Giant Mucinous Adenocarcinoma of the Appendix

with disseminated peritoneal adenomucinosis

Dylan Carney, Harvard Medical School Year III

Gillian Lieberman, MD
Overview

• Case presentation
  - Patient presentation
  - Radiographic findings
  - Surgical procedure
  - Pathology findings

• Neoplasms of the appendix
  - Histologic types
  - Menu of radiographic tests
  - Treatment and outcomes

• Pseudomyxoma peritonei
  - Radiographic findings
Case Presentation

- Our patient is a previously-healthy 48 y.o. male who presents with a 4-day history of focal, intermittent RLQ abdominal pain that is non-radiating.
- No nausea, vomiting, fever, chills, melena, hematochezia, hematemesis, association with PO intake.
- Physical notable for normal vital signs, normal bowel sounds, guarding in RLQ, tenderness to palpation with palpable mass in RLQ.
- Labs notable for leukocytosis of 13.9.
The patient goes for urgent CT abdomen with and without contrast...
Our patient’s CT abdomen: what do you see?
Out pt: appendiceal mass

Large, non-enhancing cystic mass with rim of enhancement extending from appendix – indicating pathology is likely appendiceal in origin

Cecum is displaced medially, superiorly, and rotated

Large bowel is contrast-filled throughout with air distal to lesion, and is of normal to mildly-dilated caliber

Extension of fluid into inguinal canal

PACS, BIDMC

Coronal CT + C
What do you see in this coronal section?
Out pt: mucinous neoplasm

Cystic mass is 25HU, denser than simple fluid and less dense than blood – consistent with mucous. It is also multi-lobed.

Cecum adjacent to cyst

Large bowel with contrast and air throughout
What do you see in this axial CT section?
Out pt: rim calcifications and free mucus

Cystic mass with rim of enhancement and calcifications. This portion of the mass is intraperitoneal, anterior the the anterior perirenal space, medial to the liver and lateral to the ascending colon.

Free mucus in the peritoneal cavity consistent with rupture.

Note the absence of frank ascites or pseudomyxoma peritonei “jelly belly”, vasculature non-compressed.
What spaces is the pathology in?
Our pt: retroperitoneal extension

Multi-lobed cystic mass with rim of enhancement and pockets of air, indicating rupture into intestinal lumen (v. emphysematous infection). Note that the posterior lobe of the mass is in the anterior perirenal space, adjacent to the psoas.

Free mucus in the peritoneal cavity consistent with rupture.
How is the mass different on this lesion?
Our pt: heterogeneous mucocele

Mucocele displays heterogeneity at this level. The lobes here are also fused and invading the retroperitoneum. Thus, the mass is singular and continuous.

The mucocele is now directly abutting the psoas.
Differential Diagnosis

• At this point it is narrow, and includes:
  - Appendiceal neoplasm with or without pseudomyxoma peritonei
  - Appendicitis with abscess
The patient is brought to the OR for tumor debulking.

Let’s look at the intraoperative findings...
Our pt: visceral mucosal implants
Our pt: resection cavity
Gross Specimen: mucocele removed en bloc with ascending colon and transverse colon

Courtesy of Dr. James Hurst, Acute Care Surgery
Mucocele, ileum, ascending, transverse colon and mucosal implants are sent to pathology.

Let’s see the findings...
Histology: infiltrating glandular tissue

Infiltrating glandular tissue

Courtesy of Dr. Robert Najarian and Dr. Shu-Hsien Sheu, BIDMC Pathology
Histology: neoplastic epithelium

Neoplastic epithelium with enlarged, hyperchromatic nuclei, numerous mitotic figures, abundant intraluminal mucin

Courtesy of Dr. Robert Najarian and Dr. Shu-Hsien Sheu, BIDMC Pathology
Histology: Pools of Mucin

Pools of mucin outside lumen

Courtesy of Dr. Robert Najarian and Dr. Shu-Hsien Sheu, BIDMC Pathology
Pathology Report: Mucinous Adenocarcinoma

- Well-differentiated mucinous adenocarcinoma of the appendix
- 0 of 18 lymph nodes involved
- Ileum through transverse colon normal with clear margins
- Acellular mucosal studding along serosal surface consistent with disseminated peritoneal adenomucinosis
The patient recovered well post-operatively and was discharged on hospital day #6.

He was seen in clinic 2 weeks later and reported resolution of symptoms with minimal residual pain.
Let’s learn more about neoplasms of the appendix...
Appendiceal Neoplasms

- Common presentations: abdominal pain, appendicitis, ascites, obstruction
- Incidental finding on 1% of appy specimens
- Overall incidental 0.12 cases / 1M pt-years
- Diagnosis
  - Contrast-enhanced CT (gold standard) - shows non-enhancing, mucous-filled, rim-enhancing lesion of appendix (because most patients present with appendicitis, this is usually the test of choice)
  - Plain films - may see air-fluid level if there is rupture, or mass effect on nearby organs
  - Barium enema - cecal impaction, non-filling of appendix
  - U/S - layering (“onion skin”), nodular mural thickening indicates malignancy (indicated in children, pregnant women)

CT Appearance of Appendiceal Mucoceles Compared to Acute Appendicitis

• Findings in appendicitis and small appendiceal mucoceles often overlap, making preoperative diagnosis of mucoceles tricky

• CT features found to be associated with mucoceles
  - Cystic dilation of the appendix
  - Mural calcification
  - Luminal diameter > 1.3cm (71% sensitive and 95% specific)

• Non-specific CT findings: appendicolith, fat stranding, periappendiceal fluid, lymphadenopathy
CT Findings: Appendicitis with and without Mucocele

**TABLE 2: Percentage of Patients with Each CT Finding and Significance in Differentiating Acute Appendicitis With and Without Mucocele**

<table>
<thead>
<tr>
<th>CT Finding</th>
<th>Normal Appendix</th>
<th>Appendicitis without Mucocele</th>
<th>Appendicitis with Mucocele</th>
<th>( \beta^p )</th>
<th>Reader 1</th>
<th>Reader 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cystic dilatation</td>
<td>0 (0/57)</td>
<td>6.9 (4/58)</td>
<td>66.7 (16/24)</td>
<td>0.0066</td>
<td>&lt;0.0001</td>
<td></td>
</tr>
<tr>
<td>mural calcification</td>
<td>0 (0/57)</td>
<td>0 (0/57)</td>
<td>25 (8/24)</td>
<td>0.0646</td>
<td>0.0049</td>
<td></td>
</tr>
<tr>
<td>mural enhancement</td>
<td>8.6 (5/58)</td>
<td>92.6 (50/54)</td>
<td>66.7 (16/24)</td>
<td>0.0020</td>
<td>1.0000</td>
<td></td>
</tr>
<tr>
<td>Appendicolith</td>
<td>0 (0/58)</td>
<td>23.8 (13/57)</td>
<td>0 (0/24)</td>
<td>0.1529</td>
<td>0.0850</td>
<td></td>
</tr>
<tr>
<td>Intraperitoneal fluid</td>
<td>6.9 (4/58)</td>
<td>34.5 (20/58)</td>
<td>33.3 (8/24)</td>
<td>1.0000</td>
<td>1.0000</td>
<td></td>
</tr>
<tr>
<td>Lymphadenopathy</td>
<td>17.2 (10/58)</td>
<td>75.9 (44/58)</td>
<td>54.2 (13/24)</td>
<td>0.1654</td>
<td>0.3069</td>
<td></td>
</tr>
<tr>
<td>Small bowel mural thickening</td>
<td>1.7 (1/58)</td>
<td>23.6 (13/55)</td>
<td>20.8 (5/24)</td>
<td>1.0000</td>
<td>1.0000</td>
<td></td>
</tr>
<tr>
<td>Periappendiceal fat stranding</td>
<td>3.5 (2/58)</td>
<td>86.2 (50/58)</td>
<td>83.3 (20/24)</td>
<td>0.4410</td>
<td>1.0000</td>
<td></td>
</tr>
<tr>
<td>Extraluminal gas</td>
<td>0 (0/58)</td>
<td>5.2 (3/58)</td>
<td>17.4 (4/23)</td>
<td>0.5670</td>
<td>0.1781</td>
<td></td>
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<tr>
<td>Intraluminal gas</td>
<td>56.9 (33/58)</td>
<td>26.3 (15/57)</td>
<td>8.3 (2/24)</td>
<td>0.2332</td>
<td>0.3984</td>
<td></td>
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<tr>
<td>Arrowhead sign</td>
<td>1.7 (1/58)</td>
<td>52.6 (30/57)</td>
<td>41.7 (10/24)</td>
<td>1.0000</td>
<td>0.3246</td>
<td></td>
</tr>
<tr>
<td>Target sign</td>
<td>0 (0/58)</td>
<td>37.5 (21/56)</td>
<td>20.8 (5/24)</td>
<td>1.0000</td>
<td>0.0655</td>
<td></td>
</tr>
<tr>
<td>Abscess</td>
<td>0 (0/58)</td>
<td>15.5 (9/58)</td>
<td>16.7 (4/24)</td>
<td>1.0000</td>
<td>1.0000</td>
<td></td>
</tr>
<tr>
<td>Focal mass</td>
<td>0 (0/58)</td>
<td>1.8 (1/57)</td>
<td>8.3 (2/24)</td>
<td>1.0000</td>
<td>0.2002</td>
<td></td>
</tr>
<tr>
<td>Irregular wall contour</td>
<td>0 (0/58)</td>
<td>29.8 (17/57)</td>
<td>25.0 (5/24)</td>
<td>0.4507</td>
<td>0.7211</td>
<td></td>
</tr>
</tbody>
</table>

*Note—Values in parentheses are raw numbers. Magnitude and variation of the denominators reflect missing data and the fact that data were provided by each of two readers ([denominator = 2 x number of subjects – number missing]).

*Fisher’s exact test.*

Let’s see some other examples of appendiceal mucoceles
Companion Patient 1: Mucocele with Air and Mural Calcifications

Companion Patient 2: Mural Calcifications

Companion Patient 3: Mural Calcifications and Fat Stranding

Companion Patient 4: Fat Stranding

Companion Patient 5: Fat Stranding

Companion Patient 5: Appendicolith

Companion Patients 5: Appendicitis!

These last two are actually examples of acute appendicitis with appendicolith – there is no mucocele!
Appendiceal Neoplasms: Histologic Types

- **Histologic types**
  - Carcinoid
  - Epithelial (appendiceal mucoceles)
    - Mucosal hyperplasia (20%)
    - Simple cyst (18%)
    - Mucinous adenoma (10%)
    - Mucinous adenocarcinoma (52%)
  - Other (Signet Ring, lymphoma)

References:
Complications of Appendiceal Neoplasms

- “Mucocele” encompasses any mucinous epithelial neoplasm of the appendix, from benign to malignant
- Complications
  - Bowel obstruction
  - Perforation
  - Infection
  - Pseudomyxoma Peritonei (PMP)
    - Disseminated peritoneal mucinous tumors arising from perforation of true appendiceal neoplasms (adenoma or adenocarcinoma) and subsequent omental/peritoneal implantation of well-differentiated mucin-secreting epithelium
    - Implantation occurs in a gravity-dependent fashion: the pouch of Douglas, retrohepatic space, paracolic gutters, and the fossa created by ligament of Trietz

Appendiceal Mucocele: Treatment and Outcomes

• Debate over appendectomy versus hemicolecotomy, with trend towards hemicolecotomy

• Andersson et al, 1976
  - Of 7 cases of mucinous adenocarcinoma, 6 were treated with appendectomy alone, 5 of whom survived beyond 5 years

• Edmonds et al, 1984
  - Of 10 cases, 5-year survival was significant longer with right hemicolecotomy versus appendectomy (60% versus 20%)

• Nitechki et al, 1994
  - Of 94 cases, 5-year survival with right hemicolecotomy was 68% versus 20% with appendectomy alone.
  - Secondary right hemicolecotomy led to tumor downstaging and improved outcomes

What about pseudomyxoma peritonei?

Let’s see some examples...
Companion Patient 6: Pseudomyxoma Peritonei

- Non-contrast CT of the abdomen showing large cavity with an air fluid level (indicating frank rupture), compressing the small and large bowel

Companion Patient 7: Pseudomyxoma Peritonei

- Contrast-enhanced CT showing abundant intraperitoneal mucin with non-enhancing, fluid-filled cysts scalloping the liver and spleen

Pseudomyxoma Peritonei - Treatment

- Systemic and intraperitoneal chemotherapy
- Debulking
- Peritonectomy
- Outcomes - typically poor
  - 25% 5-year survival
  - Mortality frequently secondary to intestinal or renal obstruction

Summary

- Appendiceal tumors are rare gastrointestinal neoplasms
- Histological subtypes include carcinoid, epithelial (hyperplasia, cystic, mucinous adenoma and mucinous adenocarcinoma), signet ring and lymphomas
- Patients frequently mimic acute appendicitis and tumors are frequently discovered on CT, intraoperatively, or via postoperative pathology
- Complete debulking, usually with right hemicolectomy, should be performed with care to avoid rupture
- Rupture of adenomas and adenocarcinoma can lead to peritoneal implants and subsequent pseudomyxoma peritonei (PMP)
- PMP is treated with debulking, intraperitoneal chemotherapy or peritonectomy, and overall 5-year prognosis is poor
Bibliography

Acknowledgements

- Dr. James Hurst and Dr. Stephen Odom, BIDMC Acute Care Surgery Service, for mentoring me and assisting with the preparation of this case.
- Dr. Krithica Kaliannan, BIDMC Radiology, for guiding me in the interpretation of the index case radiographs.
- Dr. Robert Najarian and Dr. Shu-Hsien Sheu, BIDMC Pathology, for preparation of pathology specimens and going through the relevant findings with me.
- Kat Wakeham and Christopher Doughty, for their valuable critical feedback.
- Emily Hanson, for guiding me with the creation of this presentation
- Dr. Gillian Lieberman, for teaching me everything I know about Radiology! Learn more at: www.eradiology.bidmc.harvard.edu