Interval Appendectomy

Downstate Surgery Grand Rounds
Jolita Auguste and Cynthia Kwong
9/29/2016
Case Presentation

51 F with PMHx of SLE who had been admitted to OSH 6/2016 for perforated appendicitis. Treated conservatively with 10 days of Abx and referred to UHB for GI and Surgery follow up. Repeat CT scan performed on 7/11/2016.
She was referred to GI for colonoscopy. Performed and only positive for a hyperplastic polyp in the rectum. On 8/22 she underwent an interval laparoscopic appendectomy.

Pathology: Chronic appendicitis, appendiceal lumen obliterated by fecalith
Jacopo Berengario da Carpi

1524

Credited for having the first preserved written account of the appendix
Claudius Amyand

1735

First successful appendectomy
Reginald Fitz

1886

Coined the term “appendicitis”

Described series of successful drainage of abscesses of the appendix between 1848-1886
Charles McBurney

1889

Described the pathologic changes in appendicitis and described the abdominal area of maximal tenderness.
Kurt Semm

1981

Performed the first laparoscopic appendectomy
Epidemiology

• 250,000 cases annually

• Peak Incidence: 10-30 yo
  
  — Higher rates of perforation in children and elderly

• 7% Lifetime risk in US
Pathophysiology of Appendicitis (Appendix)

Non-modifiable
Age:
Gender: male
(male: female = 2:1)
Hereditary: tumor formation in the opening of the appendix

Modifiable
- **Diet**: People whose diet is low in fiber and rich in refined carbohydrates
- **Infections**: Gastrointestinal infections such as Amebiasis, Bacterial Gastroenteritis, Mumps

Obstruction of the appendix by
(fecalith (hardened stool), lymph node, tumor, foreign objects)

Increase in pressure inside the appendix lumen that result to
distention of appendix

Impaired venous return causing hyperemia (improper O₂ and nutrient supply)
Normal bacteria found in appendix begin to invade (infect) the lining of the wall

Inflammatory Response – body response to the bacterial invasion in the wall of appendix.
Increased Immune complex (disease plus antibody) causes swelling of tissue resulting to inflammation of appendix

*S/P*: abdominal pain, fever, and increase swelling of appendix
Vomiting and loss of appetite

Pain-located @ RLQ, causing Guarding, Vomiting & loss of appetite

Inflammation and infection spread through the wall of the appendix causing death of tissue.
The appendix ruptures due to increase pressure (Perforation)

Appendectomy, pain medications
MANTRELS

• Abdominal pain that migrates to right iliac fossa
• Anorexia
• Nausea and vomiting
• Tenderness in the right lower quadrant (2 pts)
• Rebound tenderness
• Elevated temperature (>99.1°F / 37.3°C)
• Leukocytosis (>10,000) (2 pts)
• Shift of white cells to the left (>75%)
Figure 1. Frequency Of Appendix Locations

- Retrocecal (64%)
- Subcecal (2%)
- Pelvic (32%)
- Postileal (0.4%)
- Preilial (1%)
Clinical Signs

• Rovsing sign: pain in the right lower quadrant during left-sided pressure

• Dumphy’s sign: increased pain in right lower quadrant with coughing

• Psoas sign: pain with...
  – Flexing right hip against resistance, or
  – Passive extension of right hip

• Obturator sign: pain with internal rotation of hip while right hip and knee flexed
Normal Radiology

Barium Study

Contrast filled appendix without wall thickening or fat stranding
Acute appendicitis

- Aperistaltic, noncompressible, dilated (>6 mm outer diameter)
- Target appearance
- Distinct appendiceal layers
- Echogenic prominent pericecal fat
- Appendicolith

Non opacified appendix
Presence of fecalith
Wall thickening (>6mm in adults, >8mm in children)
Periappendical fat stranding
Uncomplicated Appendicitis

• Take it out

• Unless you’re Dr. Sulkowski
Appendectomy
Appendectomy

Fig. 3. Ligation of mesoappendix.
Complicated

• A result of perforation

• Happens in 7% of cases of acute appendicitis
  – Phlegmon/Abscess
  – Peritonitis/Free air
Complicated Appendicitis

- Conservative therapy has been shown to have decreased complications compared to immediate appendectomy.
- Antibiotics which cover for intraabdominal flora (Gram negatives, anaerobes)
- Pain control
- +/- Percutaneous drainage
- ????? Interval appendectomy????
Immediate Surgery vs Conservative Management

**FIGURE 1.** Meta-analysis of the morbidity of nonsurgical compared with that of immediate surgical treatment of contained appendiceal inflammation.
Should we perform routine interval appendectomies after complicated appendicitis?
Point-Counterpoint

PRO
• Definitive treatment of disease process; reduce/eliminate recurrence risk.
• Operative risks are minor (wound infections, suture granuloma)
• Risk of underlying malignancy (carcinoid, mucinous neoplasms)

CON
• Operative risk – 9%
• Low rate of recurrence and/or underlying malignancy
• Operative costs
• No significant difference in duration of antibiotic use in appendicitis
• Rate of recurrent appendicitis = 11.4%
  – Morbidity 12.73%
  – Hospital Stay 8.95 days

• Interval appendectomy
  – Morbidity 10.5%
  – Hospital Stay 5.4 days
Analysis of Recurrence Management in Patients Who Underwent Nonsurgical Treatment for Acute Appendicitis

Tsung-Jung Liang, MD, Shiuh-Inn Liu, MD, PhD, Chung-Yu Tsai, MD, Chi-Hsiang Kang, MD, Wei-Chun Huang, MD, PhD, Hong-Tai Chang, MD, and I-Shu Chen, MD

FIGURE 1. Flowchart of nonoperatively managed patients.
Morbidity of Interval Appendectomy

Interval appendectomy after perforated appendicitis: what are the operative risks and luminal patency rates?

Corey W. Iqbal, MD, E. Marty Knott, DO, PhD, Vincent E. Mortellaro, MD, Keely M. Fitzgerald, BA, Susan W. Sharp, PhD, and Shawn D. St. Peter, MD*

Table 1 – Risk factors for postoperative complications.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Complicated</th>
<th>Uncomplicated</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male gender (%)</td>
<td>58</td>
<td>55</td>
<td>0.6</td>
</tr>
<tr>
<td>Mean age (y)</td>
<td>10.4 ± 4.2</td>
<td>9.0 ± 4.1</td>
<td>0.3</td>
</tr>
<tr>
<td>Mean body mass index (kg/m²)</td>
<td>18.0 ± 3.4</td>
<td>18.1 ± 4.5</td>
<td>0.9</td>
</tr>
<tr>
<td>Presence of abscess (%)</td>
<td>92</td>
<td>91</td>
<td>0.7</td>
</tr>
<tr>
<td>Readmission (%)</td>
<td>8</td>
<td>7</td>
<td>0.6</td>
</tr>
<tr>
<td>Presence of appendicolith on initial imaging study (%)</td>
<td>58</td>
<td>43</td>
<td>0.2</td>
</tr>
<tr>
<td>Repeat computed tomography scan (%)</td>
<td>58</td>
<td>61</td>
<td>0.5</td>
</tr>
<tr>
<td>Mean time to interval appendectomy (d)</td>
<td>69.2 ± 16.3</td>
<td>65.5 ± 20.7</td>
<td>0.5</td>
</tr>
<tr>
<td>Mean operative time (min)</td>
<td>50.6 ± 15.9</td>
<td>42.9 ± 19.4</td>
<td>0.1</td>
</tr>
<tr>
<td>Use of Endocatch bag (%)</td>
<td>33</td>
<td>15</td>
<td>0.1</td>
</tr>
<tr>
<td>Intra-abdominal fecolith removed at appendectomy (%)</td>
<td>17</td>
<td>8</td>
<td>0.3</td>
</tr>
<tr>
<td>Fecalith present in appendix on pathologic examination (%)</td>
<td>33</td>
<td>25</td>
<td>0.4</td>
</tr>
<tr>
<td>Use of postoperative antibiotics (%)</td>
<td>8</td>
<td>8</td>
<td>0.6</td>
</tr>
<tr>
<td>Mean lumen size (cm)*</td>
<td>0.5 ± 0.3</td>
<td>0.4 ± 0.2</td>
<td>0.4</td>
</tr>
<tr>
<td>Lumen reported as patent* (%)</td>
<td>100</td>
<td>82</td>
<td>0.2</td>
</tr>
</tbody>
</table>

* Minimal luminal diameter was reported in 24 specimens (3 complicated, 21 uncomplicated); patency was reported in 82 specimens (9 complicated, 73 uncomplicated).
# Increased Risk of Mucinous Neoplasm of the Appendix in Adults Undergoing Interval Interval Appendectomy

Matthew J. Furman, MD; Mitchell Cahan, MD; Philip Cohen, MD; Laura A. Lambert, MD

## Table 1. Characteristics and Demographic Data of Patient Population

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of appendectomies</td>
<td>376 (100.0)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>182 (48.4)</td>
</tr>
<tr>
<td>Female</td>
<td>194 (51.6)</td>
</tr>
<tr>
<td>Age, mean (range), y</td>
<td>41 (18-94)</td>
</tr>
<tr>
<td>Technique</td>
<td></td>
</tr>
<tr>
<td>Open</td>
<td>191 (50.8)</td>
</tr>
<tr>
<td>Laparoscopic</td>
<td>170 (45.2)</td>
</tr>
<tr>
<td>Conversion, laparoscopic→open (n = 361)</td>
<td>15 (4.2)</td>
</tr>
<tr>
<td>Interval appendectomy</td>
<td>17 (4.5)</td>
</tr>
<tr>
<td>Morbidity</td>
<td>25 (6.6)</td>
</tr>
<tr>
<td>Length of stay, mean, d</td>
<td></td>
</tr>
<tr>
<td>Immediate appendectomy</td>
<td>1.9</td>
</tr>
<tr>
<td>Interval appendectomy</td>
<td>1.4</td>
</tr>
<tr>
<td>Negative appendectomy*</td>
<td>10 (2.7)</td>
</tr>
<tr>
<td>Neoplasms</td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>14 (3.7)</td>
</tr>
<tr>
<td>Immediate appendectomy (n = 359)</td>
<td>9 (2.5)</td>
</tr>
<tr>
<td>Interval appendectomy (n = 17)</td>
<td>5 (29.4)*</td>
</tr>
</tbody>
</table>

* Indicates no pathologic evidence of appendicitis.

b $P < .001$ compared with immediate appendectomy.
### Table 2. Incidence and Type of Appendiceal Neoplasm by Age

<table>
<thead>
<tr>
<th>Age Range, y</th>
<th>No. of Patients</th>
<th>Mucinous Neoplasms</th>
<th>Carcinoid Tumors</th>
<th>Other Tumors&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>35-39</td>
<td>39</td>
<td>2 (5.1)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>40-44</td>
<td>41</td>
<td>1 (2.4)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1 (2.4)</td>
<td>1 (2.4)</td>
</tr>
<tr>
<td>45-49</td>
<td>27</td>
<td>2 (7.4)&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0</td>
<td>1 (3.7)</td>
</tr>
<tr>
<td>50-54</td>
<td>25</td>
<td>2 (8.0)&lt;sup&gt;d&lt;/sup&gt;</td>
<td>1 (4.0)</td>
<td>0</td>
</tr>
<tr>
<td>55-59</td>
<td>20</td>
<td>0</td>
<td>0</td>
<td>1 (5.0)</td>
</tr>
<tr>
<td>60-64</td>
<td>23</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>65-69</td>
<td>14</td>
<td>1 (7.1)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>70-74</td>
<td>10</td>
<td>1 (10.0)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<sup>a</sup> Includes metastatic cancer and lymphoma.

<sup>b</sup> This patient underwent interval appendectomy.

<sup>c</sup> Of these, 1 patient underwent interval appendectomy.

<sup>d</sup> Two patients who underwent interval appendectomy had 1 neoplasm each.
• 6038 patients diagnosed with acute appendicitis
  -- 188 underwent initial non-operative management
• 89 patients underwent interval appendectomy
  -- 12% found to have appendiceal neoplasms
  -- 5 patients required more extensive resections
• 2771 patients followed after nonsurgical management of complicated appendicitis

• Malignant disease detected in 1.2%

• Important benign disease (Crohn’s disease) detected in 0.7%
A 55-year-old man undergoes an uneventful laparoscopic appendectomy for appendicitis. Final pathology reveals the presence of a 2-cm carcinoid tumor. What would you recommend at the clinic visit?

A. No further intervention
B. Right hemicolecetomy
C. Adjuvant interferon alpha
D. Adjuvant octreotide
E. Cecectomy
A 55-year-old man undergoes an uneventful laparoscopic appendectomy for appendicitis. Final pathology reveals the presence of a 2-cm carcinoid tumor. What would you recommend at the clinic visit?

A. No further intervention
B. Right hemicolecotomy
C. Adjuvant interferon alpha
D. Adjuvant octreotide
E. Cecectomy
Questions

An otherwise healthy 16-year-old boy presents with 2 days of abdominal pain, nausea, and anorexia. His physical exam reveals a temperature of 37.4 °C and mild involuntary guarding in the right lower quadrant. Rovsing, obturator, and psoas signs are negative. His white cell count is 12,500/mm³ and C-reactive protein is 18 mg/L. Ultrasound poorly visualizes the cecum: the appendix is not visualized. Which of the following is the next most appropriate step in his management?

A. CT abdomen with appendix protocol
B. Appendectomy
C. Intravenous antibiotics and serial examinations
D. Meckel scan with technetium-99
E. Repeat ultrasound and complete blood count in 24 hours
An otherwise healthy 16-year-old boy presents with 2 days of abdominal pain, nausea, and anorexia. His physical exam reveals a temperature of 37.4 °C and mild involuntary guarding in the right lower quadrant. Rovsing, obturator, and psoas signs are negative. His white cell count is 12,500/mm³ and C-reactive protein is 18 mg/L. Ultrasound poorly visualizes the cecum: the appendix is not visualized. Which of the following is the next most appropriate step in his management?

A. CT abdomen with appendix protocol
B. Appendectomy
C. Intravenous antibiotics and serial examinations
D. Meckel scan with technetium-99
E. Repeat ultrasound and complete blood count in 24 hours
Questions

Compared with open appendectomy, patients undergoing laparoscopic appendectomy have

A. equivalent hospital length of stay
B. equivalent overall morbidity
C. higher rates of septic shock
D. higher rates of wound disruption
E. lower rates of surgical site infection
Questions

Compared with open appendectomy, patients undergoing laparoscopic appendectomy have

A. equivalent hospital length of stay
B. equivalent overall morbidity
C. higher rates of septic shock
D. higher rates of wound disruption
E. lower rates of surgical site infection
After an uncomplicated appendectomy for acute appendicitis, pathologic examination reveals a carcinoid tumor in the specimen. All of the following are indications for repeat operation and right hemicolecotony EXCEPT:

A. tumor size smaller than 1 cm
B. lymphovascular invasion
C. presence of goblet-cell features
D. invasion of appendiceal mesentery
E. tumor location at the base of the appendix
After an uncomplicated appendectomy for acute appendicitis, pathologic examination reveals a carcinoid tumor in the specimen. All of the following are indications for repeat operation and right hemicolecetomy EXCEPT:

A. tumor size smaller than 1 cm
B. lymphovascular invasion
C. presence of goblet-cell features
D. invasion of appendiceal mesentery
E. tumor location at the base of the appendix