Endoscopic Management of Pancreatic Fluid Collections (PFC)

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Pathways to PFCs following acute pancreatitis

Acute pancreatitis

80-90%

Interstitial edematous pancreatitis

>90% resolve

10-20%

Necrotizing pancreatitis

10-20%

APFC

ANC

4 wks

Pseudocyst

WOPN

Wu BU. Gastroenterology 2013
Fagenholz PJ. Ann Epidemiol 2007
Fagenholz PJ. BMC Emerg Med 2007
Poornachandra KS. J Clin Gastroenterol 2011

5-15% pancreatitis cases
PFC Classification
Revised Atlanta Criteria

- PFC
  - Acute (<4 weeks)
    - Acute Peripancreatic Fluid Collection (APFC)
  - Chronic (>4 weeks)
    - Acute Necrotic Collection (ANC)
    - Pseudocyst
    - Walled-Off Pancreatic Necrosis (WOPN)

APFC

Pseudocyst

ANC

WOPN

### Who Needs Treatment of PFC’s?

<table>
<thead>
<tr>
<th>Indications</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infection or suspected infection</td>
<td>~20% in necrotizing pancreatitis&lt;br&gt;Routine FNA not needed- clinical signs accurately predict &gt;90%</td>
</tr>
<tr>
<td>Ongoing organ failure</td>
<td>~40% will have infected PFC</td>
</tr>
<tr>
<td>Mass effect causing GOO, biliary/bowel obstruction</td>
<td>Less common</td>
</tr>
<tr>
<td>Refractory pain, wt loss, &gt;8wks</td>
<td></td>
</tr>
<tr>
<td>Bleeding into PFC</td>
<td></td>
</tr>
<tr>
<td>Abdominal compartment syndrome</td>
<td>Rare</td>
</tr>
<tr>
<td>Bowel ischemia</td>
<td></td>
</tr>
</tbody>
</table>

IAP/APA acute pancreatitis guidelines. Pancreatology 2013
ASGE guideline- role of endoscopy in pancreatic fluid collections. Gastrointest Endosc 2016
General Principles for Treating Symptomatic PFC’s

APFC or ANC → DELAY

Pseudocyst (>4 wks) → DRAIN

WOPN (>4WKS) → DEBRIDE
Improving Outcomes with Delay

- RCT – 25 early (<72hrs) vs. 11 late (>12 days) surgical necrosectomy
- Mortality 58% vs. 27% (OR 3.4) – study stopped early

Mortality based on time to intervention in 242 pts

<table>
<thead>
<tr>
<th>Days to surgical, perc, or endoscopic intervention</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-14</td>
<td>56%</td>
</tr>
<tr>
<td>14-29</td>
<td>26%</td>
</tr>
<tr>
<td>&gt;29</td>
<td>15%</td>
</tr>
</tbody>
</table>

P<0.001
Treatment Options for Symptomatic Pseudocyst

• Surgical Cystogastrostomy / cystenterosomy ("gold standard")
• Percutaneous drainage
• Endoscopic Cystogastrostomy (Conventional Transmural Drainage (CTD))
• EUS-guided Cystogastrostomy
Conventional Transmural Drainage (CTD) Approach

From Byung MY, Korean J Intern Med 2009
Conventional Transmural Drainage (CTD) Approach

<table>
<thead>
<tr>
<th>Study</th>
<th>Pts</th>
<th>Success</th>
<th>Recurrence</th>
<th>Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cremer 1989</td>
<td>33</td>
<td>82%</td>
<td>12%</td>
<td>2%</td>
</tr>
<tr>
<td>Bimoeller 1995</td>
<td>53</td>
<td>87%</td>
<td>21%</td>
<td>11%</td>
</tr>
<tr>
<td>Beckingham 1999</td>
<td>34</td>
<td>71%</td>
<td>7%</td>
<td>N/A</td>
</tr>
<tr>
<td>Baron 2002</td>
<td>138</td>
<td>72-92%</td>
<td>16%</td>
<td>17-37%</td>
</tr>
<tr>
<td>Cahen 2005</td>
<td>92</td>
<td>71%</td>
<td>11%</td>
<td>34%</td>
</tr>
<tr>
<td>Hookey 2006</td>
<td>116</td>
<td>87.9%</td>
<td>N/A</td>
<td>11%</td>
</tr>
<tr>
<td>Weckman 2006</td>
<td>170</td>
<td>86.19</td>
<td>N/A</td>
<td>22%</td>
</tr>
</tbody>
</table>

Limitation of this technique is the need of a gastric bulge. No bulge seen in 42-48%.

EUS Guided Drainage (EUSGD)

- Provides the ability to identify and avoid vascular structures between the cyst and the gastric wall.
- Measured distance between cyst and gastric wall.
- Ensure adequate apposition.
- Localization of non-bulging pseudocyst.
- Evaluation for necrosis.

EUS Guided Drainage (EUSGD)

- **Simple Pseudocyst**
  - Success 80-100%
  - Complications 10%
    - Bleeding
    - Perforation

- **Infected pseudocyst**
  - Success rate 63-80%
  - Complications 16-30%

Sadik et al. World J Gastroenterol 20011;17:499-505
Stent for Drainage

• Plastic stent placement required at least 2 double pigtail stents
  – Disadvantage
    ○ Labor intense/prolonged procedure time
    ○ Risk for occlusion
    ○ Need for repeat procedures
  – Advantage
    ○ Cost

• Fully-covered self-expanding metal stent (FCSEMS)
  – Advantage
    ○ Large lumen decrease risk for occlusion
    ○ Shorter procedure time
    ○ Decrease change of repeat procedures
  – Disadvantage
    ○ Cost
    ○ Migration/ hyperplastic growth/local trauma

Tyberg A. World J Gastroenterol 2016
Penn DE. Gastrointest Endosc 2012
What is better? Plastic vs. Metal

• Recent meta-analysis of 698 patients did not find difference between pseudocysts drained with multiple plastic stents vs. metal stents.
  – Treatment success/adverse events/recurrence rates.¹

• Retrospective cohort study of 230 patients.
  – Complete resolution 89% (plastic) vs. 98% (metal).
  – Plastic stent were 2.9 times most likely to report adverse events.²

¹ Navaneethan U. Gastrointest Endosc 2014
² Sharaiha RZ. Gastrointest Endosc 2015
New technology for endoscopic drainage / debridement of PFCs: Lumen-apposing stent (LAMS)
Clinical evaluation of a novel lumen-apposing metal stent for endosonography-guided pancreatic pseudocyst and gallbladder drainage (with videos)

Takao Itoi, MD,1 Kenneth F. Binmoeller, MD,2 Janak Shah, MD,2 Atsushi Sofuni, MD,1 Fumihide Itokawa, MD,1 Toshio Kurihara, MD,1 Takayoshi Tsuchiya, MD,1 Kentaro Ishii, MD,1 Shujiro Tsuji, MD,1 Nobuhito Ikeuchi, MD,1 Fuminori Moriyasu, MD1

• 1st clinical experience with pseudocyst and GB drainage (GB drainage off-label in USA)
• 15 pseudocyst successfully treated

Gastrointest Endosc 2012
# Lumen-apposing Metal Stent in Pseudocyst

<table>
<thead>
<tr>
<th>Study</th>
<th>Pts</th>
<th>Success</th>
<th>Recurrence</th>
<th>Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ito 2012</td>
<td>15</td>
<td>100%</td>
<td>0%</td>
<td>6%</td>
</tr>
<tr>
<td>Shah 2015</td>
<td>33</td>
<td>93%</td>
<td>N/A</td>
<td>15%</td>
</tr>
<tr>
<td>Gornals 2013</td>
<td>9</td>
<td>100%</td>
<td>11%</td>
<td>11%</td>
</tr>
<tr>
<td>Walters 2015</td>
<td>15</td>
<td>93%</td>
<td>N/A</td>
<td>6%</td>
</tr>
<tr>
<td>Rinninella 2015</td>
<td>41</td>
<td>98%</td>
<td>N/A</td>
<td>5%</td>
</tr>
</tbody>
</table>
Comparing Drainage Techniques for Symptomatic Pseudocyst

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgical vs. percutaneous¹</td>
<td>- Studies from 1990’s</td>
</tr>
<tr>
<td></td>
<td>- Surgery more definitive than percutaneous</td>
</tr>
<tr>
<td></td>
<td>- Higher mortality with primary surgical treatment</td>
</tr>
<tr>
<td></td>
<td>- Percutaneous used as bridge to surgery</td>
</tr>
<tr>
<td>Endoscopic vs. percutaneous²</td>
<td>- Similar to higher clinical success and similar adverse events</td>
</tr>
<tr>
<td></td>
<td>- Lower re-intervention/surgery/LOS with endoscopic</td>
</tr>
<tr>
<td>Endoscopic vs. EUS³</td>
<td>- Two RCTs- higher technical success with EUS (standard endo difficult</td>
</tr>
<tr>
<td></td>
<td>if no bulge); no diff in adverse events (although higher rate in endo)</td>
</tr>
<tr>
<td>EUS vs. surgical⁴</td>
<td>- RCT (20 vs. 20)</td>
</tr>
<tr>
<td></td>
<td>- No difference in treatment success, complications, re-interventions</td>
</tr>
<tr>
<td></td>
<td>- Shorter hospital stay, lower cost, better pt well-being (EUS)</td>
</tr>
</tbody>
</table>

⁴ Varadarajulu S. Gastroenterol 2013
Treating Necrotizing Pancreatitis/WOPN: A Step-up Approach

Conservative management

Drainage (perc / endo) if concern for infection / other sxms

Surgical or endoscopic debridement (if needed)

IAP/APA evidence-based acute pancreatitis guidelines. Pancreatology 2013
Conservative Approach to Necrotizing Pancreatitis

Necrotizing pancreatitis
N=639

Conservative treatment
397/639 (62%)

Radiological, endoscopical or surgical intervention
242/639 (38%)

Early emergency laparotomy
32/639 (5%)

Intervention for suspected/confirmed infected necrosis
208/639 (33%)

Intervention for gastric outlet obstruction from sterile necrosis
2/639 (0.3%)

Primary catheter drainage
130/208 (63%)

Primary necrosectomy
78/208 (38%)

No additional necrosectomy
45/130 (35%)

Additional necrosectomy
76/130 (58%)

Laparotomy
68/78 (87%)

Video-assisted retroperitoneal debridement
6/78 (8%)

Endoscopic transluminal necrosectomy
4/78 (5%)

Catheter drainage
1/2 (50%)

Endoscopic transluminal necrosectomy
1/2 (50%)

78% mortality

7% mortality

87% perc / 13% endo
Dutch Pancreatitis Study Group: RCTs - necrotizing pancreatitis needing intervention

**PANTER Trial**
Step-up (drain/debride) vs. open necrosectomy

- Step-up group - drainage alone sufficient in 35%
- MC or death 40% step-up group vs. 69% open group (RR 0.57; 95%CI 0.38-0.87; p=0.006)
- No difference mortality: 19% step-up vs. 16% open

**PENGUIN Trial**
Endoscopic vs. surgical necrosectomy

- Outcomes ↓IL-6 ↓composite of major complications/death (20% vs. 80%) endo vs. surg groups

**TENSION Trial**
Endoscopic step-up (drain-debride) vs. surgical step-up (video-assisted retroperitoneal debridement [VARD] → open)
## TENSION Trial

<table>
<thead>
<tr>
<th></th>
<th>Endo step-up (n=49)</th>
<th>Surgical step-up (n=51)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary end-point (major complication/death)</td>
<td>20%</td>
<td>28% (p=NS)</td>
</tr>
<tr>
<td>% not needing necrosectomy after initial drainage</td>
<td>41%</td>
<td>49% (p=NS)</td>
</tr>
<tr>
<td>Pancreatic fistula</td>
<td>5%</td>
<td>32% (p=0.001)</td>
</tr>
<tr>
<td>LOS</td>
<td>36 days</td>
<td>69 days (p=0.03)</td>
</tr>
<tr>
<td>costs</td>
<td>Lower in endo group</td>
<td></td>
</tr>
</tbody>
</table>
## Direct Endoscopic Necrosectomy (DEN) for Infected WOPN

A matched cohort study compared early DEN vs. conventional step-up DEN (n=12) with Step-up (n=12) Drain followed by minimally invasive surgery (if needed). The results are as follows:

<table>
<thead>
<tr>
<th></th>
<th>DEN (n=12)</th>
<th>Step-up (n=12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical resolution</td>
<td>11 (1 required IR drainage)</td>
<td>3 with IR drain; 9 required VARD</td>
</tr>
<tr>
<td>LOS</td>
<td>Shorter with DEN</td>
<td></td>
</tr>
<tr>
<td>Health care costs</td>
<td>5x more with step-up</td>
<td></td>
</tr>
</tbody>
</table>

Kumar N. Pancreas 2014
Endoscopic Debridement of WOPN: conventional technique and concerns

- Large diameter tract dilation - > perforation, bleeding, leak
- Removal of necrotic tissue - > multiple repeat procedures, bleeding, perforation, air embolism
- Maintaining Cystogastrostomy tract - > stent clogging, infection

* Complications in 20-35% (infection, bleeding, perforation) in MA / systematic reviews

From Brunched. BMC Gastroenterol 2013

Lumen-apposing stent (LAMS)
EUS-guided drainage of peripancreatic fluid collections and necrosis by using a novel lumen-apposing stent: a large retrospective, multicenter U.S. experience (with videos)  

Ali A. Siddiqui, MD, 1,* Douglas G. Adler, MD, 2,* Jose Nieto, MD, 3 Janak N. Shah, MD, 4 Kenneth F. Binmoeller, MD, 4 Steve Kane, BS, 4 Linda Yan, MD, 1 Sobia N. Laique, MD, 1 Thomas Kowalski, MD, 1 David E. Loren, MD, 1 Linda Jo Taylor, BS, 2 Satish Munigala, MD, MPH, 5 Yasser M. Bhat, MD 4

<table>
<thead>
<tr>
<th></th>
<th>Pseudocysts (n=14)</th>
<th>WON (n=68)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical success</td>
<td>12 (86%)</td>
<td>68 (100%; p=0.027)</td>
</tr>
<tr>
<td>Adverse events:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>stent maldeployment (operator error)</td>
<td>2 (14%)</td>
<td>0 (0%; p=0.027)</td>
</tr>
<tr>
<td>self-limited bleeding</td>
<td>1 (7%)</td>
<td>5 (7%)</td>
</tr>
<tr>
<td>delayed infection of PFC cavity</td>
<td>1 (7%)</td>
<td>4 (6%)</td>
</tr>
</tbody>
</table>

Results after successful placement of LAMS

<table>
<thead>
<tr>
<th># endoscopic sessions for treatment:</th>
<th>Pseudocysts (n=14)</th>
<th>WON (n=68)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10 (83%)</td>
<td>14 (21%)</td>
</tr>
<tr>
<td>2</td>
<td>1 (8%)</td>
<td>21 (31%)</td>
</tr>
<tr>
<td>≥ 3</td>
<td>1 (8%)</td>
<td>33 (49%)</td>
</tr>
</tbody>
</table>

Mean # of endo sessions

<table>
<thead>
<tr>
<th></th>
<th>Pseudocysts (n=14)</th>
<th>WON (n=68)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.5</td>
<td>2.8</td>
</tr>
</tbody>
</table>

Long term success

<table>
<thead>
<tr>
<th></th>
<th>Pseudocysts (n=14)</th>
<th>WON (n=68)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>12 (100%)</td>
<td>60 (88%)</td>
</tr>
</tbody>
</table>

GIE 2016
Lumen-apposing Metal Stent Complications

• RTC comparing Hot AXIOS LAMS vs. double pigtail stent.
• 50% complications on LAMS (6/12) vs. 0% Double pigtail (0/9)
• Adverse events
  – Delay bleeding (25%)
  – Buried stent syndrome (16%)
  – Biliary obstruction (8%)

Bang JY. Gut 2016
## FCSEMS vs. LAMS vs. Plastic Stents for WOPN

Overall the technical success- 99%
Mean # procedure- 2.5
Complications- 8.6%
Successful therapy- 89.6%

<table>
<thead>
<tr>
<th>313 pts</th>
<th>Technical success P = .37</th>
<th># procedures P = .04</th>
<th>Long-term success P = .001</th>
<th>Complication P &lt; 0.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastic stent (106)</td>
<td>99%</td>
<td>3.6</td>
<td>81%</td>
<td>7.5%</td>
</tr>
<tr>
<td>FCSEMS (121)</td>
<td>99%</td>
<td>3</td>
<td>95%</td>
<td>1.6%</td>
</tr>
<tr>
<td>LAMS (86)</td>
<td>99%</td>
<td>2.2</td>
<td>90%</td>
<td>9.3%</td>
</tr>
</tbody>
</table>
Integrity of the Main PD

• Disruption of the PD has been shown to result from a more severe episode of pancreatitis.¹

• Nearly half of patients with severe pancreatitis had PD disruption vs. normal PD in 100% of patients with mild pancreatitis.²

• Spontaneous resolution
  – 0-5% with PD disruption vs. 87% with normal PD.³

¹ Parihar V. Eur J Gastroenterol Hepatol 2016
² Neoptolemos J. Br J Surg 1993
³ Nealon W. J Am Coll Surg 2009
Integrity of the Main PD

• Resolution of Pseudocyst/WOPN in Patients with PD Disruption after ERP/EUSGD
  – 97.5% combination vs. 80% EUSGD alone.¹

• However in cases of complete PD disruption ERP/EUSGD had no additional benefit over EUSGD or Percutaneous drainage alone.²

• The role ERP before EUSGD for PD disruption has not been established.³

¹ Trevino J. J Gastroenterol Hepatol 2010
² Varadarajulu S. J Gastrointest Surg 2011
³ Parihar V. Eur J Gastroenterol Hepatol 2016
Our General Approach

Multi-D discussion - GI / surgery

Conservative management - supportive care

Treatment needed <4wks (immature wall)
- IR drainage vs. surgery
- Pseudocyst
- Endo tx > IR Surg drainage VERY RARE

Treatment needed >4wks (mature wall)
- WOPN
- DEN, IR, +/- surgery (depending on situation)