BENIGN APPENDIX

DOESN'T DO ANYTHING

EXCEPT LEAK POISON
Reginald Herbert Fitz

Shattuck Professor of Pathological Anatomy Harvard
American
(1843 – 1913)

First to describe appendicitis
(The American Journal of the Medical Sciences 1885)

“Perforating Inflammation of the Vermiform Appendix; With Special Reference to Its Early Diagnosis and Treatment”
Clinical Presentation of Acute Appendicitis

Epidemiology

• Most common cause of emergency surgery worldwide

• Most commonly occurs in 10-30 years of age.

• More common in men (1.4 : 1)

• Life time incidence 6.7 – 8.6 %
Clinical Presentation of Acute Appendicitis

History and Physical Examination

Classic constellation of symptoms

- Abdominal pain, anorexia, nausea and vomiting

Non-specific symptoms

- Indigestion, malaise, tenesmus, diarrhea, dysuria, and atypical pain

Migratory abdominal pain – occurs in 50-60% of patients
Behind the caecum (ascending retrocaecal): 65%

Inferior to the caecum (subcaecal): 31%

Behind the caecum (transverse retrocaecal): 2%

Anterior to the ileum (ascending paracaecal preileal): 1%

Posterior to the ileum (ascending paracaecal retroileal): 0.5%
Clinical Presentation of Acute Appendicitis

History and Physical Examination

Tachycardia
Fever
Abdominal pain RLQ
Focal Peritonitis
Rebound tenderness
RLQ mass

Pelvic examination
Rectal examination
McBurney’s Point
(Ann Surg 1894)

Uptodate:
Maximal tenderness typically 1.5 - 2 inches from the anterior superior iliac spine, on a straight line drawn from the ASIS to the umbilicus.

“The incision in the skin is an oblique one about four inches long. It crosses a line drawn from the anterior iliac spine to the umbilicus nearly at right angles about one inch from the iliac spine, and is so situated that its upper third lies above that line” - McBurney
Niels Thorkild Rosving
Danish
(1862 – 1927)

Rosving’s Sign
(Zentralblatt für Chirurgie 1907)

Uptodate:
Pain in the right lower quadrant when palpated in the left lower quadrant.

“Smerter i højre nedre kvadrant med palpering af den venstre nederste kvadrant” - Rosving
Psoas Sign - Right lower quadrant pain with passive right hip extension

Obturator Sign - Right lower quadrant pain with passive flexion of the right hip and knee followed by internal rotation of the hip
## Clinical Presentation of Acute Appendicitis

### History and Physical Examination

<table>
<thead>
<tr>
<th>Sign</th>
<th>Specificity</th>
<th>Sensitivity</th>
<th>Utility</th>
</tr>
</thead>
<tbody>
<tr>
<td>McBurney’s Point Tenderness</td>
<td>50 – 94%</td>
<td>75 – 86%</td>
<td>✔✔✔</td>
</tr>
<tr>
<td>Rosving’s sign</td>
<td>22 – 68%</td>
<td>58 – 96%</td>
<td>✔✔</td>
</tr>
<tr>
<td>Cope’s Psoas Sign</td>
<td>13 – 48%</td>
<td>79 – 97%</td>
<td>✔</td>
</tr>
<tr>
<td>Cope’s Obturator Sign</td>
<td>8%</td>
<td>94%</td>
<td>✗</td>
</tr>
</tbody>
</table>
Clinical Presentation of Acute Appendicitis

**Investigations**

- CBC, electrolytes, CRE, bHCG
- Urine dip/culture
- WBC > 10,000 (sens 80%, spec 55%)
- Total Bilirubin >10 (sens 70%, spec 86%)
- Abdominal X-ray
- CT
- Ultrasound
What are the **CLASSIC** findings on X-ray of appendicitis?
Imaging in Acute Appendicitis

Investigations – X ray

1. Fecalith
2. Dilated loops of bowel with air fluid levels
3. Scoliosis of the spine
4. Obliteration of the right lower psoas shadow
5. Obliteration of the preperitoneal fat line
6. Paucity of gas in the RLQ
7. Small bowel obstruction
8. Air bubbles in the RLQ
9. Free air
Imaging in Acute Appendicitis

Investigations - Ultrasound

- Dilated appendix (>6 mm outer diameter)
- Non-compressible
- Appendicolith/Fecalith/Poopalith
- Prominent echogenic pericaecal fat
- Periappendiceal fluid collection
- Target appearance (axial section)
Imaging in Acute Appendicitis

Investigations – CT Scan

• Dilated appendix with distended lumen ( >6 mm diameter)
• Thickened and enhancing wall
• Thickening of the cecal apex (up to 80%):
  • Cecal bar sign, arrowhead sign
• Periappendiceal inflammation
• Extraluminal fluid
• Inflammatory phlegmon
• Abscess formation
• Appendicolith
# Performance of Ultrasound in the Diagnosis of Appendicitis in Children in a Multicenter Cohort

Manoj K. Mittal, MD, Peter S. Dayan, MD, MSc, Charles G. Macias, MD, MPH, Richard G. Bachur, MD, Jonathan Bennett, MD, Nanette C. Dudley, MD, Lalit Bajaj, MD, MPH, Kelly Sinclair, MD, Michelle D. Stevenson, MD, MS, Anupam B. Kharbanda, MD, MSc, for the Pediatric Emergency Medicine Collaborative Research Committee of the American Academy of Pediatrics*

<table>
<thead>
<tr>
<th>Impression</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnostic of appendicitis</td>
<td>72.5%</td>
<td>97.0%</td>
</tr>
<tr>
<td>Appendicitis cannot be out ruled</td>
<td>79.9%</td>
<td>84.0%</td>
</tr>
<tr>
<td>Modality</td>
<td>N</td>
<td>Diagnostic</td>
</tr>
<tr>
<td>--------------</td>
<td>-----</td>
<td>------------</td>
</tr>
<tr>
<td>Ultrasound</td>
<td>1777</td>
<td>1101</td>
</tr>
<tr>
<td>CT</td>
<td>965</td>
<td>473</td>
</tr>
<tr>
<td>Physical Exam</td>
<td>303</td>
<td>218</td>
</tr>
</tbody>
</table>
Comparison of Imaging Strategies with Conditional Contrast-enhanced CT and Unenhanced MR Imaging in Patients Suspected of Having Appendicitis: A Multicenter Diagnostic Performance Study

All patients had MRI
Ultrasound first
If US equivocal then CT was performed

N=230

<table>
<thead>
<tr>
<th>Modality</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultrasound only</td>
<td>77%</td>
<td>94%</td>
</tr>
<tr>
<td>CT</td>
<td>97%</td>
<td>91%</td>
</tr>
<tr>
<td>MRI</td>
<td>97%</td>
<td>83%</td>
</tr>
</tbody>
</table>
A Practical Score for the Early Diagnosis of Acute Appendicitis

We conducted a retrospective study of 305 patients hospitalized with abdominal pain suggestive of acute appendicitis. Signs, symptoms, and laboratory findings were analyzed for specificity, sensitivity, predictive value, and joint probability. The total joint probability, the sum of a true-positive and a true-negative result, was chosen as a diagnostic weight indicative of the accuracy of the test. Eight predictive factors were found to be useful in making the diagnosis of acute appendicitis. Their importance, according to their diagnostic weight, was determined as follows: localized tenderness in the right lower quadrant, leukocytosis, migration of pain, shift to the left, temperature elevation, nausea-vomiting, anorexia-acetone, and direct rebound pain. Based on this weight, we devised a practical diagnostic score that may help in interpreting the confusing picture of acute appendicitis. [Alvarado A: A practical score for the early diagnosis of acute appendicitis. Ann Emerg Med May 1986;15:557-564.]

Alfredo Alvarado, MD
Plantation, Florida

From the Department of Surgery,
Plantation General Hospital and Humana Hospital Bennett, Plantation, Florida.

Received for publication April 5, 1985.
Revision received September 11, 1985.
Accepted for publication November 11, 1985.

Address for reprints: Alfredo Alvarado, MD, 4101 NW 4th Street, Suite 407, Plantation, Florida 33317.
# Clinical Scoring Systems - Alvarado

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Migratory Abdominal Pain</td>
<td>2</td>
</tr>
<tr>
<td>Anorexia</td>
<td>1</td>
</tr>
<tr>
<td>Nausea AND Vomiting</td>
<td>1</td>
</tr>
<tr>
<td>Tenderness RLQ</td>
<td>1</td>
</tr>
<tr>
<td>Rebound tenderness</td>
<td>1</td>
</tr>
<tr>
<td>Elevated temp (&gt;37.5)</td>
<td>1</td>
</tr>
<tr>
<td>Leukocytosis (&gt;10,000)</td>
<td>2</td>
</tr>
<tr>
<td>Shift (Left shift/bands)</td>
<td>1</td>
</tr>
</tbody>
</table>

**MANTRELS**

Highly Suspicious (7-10)
- Operate
- *Surgical consultation
  - Sensitivity 58-88%

Intermediate (5-6)
- Imaging with US or CT
- *4-6 obtain CT

Low (1-4)
- Discharge from ER
- * <3 No imaging indicated
- Sensitivity 98% for non-acute appendicitis
A cut point of 5 performs well as a rule out CPR in all patient groups with suspected appendicitis.

This CPR calibrates well in men, over-predicts in women and is inconclusive in children.

The Alvarado scoring system compares similarly to other CPR currently in use (Ottawa ankle).

**Sensitivity (non-appendicitis) at a score of 5: 94-99%**

There is not enough evidence to support a decision to go to surgery at a cut-point of 7.

**Sensitivity 88%, Specificity 81%, negative appendectomy rate 13.3-16.7%**
Management of Acute Appendicitis

The goal of management is early diagnosis and prompt surgical intervention

- **Resuscitate the patient – IV access, fluid administration, urinary catheter, correction of electrolytes and antibiotics.**
- **Antibiotics:**
  - **Within 60 minute window of cutting skin**
  - **Non-complicated:**
    - Cefazolin (1-2 gm IV) + metronidazole (500mg IV)
  - **Complicated (perforated):**
    - Piperacillin-Tazobactam or Ceftriaxone + metronidazole
  - **Within 24 – 72 hours of symptom onset**
  - **Operation Open or Laparoscopic**
Open Appendectomy
Claudius Amyand
French/British
(1680-1740)

First appendectomy
(Phil. Trans 1735)
-11yo boy with incarcerated hernia
-"Poppin" caused appendiceal perforation.

Amyand’s Hernia
-Inguinal hernia with the appendix within the sac.

“This operation proved the most complicated and perplexing I ever met; with many unsuspected oddities and events concurring to make it as intricate as it proved laborious... 'Tis easy to conceive that this operation was a painful to the patient as laborious to me - it lasted nearly half an hour.”
THE INCISION MADE IN THE ABDOMINAL WALL
IN CASES OF APPENDICITIS, WITH A DE-
SCRIPTION OF A NEW METHOD
OF OPERATING.

By CHARLES McBURNEY, M.D.,

OF NEW YORK,

SURGEON TO THE ROOSEVELT HOSPITAL.
Sir Fredrick Treves  
*British*  
*(1853-1923)*  

Bloodless Fold of Treves  

Friends with John Merrick  
AKA Elephant man
Zollinger's Atlas of Surgical Operations, 9e

Robert M. Zollinger Jr, Author, E. Christopher Ellison, Author, Marita Bitans, Illustrator, Jennifer Smith, Illustrator

Search Textbook
Auto-appendectomy in the Antarctic: case report

*BMJ* 2009; 339  doi: http://dx.doi.org/10.1136/bmj.b4965 (Published 15 December 2009)
Cite this as: *BMJ* 2009;339:b4965

Leonid Ivanovich Rogozov
*Russian*
*(1934 - 2000)*

First auto-appendectomy
*(BMJ 2009)*
-1960-61 Antarctic Expedition
-May 1961 2am
-27 year old first medical post

- OR time 1:45min
Laparoscopic Appendectomy
Kurt Semm
German Obstetric and Gynecology (1927 - 2003)

First laparoscopic appendectomy (1980)
- Attempts to publish were rejected for 5 years – “unethical”
- German Surgical Society tried to suspend his license.
- Muhe used Semm’s instruments to perform first lap chole

“Both surgeons and gynecologists were angry with me, they were throwing stones at me. All my initial attempts to publish on laparoscopic appendectomy were refused, with the comment that such nonsense does not and will never belong to general surgery,”
SAGES - Appendectomy
Laparoscopic Versus Open:

Wound infections (OR 0.43, 0.34 – 0.54)
Less pain (p<0.05)
Return to normal activity 5 days (4 – 7 days)
Intraabdominal infections (OR 1.77, 1.14 – 2.76)
Operative time 10 minutes longer
Return to work 2 (-2 to 4 days)
Actual cost ???
Amoxicillin plus clavulanic acid versus appendicectomy for treatment of acute uncomplicated appendicitis: an open-label, non-inferiority, randomised controlled trial

Corinne Vons, Caroline Barry*, Sophie Maître*, Karine Pautrat, Mahaut Leconte, Bruno Costaglioli, Mehdi Karoui, Arnaud Alves, Bertrand Dousset, Patrice Valleur, Bruno Falissard, Dominique Franco

N= 239 (randomized)
119 in Appendicectomy group
120 in Antibiotic group

Primary endpoint: 30 – day abdominal peritonitis rate
• Antibiotic: Dx at appendicectomy or on CT-scan
• Appendicectomy: Persistent fevers, elevated wbc, elevated CRP, CT-scan
• Non-inferior 2% versus 9%

*18-34% recurrent appendicitis within 1-year in antibiotic group
Included 4 RCT

Results:
• Peri-operative complications – RR 0.69 (RR 0.61) favoring antibiotic group
• Length of stay – no difference
• Treatment efficacy – Heterogenous
  • Successful treatment 44 - 85% in the antibiotic group

Conclusions:
• Antibiotics can be used safely (no increased complications).
• Perhaps acute uncomplicated appendicitis could be treated like uncomplicated diverticulitis with an early trial of antibiotic therapy
Surgical outcomes are improving...

- Conversion from laparoscopic to open 1.2% (2.2%)
- Intraoperative complications 0.7 % (3.1%)
- Post op complications 1.9 % (6.1%)
Management of Acute Appendicitis

Conclusion:

- Open and Laparoscopic approaches are equivocal, however certain populations may benefit from a laparoscopic approach.

- Diagnostic uncertainty – allows for assessment of other Intraabdominal viscera if appendicitis is not the true diagnosis
- Female patients – Shown to have higher negative appendectomy rates compared to men (~20%).
- Elderly patients – Shown to have lower morbidity in some studies
- Obese patients – Exposure can be difficult in the open approach
Clinical Presentation of Acute Appendicitis

Management of Acute Appendicitis

- The goal of management is early diagnosis and prompt surgical intervention.

- But....

- Patients presenting with >5 days of symptoms

- Or

- Mass in the RLQ with localizing pain
  ie. walled off abscess
Clinical Presentation of Acute Appendicitis

Management of Missed Appendicitis

Operating on missed appendicitis

- Risk of bowel and enterocutaneous fistula
- Right hemicolecctionomy or cecostomy

Non-operative management:

- NPO
- Antibiotics
- Observation
- Interventional radiology – drains

If patient does not respond then operative intervention is indicated. Patient should be aware of the risk of bowel resection.
Clinical Presentation of Acute Appendicitis

Management of Missed Appendicitis

Interval Appendectomy

- Appendectomy performed electively 6-8 weeks after recovery.
- Colonoscopy should be performed in patients >50 before surgery.
- Equipoise concerning the evidence to support elective appendectomy versus watchful waiting.
32398 patient were diagnosed at 12 medical centers
1012 were treated non-operatively
   148 were not treated with interval appendectomy
   864 were treated with interval appendectomy

Recurrence rates were 5% over a 4 year follow-up
Length of hospital stay was 6 days for interval appendectomy
Length of hospital stay was 4 days for recurrent appendicitis (P=0.006)
Results:

- Risk of “enclosed inflammation” ie missed appendicitis was 3.8% (n= 59,448)
- Failure rate of non-operative management 7.8%
- Risk of recurrent appendicitis in non-operative groups 7.2%
- Rate of malignant disease on follow-up 1.2% (n= 2775)
- Rate of significant non-malignant disease at follow-up 0.7% (i.e. crohn’s)

- Morbidity was compared, showed a significantly greater morbidity with surgical invention compared to non-operative management with out interval appendectomy.
  - Significant heterogeneity in these outcomes
The first-year McGill student asked Houdini whether it was true that punches in the stomach did not hurt him. Houdini remarked rather unenthusiastically that his stomach could resist much, though he did not speak of it in superlative terms. Thereupon he gave Houdini some very hammer-like blows below the belt, first securing Houdini's permission to strike him. Houdini was reclining at the time with his right side nearest Whitehead, and the said student was more or less bending over him. These blows fell on that part of the stomach to the right of the navel, and were struck on the side nearest to us, which was in fact Houdini's right side; I do not remember exactly how many blows were struck. I am certain, however, of at least four very hard and severe body blows, because at the end of the second or third blow I verbally protested against this sudden onslaught on the part of this first-year student, using the words, "Hey there. You must be crazy, what are you doing?"

Harry Houdini (1874 – 1926)

Joselyn Gordon Whitehead - McGill
RUPTURED APPENDIX?

YOU MEAN INDIGESTION
you don’t have to remove your appendix just because you don’t know what we do!

BUT IF YOU DON’T, I WILL KILL YOU IF THE URGE STRIKES ME!

but I might help your immune system!

MAYBE.
Classification of Appendiceal Neoplasms

- Appendiceal malignancy is rare
  \(~1\%\) of appendectomy specimens

- Mucocele (Benign)

- Adenocarcinomas

- Carcinoid Tumors
Appendiceal Neoplasms: Mucoceles

- Appendiceal mucocele is a lesion characterized by a distended mucus-filled appendix
- Rare – 0.3% of appendix specimens

* Relative frequency
Appendiceal Neoplasms: Mucocele

Clinical Presentation:
- Asymptomatic (Most common)
- RLQ abdominal pain
- Colicky abdominal pain
- GI bleeding – intussusception
- Bowel obstruction
- Hydroureter
- Acute abdomen if ruptures

Laboratory Findings:
- CA 19-9
- CEA
- ESR

*Evidence is not great to support these for diagnostic purposes
Appendiceal Neoplasms: Mucocele

Imaging:
- Ultrasound
- CT

Findings to suggest mucocele:
- Calcification in the appendiceal wall
- Cystic lesion
- Irregular wall, but normal wall thickness
- Hypodense spots in the peritoneum

Endoscopy
Appendiceal Neoplasms: Mucocele

Management:

• Early diagnosis and surgical resection

• Appendectomy – staple across the base of the cecum

• Right hemicolectomy – if malignant features (cystadenocarcinoma), or obvious invasion into the terminal ileum, cecum or adjacent mesentery at the time of operation.

• Rule out synchronous cancer – 20%
  • Check colon, ovaries, endometrium, breast and kidney
Pseudomyxoma Peritonei

“Jelly Belly bit with a big fat bite...” – Denis Lee
Pseudomyxoma Peritonei

Originally used to describe Intraabdominal spread of a cystadenoma of the appendix.

Cystadenoma of the appendix ruptures, spreading mucous producing cells throughout the peritoneum.

Mucous accumulates in the abdomen (Jelly Belly) until it causes obstruction, which has no curative surgical treatment.

Some also include peritoneal carcinomatosis from malignant mucous producing tumors of the appendix, small and large bowel, lung, pancreas, stomach, breast and ovaries in the definition.

Prognosis is very different for indolent cystadenoma type versus all others.
Clinical Presentation of Pseudomyxoma Peritonei

Presenting Symptoms

*Non-specific Symptoms*

- *Increasing abdominal girth*
- *Inguinal hernia in men*
- *Ovarian mass on pelvic examination*
**Typical CT findings:**
- Mucin same density as water
- Calcifications are common
- Scalloping of the liver, spleen and peritoneum
- Spares the central portion of the abdomen (redistribution phenomenon)
Pseudomyxoma Peritonei: HIPEC and CRS
Hyperthermic Intraperitoneal Chemotherapy and Cytoreductive Surgery

Theory behind the treatment:
• Intraabdominal administration increases the effective concentration 7-fold (mitomycin or 5-FU)
• Limits systemic effects
• Heating increases the depth of penetration

Patient Selection (Surgarbaker, PH)
1. Histopathological assessment
   • Non-invasive neoplasms (better)
2. Radiological assessment
   • No liver, lung mets or lymphadenopathy
   • Segmental obstruction of small bowel (worse)
   • Tumor deposit >5cm (worse)
3. Peritoneal Cancer index
4. Complete Cytoreduction
Pseudomyxoma Peritonei: HIPEC and CRS

http://www.surgicaloncology.com/gpmtitle.htm

MANAGEMENT OF PERITONEAL SURFACE MALIGNANCY USING INTRAPERITONEAL CHEMOTHERAPY AND CYTOREDUCTIVE SURGERY

A Manual for Physicians and Nurses

Paul H. Sugarbaker, M.D., F.A.C.S.
Washington Cancer Institute
110 Irving Street NW Washington, DC 20010
Appendiceal Neoplasms: Adenocarcinoma
Appendiceal Neoplasms: Adenocarcinoma

Histologic Subtypes
- Mucinous cystadenocarcinoma (Most Common)
- Intestinal type adenocarcinoma
- Signet ring cell adenocarcinoma

<table>
<thead>
<tr>
<th>Histology</th>
<th>Frequency</th>
<th>5 year Disease Specific Survival</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mucinous cystadenocarcinoma</td>
<td>37%</td>
<td>58%</td>
</tr>
<tr>
<td>Intestinal type adenocarcinoma</td>
<td>27%</td>
<td>55%</td>
</tr>
<tr>
<td>Signet Ring adenocarcinoma</td>
<td>6%</td>
<td>27%</td>
</tr>
<tr>
<td>Carcinoid Tumors</td>
<td>11%</td>
<td>93%</td>
</tr>
</tbody>
</table>
### Primary tumor (T)

<table>
<thead>
<tr>
<th>T</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TX</td>
<td>Primary tumor cannot be assessed</td>
</tr>
<tr>
<td>T0</td>
<td>No evidence of primary tumor</td>
</tr>
<tr>
<td>Tis</td>
<td>Carcinoma in situ: intraepithelial or invasion of lamina propria*</td>
</tr>
<tr>
<td>T1</td>
<td>Tumor invades submucosa</td>
</tr>
<tr>
<td>T2</td>
<td>Tumor invades muscularis propria</td>
</tr>
<tr>
<td>T3</td>
<td>Tumor invades through muscularis propria into subserosa or into mesoappendix</td>
</tr>
<tr>
<td>T4</td>
<td>Tumor penetrates visceral peritoneum, including mucinous peritoneal tumor within the right lower quadrant and/or directly invades other organs or structures¹Δ</td>
</tr>
<tr>
<td>T4a</td>
<td>Tumor penetrates visceral peritoneum, including mucinous peritoneal tumor within the right lower quadrant</td>
</tr>
<tr>
<td>T4b</td>
<td>Tumor directly invades other organs or structures</td>
</tr>
</tbody>
</table>

### Distant metastasis (M)

<table>
<thead>
<tr>
<th>M</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>M0</td>
<td>No distant metastasis</td>
</tr>
<tr>
<td>M1</td>
<td>Distant metastasis</td>
</tr>
<tr>
<td>M1a</td>
<td>Intraperitoneal metastases beyond the right lower quadrant, including pseudomyxoma peritonei</td>
</tr>
<tr>
<td>M1b</td>
<td>Nonperitoneal metastases</td>
</tr>
</tbody>
</table>

**pTNM pathologic classification.** The pT, pN, and pM categories correspond to the T, N, and M categories.

**pN0.** Histological examination of a regional lymphadenectomy specimen will ordinarily include 12 or more lymph nodes. If the lymph nodes are negative, but the number ordinarily examined is not met, classify as pN0.

### Histologic grade (G)

<table>
<thead>
<tr>
<th>G</th>
<th>Description</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>GX</td>
<td>Grade cannot be assessed</td>
<td></td>
</tr>
<tr>
<td>G1</td>
<td>Well differentiated</td>
<td>Mucinous low grade</td>
</tr>
<tr>
<td>G2</td>
<td>Moderately differentiated</td>
<td>Mucinous high grade</td>
</tr>
<tr>
<td>G3</td>
<td>Poorly differentiated</td>
<td>Mucinous high grade</td>
</tr>
<tr>
<td>G4</td>
<td>Undifferentiated</td>
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</table>

### Regional lymph nodes (N)

<table>
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<tr>
<th>N</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NX</td>
<td>Regional lymph nodes cannot be assessed</td>
</tr>
<tr>
<td>N0</td>
<td>No regional lymph node metastasis</td>
</tr>
<tr>
<td>N1</td>
<td>Metastasis in 1 to 3 regional lymph nodes</td>
</tr>
<tr>
<td>N2</td>
<td>Metastasis in four or more regional lymph nodes</td>
</tr>
<tr>
<td>Stage</td>
<td>Tis</td>
</tr>
<tr>
<td>-------</td>
<td>-----</td>
</tr>
<tr>
<td>Stage I</td>
<td>T1</td>
</tr>
<tr>
<td></td>
<td>T2</td>
</tr>
<tr>
<td>Stage IIA</td>
<td>T3</td>
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<tr>
<td>Stage IIB</td>
<td>T4a</td>
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<tr>
<td>Stage IIC</td>
<td>T4b</td>
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<td>Stage IIIA</td>
<td>T1</td>
</tr>
<tr>
<td></td>
<td>T2</td>
</tr>
<tr>
<td>Stage IIIB</td>
<td>T3</td>
</tr>
<tr>
<td></td>
<td>T4</td>
</tr>
<tr>
<td>Stage IIIC</td>
<td>Any T</td>
</tr>
<tr>
<td>Stage IVA</td>
<td>Any T</td>
</tr>
<tr>
<td>Stage IVB</td>
<td>Any T</td>
</tr>
<tr>
<td></td>
<td>Any T</td>
</tr>
<tr>
<td></td>
<td>Any T</td>
</tr>
<tr>
<td>Stage IVC</td>
<td>Any T</td>
</tr>
</tbody>
</table>
Appendiceal Neoplasms: Adenocarcinoma

Management

• Diagnosis made pre-op
  • Right hemicolectomy
  • However, some evidence to suggest survival is no different for early lesions with simple appendectomy

• Found post-appendectomy
  • Right hemi-colectomy
  • No further operation if:
    • Adenocarcinoma confined to the mucosa
    • Well differentiated lesions no deeper than submucosa
Appendiceal Neoplasms: Adenocarcinoma

Adjuvant Therapy

• No randomized evidence exists due to the rare nature of these types of malignancy

• Chemotherapy ???
  • Retrospective evidence to suggest some patients with advanced disease may benefit from treatment.

• Radiation ???
Appendiceal Neoplasms: Peritoneal Mucinous Carcinomatosis

Adenocarcinoma

Role of HIPEC and CRS
Randomized trial of cytoreduction and hyperthermic intraperitoneal chemotherapy versus systemic chemotherapy and palliative surgery in patients with peritoneal carcinomatosis of colorectal cancer.

Verwaal VJ, van Ruth S, de Bree E, van Sloothen GW, van Tinteren H, Boot H, Zoetmulder FA.

Only RCT looking at HIPEC and cytoreductive surgery

105 Patient with peritoneal carcinomatosis

- 87 with colon cancer
- 18 with appendiceal cancer

Control – Standard therapy

- 5-FU and leucovorin chemotherapy
- Palliative surgery if required

Experimental – HIPEC and debulking surgery

- Debulking to <2.5mm lesions
- HIPEC – 90 minutes of isotonic dialysis fluid with mitomycin at 41 degrees.
- 5-FU and leucovorin started 6 weeks post

Median Survival: 22.4 months versus 12.6 months
Right hemicolecctomy does not confer a survival advantage in patients with mucinous carcinoma of the appendix and peritoneal seeding

S. González-Moreno and P. H. Sugarbaker

Program in Peritoneal Surface Malignancy, The Washington Cancer Institute, Washington, DC, USA

Correspondence to: Dr P. H. Sugarbaker, Department of Surgical Oncology, Washington Cancer Institute, 110 Irving Street NW, Suite CG-185, Washington, DC 20010, USA (e-mail: Paul.Sugarbaker@medstar.net)

British Journal of Surgery 2004; 91: 304–311

Cohort of 501 patients with mucinous adenocarcinoma of the appendix

- 17-year experience
- Compared appendectomy versus right hemicolecctomy
- All patients were treated with HIPEC and CRS

Overall results:

- 5 year survival 74% (SEER stage IV 22%)
- 10 year survival 52%
282 patients with peritoneal carcinomatosis undergoing HIPEC and CRS

Simplified peritoneal cancer index (SPCI) – pre-operative tumor load
Complete cytoreduction score (CC-score) – visible disease remaining

Lower SPCI showed better survival
Lower CC-score showed better survival

Survival 3 year – 67%
Survival 5 year – 52%
Appendiceal Neoplasms: Carcinoid Tumors

Johnny Optimism

IT'S AMAZING HOW MUCH THE HUMAN APPENDIX LOOKS LIKE A LITTLE FINGER.

DOCTOR! YOUR HAND....!

WELL SHOOT! THAT'S NOT GONNA HELP MY GOLF GAME...
Appendiceal Neoplasm: Carcinoid Tumors

- Approximately 11% of appendiceal malignancies
- Age 40 – 50 years
- More common in women
- Occur most often in the distal third of the appendix
- Large tumors cause obstruction

Carcinoid Syndrome: Metastatic Disease

- **Episodic Flushing** *(EtOH, emotional stress, eating, liver palpation and anesthesia)*
- Venous telangiectasia
- Bronchospasm
- Diarrhea

Carcinoid Crisis:

- Significant hemodynamic instability
- **Octreotide Prophylaxis (300-500mcg IV), repeat PRN**
Appendiceal Neoplasm: Carcinoid Tumors
Clinical Presentation

- Most patients are symptomatic at time of diagnosis
- Appendicitis (10% reside at base of appendix)
- Bowel obstruction
- Carcinoid Syndrome
- Incidental finding

Work-Up of Carcinoid Tumors
- CT abdomen
- CT chest
- Octreotide scan
- 24-Hour 5-HIAA (5-hydroxindolacetic acid)
- Chromogranin A
Endoscopic image of an appendiceal carcinoid
## TNM staging of appendiceal carcinoid

### Primary tumor (T)*

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TX</td>
<td>Primary tumor cannot be assessed</td>
</tr>
<tr>
<td>T0</td>
<td>No evidence of primary tumor</td>
</tr>
<tr>
<td>T1</td>
<td>Tumor 2 cm or less in greatest dimension</td>
</tr>
<tr>
<td>T1a</td>
<td>Tumor 1 cm or less in greatest dimension</td>
</tr>
<tr>
<td>T1b</td>
<td>Tumor more than 1 cm but not more than 2 cm</td>
</tr>
<tr>
<td>T2</td>
<td>Tumor more than 2 cm but not more than 4 cm or with extension to the cecum</td>
</tr>
<tr>
<td>T3</td>
<td>Tumor more than 4 cm or with extension to the ileum</td>
</tr>
<tr>
<td>T4</td>
<td>Tumor directly invades other adjacent organs or structures, eg, abdominal wall and skeletal muscle</td>
</tr>
</tbody>
</table>

### Regional lymph nodes (N)

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NX</td>
<td>Regional lymph nodes cannot be assessed</td>
</tr>
<tr>
<td>N0</td>
<td>No regional lymph node metastasis</td>
</tr>
<tr>
<td>N1</td>
<td>Regional lymph node metastasis</td>
</tr>
</tbody>
</table>

### Distant metastasis (M)

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>M0</td>
<td>No distant metastasis</td>
</tr>
<tr>
<td>M1</td>
<td>Distant metastasis</td>
</tr>
</tbody>
</table>

### Anatomic stage/prognostic groups

<table>
<thead>
<tr>
<th>Stage</th>
<th>T</th>
<th>N</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>T1</td>
<td>N0</td>
<td>M0</td>
</tr>
<tr>
<td>II</td>
<td>T2, T3</td>
<td>N0</td>
<td>M0</td>
</tr>
<tr>
<td>III</td>
<td>T4</td>
<td>N0</td>
<td>M0</td>
</tr>
<tr>
<td>IV</td>
<td>Any T</td>
<td>N1</td>
<td>M0</td>
</tr>
<tr>
<td></td>
<td>Any T</td>
<td>Any N</td>
<td>M1</td>
</tr>
</tbody>
</table>

**pN0**: Histological examination of a regional lymphadenectomy specimen includes 12 or more lymph nodes. If the lymph nodes are negative but are not ordinarily examined is not met, classify as pN0.
### Appendiceal Neoplasm: Carcinoid Tumors

#### WHO Grade

<table>
<thead>
<tr>
<th>Grade</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low grade (G1)</td>
<td>&lt;2 Mitoses/10 high-power fields, and &lt;3% Ki-67 index</td>
</tr>
<tr>
<td>Intermediate grade (G2)</td>
<td>2–20 Mitoses/10 high-power fields, or 3%–20% Ki-67 index</td>
</tr>
<tr>
<td>High grade (G3)</td>
<td>&gt;20 Mitoses/10 high-power fields or &gt;20% Ki-67 index</td>
</tr>
</tbody>
</table>
Appendiceal Neoplasm: Carcinoid Tumors
Management:

NANETS

- <1cm tumors with no evidence of lymphovascular invasion or invasion into the mesoappendix are considered a cure.

- Right Hemicolecotomy
  - >1cm at the base of the appendix
  - >2cm or size cannot be evaluated
  - Grade 2 and 3 tumors
  - Lymphovascular invasion
  - Invasion of mesoappendix
  - Positive margins
Appendiceal Neoplasm: Carcinoid Tumors
Management:

**ENETS**

- <2cm tumors with no evidence of lymphovascular invasion or invasion into the mesoappendix are considered a cure.

- Right Hemicolecotmy (within 3 moths):
  - >2cm or size cannot be evaluated
  - Invasion of mesoappendix
  - Positive margins
Appendiceal Neoplasm: Carcinoid Tumors

Follow-Up:

**ENETS**
- **Curative Tumors** – Chromogranin A at 6-12 months
- **All others** – CT, Octreotide scan, Chromogranin A q6-12 months indefinitely

**NANETS**
- **Curative Tumors** – (G1, <1cm) no follow up
- **All others** – Restage at 3 – 6 months
  - HIAA, Chromogranin A, CT/MRI and Octreotide scan q6-12 months for 7 years.
FIGURE 2. Overall survival among patients with midgut NETs. Survival by stage and primary site in patients with G1/G2 NETs diagnosed from 1988 to 2004. Cases were selected from SEER database (1973–2004) using International Classification of Diseases for Oncology third edition histology codes 8150–8157, 8240–8246, and 8249. Localized disease (A), regional disease (B), distant disease (C), survival by disease stage and primary tumor site (D).
Appendiceal Neoplasm: Carcinoid Tumors
Advanced Disease:

Systemic Therapy
• Octreotide alone
  • Improved time to progression
  • Survival advantage suspected
• Octreotide + INF alpha
• Cytotoxic Chemo (5FU – based)
• Everolimus/Sirolimus (mTOR)
• Bevacizumab (anti-VEGF)

Cytoreductive Surgery
• Hepatic Resection
• Liver directed therapy
  • Cryo, radio or microwave ablation
  • Embolization (Bland, chemo or radioactive)
  • Peptide receptor radiotherapy
“Idleness is the appendix to nobility…” - Robert Burton
Dr. Elizabeth Pomfret, MD, PhD, FACS

Chair, Dept. of Transplantation and Hepatobiliary Diseases,
Lahey Medical Center, Burlington, Massachusetts
Professor of Surgery, Tufts University School of Medicine

Wednesday, February 17, 2016
5:00-6:00pm, Auditorium B, UH