Pre-operative warnings - intraoperative tips

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• Magnitude of the problem
• Implications for patients
• Causes of Bile Duct Injuries
• Making Laparoscopic Cholecystectomy safer
Laparoscopic bile duct injuries: 23 years later

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

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Bile Duct Injuries
GSH: 1991-2009

n = 115
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bile duct injury is serious

• leads to considerable morbidity
• inappropriate treatment may cause death
• long-term sequelae 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%)

3 times higher
2.7 times higher

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Flum et al JAMA 2003
Impaired Quality of Life 5 Years After Bile Duct Injury During Laparoscopic Cholecystectomy
A Prospective Analysis

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From the Departments of *Surgery and †Gastroenterology, Academic Medical Center, Amsterdam, The Netherlands
Laparoscopic cholecystectomy-related BD injury

- a health and financial disaster - 49 patients

- total cost $ 51,411 : 4.5-26 times of uncomplicated cases

- average 32 days hospital stay
  10 days outpatient care days

- 2 deaths (4%)

causes of bile duct related complications

• misidentification of biliary anatomy

• technical errors
  
  - cystic duct leak
  - thermal injuries
  - bleeding
  - “tenting”
Fig. 1. The Strasberg Classifications of Biliary Injury from Laparoscopic Cholecystectomy. (adapted from J Am Coll Surg. 1995;180(1):101–125)
Stewart-Way Classification
Laparoscopic Bile Duct Injuries

252 cases  (Way et al Ann Surg 2003)

Class I  
(7%)

Class II  
(22%)

Class III  
(61%)

Class IV  
(10%)

causes

Misidentification- Class I, III, IV

close dissection - Class II & IV
How does this occur?

Way has used scientific principles from human factor research and cognitive psychology to understand BDI

- misconception leading to misidentification of anatomy
- skills error leading to dangerous dissection

Kanizsa Triangle

creation of visual perceptions as a form of heuristics

once it is there you can’t make an illusion disappear

subconscious
Class E (Strasberg)  Class III (Stewart –Way)

common bile duct is misidentified for the cystic duct

“the entire injury consists of the fallout from a single initial misperception”


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“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”.

So can we change it?

- Retraining has been the focus – “blame”
  - Education regarding the mechanism of the injury will help
    - if we understand when the event occurs even although subconscious, improved vigilance will help
- System changes: the process and technology
  - Ensure technology is optimal
  - Consider alternative surgical approach
    - subtotal cholecystectomy
    - fundus first dissection
laparoscopic cholecystectomy

how can we make it a safer procedure?

• training
• identifying the high risk patient
• operative cholangiography
• refinements to operative technique
• built in “stopping rules”
the learning curve

Nuzzo et al. Arch Surg 2005
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the learning curve

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Nuzzo et al Arch Surg 2005
ANZHPBA Oct 2010
bile duct injuries
- the learning curve continues

• 30% of BDI -> 200 cases
• no reduction in other complications
  - bleeding and bile leaks from cystic duct
    may cause major M&M

Archer et al Ann Surg 2001
who are at risk for bile duct injury?

- elderly, males, obesity
- cholecystitis (previous attacks)
- gallstone pancreatitis
- previous BDS
- Mirizzi syndrome
who are at risk for bile duct injury?

- elderly, males, obesity
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- Mirizzi syndrome

No risk factors in 80% of BDI

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routine operative cholangiography?

protagonists

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

Ludwig et al Surg Endosc 2002
Sceptics - it is not infallible

- 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
Sceptics - it is not infallible

- 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

IOC is not a substitute for careful delineation of the biliary anatomy
<table>
<thead>
<tr>
<th>collected series</th>
<th>% bile duct injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>• routine</td>
<td>0.20 – 0.39</td>
</tr>
<tr>
<td>• selective</td>
<td>0.30 – 0.60</td>
</tr>
<tr>
<td>• none</td>
<td>0.34 – 0.58</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>IOC Use Categories</th>
<th>Rate of CBD Injury, %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Overall*</td>
</tr>
<tr>
<td>&lt;25% (n = 741,742)</td>
<td>0.52</td>
</tr>
<tr>
<td>25%-49% (n = 279,270)</td>
<td>0.54</td>
</tr>
<tr>
<td>50%-75% (n = 211,880)</td>
<td>0.51</td>
</tr>
<tr>
<td>&gt;75% (n = 337,469)</td>
<td>0.43</td>
</tr>
<tr>
<td>All (N = 1,570,361)</td>
<td>0.50</td>
</tr>
</tbody>
</table>

* 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).
## Operative cholangiography

**risk of bile duct injury**

<table>
<thead>
<tr>
<th></th>
<th>routine</th>
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<tbody>
<tr>
<td>Number</td>
<td>6024</td>
<td>3268</td>
</tr>
<tr>
<td>complete transection</td>
<td>0.02%</td>
<td>0.09% p 0.13</td>
</tr>
<tr>
<td>minor injury</td>
<td>0.28%</td>
<td>0.18% p 0.25</td>
</tr>
<tr>
<td>recognition</td>
<td>93%</td>
<td>33% p 0.01</td>
</tr>
</tbody>
</table>

verdict - operative cholangiography

- routine: continue if that’s the way you were taught

- selective: ? doubt about anatomy

- none: extra care to define biliary anatomy
how can we prevent bile duct injury?
high resolution imaging and quality equipment

Use of energy devices including power on diathermy
lateral traction of infundibulum

expose Calot’s triangle
port placements

dissection at 90 degrees
“upward traction”

“crowding” Calot’s triangle

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starting the dissection too low

misidentification of CBD for CD

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potential flaw of infundibular technique

“error trap” - hidden cystic duct (Strasberg)

false infundibulum
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)

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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.
securing the cystic duct

wide cystic duct

Endo-loop

Lockable PDS clip

“Hartmann’s stone”

“circumcise”
Additional steps to avoid bile duct injury

• avoid “tunnel vision”: “zoom out” to ID landmarks
• avoid dissecting towards CBD and behind duodenum.
• keep dissection, division of cystic duct close to GB
• avoid excessive diathermy (close to bile duct region)
• stay away from the cystic duct/ bile duct junction
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close dissection - Class II & IV
hints suggesting dissection of the bile duct instead of cystic duct

- duct diameter larger than what can be encompassed by a standard (9mm) clip.
- any duct that can be traced uninterrupted behind the duodenum.
- the presence of another unexpected duct structure.
- a large artery behind the duct = R hepatic artery = CBD.
Subtotal Cholecystectomy

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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
“stopping rules” or “call a friend”

depends on the surgeons experience

• Not making progress
• unable to obtain “critical view of safety”
• IOC: non filling of hepatic ducts
• tell-tale of a bile duct injury
  - unexplained bile leak
  - division of an unidentified structure
• major bleeding

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“stopping rules” or “call a friend” depends on the surgeons experience

- unable to obtain “critical view of safety”
- IOC: non filling of hepatic ducts
- tell-tale of a bile duct injury
  - unexplained bile leak
  - division of an unidentified structure
  - major bleeding

“surgical manhood” is not lost by converting to open cholecystectomy
conclusions

Prevention of bile duct injury

• training with the emphasis on proctoring
• devise methods to prevent “misperceptions”
• adopt a culture of caution
  no cholecystectomy is simple
  discourage complacency and a cavalier attitude
• low threshold to convert and/or seek advice
  introduce “stopping rules” to control damage

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recognition and management of
bile leak and bile duct injury
laparoscopic cholecystectomy

recognition of bile leaks / duct injuries

• intra-operative
• early post-operative
• delayed presentation

key to successful outcome

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intra-operative detection

partial defect
- primary repair
- avoid T-tube
- drain

complete transection
- hepatico-jejunostomy
  (HPB surgeon)
- drain and refer
intra-operative detection

treatment strategy

- avoid collateral damage
- when in doubt, drain and refer
successful outcome after bile duct repair

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Steward & Way  Arch Surg 1995
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successful outcome after bile duct repair

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

Steward & Way  Arch Surg 1995
Flum et al JAMA 2003

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management of bile duct injury

the ideal scenario

• early detection
• maximum information on biliary anatomy
• specialised multi-disciplinary unit
Laparoscopic Cholecystectomy
prevention of bile duct injuries

“An error does not have to be a mistake unless you refuse to correct it”

J F Kennedy