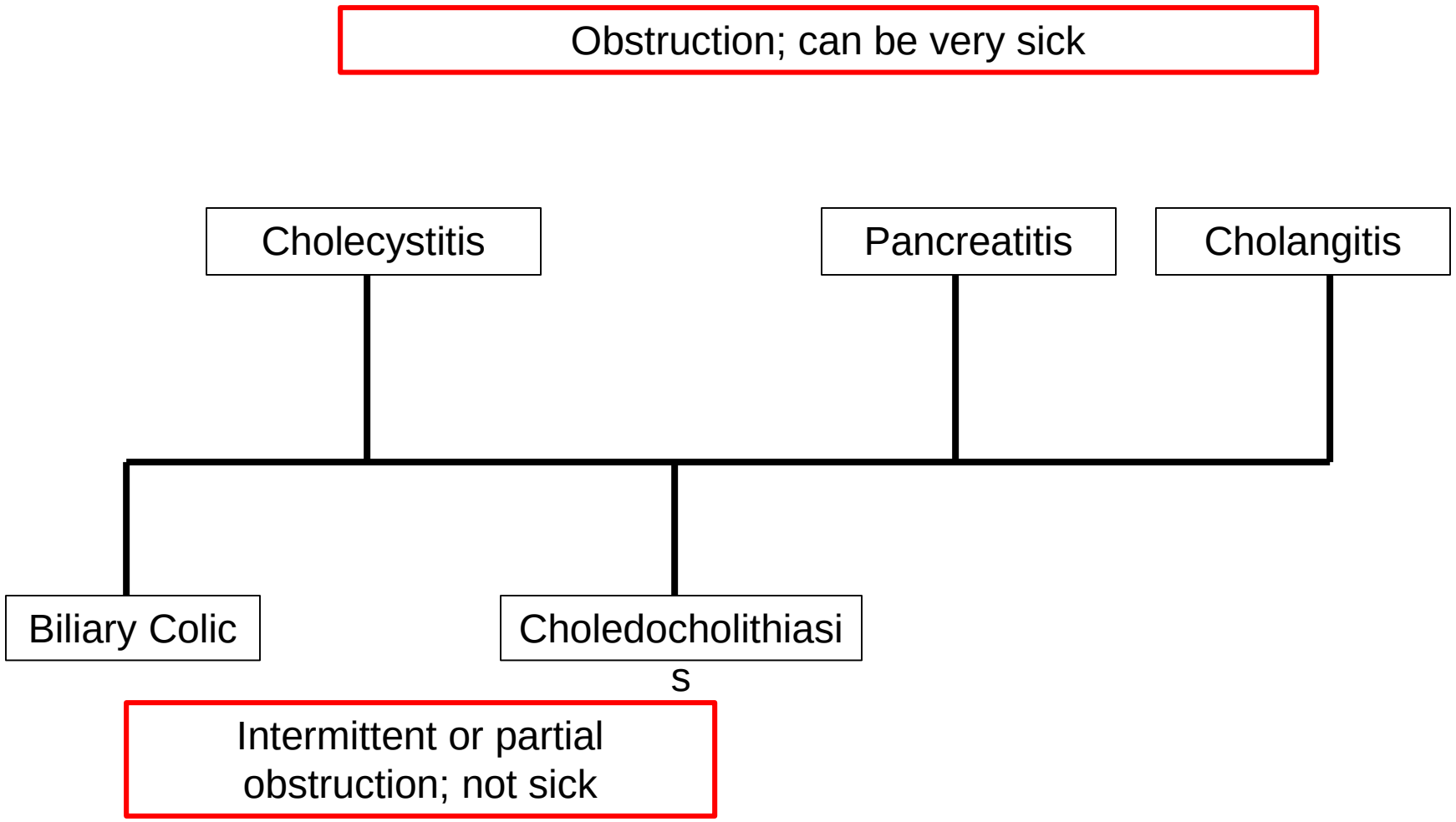
Gallstone blocking cystic duct; can cause cholecystitis



Choledocholithiasis; can cause cholangitis

Choledocholithiasis; can cause pancreatitis and/or cholangitis

Spectrum of Disease by Acuity



Presentation of Gallstone Disease

- Biliary colic
  - Intermittent RUQ pain, usually after fatty foods
  - Resolves on its own
  - No physiologic alterations

- Cholecystitis
  - Constant RUQ pain, often after fatty food
  - Fever, mild tachycardia, mild leukocytosis
  - Murphy's sign
  - Usually no elevation in bilirubin/liver enzymes

Presentation of Gallstone Disease

- Cholangitis: SICK!
  - Charcot's triad: fever, jaundice, RUQ pain (in 50-75% of pts)
  - may present without abdominal pain, especially in elderly
  - Reynold's pentad: Charcot's triad + mental status change + hypotension, ie SEPSIS!
  - leukocytosis, elevation in bilirubin/alk phos/liver enzymes

- Pancreatitis
  - spectrum of illness: may be mild to very severe
  - typically epigastric pain radiating to back
  - elevated lipase
  - may be febrile with leukocytosis
  - very sick patients may present with hypotension, mental status changes and sequester a large amount of fluid

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Evaluation of Gallstone Disease

- Suggestive history (ie fatty food intolerance)

- Physical Exam
  - Murphy's sign

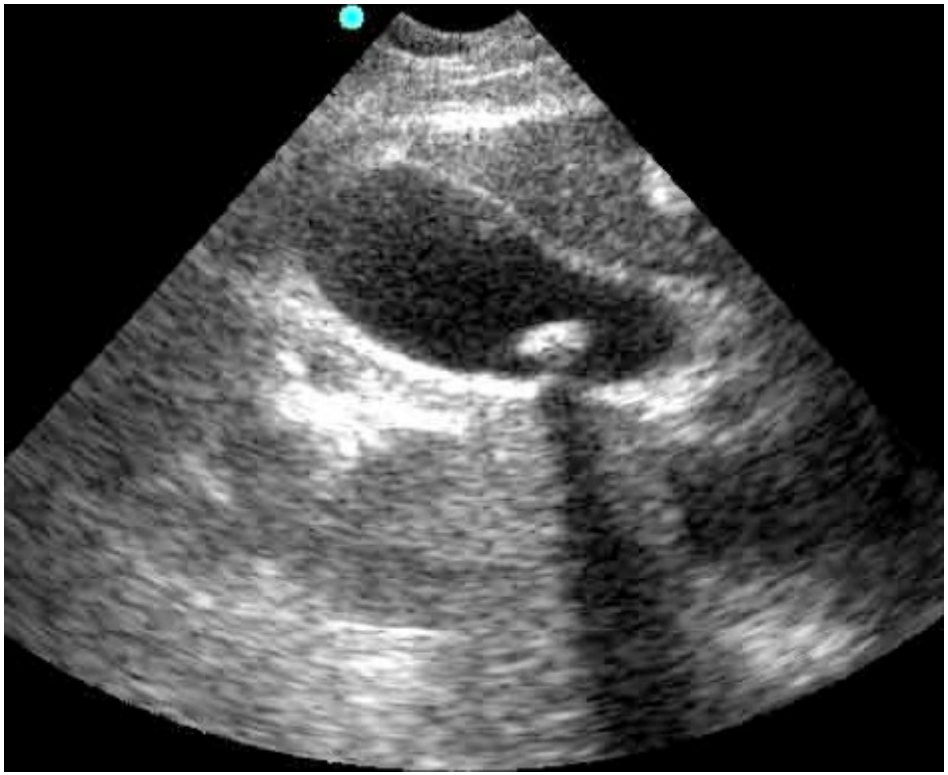
- Laboratory work
  - CBC, chemistry
    - biliary colic will not have elevated white count

  - Liver panel
    - alk phos usually elevated in all conditions other than biliary colic
    - bilirubin and liver enzymes usually elevated in choledocholithiasis
      - Transient – passed a stone or dehydrated
      - Persistent – obstructed duct
  - Lipase
    - Elevated in pancreatitis
    - Elevation does not correlate to clinical severity

Imaging of Gallstone Disease

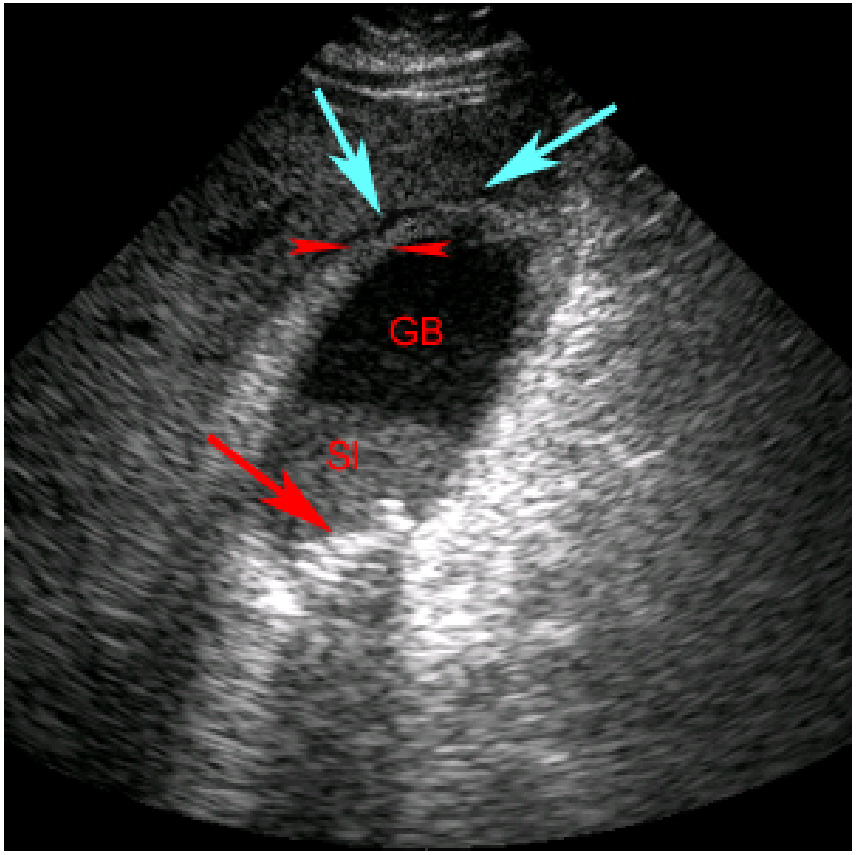
- RUQ ultrasound
  - first line test – noninvasive, relatively inexpensive, widely available
  - can be operator dependent
  - sensitivity of only 60-70%
  - will demonstrate stones in gallbladder
  - signs of cholecystitis
    - pericholecystic fluid
    - gallbladder wall thickening
  - measures the common bile duct (CBD); upper limit of normal 4-5 mm, but for each decade after 50, the duct may dilate 1 mm. >1 cm is always abnormal.
  - can see peripancreatic fluid and inflammation

RUQ Ultrasound



gallstones

cholecystitis

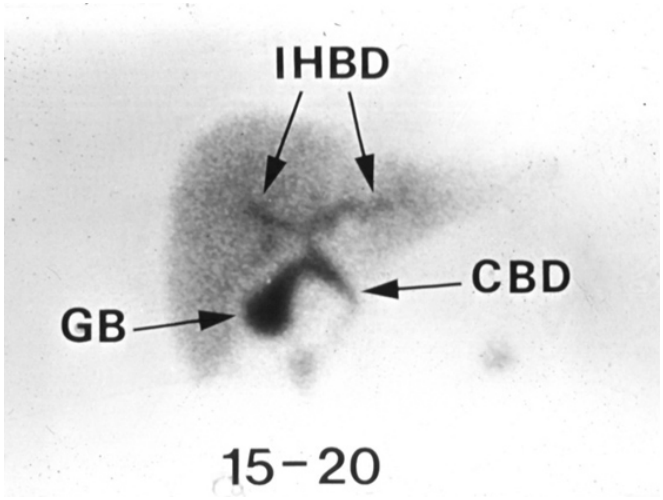


Imaging of Gallstone Disease

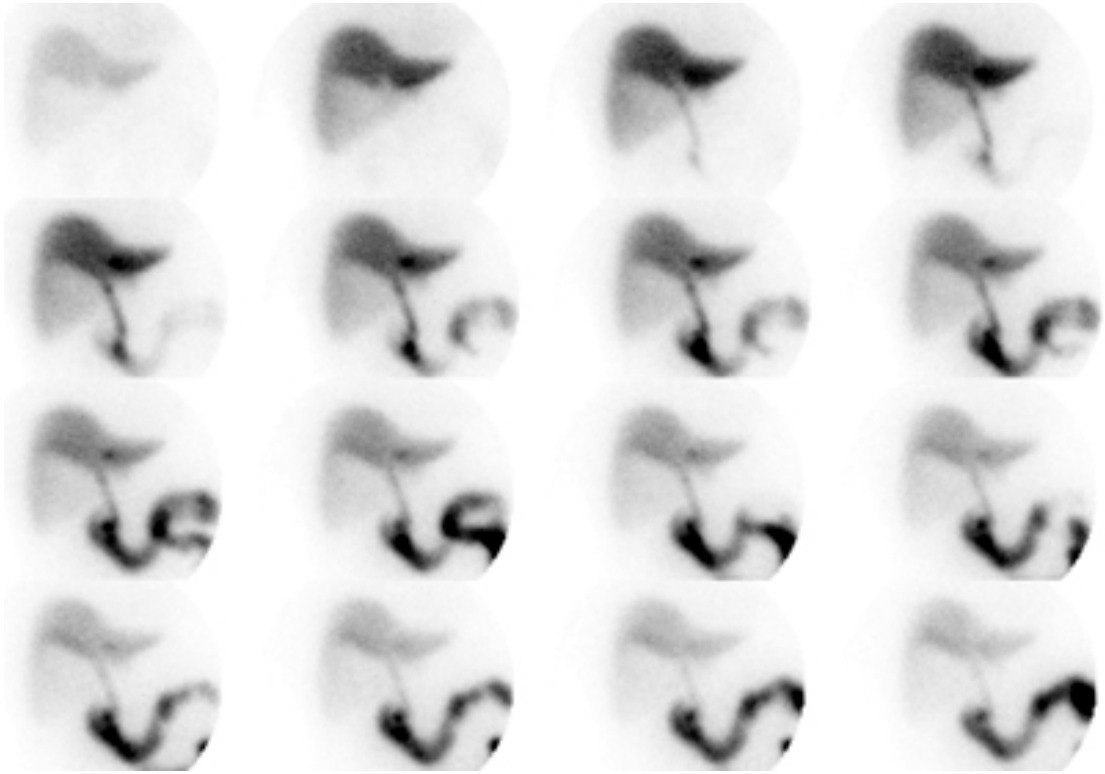
- HIDA
  - nuclear scan
  - sensitivity of 90 – 97%
  - More expensive, not always available
  - gallbladder non-visualized indicates obstruction of cystic duct (cholecystitis)
  - often used as definitive test if sx are consistent with cholecystitis but ultrasound is negative

HIDA scan

Normal HIDA: GB Fills after 15-20 min



HIDA in cholecystitis: GB does not fill, even after several hours

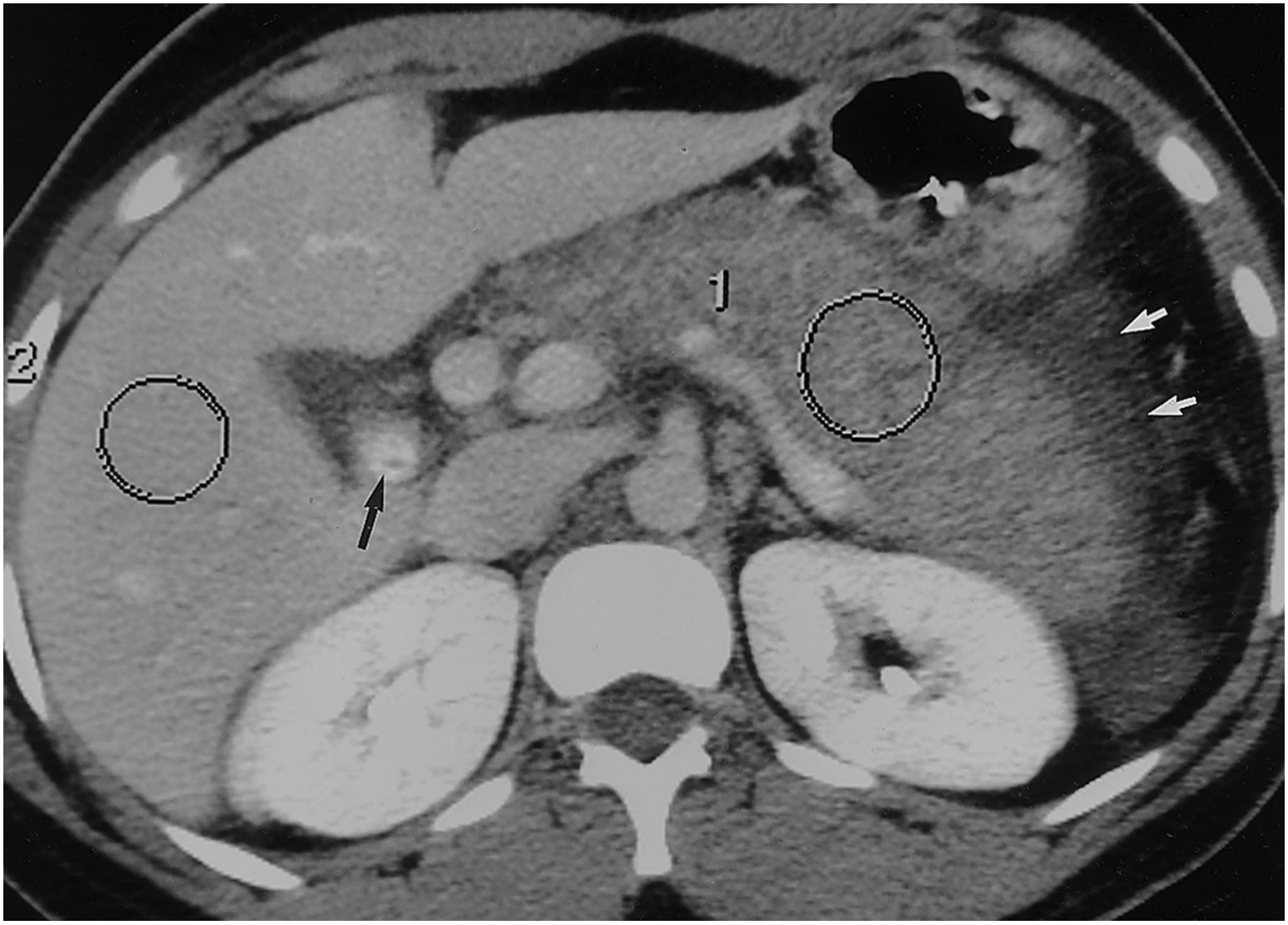


Imaging of Gallstone Disease

- CT
  - best for pancreatitis
  - rated according to Balthazar criteria
  - demonstrates peripancreatic fluid and inflammation and pancreatic necrosis
  - can see bile duct
  - can overcall cholecystitis

- MRCP
  - excellent test for ductal anatomy
  - expensive, not always available
  - reserve for complicated cases in which ductal anatomy needs to be seen

CT of Acute Gallstone Pancreatitis



Summary of Evaluation of Gallstone Disease

Disease Process	Pain	Exam	Labs	Ultrasound
Biliary Colic	Intermittent	Not sick No fever Usually non-tender	No white count or elevation in liver tests	Gallstones
Cholecystitis	Constant	Mildly sick Fever, mild tachycardia Tender, +Murphy's	Elevated white count; usually no elevation in liver tests (if +, suspect common duct stone)	Gallstones Pericholecystic fluid Wall thickening
Gallstone Pancreatitis	Constant Epigastric radiating to back	Can appear well to septic	Elevated lipase; may have elevated white count and liver enzymes	Gallstones Peripancreatic fluid and inflammation
Cholangitis	May have pain May not	SICK! Charcot's triad Reynold's pentad	Elevated white count and liver tests	Gallstones Dilated CBD

Summary of Evaluation of Gallstone Disease

- Workup prior to referring a patient with biliary colic to a surgeon:
  - Typical history
  - Laboratory work: CBC, Chemistry, Liver panel
  - Records of any ER visits
  - RUQ ultrasound
  - Risk stratification to assist the surgeon with deciding whether to offer surgery

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Management of Gallstone Disease: Options

- Observation
- Cholecystostomy Tube
- Cholecystectomy
  - laparoscopic vs. open
  - intraoperative cholangiogram
- Common Duct Stones
  - intraoperative common duct exploration
  - Endoscopic Retrograde Cholangiopancreaticography (ERCP)

Management of Gallstone Disease: Options

- Observation
  - reserved for asymptomatic gallstones under 2 cm
  - or for patients with biliary colic and not fit for surgery (or refuse)

Management of Gallstone Disease: Options

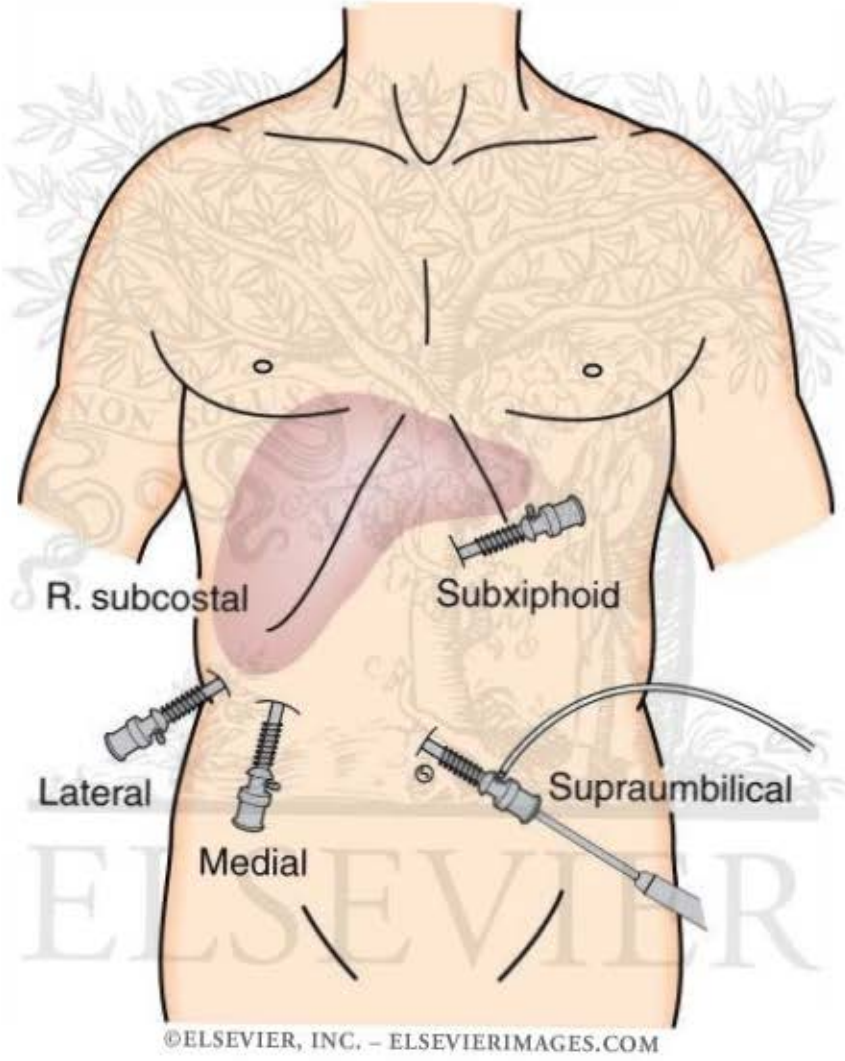
- Cholecystostomy Tube
  - interventional radiology procedure
  - percutaneous drainage of gallbladder; does not remove stones
  - not definitive therapy
  - used in cholecystitis for patients who are too sick to undergo surgery
  - can bridge patients until they are well enough for surgery or until they recover from cholecystitis

Management of Gallstone Disease: Options

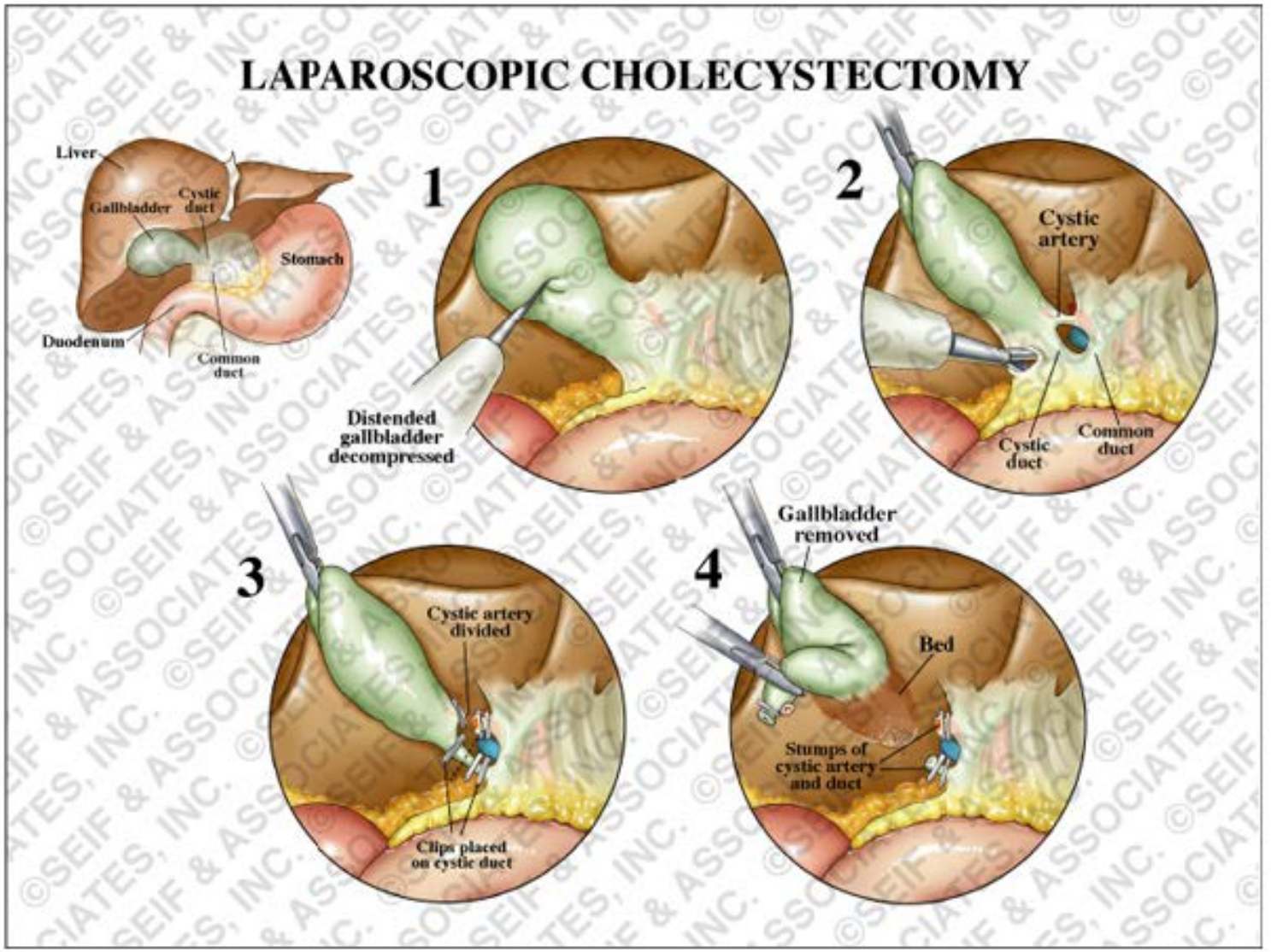
- Cholecystectomy
  - remove gallbladder
  - most commonly done laparoscopically
  - open only if unable to perform laparoscopically
  - indicated in all symptomatic patients fit for surgery

  - indicated in asymptomatic patients fit for surgery in the following situations:
    - stone > 2 cm
    - gallbladder polyp > 1 cm
    - women who wish to become pregnant

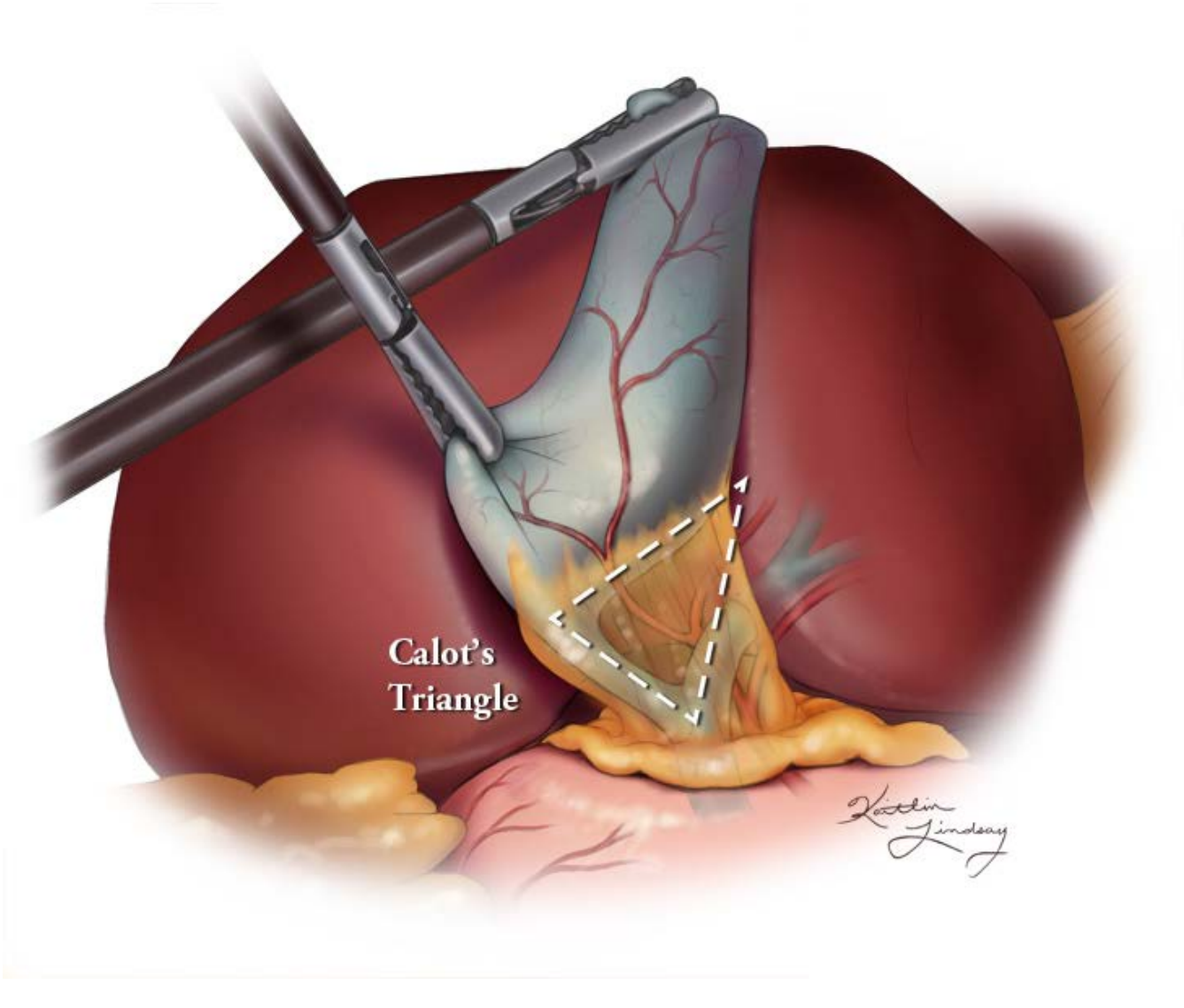
Laparoscopic Cholecystectomy: Ports



Laparoscopic Cholecystectomy: Steps



Laparoscopic Cholecystectomy: Critical View



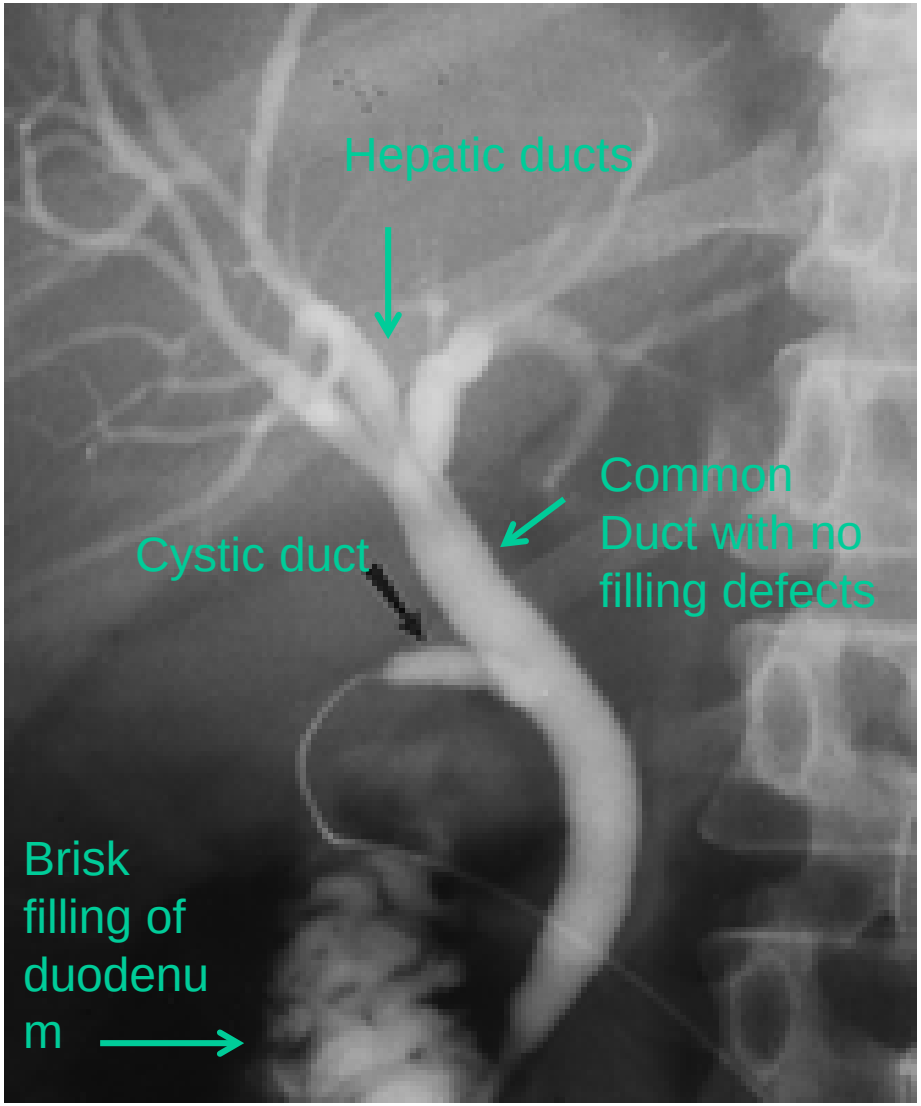
Straight-forward Lap Chole

- **Laparoscopy Surgery Full Video For Gall Stones**

Difficult Lap Chole

http://www.youtube.com/watch?feature=player_detailpage&v=ec_LntT0e5Y

Intraoperative Cholangiogram



Pros and Cons of Routine Intraoperative Cholangiogram

PRO

- ? Decrease rate of bile duct injury
- Evaluate duct for stones

CON

- Adds time (mean 16 min) and expense
- Requires correct interpretation (operator dependent)
- False positive rate not insignificant – can commit surgeon to CBDE

Argument that Intraoperative Cholangiogram Decreases Bile Duct Injury (BDI)

- Widely cited paper, still used today
- Meta-analysis of 40 papers of lap chole from 1990-1994
- 327,523 lap choles
- 26 studies had exact information on 405 major injuries

- RESULTS:
  - average incidence of BDI = 0.36% (range 0-1.4%)
  - 50% reduction in injuries with routine IOC
    - 0.21 vs. 0.43% $p<0.05$

Ludwig et al. Contribution of intraoperative cholangiography to incidence and outcome of common bile duct injuries during laparoscopic cholecystectomy. Surg Endosc. 2002;16:1098-1104.

Argument that Intraoperative Cholangiogram Decreases Bile Duct Injury (BDI)

Table 3. Characteristics of 103 major CBD injures according to case-specific proceeding and depence on IOC

	Without IOC (n = 78)	With IOC (n = 26)	p <0.05
Type B injury	11 (14%)	—	s.
Type C injury	23 (29.6%)	21 (80.7%)	s.
Type D injury	36 (46.1%)	2 (7.7%)	s.
Type E injury	8 (10.2%)	3 (11.5%)	n.s.
Intraoperative detection	17 (21.7%)	20 (76.9%)	s.
Repair by suture or bil.-bil. anastomosis	27 (34.6%)	20 (76.9%)	s.
Repair by bil.-digestive anastomosis	45 (57.7%)	5 (19.2%)	s.
Redo-procedure necessary	32 (41%)	2 (7.7%)	s.

With IOC
- fewer injuries overall
- less severe injuries
- majority detected intraoperatively, which is best time for repair
- many fewer redo procedures needed

Ludwig et al. Contribution of intraoperative cholangiography to incidence and outcome of common bile duct injuries during laparoscopic cholecystectomy. Surg Endosc. 2002;16:1098-1104.

Criticism of Data Supporting Routine IOC as Strategy to Decrease BDI

- Data from early in laparoscopic era
- Small trials, non-standardized
- Number of bile duct injuries so small that a properly powered randomized trial is impossible

More Recent Review of Routine IOC = Equivocal

- Review of randomized trials of routine IOC vs. no IOC from 1980 – 2011
- 8 RTC found; too few and too heterogenous for formal meta-analysis
- 1715 patients
- overall poor quality of studies

- RESULTS:
  - 2 major BDI; neither had IOC (0.1%)
  - 5 patients had retained stones found in f/u
    - 4 did not have IOC
    - 1 had a false negative IOC
    - 4/5 retained stones occurred in 1 study alone

Ford et al. Systematic review of intraoperative cholangiography in cholecystectomy. Br J Surg. 2012;99:160-7.

More Recent Review of Routine IOC = Equivocal

Table 3 Main outcomes for randomized trials of intraoperative cholangiography *versus* no intraoperative cholangiography

Reference	CBD injury		Intraoperative stones		Retained stones at follow-up		True-positive cholangiograms	False-positive cholangiograms
	IOC	No IOC	IOC	No IOC	IOC	No IOC		
Khan *et al.*[15] ($n = 190$)	0	1*	3	–	0	0†	3	0
Nies *et al.*[17] ($n = 275$)	0	1	3	–	0	4	3	1
Tusek *et al.*[18] ($n = 100$)	NR	NR	4	–	0	0	4	0
Hauer-Jensen *et al.*[19,20] ($n = 280$)	0	0	4	–	0	0	4	3
Murison *et al.*[21] ($n = 285$)	NR	NR	12	–	1‡	0	12	16
Soper and Dunnegan[23] ($n = 115$)	0	0	3	–	0	0	3	3

- Numbers of BDI too small to make statistically significant comparisons
- Retained stone data difficult to interpret since occurred in 1 study
- Significant false positive rate

Ford et al. Systematic review of intraoperative cholangiography in cholecystectomy. Br J Surg. 2012;99:160-7.

Summary of IOC

- Routine use still widely debated
- Must be skilled at interpreting images
- Surgeon choice

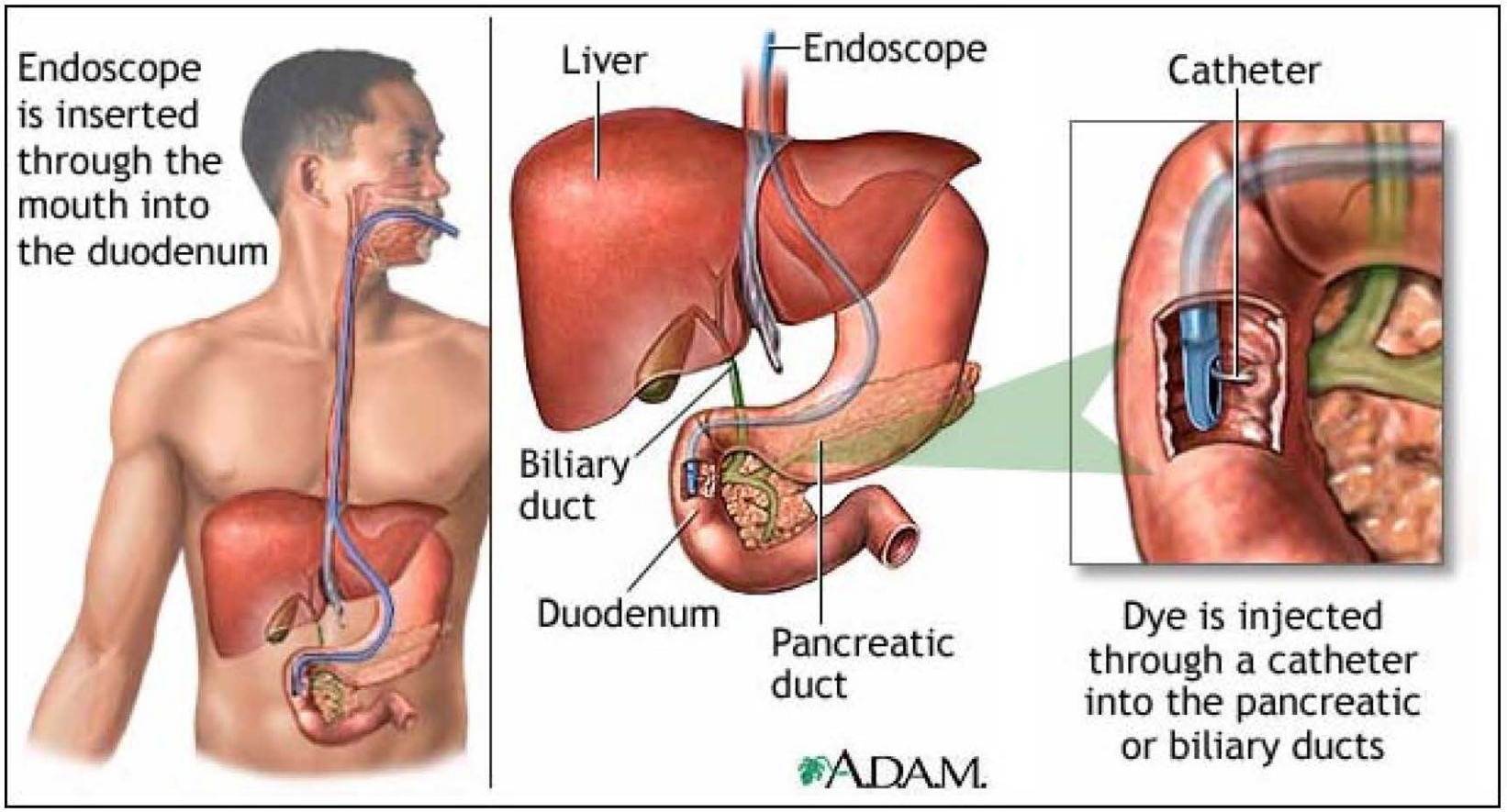
- Regardless of whether IOC is used, best practice includes
    - obtaining critical view in all dissections
    - understand anomalies of vascular and biliary anatomy
    - have second surgeon look at anatomy if concerned BEFORE clipping
    - if a bile duct injury is recognized, call for help from another surgeon before proceeding

Management of Common Duct Stones: ERCP vs. CBDE

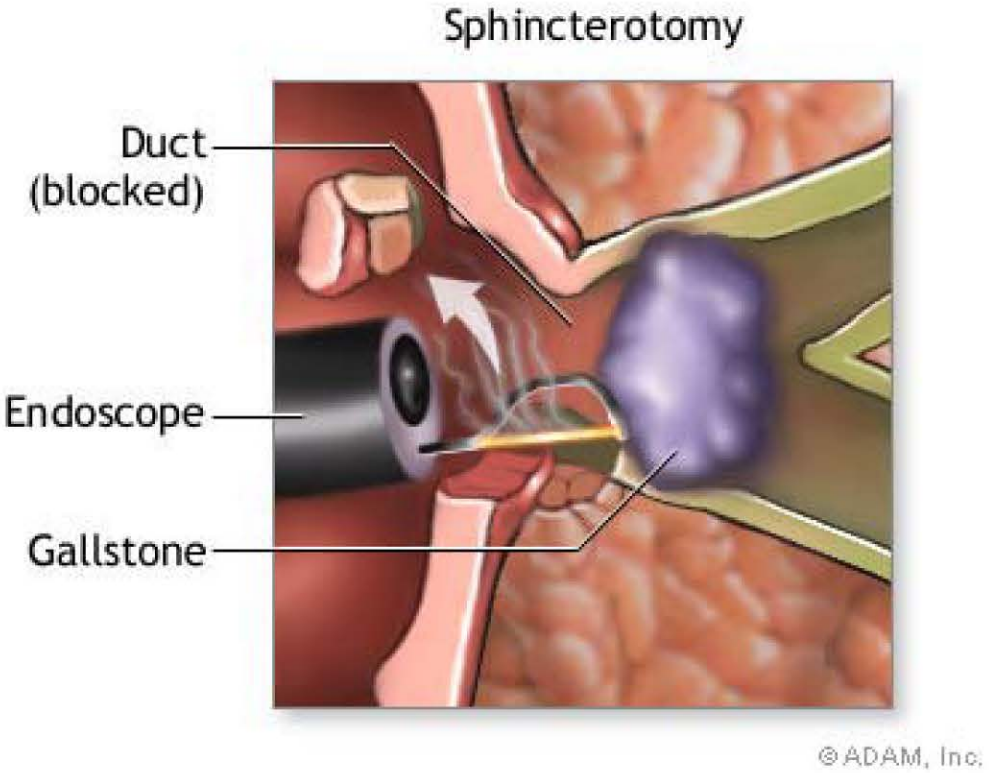
- ERCP
  - Performed by interventional gastroenterologists; have advanced training
  - widely available in suburban and urban areas

- Laparoscopic CBDE
  - requires advanced laparoscopic skills and specialized equipment
  - adds significant time to operation

Management of Common Duct Stones: ERCP



Management of Common Duct Stones: ERCP



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Special Considerations- Pregnancy SAGES Guidelines

- **Diagnosis and Workup**
- **A. <u>Imaging Techniques</u>**
- **<u>Ultrasound</u>**
  Guideline 1: Ultrasonographic imaging during pregnancy is safe and useful in identifying the etiology of acute abdominal pain in the pregnant patient (Moderate; Strong).
- **<u>Risk of Ionizing Radiation</u>**
  Guideline 2: Expeditious and accurate diagnosis should take precedence over concerns for ionizing radiation. Cumulative radiation dosage should be limited to 5-10 rads during pregnancy (Moderate; Strong).
- **<u>Computed Tomography</u>**
  Guideline 3: Contemporary multidetector CT protocols deliver a low radiation dose to the fetus and may be used judiciously during pregnancy (Moderate; Weak).
- **<u>Magnetic Resonance Imaging</u>**
  Guideline 4: MR Imaging without intravenous Gadolinium can be performed at any stage of pregnancy (Low; Strong).
- **<u>Nuclear Medicine</u>**
  Guideline 5: Administration of radionucleotides for diagnostic studies is generally safe for mother and fetus (Low; Weak).
- **<u>Cholangiography</u>**
  Guideline 6: Intraoperative and endoscopic cholangiography exposes the mother and fetus to minimal radiation and may be used selectively during pregnancy. The lower abdomen should be shielded when performing cholangiography during pregnancy to decrease the radiation exposure to the fetus (Low; Weak).
- **<u>B.Surgical techniques</u>**
- **Guideline 7: Diagnostic laparoscopy is safe and effective when used selectively in the workup and treatment of acute abdominal processes in pregnancy (Moderate; Strong).**

Special Considerations- Pregnancy SAGES Guidelines

- **Patient Selection**
- **Pre-operative Decision Making**
  Guideline 8: Laparoscopic treatment of acute abdominal disease has the same indications in pregnant and non-pregnant patients (Moderate; Strong).
- **Laparoscopy and Trimester of Pregnancy**
  Guideline 9: Laparoscopy can be safely performed during any trimester of pregnancy (Moderate; Strong).
- **Treatment**
- **Patient Positioning**
  Guideline 10: Gravid patients should be placed in the left lateral decubitus position to minimize compression of the vena cava (Moderate; Strong).
- **Initial Port Placement**
  Guideline 11: Initial abdominal access can be safely performed with an open (Hasson) technique, Veress needle or optical trocar, if the location is adjusted according to fundal height and previous incisions (Moderate; Weak).
- **Insufflation Pressure**
  Guideline 12: CO_2 insufflation of 10-15 mmHg can be safely used for laparoscopy in the pregnant patient (Moderate; Strong).
- **Intra-operative CO_2 monitoring**
  Guideline 13: Intraoperative CO_2 monitoring by capnography should be used during laparoscopy in the pregnant patient (Moderate; Strong).
- **Venous Thromboembolic (VTE) Prophylaxis**
  Guideline 14: Intraoperative and postoperative pneumatic compression devices and early postoperative ambulation are recommended prophylaxis for deep venous thrombosis in the gravid patient (Moderate; Strong).
- **Gallbladder Disease**
  Guideline 15: Laparoscopic cholecystectomy is the treatment of choice in the pregnant patient with gallbladder disease, regardless of trimester (Moderate; Strong).
- **Choledocholithiasis**
  Guideline 16: Choledocholithiasis during pregnancy may be managed with preoperative endoscopic retrograde cholangiopancreatography (ERCP) with sphincterotomy followed by laparoscopic cholecystectomy, laparoscopic common bile duct exploration, or postoperative ERCP (Moderate; Strong).

Special Considerations- Pregnancy SAGES Guidelines

- **Perioperative care**
- **<u>Fetal Heart Monitoring</u>**
  Guideline 21: Fetal heart monitoring should occur pre and postoperatively in the setting of urgent abdominal surgery during pregnancy (Moderate; Strong).
- **<u>Obstetrical Consultation</u>**
  Guideline 22: Obstetric consultation can be obtained pre- and/or postoperatively based on the severity of the patient's disease and availability (Moderate; Strong).
- **<u>Tocolytics</u>**
  Guideline 23: Tocolytics should not be used prophylactically in pregnant women undergoing surgery but should be considered perioperatively when signs of preterm labor are present (High, Strong).

Special Considerations- Cirrhosis

- J Am Coll Surg. 2003 Dec;197(6):921-6.
- **A metaanalysis of laparoscopic cholecystectomy in patients with cirrhosis.**
- Puggioni A, Wong LL.
- **Source**
- University of Hawaii John A Burns School of Medicine, Honolulu, HI, USA.
- **Abstract**
- **BACKGROUND:**
- Few articles address the issue of LC in patients with cirrhosis. Existing articles are retrospective and with small sample sizes, which makes it difficult to draw conclusions about indications and complications with LC in this setting.
- **STUDY DESIGN:**
- An extensive search of the Medline, Embase, and Cochrane databases using the terms "laparoscopic cholecystectomy" and "cirrhosis" or "cirrhotic" was conducted. The data from each study were extracted, combined with those of similar studies, and analyzed.
- **RESULTS:**
- Twenty-five publications (400 patients with cirrhosis undergoing LC) from 1993 to 2001 were identified. Four articles compared LC with open cholecystectomy in patients with cirrhosis, and six compared patients with cirrhosis to patients without cirrhosis. Patients were primarily in Child-Pugh class A or B, with only six patients in Child-Pugh class C. Compared with patients without cirrhosis, patients with cirrhosis had higher conversion rates (7.06% versus 3.64%, $p = 0.024$), operative times (98.2 minutes versus 70 minutes, $p = 0.005$), bleeding complications (26.4% versus 3.1%, $p < 0.001$), and overall morbidity (20.86% versus 7.99%, $p < 0.001$). Acute cholecystitis was evident in 47% of patients with cirrhosis versus 14.7% of patients without cirrhosis ($p < 0.001$). When LC was compared with open cholecystectomy in patients with cirrhosis, LC was associated with less operative blood loss (113 mL versus 425.2 mL, $p = 0.015$), operative time (123.3 minutes versus 150.2 minutes, $p < 0.042$), and length of hospital stay (6 days versus 12.2 days, $p < 0.001$).
- **CONCLUSIONS:**
- Patients with cirrhosis undergo cholecystectomies for more emergent reasons and have higher morbidity. The laparoscopic approach offers advantages of less blood loss, shorter operative time, and shorter length of hospitalization in patients with cirrhosis. Prospective studies will establish which factors affect outcomes and determine the appropriateness of LC in Child's-Pugh class C cirrhosis.
- PMID: 14644279 [PubMed - indexed for MEDLINE]

Special Considerations- Cancer

- Cancer Among American Indians and Alaska Natives in the United States, 1999–2004
  - An Update on Cancer in American Indians and Alaska Natives, 1999-2004 Supplement to Cancer

Special Considerations- Cancer

TABLE 2
Incidence Rates, Ranks, and Rate Ratios of the Top 25 Cance
Males by Indian Health Service Region in Contract Health S

	All Regions Combined				
	AI/AN		NHW		AI/AN:N
Type of Cancer	Rank	Rate[a]	Rank	Rate[a]	RR
All sites/types	—	414.6	—	549.2	0.75[b]
Prostate	1	105.6	1	154.4	0.68[b]
Lung and bronchus	2	69.6	2	85.9	0.81[b]
Colon and rectum	3	52.6	3	59.8	0.88[b]
Kidney/renal pelvis	4	23.2	7	17.2	1.35[b]
Urinary bladder	5	16.5	4	41.5	0.40[b]
NHL	6	15.2	6	23.1	0.65[b]
Stomach	7	14.7	12	8.5	1.74[b]
Oral cavity/pharynx	8	13.1	8	16.4	0.80[b]
Liver/IHBD	9	12.7	16	6.4	2.00[b]
Leukemia	10	11.5	9	16.3	0.71[b]
Pancreas	11	9.8	10	12.5	0.78[b]
Esophagus	12	8.1	11	8.7	0.93
Myeloma	13	6.7	17	6.3	1.06
Melanoma, skin	14	5.8	5	26.6	0.22[b]
Larynx	15	5.5	15	6.6	0.84[b]
Brain	16	4.5	13	8.3	0.54[b]
Testis	17	4.1	14	6.7	0.61[b]
Gallbladder	18	2.5	33	0.7	3.69[b]
Thyroid	19	2.4	18	4.4	0.55[b]
Other biliary	20	2.4	24	1.9	1.26
Soft tissue including heart	21	2.1	19	3.5	0.59[b]
Hodgkin lymphoma	22	1.7	20	3.3	0.51[b]
Penis	23	1.3	31	0.8	1.69[b]
Bones and joints	24	1.1	27	1.1	1.00
Anorectum	25	1.1	26	1.3	0.84

Special Considerations- Cancer

	Southwest				
	AI/AN		NHW		AI/AN:NHW
Type of Cancer	Rank	Rate[a]	Rank	Rate[a]	RR
All sites/types	0	256.2	0	505.0	0.51[b]
Prostate	1	65.7	1	133.8	0.49[b]
Lung and bronchus	4	21.2	2	77.3	0.27[b]
Colon and rectum	2	25.7	3	55.1	0.47[b]
Kidney/renal pelvis	3	25.2	7	15.7	1.60[b]
Urinary bladder	11	5.7	4	40.7	0.14[b]
NHL	7	10.9	6	20.4	0.54[b]
Stomach	5	15.3	13	7.1	2.17[b]
Oral cavity/pharynx	12	4.7	8	15.3	0.30[b]
Liver/IHBD	6	12.3	15	6.3	1.95[b]
Leukemia	9	7.0	9	14.2	0.49[b]
Pancreas	8	7.9	10	11.4	0.69[b]
Esophagus	13	4.6	11	8.0	0.58[b]
Myeloma	9	7.0	17	5.3	1.32
Melanoma, skin	17	3.3	5	28.6	0.11[b]
Larynx	19	2.1	16	5.9	0.35[b]
Brain	16	3.3	12	7.6	0.44[b]
Testis	14	4.3	14	6.3	0.68[b]
Gallbladder	15	4.1	32	0.7	6.21[b]
Thyroid	18	2.5	18	5.2	0.48[b]
Other biliary	20	2.0	23	1.8	1.12

Gallbladder Outline

- Anatomy
- Prevalence of gallbladder disease in the US and among Native Americans
- Complications of gallstones
- Evaluation
- Management Options
- Special Considerations
- Operative Complications
- Common Bile Duct (CBD) Injury
- Conclusions

Operative Complications

- Bleeding (<1%)
- Infection (<1%)
- Visceral, solid organ or Vascular injury (rare)
- Common Bile Duct Injury(0.1-0.6%)

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CBD Injury and Survival

- JAMA. 2003 Oct 22;290(16):2168-73.
- **Bile duct injury during cholecystectomy and survival in medicare beneficiaries.**
- Flum DR, Cheadle A, Prela C, Dellinger EP, Chan L.
- **Source**
- Department of Surgery, University of Washington, Seattle, Washington 98195-6410, USA. daveflum@u.washington.edu
- **Abstract**
- **CONTEXT:**
- Common bile duct (CBD) injury during cholecystectomy is a significant source of patient morbidity, but its impact on survival is unclear.
- **OBJECTIVE:**
- To demonstrate the relation between CBD injury and survival and to identify the factors associated with improved survival among Medicare beneficiaries.
- **DESIGN, SETTING, AND PATIENTS:**
- Retrospective study using Medicare National Claims History Part B data (January 1, 1992, through December 31, 1999) linked to death records and to the American Medical Association's (AMA's) Physician Masterfile. Records with a procedure code for cholecystectomy were reviewed and those with an additional procedure code for repair of the CBD within 365 days were defined as having a CBD injury.
- **MAIN OUTCOME MEASURE:**
- Survival after cholecystectomy, controlling for patient (sex, age, comorbidity index, disease severity) and surgeon (procedure year, case order, surgeon specialty) characteristics.
- **RESULTS:**
- Of the 1 570 361 patients identified as having had a cholecystectomy (62.9% women), 7911 patients (0.5%) had CBD injuries. The entire population had a mean (SD) age of 71.4 (10.2) years. Thirty-three percent of all patients died within the 9.2-year follow-up period (median survival, 5.6 years; interquartile range, 3.2-7.4 years), with 55.2% of patients without and 19.5% with a CBD injury remained alive. The adjusted hazard ratio (HR) for death during the follow-up period was significantly higher (2.79; 95% confidence interval [CI]; 2.71-2.88) for patients with a CBD injury than those without CBD injury. The hazard significantly increased with advancing age and comorbidities and decreased with the experience of the repairing surgeon. The adjusted hazard of death during the follow-up period was 11% greater (HR, 1.11; 95% CI, 1.02-1.20) if the repairing surgeon was the same as the injuring surgeon.
- **CONCLUSIONS:**
- The association between CBD injury during cholecystectomy and survival among Medicare beneficiaries is stronger than suggested by previous reports. Referring patients with CBD injuries to surgeons or institutions with greater experience in CBD repair may represent a system-level opportunity to improve outcome.
- PMID: 14570952 [PubMed - indexed for MEDLINE]

Causes and prevention of laparoscopic bile duct injuries

FEATURE

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Causes and Prevention of Laparoscopic Bile Duct Injuries

Analysis of 252 Cases From a Human Factors and Cognitive Psychology Perspective

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This paper was presented at the 2002 annual meeting of the American Surgical Association

Objective
To apply human performance concepts in an attempt to understand the causes of and prevent laparoscopic bile duct injury.

Summary Background Data
Powerful conceptual advances have been made in understanding the nature and limits of human performance. Applying these findings in high-risk activities, such as commercial aviation, has allowed the work environment to be restructured to substantially reduce human error.

Methods
The authors analyzed 252 laparoscopic bile duct injuries according to the principles of the cognitive science of visual perception, judgment, and human error. The injury distribution was class I, 7%; class II, 22%; class III, 61%; and class IV, 10%. The data included operative radiographs, clinical records, and 22 videotapes of original operations.

Results
The primary cause of error in 97% of cases was a visual perceptual illusion. Faults in technical skill were present in only 3% of injuries. Knowledge and judgment errors were contributory but not primary. Sixty-four injuries (25%) were recognized at the index operation; the surgeon identified the problem early enough to limit the injury in only 15 (6%). In class III injuries the common duct, erroneously believed to be the cystic duct, was deliberately cut. This stemmed from an illusion of object form due to a specific uncommon configuration of the structures and the heuristic nature (unconscious assumptions) of human visual perception. The videotapes showed the persuasiveness of the illusion, and many operative reports described the operation as routine. Class II injuries resulted from a dissection too close to the common hepatic duct. Fundamentally an illusion, it was contributed to in some instances by working too deep in the triangle of Calot.

Conclusions
These data show that errors leading to laparoscopic bile duct injuries stem principally from misperception, not errors of skill, knowledge, or judgment. The misperception was so compelling that in most cases the surgeon did not recognize a problem. Even when irregularities were identified, corrective feedback did not occur, which is characteristic of human thinking under firmly held assumptions. These findings illustrate the complexity of human error in surgery while simultaneously providing insights. They demonstrate that automatically attributing technical complications to behavioral factors that rely on the assumption of control is likely to be wrong. Finally, this study shows that there are only a few points within laparoscopic cholecystectomy where the complication-causing errors occur, which suggests that focused training to heighten vigilance might be able to decrease the incidence of bile duct injury.

CBD injury

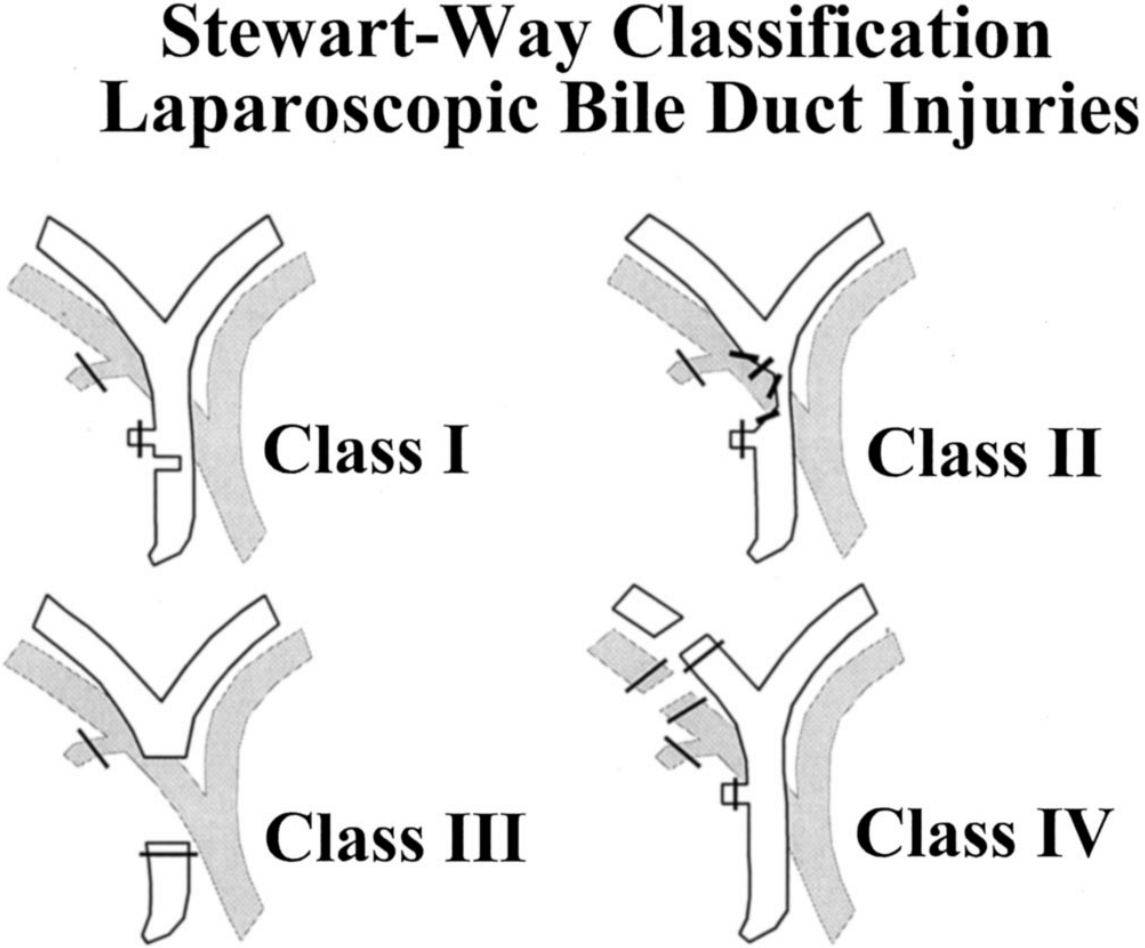
Stewart-Way Classification
Laparoscopic Bile Duct Injuries
Class I
Class II
Class III
Class IV

Table 1. MECHANISM OF INJURY

- Class I (7%)
  - CBD mistaken for cystic duct, but recognized
  - Cholangiogram incision in cystic duct extended into CBD
- Class II (22%)
  - Lateral damage to the CHD from cautery or clips placed on duct
  - Associated bleeding, poor visibility
- Class III (61%)
  - CBD mistaken for cystic duct, not recognized
  - CBD, CHD, R, L hepatic ducts transected and/or resected
- Class IV (10%)
  - RHD mistaken for cystic duct, RHA mistaken for cystic artery, RHD and RHA transected
  - Lateral damage to the RHD from cautery or clips placed on duct

Table 3. RULES OF THUMB TO HELP PREVENT BILE DUCT INJURIES

- Optimize Imaging
  - Use high-quality imaging equipment.
- Initial Steps and Objectives
  - Before starting the dissection, use the triangle of Calot for orientation; find the cystic duct starting at the triangle.
  - Pull the gallbladder infundibulum laterally to open the triangle of Calot.
  - Clear the medial wall of the gallbladder infundibulum.
  - Make sure the cystic duct can be traced uninterrupted into the base of the gallbladder.
  - Open any subtle tissue plane between the gallbladder and presumed cystic duct; the real cystic duct may be hidden in there.

CBD Injury

- Factors that Suggest One May Be Dissecting the Common Duct Instead of Cystic Duct
  - The duct when clipped is not fully encompassed by a standard M/L clip (9 mm).
  - Any duct that can be traced without interruption to course behind the duodenum is probably the CBD.
  - The presence of another unexpected ductal structure.
  - A large artery behind the duct—the right hepatic artery runs posterior to the CBD.
  - Extra lymphatic and vascular structures encountered in the dissection.
  - The proximal hepatic ducts fail to opacify on operative cholangiograms.

CBD Injury

- Obtain Operative Cholangiograms Liberally
  - Whenever the anatomy is confusing
  - When inflammation and adhesions result in a difficult dissection
  - Whenever a biliary anomaly is suspected; assume that what appears to be anomalous anatomy is really normal and confusing until proved otherwise by cholangiograms.

CBD Injury

- Avoid Unintended Injury to Ductal Structures
  - Only place clips on structures that are fully mobilized; the tip of a closed clip should not contain tissue.
  - The need for more than eight clips suggests the operation may be bloody enough to warrant conversion to an open procedure.
  - Consideration of a need for blood transfusion suggests the operation should be converted to an open procedure.
  - Open when inflammation or bleeding obscures the anatomy.

CBD Injury

- Illusions
  - Compelling anatomic illusions to which everyone is susceptible are the primary cause of bile duct injuries; experience, knowledge,and technical skill by themselves are insufficient protection against this complication.

Video of Type III CBD Injury

- http://www.youtube.com/watch?feature=player_detailpage&v=UX300cxhdJ4

Mitigating Risk

- Treat the problem promptly
- Treat the patient
- Treat the family
- Refer to an hepatobiliary surgeon

Gallbladder Outline

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Conclusions

- The incidence of gallstones are higher in AI/AN due to high cholesterol diet, hydrophobic bile salts, obesity.
- Complications of gallstones include
  - Biliary colic
  - Acute cholecystitis
  - Pancreatitis
  - Choledocholithiasis
  - Cholangitis

Conclusions

- Laparoscopic cholecystectomy is the most common treatment for complicated gallstones.
- Risks are low, but the most feared is CBD injury
- Minimize risk with adequate visualization, liberal use of cholagiogram, second surgeon to evaluate to minimize “magical thinking”.
- If injury occurs and found postoperatively, stabilize the patient and transfer to hepatobiliary surgeon.