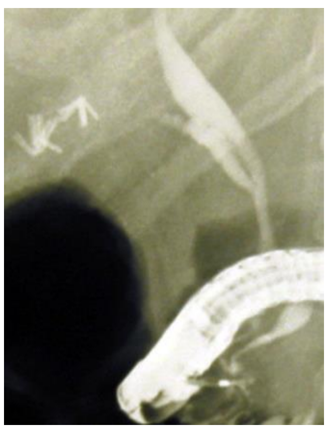
Gallstones, Common Bile Duct Stones, CBD Injury: The Surgeon



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FACULTY OF HEALTH SCIENCES

No disclosures

- Making Laparoscopic Cholecystectomy safer
- Causes of Bile Duct Injuries
- Management of Common Bile Duct Injuries
- Management of Post operative Biliary strictures
- Common Bile Duct Stones
- Alternative procedures for cholecystectomy

The SAGES Safe Cholecystectomy Program

- Strategies for Minimizing Bile Duct Injuries: Adopting a Universal Culture of Safety in Cholecystectomy
  - Patients benefit from reduced pain, faster return to normal activities, and reduced risk of surgical site infection with a laparoscopic approach compared to an open operation.

Strategies employed to develop safe cholecystectomy

1. Use the Critical View of Safety (CVS) √
2. Perform an Intra-operative Time-Out during laparoscopic cholecystectomy prior to clipping, cutting or transecting any ductal structures. √
3. Understand the potential for aberrant anatomy in all cases√
4. Make liberal use of cholangiography or other methods to image the biliary tree intraoperatively ?
5. Recognize when the dissection is approaching a zone of significant risk and halt the dissection before entering the zone√
6. Get help from another surgeon when the dissection or conditions are difficult. √

Laparoscopic bile duct injuries

magnitude of the problem

- incidence 0.1%-0.5%
- bile leak 0.3% - 0.5% (85% from cystic duct)
- 34%-49% of surgeons in USA and British Columbia
- 50%-75% missed during the operation
- 60%- 80% delayed recognition

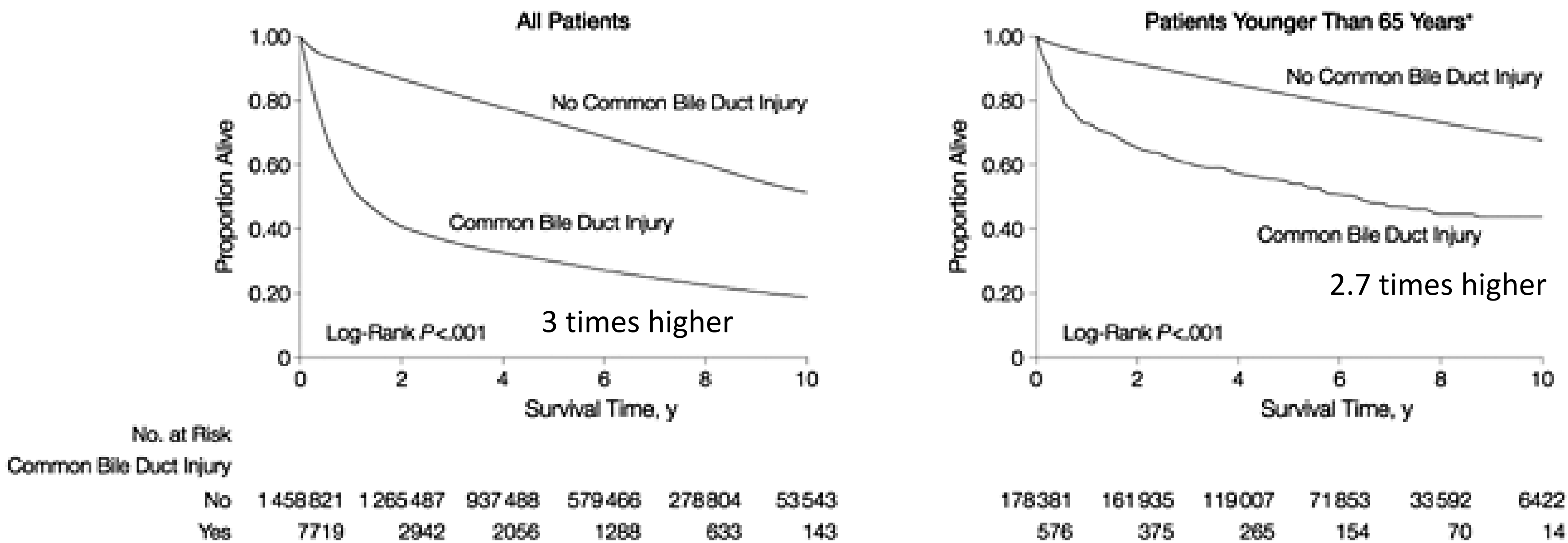
bile duct injury is serious

- leads to considerable morbidity
- inappropriate treatment may cause death
- long-term sequel may be devastating
- reduces QOL

15% of all surgical indemnities are for BDI

may ruin a surgeon's career

survival after bile duct injury



collected series(15) 602 patients

no of deaths 17 (2.8%)

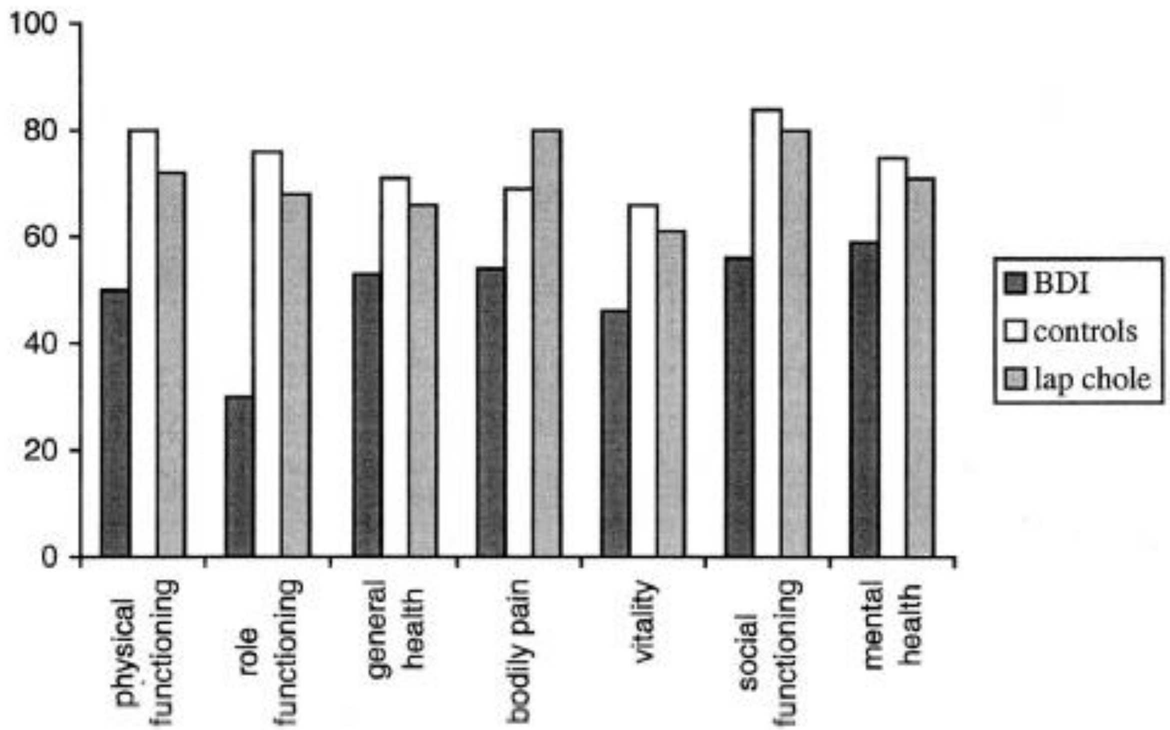
Flum et al JAMA 2003

Impaired Quality of Life 5 Years After Bile Duct Injury During Laparoscopic Cholecystectomy

A Prospective Analysis

Djemila Boerma, PhD,* Erik A. J. Rauws, PhD,† Yolande C. A. Keulemans, PhD,* Jacques J. G. H. M. Bergman, PhD,† Huug Obertop, PhD,* Kees Huibregtse, PhD,† and Dirk J. Gouma, PhD*

*From the Departments of *Surgery and †Gastroenterology, Academic Medical Center, Amsterdam, The Netherlands*



Health and financial disaster

- Cost: 4.5-26 X uncomplicated cases
  - (total cost $ 51,411)
  - average 32 days hospital stay
  - 10 days outpatient care days
  - 2 deaths 4%

Savader et al Ann Surg 1997

- 43% intraoperative recognition
  - The inflation-adjusted mean total cost of repair was R215 711 (range R68 764 - 980 830).
  - Theatre costs 22%
  - ICU costs 21%

Hofmeyr SAMJ. 2015

Causes of bile duct related complications

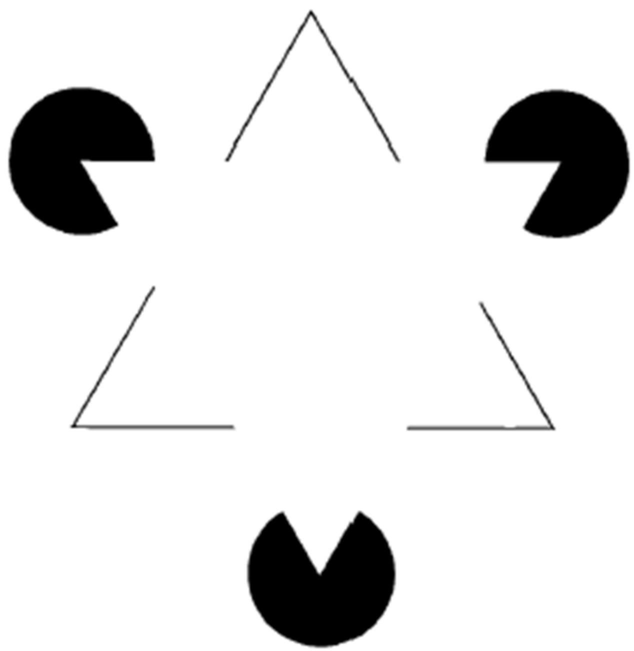
- misidentification of biliary anatomy
- technical errors

  - cystic duct leak
  - thermal injuries
  - bleeding
  - "tenting"

How does this occur?

Way has used scientific principles from human factor r[…] hology to underst[…]

– misc[…] ication of anat[…]
– skills[…] section



Way et at al Ann Surg 2003

“Laparoscopic bile duct injury is a result of misperception; not from inadequate knowledge of how to proceed or deficiencies in manual skills…….”
“Nor should it be misconstrued as a character defect; cognitive biases are normal features of the way humans reason”.

Way et al Ann Surg 2003

how can we make it a safer procedure ?

- training
- identifying the high risk patient
- operative cholangiography
- refinements to operative technique
    - "Subtotal Cholecystectomy"
- built in "stopping rules"

who are at risk for bile duct injury ?

- elderly, males, obesity
- cholecystitis(previous attacks)
- gallstone pancreatitis
- previous BDS
- Mirizzi syndrome

not for the beginner

No risk factors in 80% of BDI

Role of Routine Intra Operative Cholangiograms

Protagonists

- reduces incidence of BDI
- early recognition
- less severe injury
- less inclined to misinterpret

Sceptics

- Does not prevent BDI
- BDI frequently occur before IOC
- BDI may occur as a result of IOC
- IOC frequently misses BDI
- BDI may occur after IOC

Ludwig et al Surg Endosc 2002

operative cholangiography

collected series	% bile duct injury
• routine	0.20 – 0.39
• selective	0.30 – 0.60
• none	0.34 – 0.58

Debru et al Surg Endosc 2005

Cholangiography and the risk of common bile duct injury
1.5 million laparoscopic cholecystectomies

Table 3. Rate of Common Bile Duct (CBD) Injury Based on the Surgeon's Frequency of Intraoperative Cholangiogram (IOC) Use With and Without IOC Use

	Rate of CBD Injury, %		
IOC Use Categories	Overall*	Without IOC	With IOC†
<25% (n = 741 742)	0.52	0.49	0.78
25%-49% (n = 279 270)	0.54	0.56	0.50
50%-75% (n = 211 880)	0.51	0.85	0.31
>75% (n = 337 469)	0.43	1.50	0.26
All (N = 1 570 361)	0.50	0.58	0.39

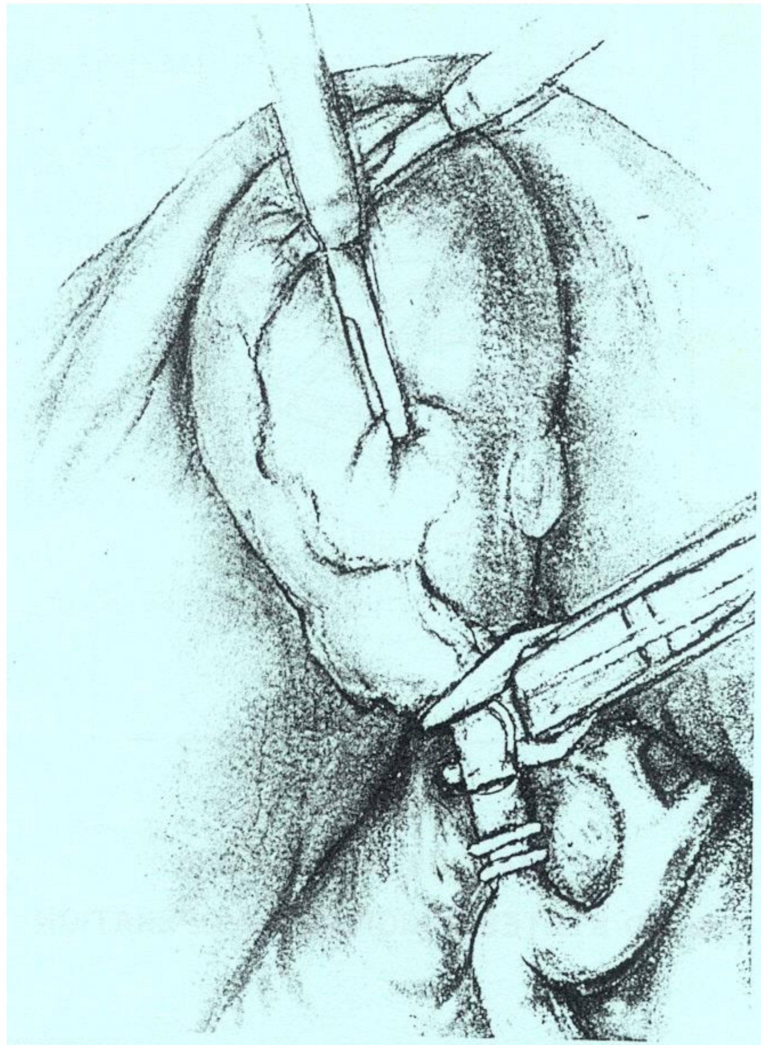
*Differences between the overall rate in the greater than 75% IOC use group compared with all other levels of IOC use were statistically significant ($P<.001$).
†Differences between CBD rates with and without IOC were all statistically significant ($P<.001$).

Flum et al JAMA 2003

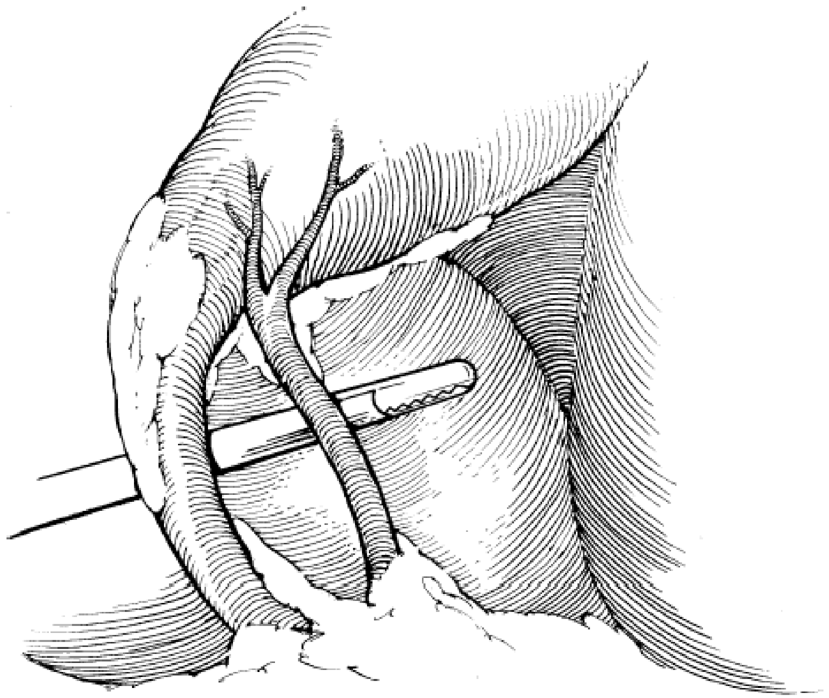
verdict - operative cholangiography

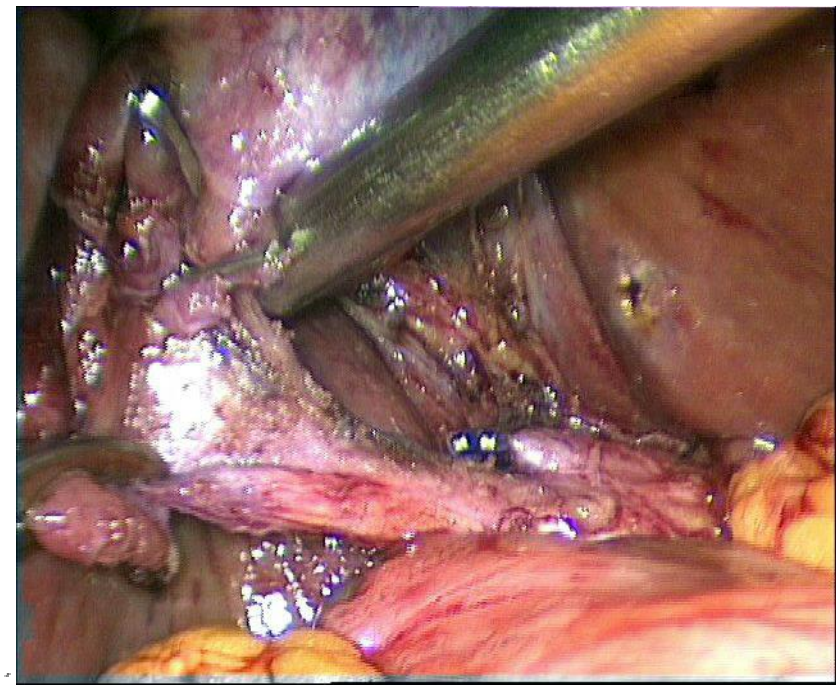
- routine: continue if that’s the way you were taught
- selective: ? doubt about anatomy
- none: extra care to define biliary anatomy
- IOC is not a substitute for careful delineation of the biliary anatomy

how can we prevent bile duct injury ?



there is no substitute for meticulous dissection of Calot's triangle with the emphasis on identifying the cystic duct / infundibulum junction.





"the critical view of safety"
(Steven Strasberg)

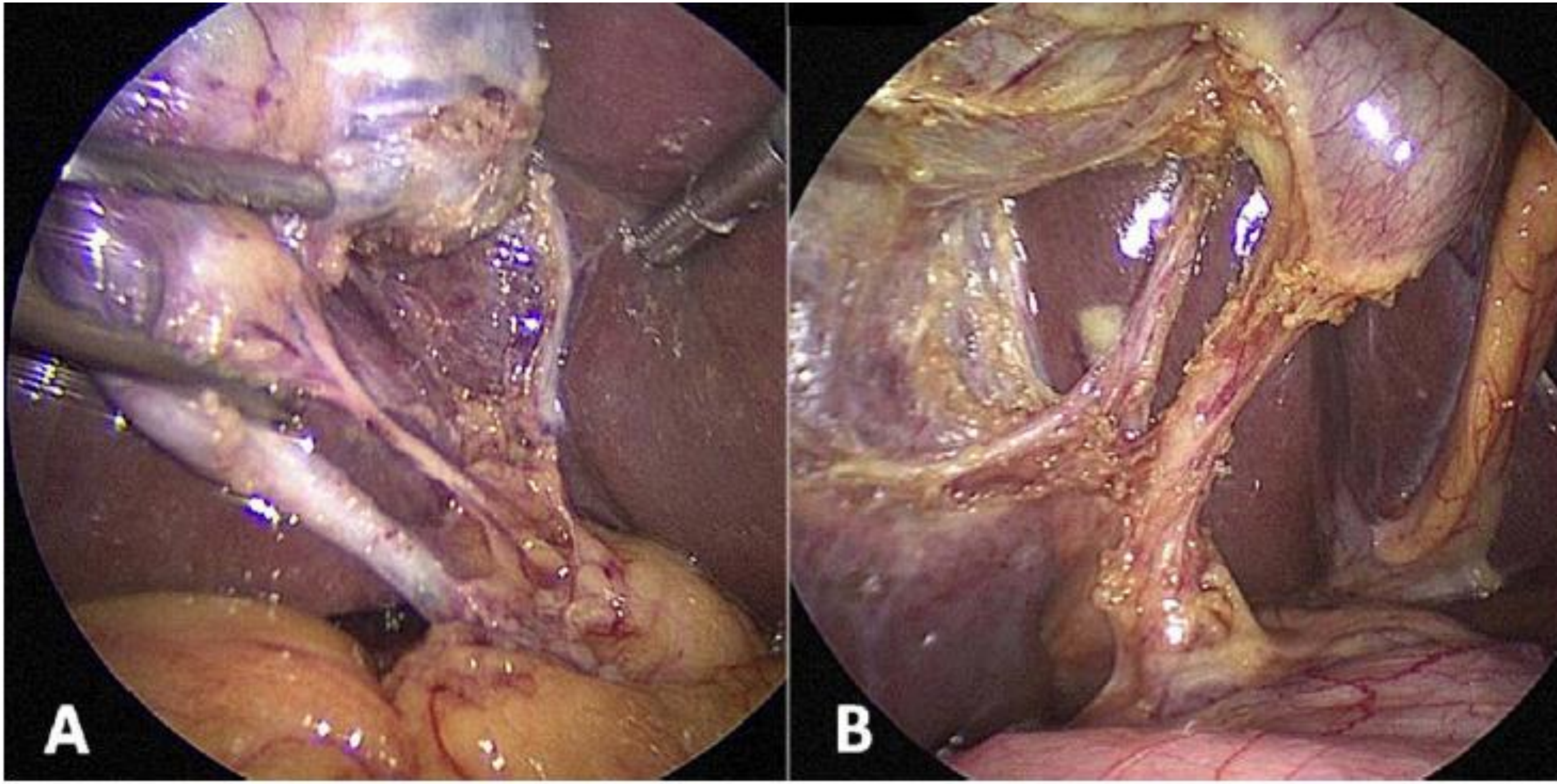
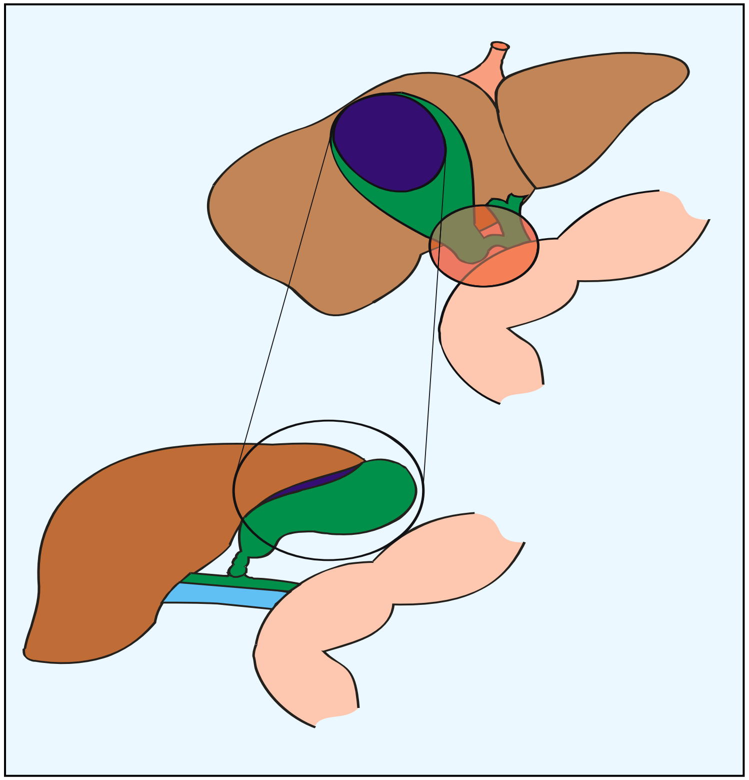
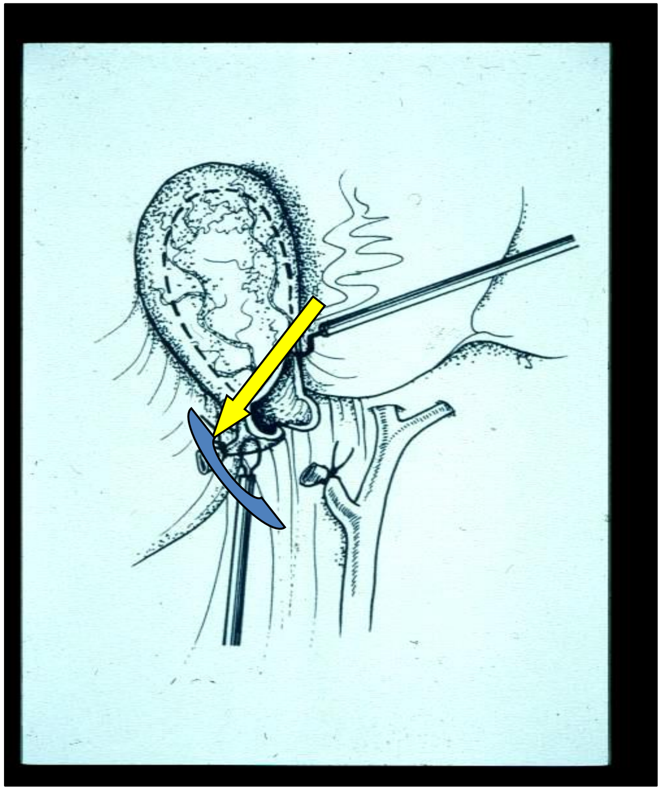


Figure 4. Different appearances of the cystic plate. (A) Critical view of safety (CVS) is seen from in front of the gallbladder as usually shown. The cystic plate is very thin. (B) CVS is seen with the gallbladder reflected to the left so that a posterior view of the triangle of Calot is shown. The cystic plate is thicker and whitish. Both views fulfill criteria for CVS.

Need a bail out procedure to prevent CBDI in the difficult Cholecystectomy



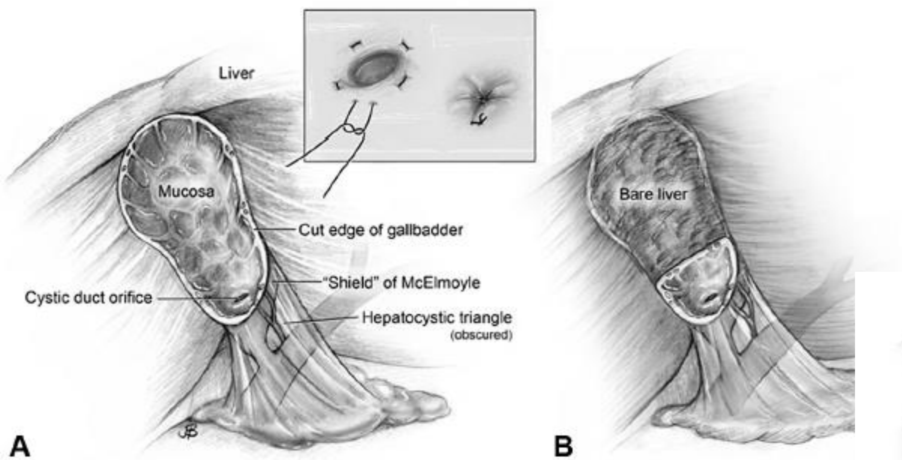


Subtotal Cholecystectomy

Subtotal Cholecystectomy—"Fenestrating" vs "Reconstituting" Subtypes and the Prevention of Bile Duct Injury: Definition of the Optimal Procedure in Difficult Operative Conditions

Steven M Strasberg, MD, FACS, Michael J Pucci, MD, FACS, L Michael Brunt, MD, FACS, Daniel J Deziel, MD, FACS

J Am Coll Surg 2016;222:89–96.



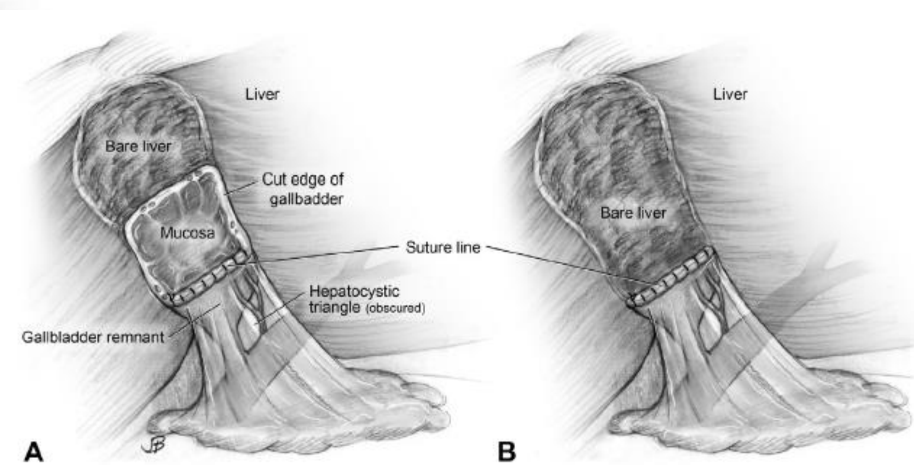


Figure 6. Subtotal reconstituting cholecystectomy. (A) The free, peritonealized portion of the

Technical approaches to the Anatomy

- Critical view of safety – routine approach
- Infundibulum approach – sometimes of value but avoid when significant inflammation present
- Start by identifying the cystic duct – common bile duct junction - avoid
- Subtotal cholecystectomy – in very selective cases

Risk for conversion

Preoperative Risk Factors for Conversion of Laparoscopic Cholecystectomy to Open Surgery – A Systematic Review and Meta-Analysis of Observational Studies

Josephine Philip Rothman[a] Jakob Burcharth[a] Hans-Christian Pommergaard[a] Søren Viereck[b] Jacob Rosenberg[a]

Table 3. Summary of results from the meta-analysis

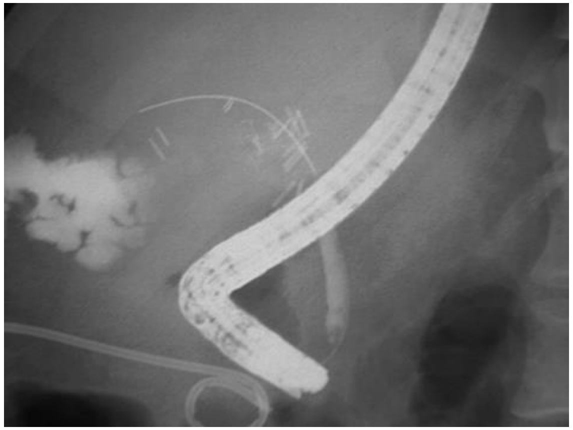
Risk factors for conversion	Might be a risk factor	Not a risk factor for conversion
Gallbladder wall >4–5 mm on preoperative ultrasound	Previous abdominal surgery	Body temperature
Age >60 or 65	BMI	Diabetes mellitus
Male gender	ASA-score	White blood cell count
Acute cholecystitis		
Contracted gallbladder on ultrasound		

Dig Surg 2016;33:414–423

Recognition of bile leaks / duct injuries

- Intra-operative
- Early post-operative
  - bile leak from drain site
  - ascites
  - abnormal LFT's / Obstructive jaundice

key to successful outcome



- Delayed presentation
  - consequence of biliary stricture

Classification of Injury

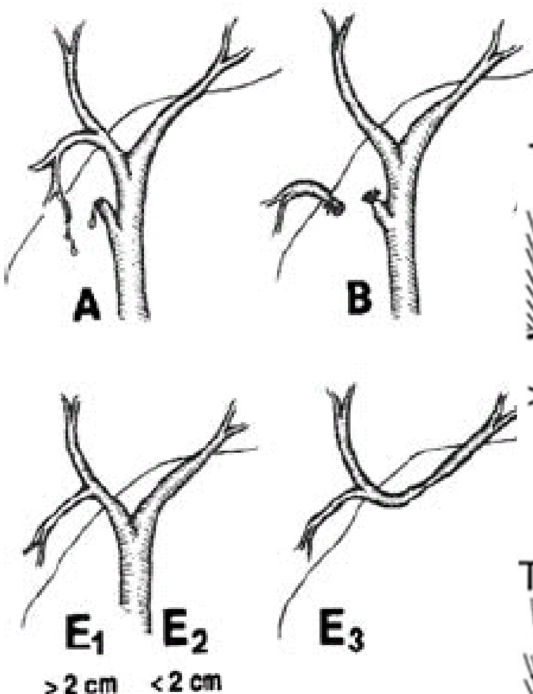
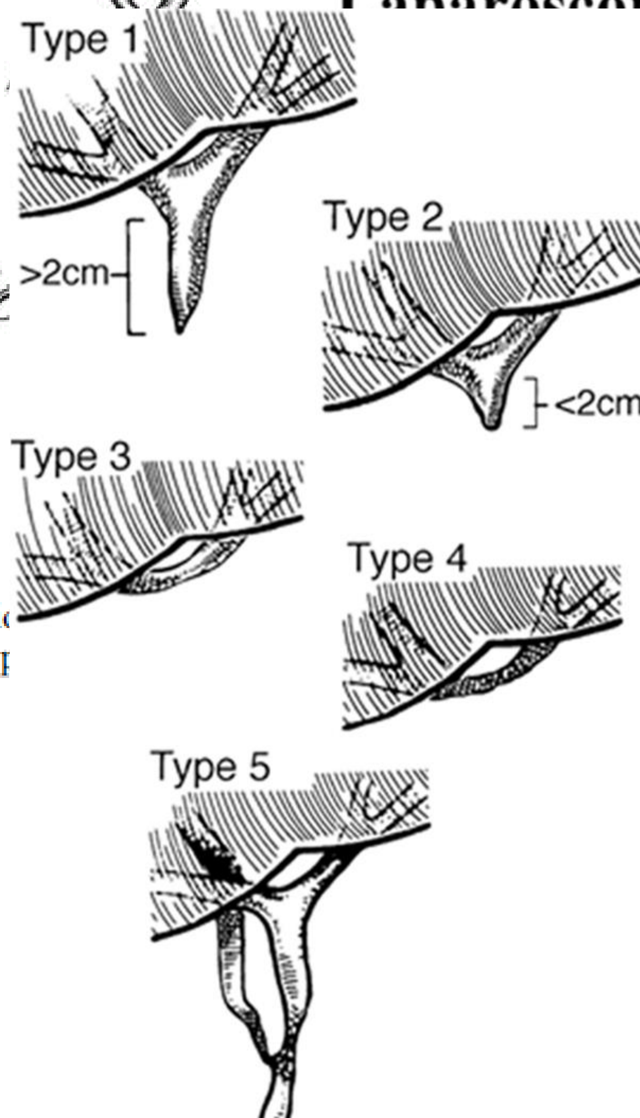
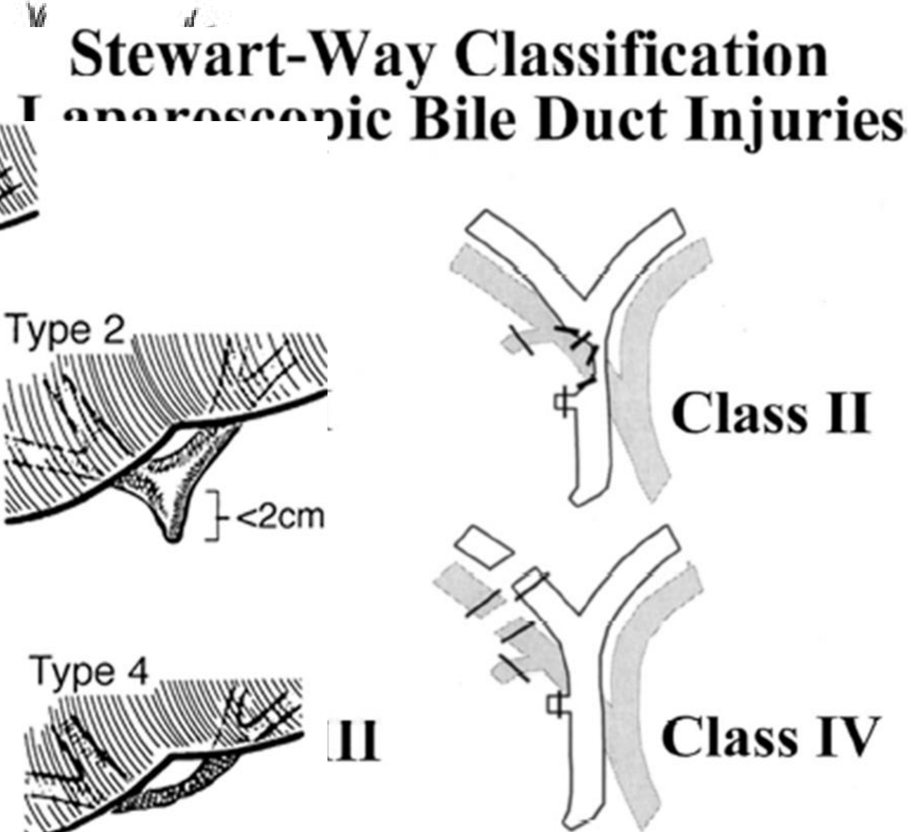


Fig. 1. The Strasberg Classificati
scopic Cholecystectomy. (adap
1995;180(1):101–125)





Factors that influence outcome not noted

- Vascular injury
- Time at which injury recognised
- Bile leak
  - Ascites
  - Drain site leak
- Portal hypertension
- Atrophy/ Hypertrophy
- Previous repair

Early

Biliary stricture

Intra-operative detection

partial defect

- primary repair
- avoid T- tube
- drain

complete transection

- hepatico-jejunostomy
  (HPB surgeon)
- drain and refer

Principles of Repair

Ideal Scenario

- Early detection
- Maximum information on biliary anatomy
- Specialised multi-disciplinary unit

Technique

- Tension free hepatico-jejunostomy
- Mucosa to mucosa anastomosis
- Well vascularised BD

Successful outcome after bile duct repair

the surgeon factor	success rate
• "injuring" surgeon	17-27%
• specialist surgeon	79-95%

50-75% repairs are still done by primary surgeon !

Steward & Way Arch Surg 1995
Caroll et al Surg Endosc 1998
Flum et al JAMA 2003

Clinical Scenario-
post operative bile leak from drain site

evidence of bile collection

yes

imaging

drainage

no

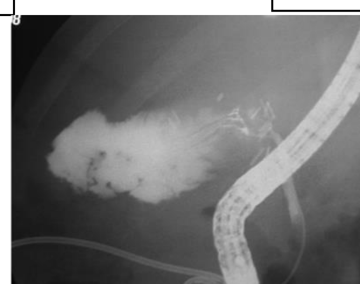
Review IOC

observe

Persist

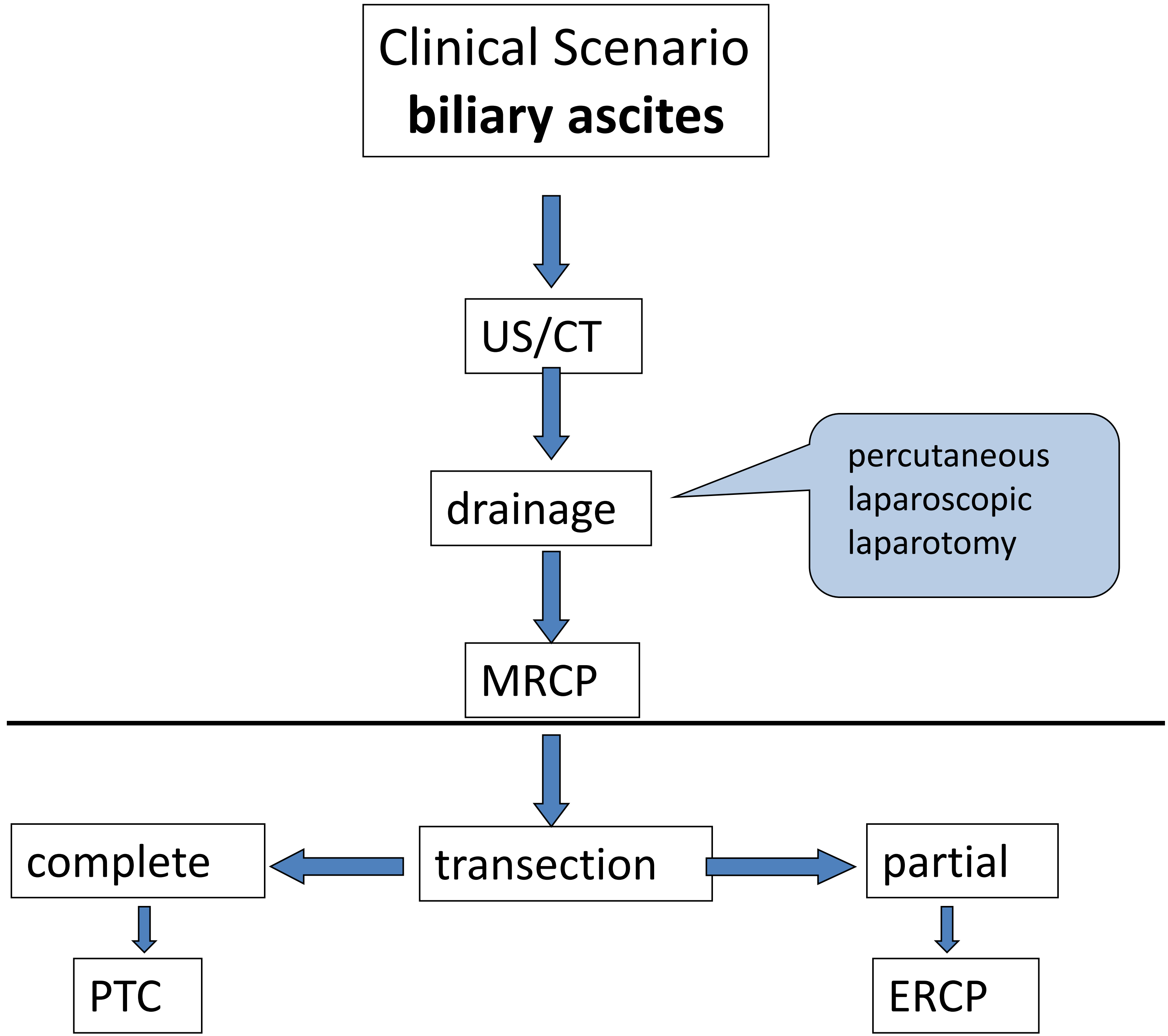
- 1week
- 500ml

MRCP/fistulogram

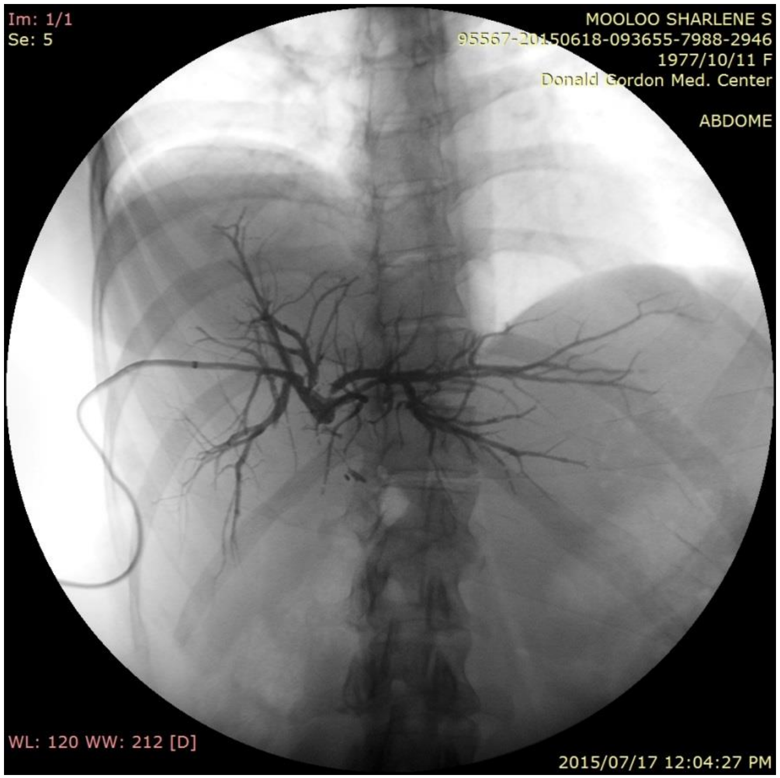


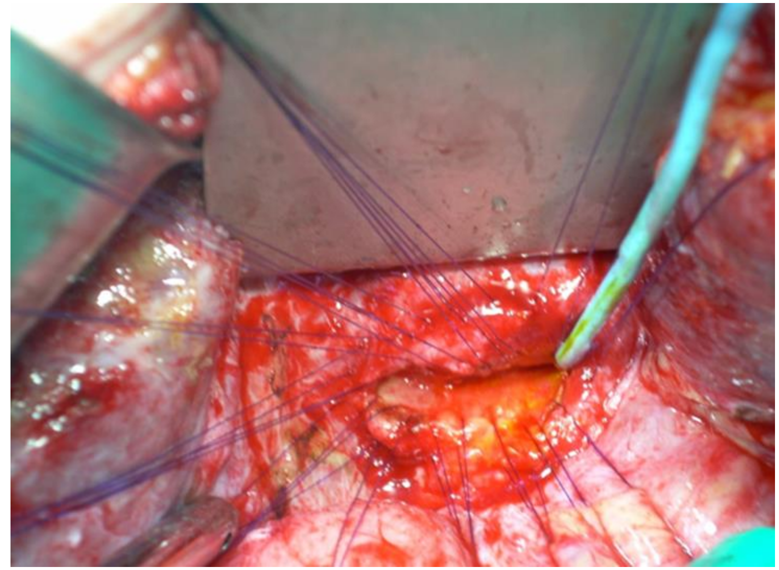
ERCP

PTC

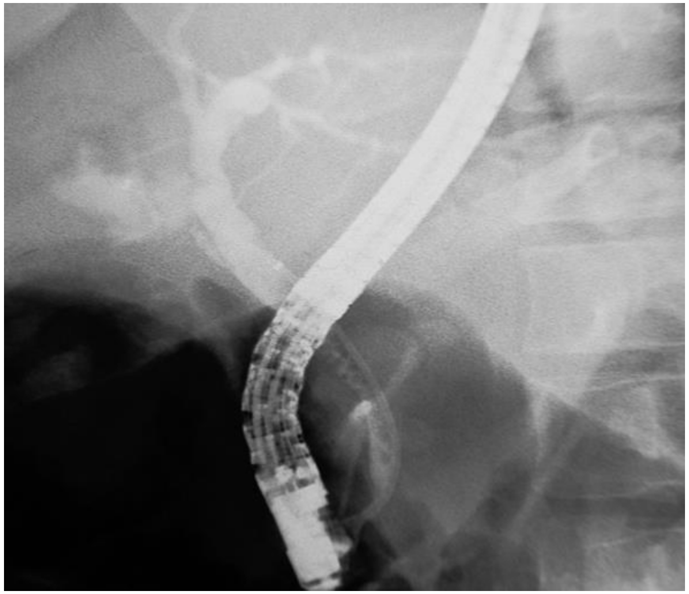

Clinical Scenario
biliary ascites
US/CT
drainage
percutaneous
laparoscopic
laparotomy
MRCP
transection
complete
partial
PTC
ERCP

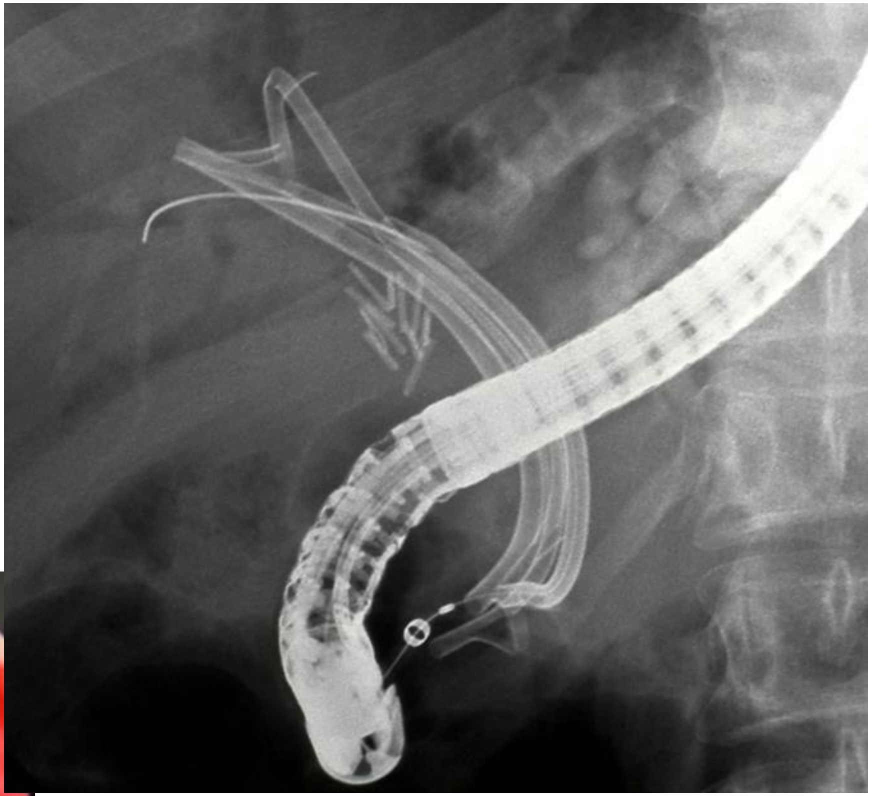
Complete Transection

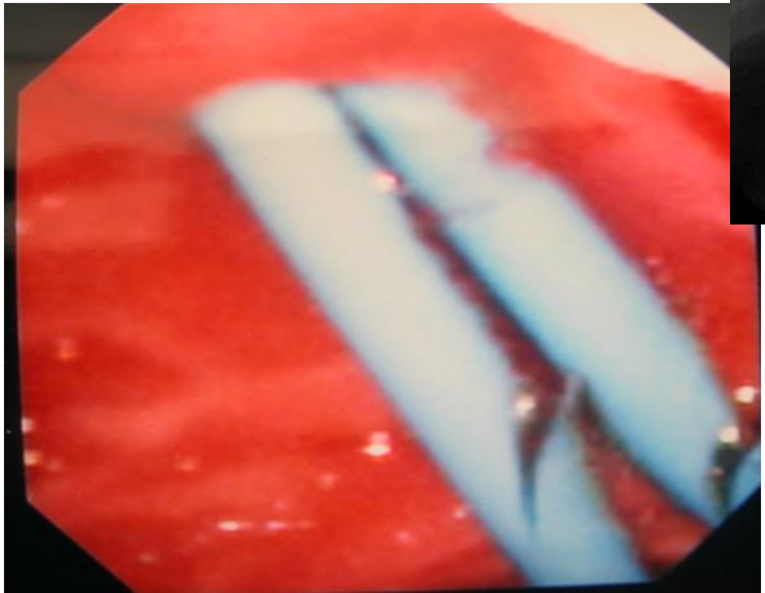




Partial Injury





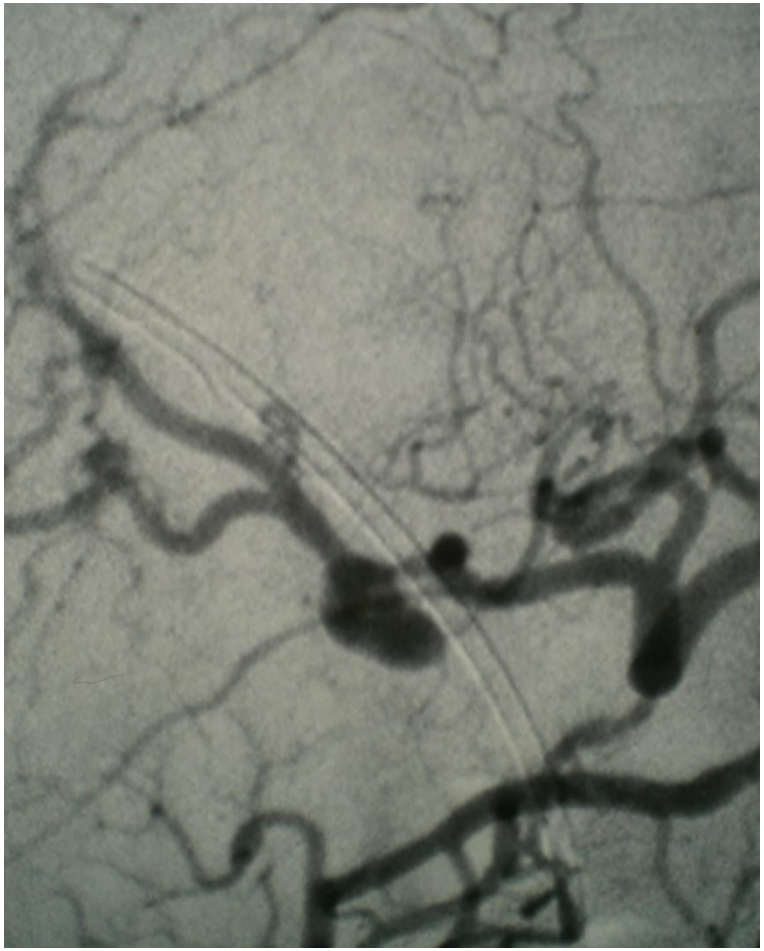


Vascular injuries

- Incidence of hepatic artery injury about 7%
- Ischemic injury to intrahepatic ducts may result in recurrent Hepaticojejunostomy strictures and delayed strictures to IHD’S
- No consensus whether to preform routine angiography
  - complex or high injury

major bleeding

selective angiography



embolization

Timing of definitive bile duct repair

protagonists for early repair (< 1-2 weeks)

- shorter duration of treatment
- less costly
- improve QOL
- equivalent results to delayed repair

Specialised HPB units

Steward and Way Arch Surg 1995
Boerma et al Ann Surg 2001
Sicklick et al Ann Surg 2005
Thomson et al Br J Surg 2006

Early repair (< 1-2 weeks)

contraindicated

- Sepsis not under control
- Confluence and vascular injury
- Significant diathermy injury
- Surgical expertise not available

Post CBDI stricture

- Surgery remains the gold standard against which other techniques must be compared
- Most series from before the 90’s
- 80-90% success with low re-stricture rate
- Referral to proper skills – first repair best chance of success
- Avoid bile duct to bile duct anastamosis
    - Terreblache and Northover description of blood supply

Lillimoe: Johns Hopkins Medical Institute

- 156 patients
  - 41% had previous repair
    - Half at time of initial surgery
    - Bile duct to bile duct repair 50% of cases
  - LC injuries more likely to be Bismuth 3,4,5,
  - Surgery
    - Hepatico-jejunostomy
    - All stented for prolonged period
    - 90% success
      - » Repair by general surgeon success 17%
      - » Repair in referral centre success 94%

Annals of Surg 2000;232

- Role for hepatic resection
- Role of trans-anastomotic stents remain controversial
- Follow up – long term
  - 2/3 failure within 2 years
  - 80% within 5years
  - 20% after 5 years

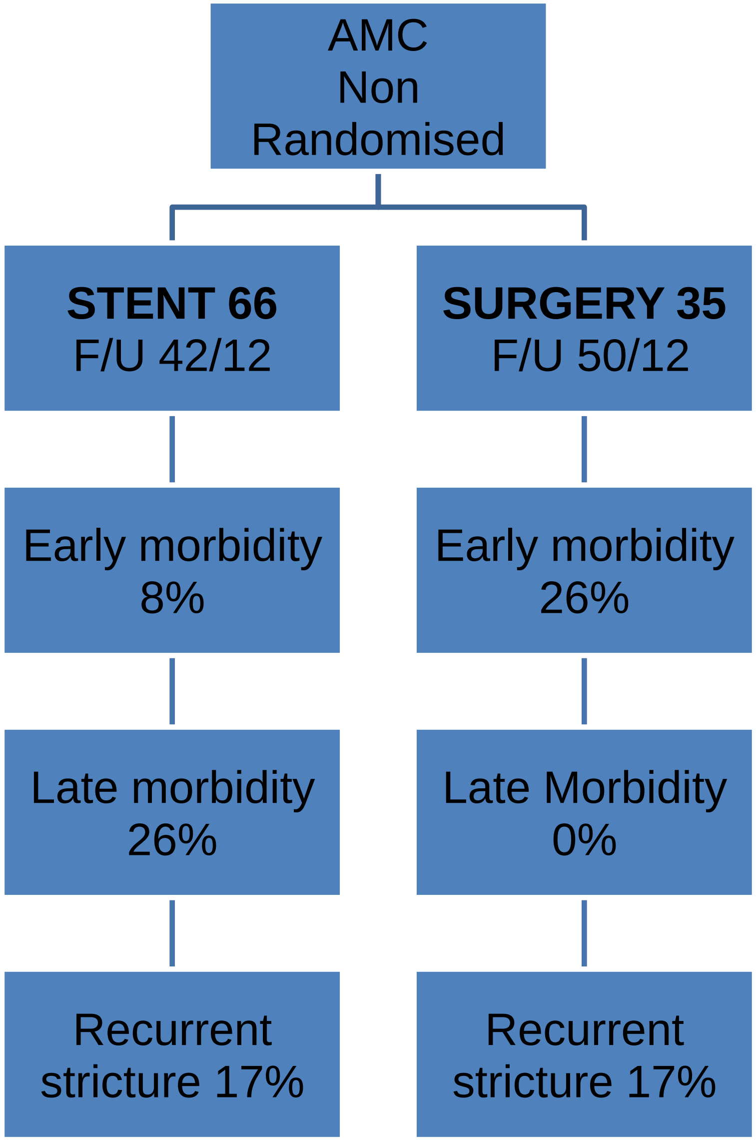
Management of Post-Cholecystectomy Benign Bile Duct Strictures: Review

Sadiq S. Sikora

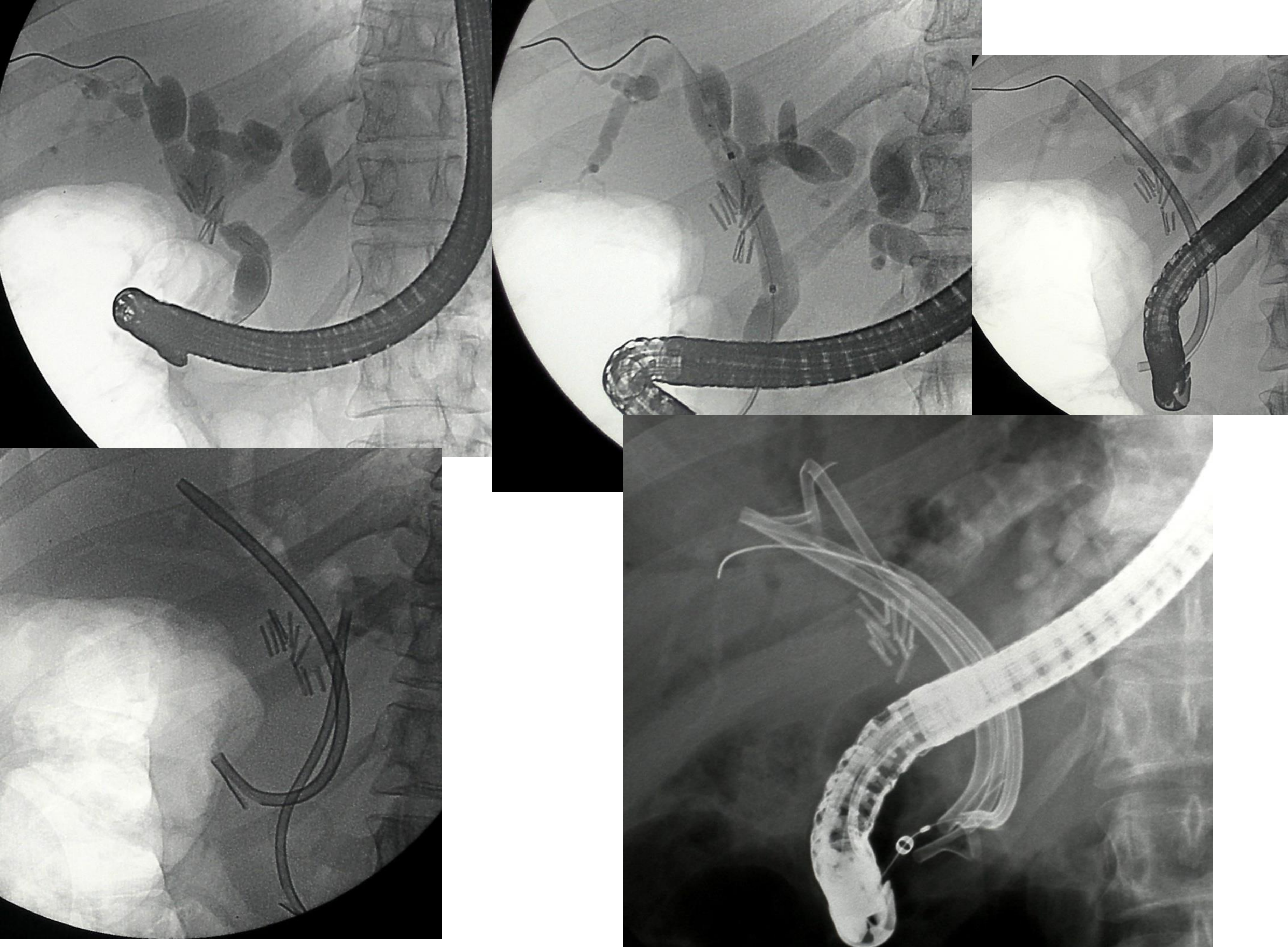
Indian J Surg (January–February 2012) 74(1):22–28

Endotherapy vs Surgery

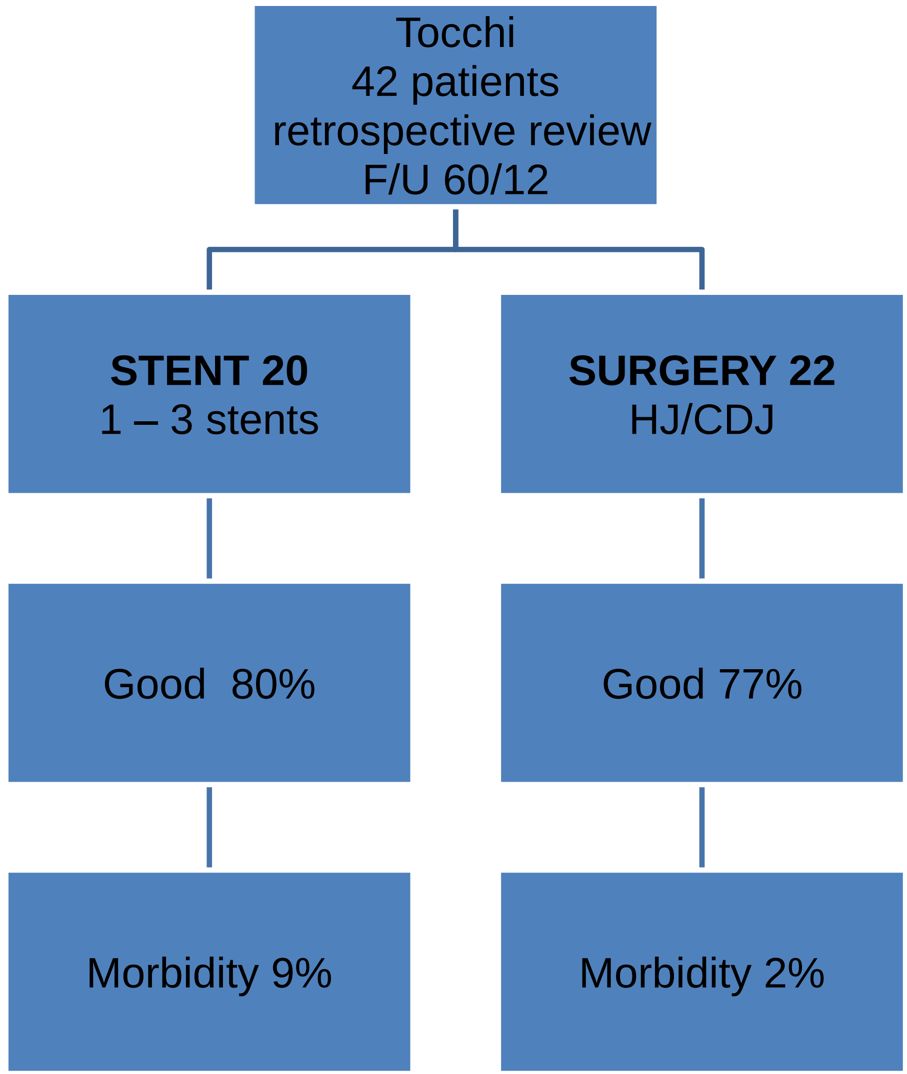
Up to 2 stents; replaced 3 monthly and placed for 1 year



Davids PH . Ann Surg 1993;217



Endotherapy vs Surgery



“Support surgery but definite place for stenting”

Arch Surg 2000;135

Endotherapy

- High recurrence rates
- Multiple procedures
- Need for surgery

- New data emerging about MES particularly fully covered and even biodegradable

CLINICAL—BILIARY

Successful Management of Benign Biliary Strictures With Fully Covered Self-Expanding Metal Stents

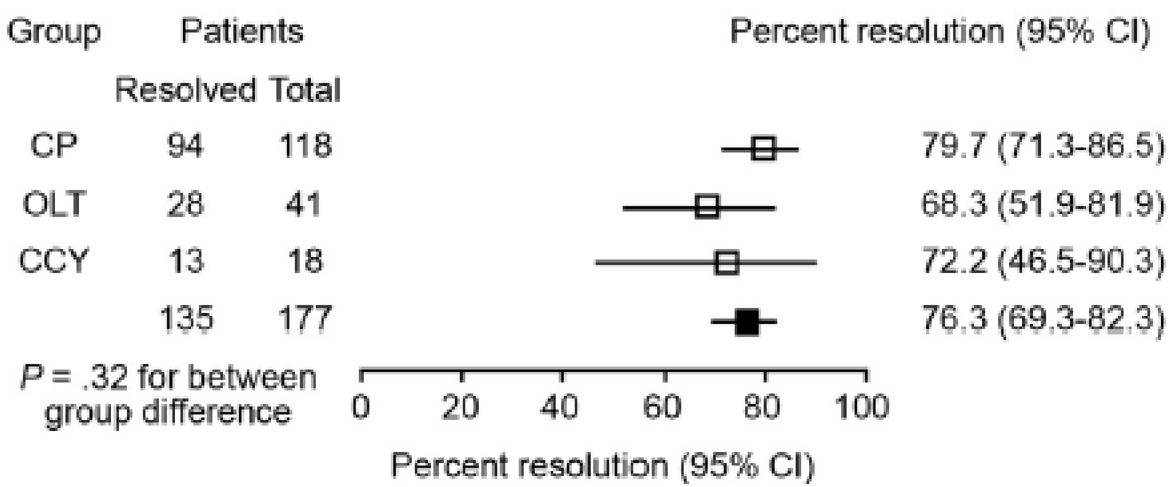
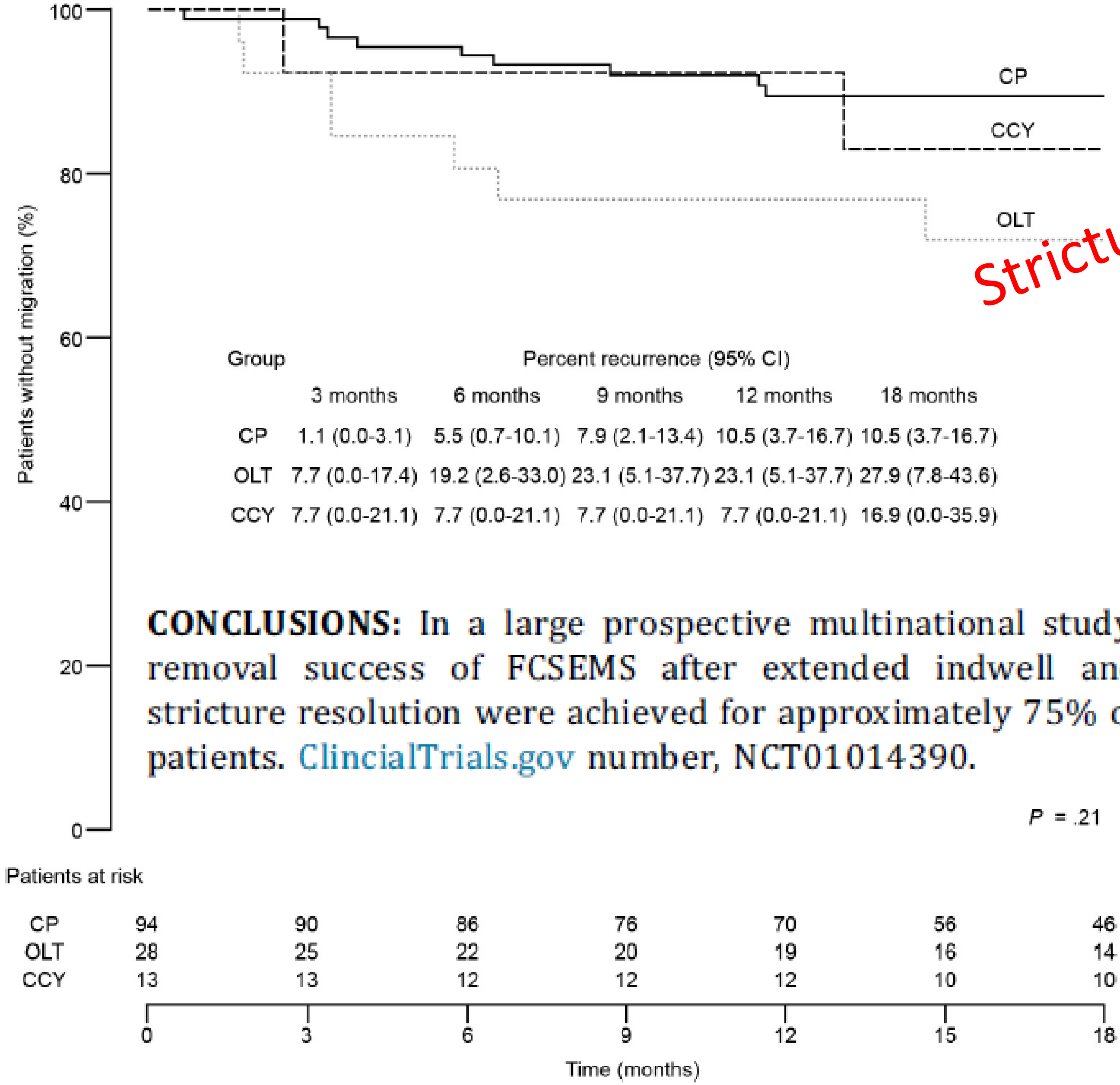


Figure 4. Stricture resolution after FCSEMS placement.

Gastroenterology 2014;147:385–395

Stricture recurrence



Group	Percent recurrence (95% CI)				
	3 months	6 months	9 months	12 months	18 months
CP	1.1 (0.0-3.1)	5.5 (0.7-10.1)	7.9 (2.1-13.4)	10.5 (3.7-16.7)	10.5 (3.7-16.7)
OLT	7.7 (0.0-17.4)	19.2 (2.6-33.0)	23.1 (5.1-37.7)	23.1 (5.1-37.7)	27.9 (7.8-43.6)
CCY	7.7 (0.0-21.1)	7.7 (0.0-21.1)	7.7 (0.0-21.1)	7.7 (0.0-21.1)	16.9 (0.0-35.9)

CONCLUSIONS: In a large prospective multinational study, removal success of FCSEMS after extended indwell and stricture resolution were achieved for approximately 75% of patients. ClincialTrials.gov number, NCT01014390.

Figure 5. Stricture recurrence after resolution. Graphic conventions as in Figure 3.

Recommendations

- Start with endotherapy (Bismuth 1 & 2)
  - If failed at 1 year go to surgery
- Complete transection – surgery
- Early unsuccessful surgical repair repeat surgery - percutaneous intervention have good results here
- Endo therapy does not preclude surgery but often surgery precludes later endo- therapy

Common Bile Duct Stones

- Prediction of CBDS
  - CBDS 10-33% of symptomatic cholecystolithiasis
  - 10-40% will still have normal CBD at ERCP
  - Silent Stones 5-10%
  - Retained stones after ERCP 2-15%
  - MRCP Sen 95%; Specificity 97%

Management Approach

- Single procedures vs Two Stage procedures

<u>Single</u>

  - LC / LCBDE
  - Open Cholecystectomy and CBDE

<u>Two Stage</u>

  - LC / ERCP
    - ERCP
      - » Preoperative
      - » Intraoperative
      - » Post operative

- LCBDE
  - No ES (theoretical)
    - Avoids Duodenal biliary reflux
    - Avoids ERCP complications
    - ES stenosis
    - Avoids metaplasia of CBD

Pre op ERCP

- No clear evidence to support or refute this
  - Specific indications
    - Cholangitis
    - Indicated in SAP
    - Persistent OJ
    - All others option exist

- Intra operative ES
  - Technically difficult
  - Rendezvous technique and therefore may reduce complications of ERCP
- Post op
  - Ramping up approach
    - Transcystic stent inserted

Outcomes

- Duct Clearance
- M&M
- Conversion
- Length of say (LOS)
- Cost
  - – Meta-analysis and Cochrane reviews

- Cochrane review 2013
  - 2005
  - 16 RCT
    - Include open CBDE vs ERCP

Surgical versus endoscopic treatment of bile duct stones (Review)

Dasari BVM, Tan CJ, Gurusamy KS, Martin DJ, Kirk G, McKie L, Diamond T, Taylor MA

THE COCHRANE COLLABORATION®

This is a reprint of a Cochrane review, prepared and maintained by The Cochrane Collaboration and published in *The Cochrane Library* 2013, Issue 9

- WJG 2012
  - 7 RCT LC/LCBDE vs LC and ERCP
    - Clearance, morbidity, mortality, conversion. LOS, time,

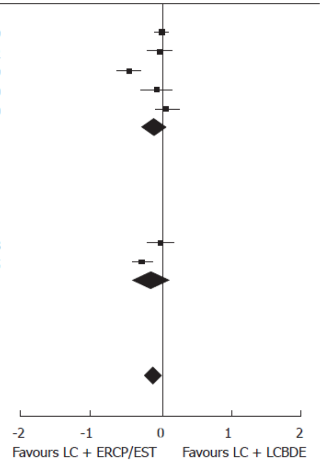
Two-stage *vs* single-stage management for concomitant gallstones and common bile duct stones

Jiong Lu, Yao Cheng, Xian-Ze Xiong, Yi-Xin Lin, Si-Jia Wu, Nan-Sheng Cheng

A

Study or subgroup	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Risk difference M-H, random, 95% CI	Year
1.1.1 Preoperative ERCP + LC *vs* LC + LCBDE							
Cuschieri *et al*[26]	82	98	90	109	16.3%	0.01 [-0.09, 0.11]	1999
Sgourakis *et al*[28]	27	32	24	28	13.8%	-0.01 [-0.19, 0.17]	2002
Noble *et al*[29]	20	36	38	38	14.4%	-0.44 [-0.61, -0.28]	2009
Bansal *et al*[5]	13	15	14	15	12.7%	0.07 [-0.28, 0.15]	2010
Rogers *et al*[24]	30	31	15	17	14.3%	0.09 [-0.08, 0.25]	2010
Subtotal (95% CI)		212		207	71.4%	-0.08 [-0.27, 0.10]	
Total events	172		181				
Heterogeneity: Tau^2 = 0.04, χ^2 = 26.23, df = 4 (P < 0.0001); I^2 = 85%							
Test for overall effect: Z = 0.91 (P = 0.36)							
1.1.2 LC + postperative ERCP *vs* LC + LCBDE							
Rhodes *et al*[25]	30	40	30	40	13.5%	0.00 [-0.19, 0.19]	1998
Nathanson *et al*[27]	32	45	40	41	15.1%	-0.26 [-0.41, -0.12]	2005
Subtotal (95% CI)		85		81	28.6%	-0.14 [-0.41, 0.13]	
Total events	62		70				
Heterogeneity: Tau^2 = 0.03, χ^2 = 5.16, df = 1 (P = 0.002); I^2 = 81%							
Test for overall effect: Z = 1.02 (P = 0.31)							
Total (95% CI)		297		288	100.0%	-0.10 [-0.24, 0.04]	
Total events	234		251				
Heterogeneity: Tau^2 = 0.03, χ^2 = 33.55, df = 6 (P < 0.00 001); I^2 = 82%							
Test for overall effect: Z = 1.39 (P = 0.17)							
Test for subgroup differences : χ^2 =0.11, df = 1 (P = 0.74); I^2 = 0%							

Risk difference
M-H, random, 95% CI

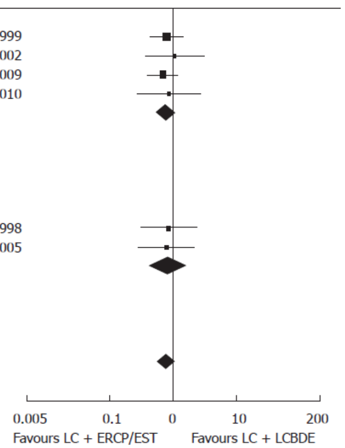


Stone Clearance

B

Study or subgroup	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Risk ratio M-H, random, 95% CI	Year
1.2.1 Preoperative ERCP/EST + LC *vs* LC + LCBDE							
Cuschieri *et al*[26]	17	136	21	133	32.0%	0.79 [0.44, 1.43]	1999
Sgourakis *et al*[28]	6	32	5	28	8.0%	1.05 [0.36, 3.07]	2002
Noble *et al*[29]	14	47	19	44	29.6%	0.69 [0.40, 1.20]	2009
Rogers *et al*[24]	5	55	6	57	8.9%	0.86 [0.28, 2.67]	2010
Subtotal (95% CI)		270		262	78.4%	0.79 [0.55, 1.13]	
Total events	42		51				
Heterogeneity: χ^2 = 0.52, df = 3 (P = 0.91); I^2 = 0%							
Test for overall effect: Z = 1.29 (P = 0.20)							
1.1.2 LC + postperative ERCP/EST *vs* LC + LCBDE							
Rhodes *et al*[25]	6	40	7	40	10.5%	0.86 [0.32, 2.33]	1998
Nathanson *et al*[27]	6	45	7	41	11.0%	0.78 [0.29, 2.13]	2005
Subtotal (95% CI)		85		81	21.6%	0.82 [0.40, 1.66]	
Total events	12		14				
Heterogeneity: χ^2 = 0.02, df = 1 (P = 0.90); I^2 = 0%							
Test for overall effect: Z = 0.56 (P = 0.58)							
Total (95% CI)		355		343	100.0%	0.79 [0.58, 1.10]	
Total events	54		65				
Heterogeneity: χ^2 = 0.55, df = 5 (P = 0.99); I^2 = 0%							
Test for overall effect: Z = 1.40 (P = 0.16)							
Test for subgroup differences : χ^2 =0.01, df = 1 (P = 0.93); I^2 = 0%							

Risk ratio
M-H, fixed, 95% CI

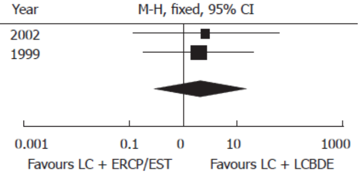


Morbidity

C

Study or subgroup	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Risk ratio M-H, random, 95% CI	Year
Sgourakis *et al*[28]	1	32	0	28	34.5%	2.64 [0.11, 62.23]	2002
Cuschieri *et al*[26]	2	136	1	133	65.5%	1.96 [0.18, 21.31]	1999
Total (95% CI)		168		161	100.0%	2.19 [0.33, 14.67]	
Total events	3		1				
Heterogeneity: χ^2 = 0.02, df = 1 (P = 0.88); I^2 = 0%							
Test for overall effect: Z = 0.81 (P = 0.42)							

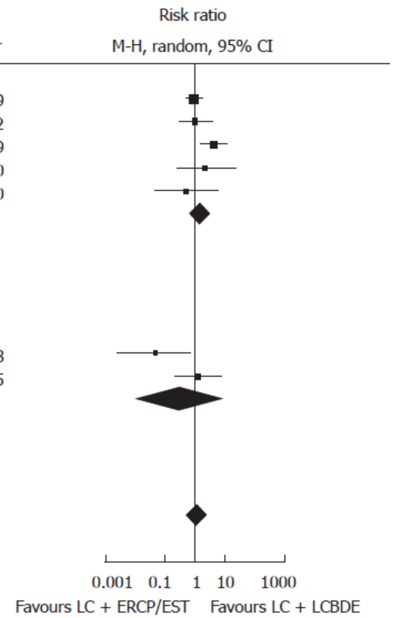
Risk ratio
M-H, fixed, 95% CI



mortality

D

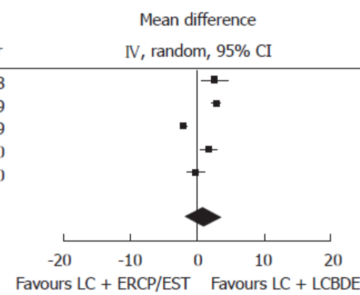
Study or subgroup	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Risk ratio M-H, random, 95% CI	Year
1.4.1 Preoperative ERCP/EST + LC *vs* LC + LCBDE							
Cuschieri *et al*[26]	20	136	20	133	25.9%	0.98 [0.55, 1.73]	1999
Sgourakis *et al*[28]	5	32	4	28	17.7%	1.09 [0.33, 3.68]	2002
Noble *et al*[29]	20	47	4	44	20.5%	4.68 [1.74, 12.62]	2009
Bansal *et al*[5]	2	13	1	15	8.8%	2.31 [0.24, 22.62]	2010
Rogers *et al*[24]	1	55	2	57	8.3%	0.52 [0.05, 5.55]	2010
Subtotal (95% CI)		283		277	81.1%	1.53 [0.70, 3.37]	
Total events	48		31				
Heterogeneity: Tau^2 = 0.38, χ^2 = 8.35, df = 4 (P = 0.08); I^2 = 52%							
Test for overall effect: Z = 1.06 (P = 0.29)							
1.4.2 LC + postperative ERCP/EST *vs* LC + LCBDE							
Rhodes *et al*[25]	0	40	10	40	6.4%	0.05 [0.00, 0.79]	1998
Nathanson *et al*[27]	3	45	2	41	12.4%	1.37 [0.24, 7.77]	2005
Subtotal (95% CI)		85		81	18.9%	0.30 [0.01, 11.05]	
Total events	3		12				
Heterogeneity: Tau^2 = 5.44, χ^2 = 4.84, df = 1 (P = 0.003); I^2 = 79%							
Test for overall effect: Z = 0.66 (P = 0.51)							
Total (95% CI)		368		358	100.0%	1.21 [0.54, 2.70]	
Total events	51		43				
Heterogeneity: Tau^2 = 0.57, χ^2 = 13.81, df = 6 (P = 0.03); I^2 = 57%							
Test for overall effect: Z = 0.46 (P = 0.65)							
Test for subgroup differences : χ^2 =0.75, df = 1 (P = 0.39); I^2 = 0%							



conversion

E

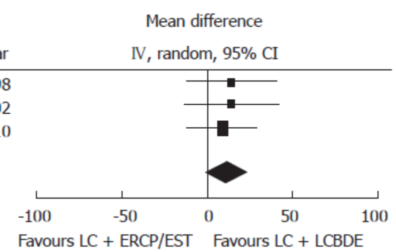
Study or subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Mean difference IV, random, 95% CI	Year
Rhodes *et al*[25]	3.5	2.5	40	1	6.25	40	18.4%	2.50 [0.41, 4.59]	1998
Cuschieri *et al*[26]	9	2.125	150	6	1.95	150	20.8%	3.00 [2.54, 3.46]	1999
Noble *et al*[29]	3	1.25	47	5	1.25	44	20.8%	-2.00 [-2.51, -1.49]	2009
Rogers *et al*[24]	4.1	3.5	55	2.3	1.9	57	20.2%	1.80 [0.75, 2.85]	2010
Bansal *et al*[5]	4	2.25	15	4.2	1.5	15	19.8%	-0.20 [-1.57, 1.17]	2010
Total (95% CI)			307			306	100.0%	0.99 [-1.59, 3.57]	
Heterogeneity: Tau^2 = 8.28; χ^2 = 209.31, df = 4 (P < 0.00 001); I^2 = 98%									
Test for overall effect: Z = 0.75 (P = 0.45)									



LOS

F

Study or subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Mean difference IV, fixed, 95% CI	Year
Rhodes *et al*[25]	105	48.75	40	90	71.25	40	27.3%	15.00 [-11.75, 41.75]	1998
Sgourakis *et al*[28]	105	48.75	32	90	60	28	25.2%	15.00 [-12.91, 42.91]	2002
Rogers *et al*[24]	183	39	55	174	67	57	47.7%	9.00 [-11.22, 29.22]	2010
Total (95% CI)			127			125	100.0%	12.14 [-1.83, 26.10]	
Heterogeneity: χ^2 = 0.18, df = 2 (P = 0.92); I^2 = 0%									
Test for overall effect: Z = 1.70 (P = 0.09)									



Total Operating Time

Figure 3 Forest plot of meta-analysis. A: Two-stage [endoscopic retrograde cholangiopancreatography (ERCP)/endoscopic sphincterotomy (EST) + laparoscopic cholecystectomy (LC)] *vs* single-stage [LC + laparoscopic common bile duct exploration (LCBDE)] in stone clearance from the common bile duct; B: Two-stage (ERCP/EST + LC) *vs* single-stage (LC + LCBDE) in postoperative morbidity; C: Two-stage (ERCP/EST + LC) *vs* single-stage (LC + LCBDE) in mortality; D: Two-stage (ERCP/EST + LC) *vs* single-stage (LC + LCBDE) in conversion to other procedures; E: Two-stage (ERCP/EST + LC) *vs* single-stage (LC + LCBDE) in length of hospital stay; F: Two-stage (ERCP/EST + LC) *vs* single-stage (LC + LCBDE) in total operating time. CI: Confidence interval.

Interfering variable

- Routine practice in a centre
- Level of Skill and experience
- Available equipment
- Multidisciplinary teams

Issues not addressed

- Size of Stone
- Number of Stones
- Size of Duct
- Previous ERCP

Techniques for LCBDE

- Trans Cystic
- Trans Ductal
- Primary closure vs T Tube

- Indication for TC
  - Stones smaller than cystic duct
  - Small number
  - Stones distal to cystic duct junction

- Indication for TD
  - CBD diameter > 8-10mm
  - IOC
  - Stone > cystic duct
  - >5CBD stones
  - Low or medial cystic duct –CBD junction
  - CHD stones

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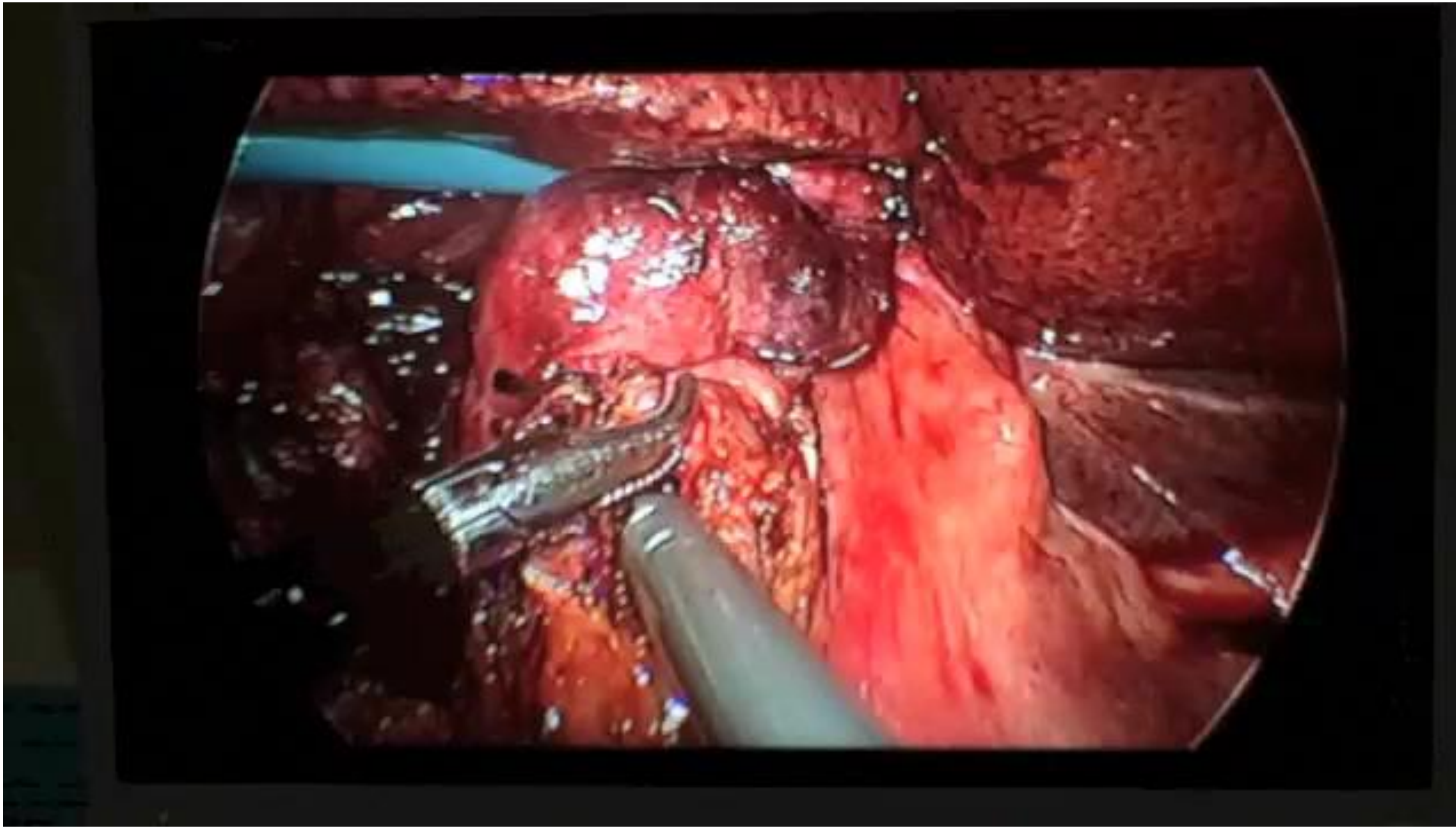

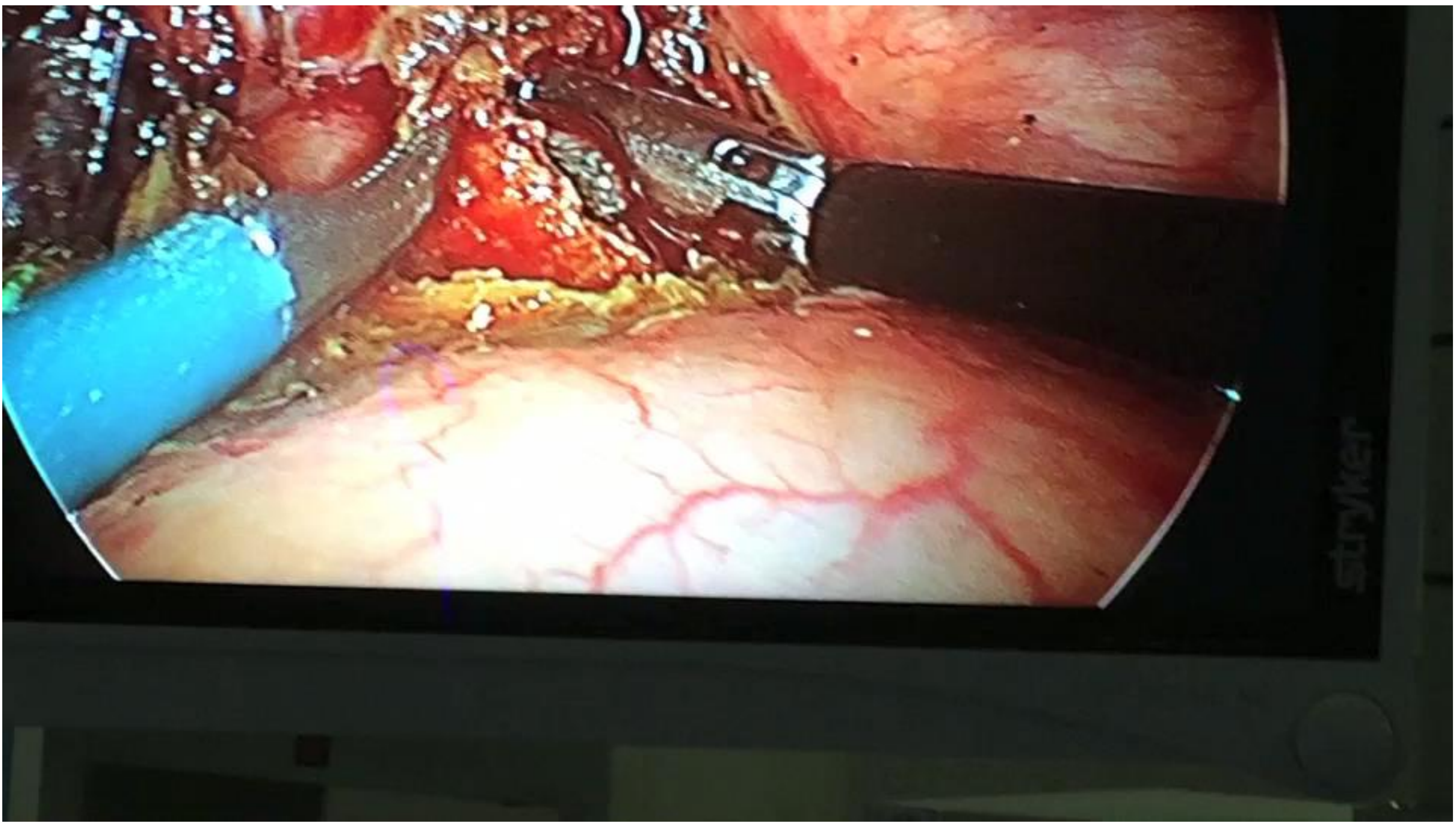
stryker

Transcystic or Transductal Stone Extraction during Single-Stage Treatment of Choledochocystolithiasis: A Systematic Review

Jan Siert K. Reinders · Dirk J. Gouma ·
Dirk T. Ubbink · Bert van Ramshorst ·
Djamila Boerma

World J Surg (2014) 38:2403–2411

*RCT	Stone Clearance	Bile leak	Morbidity
ERCP	52.9-97%	1%	9.1-38.3%
TC	80.4-100%	1.7%	7-10.5%
TD	58.3-100%	11%	18.4-26.7%

Conclusion Stone clearance rates are comparable between the three modalities, but TD stone extraction is associated with a higher risk of bile leaks and should only be performed by highly experienced surgeons. TC stone extraction seems a more accessible technique with lower complication rates. If unsuccessful, per- or postoperative endoscopic stone extraction is a viable option.

Systematic review with meta-analysis of studies comparing primary duct closure and T-tube drainage after laparoscopic common bile duct exploration for choledocholithiasis

Mauro Podda[1] · Francesco Maria Polignano[1] · Andreas Luhmann[1] · Michael Samuel James Wilson[1] · Christoph Kulli[1] · Iain Stephen Tait[1]

Surg Endosc (2016) 30:845–861

Conclusions This comprehensive meta-analysis demonstrates that PDC after LCBDE is feasible and associated with fewer complications than TTD. Based on these results, primary duct closure may be considered as the optimal procedure for dochotomy closure after LCBDE.

16 studies; 1770 patients

Primary Closure better than TTube

Post operative biliary peritonitis	OR 0.22; 95% CI 0.060 – 0.76 ***P*= 0.02**
Operating time	WMD, -22.27 , 95% CI - 33.26 to -11.28, ***P*<0.00001**
Postoperative hospital stay	WMD, -3.22; 95% CI -4.52 to – 1.92 ***P*<0.00001**
Median hospital expenses	SMD, -137, 95% CI -1.96 to -0.77 ***P*< 0.00001**
Postoperative hospital stay decreased in PDC + BD vs TTD	WMD, -2.68; 95% CI -3.23 to -2.13 ***P*< 0.00001**

	PDC	PDC+BD	TTD
Morbidity *P= N/S*	7.4%	13.2%	11.6-16.2%

- Main complications
  - Biliary Fistula
  - CBD stricture
    - PDC increased stricture if CBD <7mm
- Biliary peritonitis lower in PDC
  - PDC vs TTD *P = 0.02*

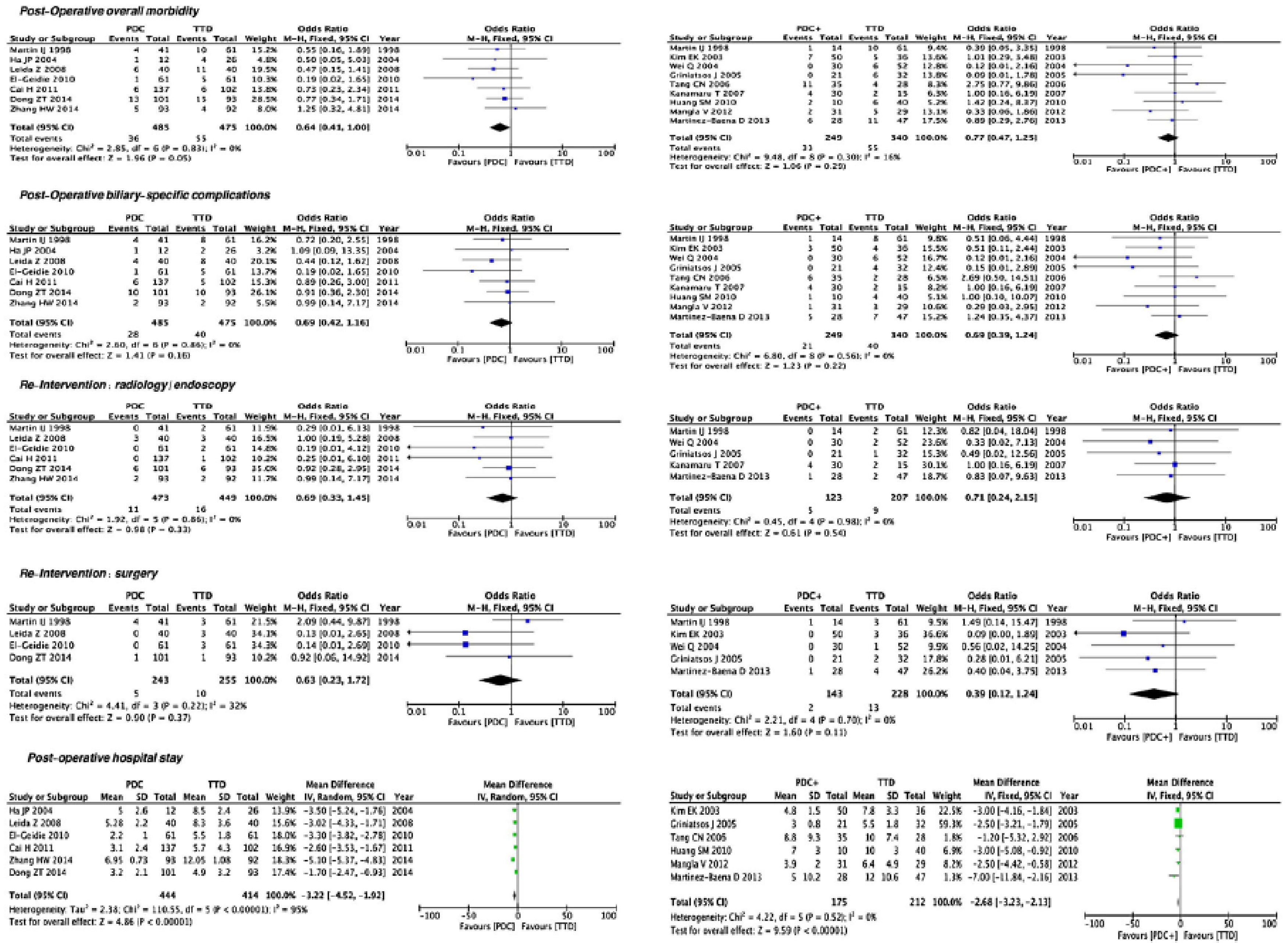

Fig. 2 Meta-analysis of primary outcomes of interest. Primary duct closure (PDC) versus T-tube drainage (TTD) and primary duct closure + biliary drainage (PDC+) versus T-tube drainage (TTD)

Meta- analysis presented

- Significant heterogeneity
- Randomization at different times (pre-op vs after IOCG)

Alternative Procedures for Cholecystectomy

- Single Incision Cholecystectomy
- Robotics

Interventional Approaches to Gallbladder Disease

Todd H. Baron, M.D., Ian S. Grimm, M.D., and Lee L. Swanstrom, M.D.

N Engl J Med 2015;373:357-65.

Single-incision laparoscopic and mini-laparoscopic cholecystectomy have failed to gain widespread acceptance because the techniques are more challenging to learn, and the procedures prolong operative time and increase costs.[17] Similarly, robotic-assisted laparoscopic cholecystectomy, which has technological appeal, has not been widely adopted for these reasons, in addition to the lack of proof of clinical benefit, limited access to the technology, and dramatically increased costs.[18]

- Making Laparoscopic Cholecystectomy safer
- Causes of Bile Duct Injuries
- Management of Common Bile Duct Injuries
- Management of Post operative Biliary strictures
- Common Bile Duct Stones
- Alternative procedures for cholecystectomy