Objectives

• Define the basic anatomy of the gallbladder and its relationship to surrounding structures

• Understand basic clinical and radiological findings in different gallbladder diseases

• Discuss cost effective treatment options for choledocholithiasis

• Discuss current recommendations for routine versus selective intraoperative cholangiograms
Gallbladder timeline

- 1420 gallstones identified on autopsy by pathologist Antonio Benevieni
- 1630 & 1637 two separate studies show the gallbladder was not an essential organ
- 1743 first cholecystostomy performed by Jean-Louis Petit
- 1867 John Bobbs from Indianapolis, IN opened a stone packed gallbladder and removed the gallstones leaving the gallbladder in the abdomen

• 1882 Carol Johann August Langenbuch performs the first cholecystectomy

• 1931 Pablo Luis Mirizzi performed the first cholangiography

• 1987 Phillipe Mouret performed the first laparoscopic cholecystectomy

• 1992 NIH concluded laparoscopic cholecystectomy treatment of choice

• 1997 single port laparoscopy

• 2007 Natural orifice transluminal endoscopic surgery (NOTES)
• Anatomically divided into a fundus, body, infundibulum and neck
• It is usually 7-10cm in length, 3-5cm in diameter and has a capacity of 30-60mL.
• Blood supply to the extrahepatic biliary system originates distally from the GDA, retroduodenal and posterosuperior pancreatoduodenal arteries; proximally from the right hepatic & cystic arteries

• These arteries supply the common bile and common hepatic ducts through branches running parallel to the duct in the 3 & 9 o’clock positions

• Ischemia of the bile duct will not be readily evident at time of dissection but can result in biliary stricture or leak postoperatively
Gallstone Disease

• One of the leading indications for surgery in the US today, with approximately 750,000+ cholecystectomies performed every year

• 10-20% of the population will develop gallstones, the incidence increases with age

• Not all management is clear cut
Asymptomatic Gallstones

• Only about 30% of asymptomatic patients will warrant surgery during their lifetime

• Landmark study by Gracie and Ransohoff followed 123 patients 15 years

  • 10% progressed to symptoms in 5 years
  • 15% by 10 years
  • 18% by 15 years
  • Overall 1-2% per year developed serious complications
• Stones greater than 2.5cm

• Congenital hemolytic anemias (Sickle, hereditary spherocytosis, thalassemia)

• During bariatric surgery secondary to rapid weight loss and increased lithogenicity

• Polyps greater than 15mm

• Transplantation ?? Cardiac only, expectant management for pancreas and/or kidney
• Higher risk than the general population for gallstone formation

• Gallstones alone are an indication for cholecystectomy

• Pretransplant cholecystectomy should be considered in clinically stable patients with gallstones
Plain abdominal film: nonspecific and not useful in differentiating biliary colic and acute cholecystitis

Ultrasound: study of choice, can evaluate GB thickness, diameter of CBD, CHD, and intrahepatic ducts, pericholecystic fluid, and stones

CT scan: should not be used as an initial study for GB disease, provides similar information as US at much higher price

MRCP: expensive, very sensitive to fluid stasis and imaging CBD stones

HIDA: limited role, reproduction of symptoms with CCK injection
• Primary symptom—PAIN

• Usually right upper quadrant, epigastric and frequently radiates to the back and right scapula

• Severe enough that many patients seek medical attention with first episode

• Only 50% experience pain with fatty meals

• Duration of pain 1-5 hours with attacks rarely lasting longer than 24 hours
Chronic Calculous Cholecystitis

Pathogenesis

- Recurrent inflammatory process involving the gallbladder
- >90% patients gallstones are the causative factor
- Attacks lead to scarring and nonfunctioning GB
- Histopathologically CCC is characterized by an increase in subepitelial and subserosal fibrosis and mononuculear cell infiltrate
Chronic Calculous Cholecystitis

Presentation

- Colicky pain
- Chronic nausea and vomiting >60% cases
- Normal physical exam
- Normal lab values
Diagnosis

- Two findings must be present—gallstones and abdominal pain consistent with biliary colic
- Gallstones without symptoms do not require treatment

Management

- Cholecystectomy
Acute Calculous Cholecystitis

Pathophysiology

• Most common complication of gallstones occurring in 20-30% of patients with symptomatic disease

• Results from stone impaction at the gallbladder-cystic duct junction

• In 5-20% obstruction can lead to ischemia and necrosis of the GB

• Inflammatory and not an infectious process with bacterial infection appearing as a secondary event
Acute Calculous Cholecystitis

Presentation

- Unremitting pain, may last several days and often associated with emesis, anorexia and fever

- Murphy’s sign—an inspiratory arrest during deep palpation of RUQ...classic finding

- Labs reveal mild leukocytosis, possible mild hyperbilirubinemia, elevated transaminases, and amylase
Acute Calculous Cholecystitis

Diagnosis

• Ultrasound >90% sensitivity for ACC suggestive findings include GB wall thickening greater than 4mm, pericholecystic fluid and sonographic Murphy’s sign

• HIDA scan may indicate and obstructed cystic duct and in the right clinical setting can have >95% sensitivity and specificity

• CT scan reveals many of the same US findings, but is less sensitive and more expensive
Acute Calculous Cholecystitis

Treatment

• Laparoscopic cholecystectomy within 24 to 72 hours of diagnosis

• Early conversion to an open procedure should be considered if dissection is difficult or clear progress cannot be made

• High risk patients whose medical condition(s) precludes cholecystectomy, a cholecystostomy can be performed
Prospective Randomized Study of Early Versus Delayed Laparoscopic Cholecystectomy for Acute Cholecystitis

Randomized trial of early *versus* delayed laparoscopic cholecystectomy for acute cholecystitis

<table>
<thead>
<tr>
<th></th>
<th>Queen Mary hospital</th>
<th>Prince of Wales hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Early</td>
<td>Late</td>
</tr>
<tr>
<td>Number of patients</td>
<td>45</td>
<td>41</td>
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<tr>
<td>Operative time</td>
<td>135 min</td>
<td>105 min</td>
</tr>
<tr>
<td>Conversion</td>
<td>11%</td>
<td>23%</td>
</tr>
<tr>
<td>Morbidity</td>
<td>13%</td>
<td>29%</td>
</tr>
<tr>
<td>Total LOS</td>
<td>6 days</td>
<td>11 days</td>
</tr>
<tr>
<td>Recurrent symptoms</td>
<td>—</td>
<td>36%</td>
</tr>
</tbody>
</table>
Acute Cholangitis

Pathophysiology

• Clinical cholangitis results from two factors—biliary obstruction and significant concentrations of bacteria in the bile

• Most common organisms recovered—E. coli, Klebsiella, Enterococcus, Bacteroides

• Biliary obstruction leads to high intrabiliary pressures resulting in bacterial organisms rapidly appearing in both blood and lymphatics
Acute Cholangitis

Presentation

- Wide spectrum of disease from self-limited to toxic
- Charcot’s triad/Reynolds’ pentad: jaundice, fever, RUQ pain / mental status change and hypotension
- Pain is usually present but much milder than acute calculous cholecystitis
- Up to 33% of East Asian patients with choledocholithiasis present with toxic cholangitis
**Acute Cholangitis**

*Diagnosis*

- Clinical diagnosis supported by leukocytosis, hyperbilirubinemia, elevation of transaminases, US, CT, or MRCP may reveal biliary ductal dilation due to stones or mass.

*Treatment*

- Initially supportive with antibiotics, fluids, and vasopressors if needed
- Approximately 15% will not respond to antibiotics within 24 hours and require biliary decompression either percutaneous or endoscopic
Treatment continued

- In the setting of failed endoscopic and percutaneous decompression surgical CBD exploration with T-tube placement remains a life-saving procedure, but carries a significantly higher mortality.

- Gallstone cholangitis requires an interval cholecystectomy within 6-12 weeks as the incidence of recurrent biliary symptoms are significantly higher if the gallbladder is left in situ (6% vs 25%).

Management of Gallstone Cholangitis in the Era of Laparoscopic Cholecystectomy

Ronnie Tung-Ping Poon, MD, FRCS(Ed); Chi-Leung Liu, MD, FRCS(Ed); Chung-Mau Lo, MS, FRCS(Ed), FRACS; Chi-Ming Lam, MD, MS, FRCS(Ed); Wai-Kei Yuen, MD, FRCS(Glasg), FRACS; Chun Yeung, MD, FRCS(Glasg); Sheung-Tat Fan, MD, FRCS(Ed), FACS; John Wong, PhD, FRACS, FACS

Acute Acalculous Cholecystitis

- 5-10% of all patients with acute cholecystitis

- Diagnosed most often in critically ill patient following trauma, burns, long term TPN, or after major nonbiliary operations such as AAA repair and cardiac bypass

- Etiology unclear although stasis and ischemia are often thought to play a role

- Emergency cholecystectomy if diagnosis is suspected as the incidence of gangrene, perforation and empyema exceeds 50%

- Mortality upwards of 40%
• Typical biliary colic symptoms, but no evidence of stones on US

• More aggressive workup—CT scan, EGD, ERCP?, HIDA

• All other studies negative and HIDA EF <35% considered abnormal

• 85-94% of patients with low EF and symptoms of biliary colic treated with cholecystectomy are improved
• CBD stones can be classified as either primary or secondary

• In the United States more than 85% are secondary

• Primary duct stones typically occur with benign biliary stricture, sclerosing cholangitis, choledochal cyst disease, or sphincter of Oddi dysfunction

• Primary stones require removal of the stones and a drainage procedure whereas secondary can be treated by removal of stones and cholecystectomy
Symptoms

- Anorexia
- Icterus
- Dark urine

H&P

- Subicterus
- Jaundice
- History of cholangitis
- History of pancreatitis
Predictors of Choledocholithiasis

Laboratory and Imaging

- Total bilirubin (>1.4 mg/dl)
- Direct bilirubin (>0.3 mg/dl)
- AST (>36 U/L)
- ALT (>36 U/L)
- CBD diameter > 6mm in the presence of stones
- Observed stone on US or other imaging
Predictors of choledocholithiasis

Biochemical predictors for absence of common bile duct stones in patients undergoing laparoscopic cholecystectomy

Ming-Hsun Yang · Tien-Hua Chen · Shin-E Wang · Yi-Fang Tsai · Cheng-Hsi Su · Chew-Wun Wu · Wing-Yiu Lui · Yi-Ming Shyr

DOI 10.1007/s00464-007-9665-2

Table 1 Predictors of common bile duct stones in patients undergoing laparoscopic cholecystectomy

<table>
<thead>
<tr>
<th>Clinical predictors</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Likelihood ratio</th>
<th>Accuracy</th>
<th>Predictive value</th>
<th>P value</th>
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</thead>
<tbody>
<tr>
<td>ERCP, n = 199</td>
<td>96.0</td>
<td>99.1</td>
<td>107.3</td>
<td>98.0</td>
<td>98.8</td>
<td>0.000</td>
</tr>
<tr>
<td>Sonography, n = 926</td>
<td>35.7</td>
<td>97.9</td>
<td>8.1</td>
<td>93.2</td>
<td>58.1</td>
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<tr>
<td>CT scan, n = 232</td>
<td>74.5</td>
<td>89.5</td>
<td>7.1</td>
<td>86.2</td>
<td>66.7</td>
<td>0.000</td>
</tr>
<tr>
<td>MRI, n = 32</td>
<td>75.0</td>
<td>87.5</td>
<td>6.0</td>
<td>84.4</td>
<td>66.7</td>
<td>0.002</td>
</tr>
<tr>
<td>CBD diameter, n = 994</td>
<td>54.5</td>
<td>91.8</td>
<td>6.6</td>
<td>88.7</td>
<td>38.8</td>
<td>0.000</td>
</tr>
<tr>
<td>Serum amylase, n = 304</td>
<td>45.5</td>
<td>91.8</td>
<td>1.6</td>
<td>67.4</td>
<td>21.1</td>
<td>0.035</td>
</tr>
<tr>
<td>GGT, n = 1002</td>
<td>84.1</td>
<td>72.0</td>
<td>3.0</td>
<td>75.7</td>
<td>22.4</td>
<td>0.000</td>
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<tr>
<td>ALP, n = 1002</td>
<td>79.5</td>
<td>72.9</td>
<td>2.9</td>
<td>73.5</td>
<td>22.0</td>
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<tr>
<td>TB, n = 1002</td>
<td>48.9</td>
<td>87.5</td>
<td>3.9</td>
<td>84.1</td>
<td>27.4</td>
<td>0.000</td>
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<tr>
<td>ALT, n = 1002</td>
<td>71.6</td>
<td>68.2</td>
<td>2.3</td>
<td>68.5</td>
<td>17.8</td>
<td>0.000</td>
</tr>
<tr>
<td>AST, n = 1002</td>
<td>63.6</td>
<td>78.7</td>
<td>3.0</td>
<td>72.4</td>
<td>22.3</td>
<td>0.000</td>
</tr>
<tr>
<td>GGT+ALP+TB+ALT+AST, n = 1002</td>
<td>87.5</td>
<td>53.3</td>
<td>1.8</td>
<td>63.4</td>
<td>15.3</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Options, options and more options...

- Preoperative endoscopic retrograde cholangiopancreatography (ERCP)
- Laparoscopic cholecystectomy with intraoperative cholangiogram
  - Postoperative ERCP
  - Intraoperative ERCP
  - Laparoscopic common bile duct exploration
  - Open common bile duct exploration
  - Placement of a double lumen catheter
Management of Preoperatively Suspected Choledocholithiasis: A Decision Analysis

Bilal Kharbutli · Vic Velanovich
DOI 10.1007/s11605-008-0624-6

PreOp ERCP/ES
  - Successful 92%
    - Lap. Chole
      - Mortality 0.1%
      - Mortality 7.6%
      - Morbidity 6.4%
  - PreOp ERCP/ES
    - S: 88%
      - M: 13.5%
      - M: 0.5%
  - Symptomatic Choledocholithiasus
    - S: 91%
      - M: 7%
      - M: 0.19%
  - Lap. Chole w/ IOC
    - Successful IOC 93.5%
      - Positive IOC 22%
      - Negative IOC 78%
      - Mortality 2.6-10%
      - Mortality 0.1%
      - Morbidity 6.4%

LCBDE
  - Successful 96%
    - Positive IOC 22%
      - Double Lumen Catheter
        - Mortality 0%
      - Mortality 0.4%
    - Negative IOC 78%
      - Mortality 2.6-10%
      - Morbidity 6.4%

Post Op ERCP
  - Successful 92%
    - Positive IOC 22%
      - Double Lumen Catheter
        - Mortality 11%
      - Mortality 0%
    - Negative IOC 78%
      - Mortality 2.6-10%
      - Morbidity 6.4%

IntraOp ERCP
  - Successful 91%
    - Positive IOC 22%
      - Double Lumen Catheter
        - Mortality 8%
      - Mortality 0.4%
    - Negative IOC 78%
      - Mortality 2.6-10%
      - Morbidity 6.4%
Sensitivity analysis

MORBIDITY AND MORTALITY

Morbidity and Mortality diagram with different stages and percentages.
• One stage management of LC with IOC followed by LCBDE for positive choledocholithiasis has the lowest rate of morbidity and mortality

• LCBDE does require a surgeon comfortable and facile with this technique. Sensitivity analysis reveal that when LCBDE added morbidity and mortality is 32% and 1.8% then the one stage management option will have higher morbidity and mortality rate compared to the two stage.

• Decreased hospital stay with one stage technique

• ERCP is preferred in patients with suppurative cholangitis, biliary sepsis or high risk surgical patients
Cost Analysis

• Estimated that surgeons in the United States deal with 50,000-115,000 cases of choledocholithiasis yearly

• The rational allocation of scarce health care resources requires that the most cost effective approach be used to deal with such a common clinical problem

• The most popular methods of detecting CBD stones include ERCP, endoscopic ultrasound, IOC, intraoperative US and MRCP
Cost-effective management of common bile duct stones

A decision analysis of the use of endoscopic retrograde cholangiopancreatography (ERCP), intraoperative cholangiography, and laparoscopic bile duct exploration

D. R. Urbach, Y. S. Khajanchee, B. A. Jobe, B. A. Standage, P. D. Hansen, L. L. Swanstrom

Department of Minimally Invasive Surgery and Surgical Research, Legacy Health Systems, 501 North Graham, Suite 120, Portland, OR 97227, USA

<table>
<thead>
<tr>
<th>Procedure or event</th>
<th>Base-case analysis</th>
<th>Range tested</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnostic ERCP</td>
<td>$1441</td>
<td>$500–2000</td>
</tr>
<tr>
<td>Therapeutic ERCP</td>
<td>$1917</td>
<td>$1000–3000</td>
</tr>
<tr>
<td>Intraoperative cholangiogram</td>
<td>$368</td>
<td>$250–1000</td>
</tr>
<tr>
<td>Laparoscopic transcystic common bile duct exploration</td>
<td>$1094</td>
<td>$500–2000</td>
</tr>
<tr>
<td>Laparoscopic transcholedochal common bile duct exploration</td>
<td>$1769</td>
<td>$1000–3000</td>
</tr>
<tr>
<td>Open cholecystectomy (conversion)</td>
<td>$1794</td>
<td>$1000–3000</td>
</tr>
<tr>
<td>Complication of laparoscopic common bile duct exploration (bile leak)</td>
<td>$1178</td>
<td>$500–3000</td>
</tr>
<tr>
<td>Complication of ERCP sphincterotomy (severe acute pancreatitis)</td>
<td>$5473</td>
<td>$2000–20,000</td>
</tr>
</tbody>
</table>

ERCP, endoscopic retrograde cholangiopancreatography

* All costs are those in excess of the cost of a laparoscopic cholecystectomy, in US dollars
Cost Analysis

• The laparoscopic cholecystectomy only strategy was the least costly, but given the prevalence of CBD stones at 10% the effectiveness is only 90%

• The LCBDE strategy had a cost effectiveness ratio of $5993.60, indicating that it would cost an additional $5993.60 to prevent one case of residual CBD stones

• Routine preoperative ERCP is very effective at preventing residual CBD stones, approximately 333 patients would need to be managed with preop ERCP in order to avoid a single case of retained CBD stone. A cost of $299,259.35

• Preop ERCP had a better average cost effectiveness than selective postop ERCP when the prevalence of CBD stones was >0.80
Intraoperative Cholangiogram

Reasons for routine IOC

- Screening for unsuspected BD pathology such as strictures, anomalies, and tumors
- Prevention of bile duct injuries
- Obtaining and maintaining proficiency
- Reduction of unnecessary BDE
Intraoperative Cholangiogram

**Reality**

- Clinically significant unsuspected anomalies are very rare

- Unsuspected CBD stones becoming symptomatic is 1 out of 10 and few of those will develop a complication

- Injuries occur whether routine IOC is used or not...when the anatomy is clear enough to incise the cystic duct for an IOC, it is clear enough not to need an IOC
Intraoperative Cholangiogram

Reasons against routine IOC

- Prolonged operative time
- Increased incidence of allergic reaction
- Pancreatitis
- BD injuries
- Unnecessary procedures
- Morbidity
- Cost

Real argument—increased unnecessary morbidity and cost
Reasons for selective IOC

- Can safely and accurately identify suspected stones and other pathology, clarify the anatomy, confirm or rule out a suspected BD injury and allow surgeons to acquire and maintain proficiency.
Indications for selective IOC

- Preop
  - Jaundice, pancreatitis, cholangitis, abnormal LFTs, defect on US or dilated CD on US

- Intraop
  - Cystic duct >5mm, common duct >10mm, stones or sludge in the cystic or common duct, questionable anatomy or BD injury
The results of 2043 LC were compiled and analyzed in regards to necessity and cost.

Overall LIOC was attempted in 1661 and successful in 1656 (99.7%). LBDE was attempted in all cases, none were referred to preop ERCP.

In order to avoid one patient with symptomatic residual CBD stone 354 unnecessary procedures would be performed at a cost of nearly $500,000.
### Table 4. Charges for laparoscopic cholangiogram as of February 1997

<table>
<thead>
<tr>
<th>Item</th>
<th>Hospital A</th>
<th>Hospital B</th>
<th>Hospital C</th>
<th>Average</th>
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</thead>
<tbody>
<tr>
<td>Setup charge</td>
<td>$189.00</td>
<td>$345.50</td>
<td>$341.00</td>
<td>$291.83</td>
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<tr>
<td>C-arm</td>
<td>168.00</td>
<td>197.50</td>
<td>217.00</td>
<td>194.17</td>
</tr>
<tr>
<td>C-arm drape</td>
<td>7.05</td>
<td>28.80</td>
<td>17.30</td>
<td>17.72</td>
</tr>
<tr>
<td>Radiologist</td>
<td>43.00</td>
<td>38.00</td>
<td>43.00</td>
<td>41.33</td>
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<tr>
<td>Surgeon</td>
<td>279.00</td>
<td>279.00</td>
<td>279.00</td>
<td>279.00</td>
</tr>
<tr>
<td>Asst. surgeon</td>
<td>70.00</td>
<td>70.00</td>
<td>70.00</td>
<td>70.00</td>
</tr>
<tr>
<td>OR time</td>
<td>150.00</td>
<td>177.20</td>
<td>256.00</td>
<td>194.40</td>
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<tr>
<td>Contrast</td>
<td>10.91</td>
<td>12.20</td>
<td>15.10</td>
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<tr>
<td>IV saline</td>
<td>21.22</td>
<td>21.00</td>
<td>8.20</td>
<td>16.81</td>
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<tr>
<td>Syringes</td>
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<td>0.00</td>
<td>4.80</td>
<td>1.60</td>
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<tr>
<td>Cholangiocatheter</td>
<td>86.90</td>
<td>113.50</td>
<td>156.60</td>
<td>119.00</td>
</tr>
<tr>
<td>Extension tube</td>
<td>12.60</td>
<td>17.20</td>
<td>12.80</td>
<td>14.20</td>
</tr>
<tr>
<td>Shield drape</td>
<td>6.30</td>
<td>6.00</td>
<td>8.20</td>
<td>6.83</td>
</tr>
<tr>
<td>Extra clips</td>
<td>19.66</td>
<td>25.30</td>
<td>25.80</td>
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<td>Anesthesia time</td>
<td>27.60</td>
<td>27.60</td>
<td>27.60</td>
<td>27.60</td>
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<tr>
<td><strong>Totals</strong></td>
<td><strong>$1063.64</strong></td>
<td><strong>$1331.20</strong></td>
<td><strong>$1454.80</strong></td>
<td><strong>$1283.21</strong></td>
</tr>
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</table>

### Table 5. Charges for transcholedochal BDE with choledochoscopy, tube, and drainage (1997)

<table>
<thead>
<tr>
<th>Item</th>
<th>Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-arm set setup</td>
<td>$127.00</td>
</tr>
<tr>
<td>C-arm drape</td>
<td>655.00</td>
</tr>
<tr>
<td>Radiologist</td>
<td>163.00</td>
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<tr>
<td>C-arm time</td>
<td>1129.00</td>
</tr>
<tr>
<td>Surgeon</td>
<td>371.50</td>
</tr>
<tr>
<td>Asst. surgeon</td>
<td>110.00</td>
</tr>
<tr>
<td>OR time</td>
<td>318.00</td>
</tr>
<tr>
<td>Anesthesia time</td>
<td>67.50</td>
</tr>
<tr>
<td>Balloon catheter</td>
<td>14.50</td>
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<tr>
<td>Choledochoscope</td>
<td>32.50</td>
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<tr>
<td>Irrigator</td>
<td>141.00</td>
</tr>
<tr>
<td>Irrigation tubing</td>
<td>80.00</td>
</tr>
<tr>
<td>Irrigation saline</td>
<td>27.50</td>
</tr>
<tr>
<td>T-tube</td>
<td>15.00</td>
</tr>
<tr>
<td>Drain</td>
<td>8.50</td>
</tr>
<tr>
<td>Suture</td>
<td>8.50</td>
</tr>
<tr>
<td>Bile bag</td>
<td>8.50</td>
</tr>
<tr>
<td>Extension tube</td>
<td>8.50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$3263.00</strong></td>
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### Table 6. Charges for ERCP with papillotomy (1997)

<table>
<thead>
<tr>
<th>Item</th>
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<tr>
<td>Hospital</td>
<td>$3250.00</td>
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<tr>
<td>Gastroenterologist</td>
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<td><strong>Total</strong></td>
<td><strong>$4303.00</strong></td>
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</tbody>
</table>
• 4,100 general surgeons randomly selected from the American College of Surgeons were mailed a survey about IOC

• 44% response rate; 27% defined themselves as routine IOC users defined as use in more than 75% of LC; academic surgeons were less often routine users; selective users were often low volume (<20LC/yr); routine users were more often high volume (>100LC/yr)

• Surgeons at greatest risk for causing CBD injury (inexperienced, low volume) and those with the greatest opportunity to train others are less likely to use IOC routinely
• 84% of routine and 82% of selective cholangiographers thought a misidentification was likely or very likely.

Figure 1. This cholangiogram was obtained in a 35-year-old woman with biliary colic and no history of common bile duct stones. It was obtained after a routine dissection, the cystic duct was identified at its junction with the gall bladder, a single clip was applied proximally, and the cholangiocatheter was introduced through a small hole in the cystic duct. After this intraoperative cholangiography, the surgeon flushed the catheter, introduced more contrast material, tilted the head down, and administered morphine to prevent flow into the duodenum.
<table>
<thead>
<tr>
<th>Demographic</th>
<th>All (n=1,411)</th>
<th>Routine (n=381)</th>
<th>Selective (n=1,030)</th>
<th>p Value*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>27.0</td>
<td>73.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Characteristics, %</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male, %</td>
<td>89.2</td>
<td>89.8</td>
<td>89.0</td>
<td>0.82</td>
</tr>
<tr>
<td>Mean age, y†</td>
<td>51.8 ± 9.6</td>
<td>51.7 ± 9.3</td>
<td>51.9 ± 9.6</td>
<td>0.83</td>
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<tr>
<td>Mean years since residency†</td>
<td>19.6 ± 10.3</td>
<td>19.7 ± 9.9</td>
<td>19.6 ± 10.4</td>
<td>0.85</td>
</tr>
<tr>
<td>Training included IOC, %</td>
<td>79.3</td>
<td>79.5</td>
<td>79.2</td>
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<tr>
<td>Practice setting, %</td>
<td></td>
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<tr>
<td>Private practice</td>
<td>55.3</td>
<td>63.3</td>
<td>52.3</td>
<td>&lt; 0.001</td>
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<td>Academic staff</td>
<td>12.0</td>
<td>6.8</td>
<td>13.9</td>
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<tr>
<td>Private/public hospital</td>
<td>10.7</td>
<td>11.3</td>
<td>10.5</td>
<td></td>
</tr>
<tr>
<td>HMO</td>
<td>1.4</td>
<td>0</td>
<td>1.9</td>
<td></td>
</tr>
<tr>
<td>Federal</td>
<td>0.9</td>
<td>1.0</td>
<td>0.9</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>4.9</td>
<td>4.7</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td>14.8</td>
<td>12.9</td>
<td>15.5</td>
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<tr>
<td>Point of care, %</td>
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<td>0.08</td>
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<td>Community hospital</td>
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<td>67.2</td>
<td>59.1</td>
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<tr>
<td>Tertiary referral center</td>
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<td>13.9</td>
<td>18.9</td>
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<tr>
<td>Outpatient surgery center</td>
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<td>1.8</td>
<td>2.6</td>
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<tr>
<td>Other</td>
<td>3.8</td>
<td>3.7</td>
<td>3.9</td>
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<tr>
<td>Missing</td>
<td>14.9</td>
<td>13.4</td>
<td>15.5</td>
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<tr>
<td>Cholecystectomies/y, %</td>
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<td></td>
<td>0.005</td>
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<td>3.2</td>
<td>5.3</td>
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<td>21–50</td>
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<tr>
<td>51–100</td>
<td>36.0</td>
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</tbody>
</table>
Summary

• Well over 750,000 laparoscopic cholecystectomies are performed every year

• Variable cystic duct, common duct and cystic artery anatomy make careful dissection a must in order to maintain low morbidity and mortality rates

• Improvement of laboratory and imaging modalities have made diagnosing CBD stones and other pathology easier

• LC with IOC for suspected choledocholithiasis has been proven to be more cost effective than routine preoperative ERCP
How to handle choledocholithiasis on an IOC depends on both surgeon and facility

Selective IOC use appears to be both safe and financially conservative


Score Portal STATdx
Questions