Difficult Cannulation Techniques and Tips

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Methodist Dallas Medical Center

Disclosures Regarding Cannulation

• Paucity of data
• Data are operator dependent
• Many variables & individual preferences
• More of an art than science
• My personal experience & opinions

A fool takes no pleasure in understanding, but only in expressing opinion.

Proverbs 18:2
Overview

• Definitions and Benchmarks
• Techniques for cannulation
  – Standard
  – Advanced
• Difficult cannulation scenarios
• Options for failed cannulation
• Methods to prevent complications

What is Cannulation?

• Injection of contrast only for diagnostic purposes – obsolete
• Deep cannulation with guidewire – necessary for therapy
• Endoscopic
• Retrieving
• Cutting
• Plumbering
Define Difficult

Condition(s) that make it hard to accomplish

Define Difficult

Requires much labor, skill, or planning to be performed successfully
Difficult Conditions & Skill

Cannulation Difficulty

- Pancreatic – main papilla
- Bile duct stone / stricture
- Impacted stone
- Bile leak
- Sclerosing cholangitis
- Neoplasia
- Duodenal Diverticulum
- Pancreatic – minor papilla
- s/p Billroth II, Whipple
- No fluoroscopy
Cannulation Benchmarks

- ≈ 20% failed biliary cannulation using standard techniques
- > 95% success +/- advanced techniques
- Success related to operator volume
- Difficult Cannulation definition and associated with increased risk *
  - Time (> 5 min)
  - Repeated attempts (> 5)
  - Inadvertent pancreatic duct (> 2)

PEP > 10%

*Halttunen, Scand J Gastroenterol 2014

Cannulation Challenges

- Access to papilla
  - Gastric outlet obstruction
  - Postoperative (BII, Whipple, RY)
- Papilla
  - Flat papilla
  - Redundant periampullary folds
  - Periampullary edema / inflammation
  - Periampullary diverticula
  - Impacted stone
  - Neoplasia
Cannulation Techniques

Standard
• Catheter & Contrast
• Wire - Guided +/- Operator Control
• Pancreatic stent
• Double – Wire
• Needle Knife over Impacted Stone

Advanced
• Needle Knife Access Sphincterotomy
• Minor papilla
• Billroth II
• Whipple
• No Fluoroscopy

Expertise & Risk

Catheter and Contrast Injection

Tarnasky, Am J Gastroenterol 2007
Guidewire Cannulation

- Contrast Injection To Facilitate
- Papilla
- Duct Cannulation
- Contrast Injection To Confirm
- Catheter
- Guidewire

Tarnasky, Am J Gastroenterol 2007

GENTLE Cannulation

- Guidewire before Contrast
- Envision duct direction
- Never force it
- Take control of wire
- Limit attempts
- Ensure drainage

- Guidewire before Contrast
- Endoscopist-controlled
- Never force it
- Tip cannulation
- Limit attempts
- Expertise

Tarnasky, Am J Gastroenterol 2007;102:2154–2156
Tarnasky, Gastrointest Endosc 2012;76:919-920
Can a Wire-Guided Cannulation Technique Increase Bile Duct Cannulation Rate and Prevent Post-ERCP Pancreatitis?: A Meta-Analysis of Randomized Controlled Trials

<table>
<thead>
<tr>
<th>Study (reference)</th>
<th>Primary cannulation rate, n/tot (%)</th>
<th>Precut performed, n/tot (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SM</td>
<td>WM</td>
</tr>
<tr>
<td>Lella (8)</td>
<td>195/200 (97.5)</td>
<td>197/200 (98.5)</td>
</tr>
<tr>
<td>Artifon (22)</td>
<td>108/150 (72)</td>
<td>132/150 (88)</td>
</tr>
<tr>
<td>Lee (24)</td>
<td>111/150 (74)</td>
<td>120/150 (80)</td>
</tr>
<tr>
<td>Bailey (9)</td>
<td>156/215 (72.5)</td>
<td>167/215 (77.7)</td>
</tr>
<tr>
<td>Katsinelos (23)</td>
<td>89/165 (53.9)</td>
<td>136/167 (81.4)</td>
</tr>
<tr>
<td>Total</td>
<td>659/880 (74.9)</td>
<td>752/882 (85.3)</td>
</tr>
</tbody>
</table>

SM, standard method; WM, wire-guided method.

WGC also associated with reduced PEP

Cennamo et al., Am J Gastroenterol 2009; 104:2343-2350

Guidewire versus conventional contrast cannulation of the common bile duct for the prevention of post-ERCP pancreatitis: a systematic review and meta-analysis

Justin Cheung, MD, FRCP, Kelvin K. Tooi, PhD, Wai-Leong Quan, MBBS, MRCP, James Y.W. Lau, MD, FRCS, Joseph J.Y. Sung, MD, PhD

• 5 papers plus 2 abstracts

Guidewire Cannulation

• Significantly higher cannulation success: 89% vs. 78%

• Significantly lower PEP: 3.2% vs. 8.7%

• Significantly lower PEP among those with inadvertent PD manipulation: 1.1% vs. 9.5%

Cheung et al., Gastrointest Endosc 2009; 70:1211-1219
Guide wire-assisted cannulation for the prevention of post-ERCP pancreatitis: a systematic review and meta-analysis

<table>
<thead>
<tr>
<th>Significant differences</th>
<th>GWC</th>
<th>CAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall PEP</td>
<td>3.5%</td>
<td>6.7%</td>
</tr>
<tr>
<td>Cannulation Success</td>
<td>83.6%</td>
<td>77.3%</td>
</tr>
<tr>
<td>Need for Precut</td>
<td>9.3%</td>
<td>12.4%</td>
</tr>
<tr>
<td>PEP with Inadvertent PD</td>
<td>1.7%</td>
<td>8.7%</td>
</tr>
<tr>
<td>PEP without Pancreatic Stents</td>
<td>2.4%</td>
<td>10.2%</td>
</tr>
</tbody>
</table>

Endoscopy, 2014

Pancreatic Guidewire Technique

- **Single Pancreatic GWT**
  - Catheter/Papillatome without 2nd guidewire

- **Double GWT** – Pancreatic guidewire then
  - Catheter/Papillatome loaded with 2nd guidewire

- **High PEP if no PD stent**
  - 23% vs 3% from RCT (Ito, 2010)
  - 22% vs 14% from RCT when c/t fistulotomy (Angsu..., 2012)
  - 38% from RCT when c/t TPP (Yoo 2013)
  - 30% after failed PD stenting (Ito, 2014)
  - 29% if no PD stent (Nakahara, 2014)
Pancreatic Guidewire Technique

• First described by Dumonceau et al. in abstract form (1998)
• Maeda 2003
• Draganov 2005
• Ito WJG 2008
• Herreros de Tejada (2009) RCT

Needle Knife over Stone
An Analysis of the Factors Associated With the Development of Complications in Patients Undergoing Precut Sphincterotomy: A Prospective, Controlled, Randomized, Multicenter Study

Gianpiero Manes, MD; Pietro Di Giorgio, MD; Alessandro Repici, MD; Giampiero Macarri, MD; Sandro Ardizzone, MD and Gabriele Bianchi Porro, MD

- Low-risk biliary indications
- Randomized to early precut vs continued attempts if attempt to cannulate:
  > 10 min and/or >4 inadvertent PD injections
- Used fistulotomy technique
- PD injections risk factor for PEP
- ↓ PEP after early precut 2.6% vs 14.9%

Manes et al., Am J Gastroenterol 2009;104:2412-2417

Precut sphincterotomy, repeated cannulation and post-ERCP pancreatitis in patients with bile duct stone disease

Pier Alberto Testoni*, Antonella Giussani, Cristian Vailati, Sabrina Testoni, Milena Di Leo, Alberto Mariani

- Retrospective study (9 yrs) in low-risk patients
- Varied cannulation techniques
- Fistulotomy precut – overall in 8.5% of patients

Table 2
Pancreatitis rates in relation to the number of attempts at cannulation, with and without precutting.

<table>
<thead>
<tr>
<th>Cannulation attempts</th>
<th>Pancreatitis rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10</td>
<td>without precutting</td>
</tr>
<tr>
<td></td>
<td>with precutting</td>
</tr>
<tr>
<td>≥10</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Testoni et al., Dig Liv Dis 2011;43:792-796
Access Sphincterotomy

- Transpancreatic precut
- Needle knife fistulotomy
- Needle Knife freehand from papilla
- Needle Knife over pancreatic guidewire
- Needle Knife over pancreatic stent
- Ampullectomy
Does leaving a main pancreatic duct stent in place reduce the incidence of precut biliary sphincterotomy-associated pancreatitis? A randomized, prospective study

Sang-Woo Cha, MD, Wesley D. Leung, MD, Glen A. Lehman, MD, James L. Watkins, MD, Lee McHenry, MD, Evan L. Fogel, MD, Stuart Sherman, MD

**TABLE 2. Frequency of precut sphincterotomy-associated pancreatitis**

<table>
<thead>
<tr>
<th>Group</th>
<th>No. of pancreatitis/total no. of patients (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stent</td>
<td>2/46 (4.3)</td>
</tr>
<tr>
<td>Stent removed</td>
<td>10/47 (21.3)</td>
</tr>
<tr>
<td>No stent</td>
<td>8/58 (13.8)</td>
</tr>
<tr>
<td>Total</td>
<td>20/151 (13.2)</td>
</tr>
</tbody>
</table>

**TABLE 3. Frequency and severity of precut sphincterotomy-associated pancreatitis**

<table>
<thead>
<tr>
<th>Severity of pancreatitis</th>
<th>Stent (n = 46)</th>
<th>Stent removed (n = 47)</th>
<th>No stent (n = 58)</th>
<th>Total (N = 151) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>9 (45)</td>
</tr>
<tr>
<td>Moderate</td>
<td>0</td>
<td>4</td>
<td>2</td>
<td>6 (30)</td>
</tr>
<tr>
<td>Severe</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>5 (25)</td>
</tr>
<tr>
<td>Total</td>
<td>2</td>
<td>10</td>
<td>8</td>
<td>20 (100)</td>
</tr>
</tbody>
</table>

*One patient died of complications of severe necrotizing pancreatitis.

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Needle-knife precut papillotomy with a small incision over a pancreatic stent improves the success rate and reduces the complication rate in difficult biliary cannulations

Kensuke Kubota · Takamitsu Sato · Shingo Kato · Seitaro Watanabe · Kunihiro Hosono · Noritoshi Kobayashi · Kantaro Hisutomi · Nobuyuki Matsumashi · Atsushi Nakajima

<table>
<thead>
<tr>
<th>2004-2006</th>
<th>2007-2011</th>
</tr>
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<tbody>
<tr>
<td>NO PPS</td>
<td>+ PPS</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>NKPP</th>
<th>NKPP-SIFS</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>36</td>
<td>98</td>
<td></td>
</tr>
<tr>
<td>Success rate</td>
<td>31/36 (86.1 %)</td>
<td>95/98 (96.9 %)</td>
<td>0.0189</td>
</tr>
<tr>
<td>Overall complication rate</td>
<td>12/36 (33.3 %)</td>
<td>7/98 (7.1 %)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Bleeding</td>
<td>3/36 (8.3 %)</td>
<td>0/98 (0 %)</td>
<td>0.0036</td>
</tr>
<tr>
<td>Pancreatitis</td>
<td>7/36 (19.4 %)</td>
<td>6/98 (6.1 %)</td>
<td>0.0208</td>
</tr>
<tr>
<td>Perforation</td>
<td>1/36 (2.8 %)</td>
<td>1/98 (1 %)</td>
<td>NS</td>
</tr>
<tr>
<td>Cholangitis</td>
<td>1/36 (2.8 %)</td>
<td>0/98 (0 %)</td>
<td>NS</td>
</tr>
</tbody>
</table>

J Hepatobiliary Pancreat Sci, 2013
**Transpancreatic Precut**

- First described in 1999 (Goff)
- Cut is started in direction of bile duct but with guidewire in pancreatic duct

**Guidewire-assisted Transpancreatic Sphincterotomy for Difficult Biliary Cannulation: A Prospective Randomized Controlled Trial**

*Jinfeng Zang, MD, Chi Zhang, MD, and Jinye Gao, MD*

- Low – risk patients (mostly stones)
- No PD stents

**TABLE 2. Outcomes of Sphincterotomy Techniques**

<table>
<thead>
<tr>
<th></th>
<th>GATS (n = 73)</th>
<th>NKS (n = 76)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Success rate</td>
<td>70 (95.9%)</td>
<td>64 (84.2%)</td>
<td>0.018</td>
</tr>
<tr>
<td>Cannulation time</td>
<td>193 (141-318)</td>
<td>485 (392-627)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Complications</td>
<td>7 (9.6%)</td>
<td>8 (10.5%)</td>
<td>0.85</td>
</tr>
<tr>
<td>Pancreatitis</td>
<td>5 (6.8%)</td>
<td>5 (6.6%)</td>
<td>1.0</td>
</tr>
<tr>
<td>Hemorrhage</td>
<td>1 (1.4%)</td>
<td>3 (3.9%)</td>
<td>0.62</td>
</tr>
<tr>
<td>Perforation</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

- Advocated for small papillae
- Suggested as safe for even inexperienced

*Surg Laparosc Endosc Percutan Tech, 2014*
Sequential algorithm analysis to facilitate selective biliary access for difficult biliary cannulation in ERCP: a prospective clinical study

Difficult Biliary Cannulation

Fistulotomy  OR  DGW

\[ \text{NKOPDS} \rightarrow \text{Pancreatic Stent} \]

Lee et al, BMC Gastroenterology 2014

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Sequential algorithm analysis to facilitate selective biliary access for difficult biliary cannulation in ERCP: a prospective clinical study

<table>
<thead>
<tr>
<th>Early Precut Fistulotomy</th>
<th>Double Wire</th>
<th>NKOPDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF</td>
<td>DG</td>
<td>PPS</td>
</tr>
<tr>
<td>No. (%)</td>
<td>71 (50.7)</td>
<td>33 (23.6)</td>
</tr>
<tr>
<td>Success of biliary cannulation</td>
<td>67/71 (94.4%)</td>
<td>33/65 (50.8%)</td>
</tr>
<tr>
<td>First attempt</td>
<td>63 (88.7)</td>
<td>33 (47.8)</td>
</tr>
<tr>
<td>Second attempt</td>
<td>4/6 (66.7)</td>
<td>0</td>
</tr>
<tr>
<td>Failure</td>
<td>4 (5.6%)</td>
<td>0</td>
</tr>
<tr>
<td>Asymptomatic hyperamylasemia</td>
<td>5 (7)</td>
<td>3 (9)</td>
</tr>
<tr>
<td>PEP (mild/moderate/severe)</td>
<td>5/7 (5/2/9)</td>
<td>4/12 (1/2/9)</td>
</tr>
<tr>
<td>Bleeding</td>
<td>1 (1.4)</td>
<td>1 (3)</td>
</tr>
<tr>
<td>Perforation</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Lee et al, BMC Gastroenterology 2014
Low-Risk Difficult Cannulation

• Bile duct stone
• Bile duct stricture
• No h/o pancreatitis
• No pancreatic contrast

Consider Freehand NKAS or fistulotomy

High-Risk Difficult Cannulation

• SOD
• h/o pancreatitis
• PSC
• Pancreatic duct contrast
• Repeated PD guidewire
High-Risk Difficult BD Cannulation

Pancreatic Duct Guidewire

DGW
TPP
NKOGW

Attempt BDC OR NKOPDS
Pancreatic Stent

Duodenal Diverticulum

Challenges
- Filled with debris
- Difficult to locate papilla
- Difficult to discern direction of ducts
- Risk of perforation

Strategies
- Focus on edge
- Identify intraduodenal segment of bile duct
- Endoclip placement
- Scope in diverticulum
- Use gastroscope +/- cap
- Pancreatic Guidewire and/or Stent
Duodenal Diverticulum

Billroth II Cannulation Challenges

- Access afferent limb
- Risk of bowel perforation
- Identify papilla
- Upside down approach to cannulation
Billroth II Approaches

• Careful intubation of afferent limb
• Consider EGD scope
• Wire – guided cannulation
  – Straight catheter
  – Papillatome turned upside down
• Double – wire technique

Billroth II Cannulation
Pregnancy: No Fluoroscopy

Failed Cannulation: Options

- Refer to another endoscopist
- EUS – guided access
- PTC +/- Rendezvous technique
- Try again later

If at first you don’t succeed
Try try again
Prophylaxis of post-ERCP pancreatitis: European Society of Gastrointestinal Endoscopy (ESGE) Guideline – Updated June 2014

- Routine use of rectal NSAIDS (100mg)
- Consider prophylactic 5F pancreatic stenting in high-risk scenarios
- Limit cannulation attempts
- Wire-guided cannulation +/- pancreatic guidewire as backup technique