MAYO CLINIC | School of Continuous Professional Development



MANAGEMENT OF APPENDICITIS

Taleen A. MacArthur, M.D.
General Surgery Resident, Mayo Clinic

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LEARNING OBJECTIVES

- Understand the workup and management options for acute appendicitis.
- Be able to evaluate patients for non-operative management of appendicitis and understand non-operative management principles.
- Be able to recognize when non-operative management has failed.
- Understand the management options for complicated forms of appendicitis.
- Be able to evaluate which patients should undergo interval appendectomy after non-operative management

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APPENDICITIS

THE MOST COMMON ABDOMINAL SURGICAL EMERGENCY



"Die Operation" (The Operation) by Gaspare Traversi in 1753, Reproduced from: https://columbiasurgery.org/news/2015/06/04/history-medicine-mysterious-appendix; Accessed July 17, 2022

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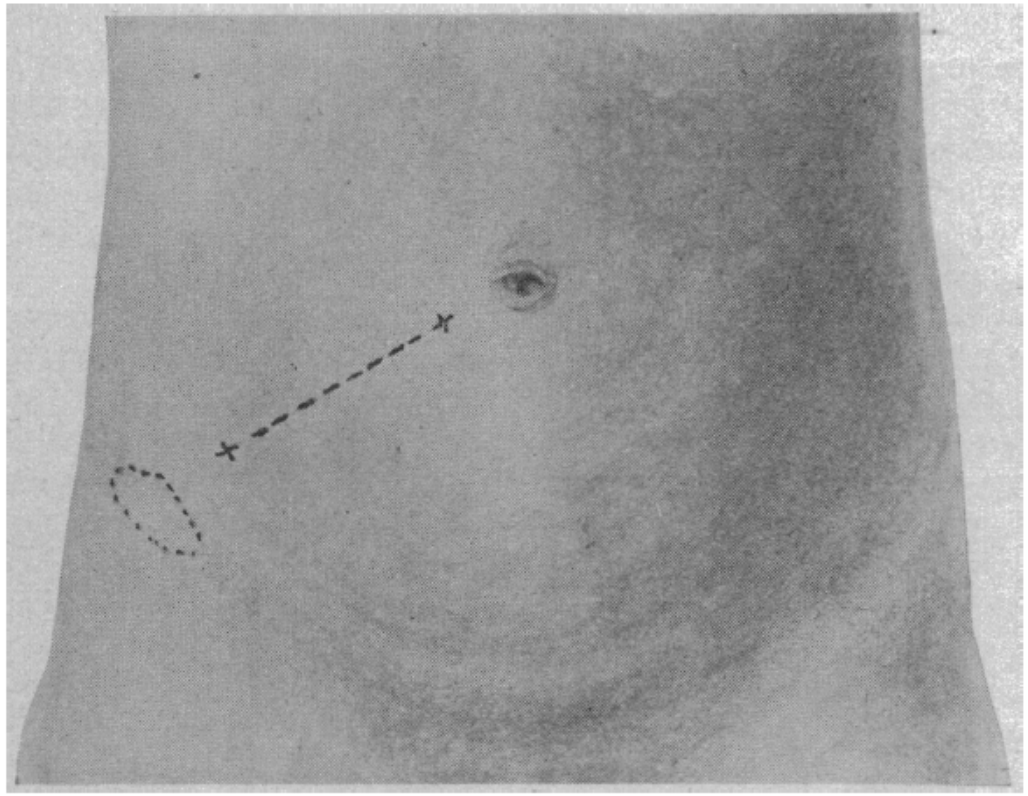
Case #1:

- 31-year-old male presents to the ED with 24 hours of abdominal pain, nausea, diarrhea, and low-grade fever.
- Pain began around umbilicus, migrated to right lower quadrant
- No significant medical or abdominal surgical history

Clinical Notes

McBURNEY'S POINT AND ANOTHER POINT IN APPENDIX DIAGNOSES.

ROBERT T. MORRIS, M.D.
Professor of Surgery in the New York Post-Graduate Medical School.
NEW YORK.



McBurney's point and another point in appendix diagnoses.

MORRIS RT. McBURNEY'S POINT AND ANOTHER POINT IN APPENDIX DIAGNOSES. *JAMA.* 1908;L(4):278.

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Case #1: Workup

- CBC: WBC 14.0, 80% neutrophils

- CT Scan: dilated appendix, mucosal hyperenhancement, fluid filled lumen
  - Diameter: > 6 mm
  - Wall Thickening: > 3 mm
  - Fat Stranding

SIMPLE ACUTE APPENDICITIS

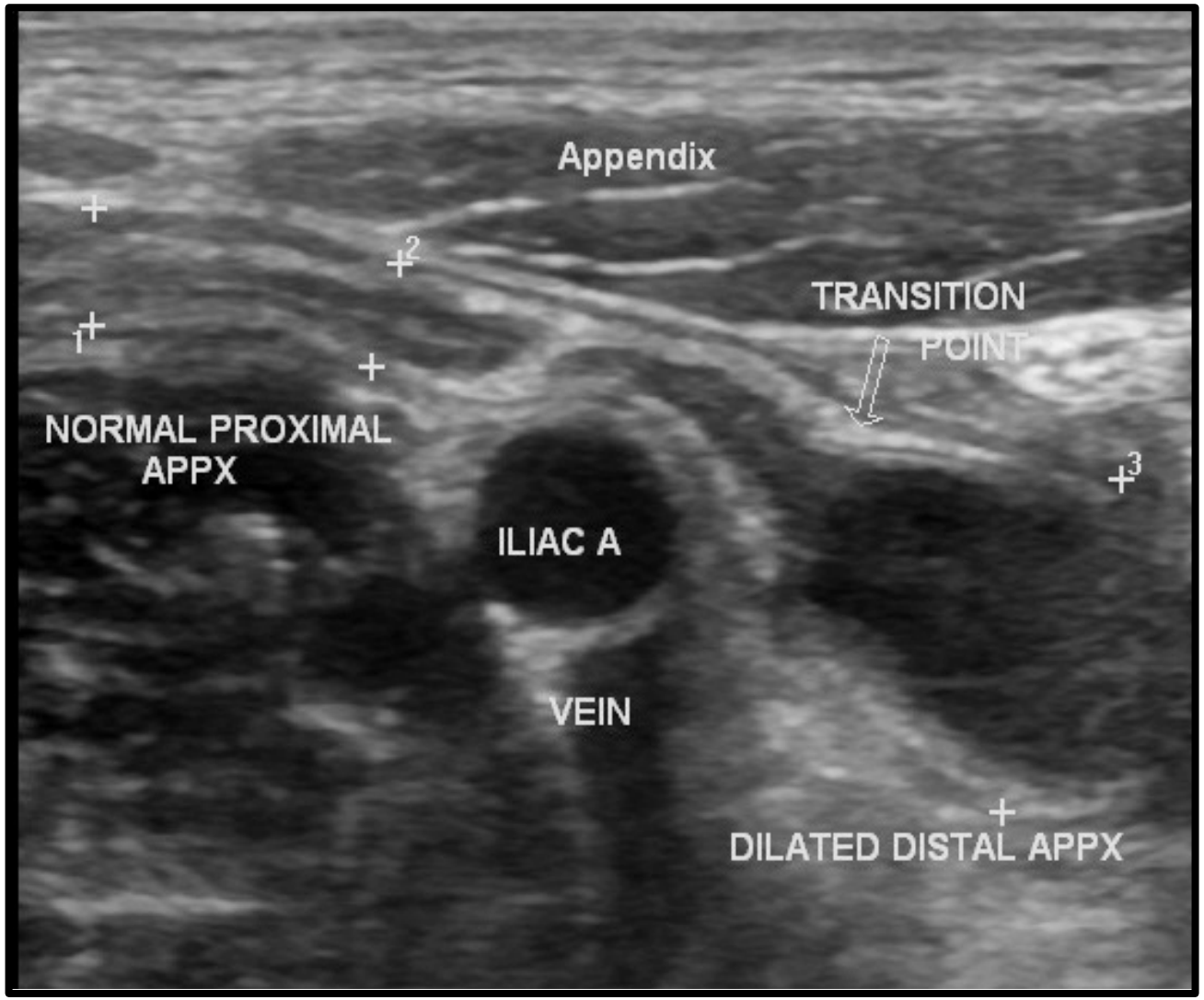


Iamwat *et al. Insights Imaging (2021) 12:143*
https://doi.org/10.1186/s13244-021-01086-3

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SIMPLE ACUTE APPENDICITIS

ULTRASOUND IMAGING



Case courtesy of Dr Maulik S Patel, Radiopaedia.org, rID: 13043



Case courtesy of Dr Natalie Lawrence, Radiopaedia.org, rID: 47075

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SIMPLE ACUTE APPENDICITIS

NON- PERFORATED

Case #1: Management

- Laparoscopic Appendectomy
- Perioperative antibiotics
  - Ceftriaxone
  - Flagyl
- Hospital Dismissal- same day



Case courtesy of Dr Andrew Dixon, Radiopaedia.org, rID: 9644

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SIMPLE ACUTE APPENDICITIS

IS APPENDECTOMY THE ONLY OPTION?

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 NOVEMBER 12, 2020 VOL. 383 NO. 20

A Randomized Trial Comparing Antibiotics with Appendectomy for Appendicitis

The CODA Collaborative*

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NON-OPERATIVE MANAGEMENT OF ACUTE APPENDICITIS

THE CODA TRIAL

- 1, 552 Adults → Randomized → 776 Antibiotics vs. 776 Appendectomy
- Included: appendicolith, simple, perforated
- Excluded: septic shock, peritonitis, walled off abscess, free air or significant free fluid, phlegmon, neoplasm concern
- 30% of eligible subjects enrolled

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NON-OPERATIVE MANAGEMENT OF ACUTE APPENDICITIS

THE CODA TRIAL

- Antibiotics: IV x 24 hours + PO x 10 days
  - 51% Hospital Admission
  - 47% ED Discharge
  - 79% discharged within 24 hours

- Peritonitis, septic shock, antibiotic failure at 48 hours → Appendectomy

- European Quality of Life 5- Dimensions Questionnaire (EQ-5D)

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NON-OPERATIVE MANAGEMENT OF ACUTE APPENDICITIS

THE CODA TRIAL

Antibiotics: Not Inferior to Appendectomy

- **11%- Appendectomy in 48 hours**
- **20%- by 30 days**
- **29%- by 90-days → 41% with appendicolith vs. 25% without**

- **Complications: antibiotics > appendectomy**
  - **Driven by appendicolith group!**

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NON-OPERATIVE MANAGEMENT OF ACUTE APPENDICITIS

THE CODA TRIAL- Quality of Life Metrics

- **Patient missed days of work:** antibiotics < appendectomy
  - 5.26 vs. 8.73 days
- **Caregiver missed days of work:** antibiotics < appendectomy
  - 1.33 vs. 2.04 days
- **30-day EQ-5D score:** antibiotics = appendectomy
- **Hospitalization after index treatment:** antibiotics > appendectomy
  - 24% vs. 5%

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NON-OPERATIVE MANAGEMENT OF ACUTE APPENDICITIS

THE CODA TRIAL: Follow Up

- **30-days from randomization → 1 year:**
  - 27% appendectomy with antibiotics

- **Appendectomy among antibiotics group:**
  - 1 year- 40%
  - 2 years- 46%
  - 4 years- 49%

- **Greater risk with appendicolith →** decreased over time

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NON-OPERATIVE MANAGEMENT OF ACUTE APPENDICITIS

WHO SHOULD BE CONSIDERED FOR THIS?

- No sepsis, peritonitis or free air
- No walled off abscess or phlegmon
- No neoplasm concern
- Appendicolith → *strongly consider appendectomy*
- Reliably able to complete antibiotic regimen
- Patient preferences and healthcare resource availability

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NON-OPERATIVE MANAGEMENT OF ACUTE APPENDICITIS

HOW TO DO IT

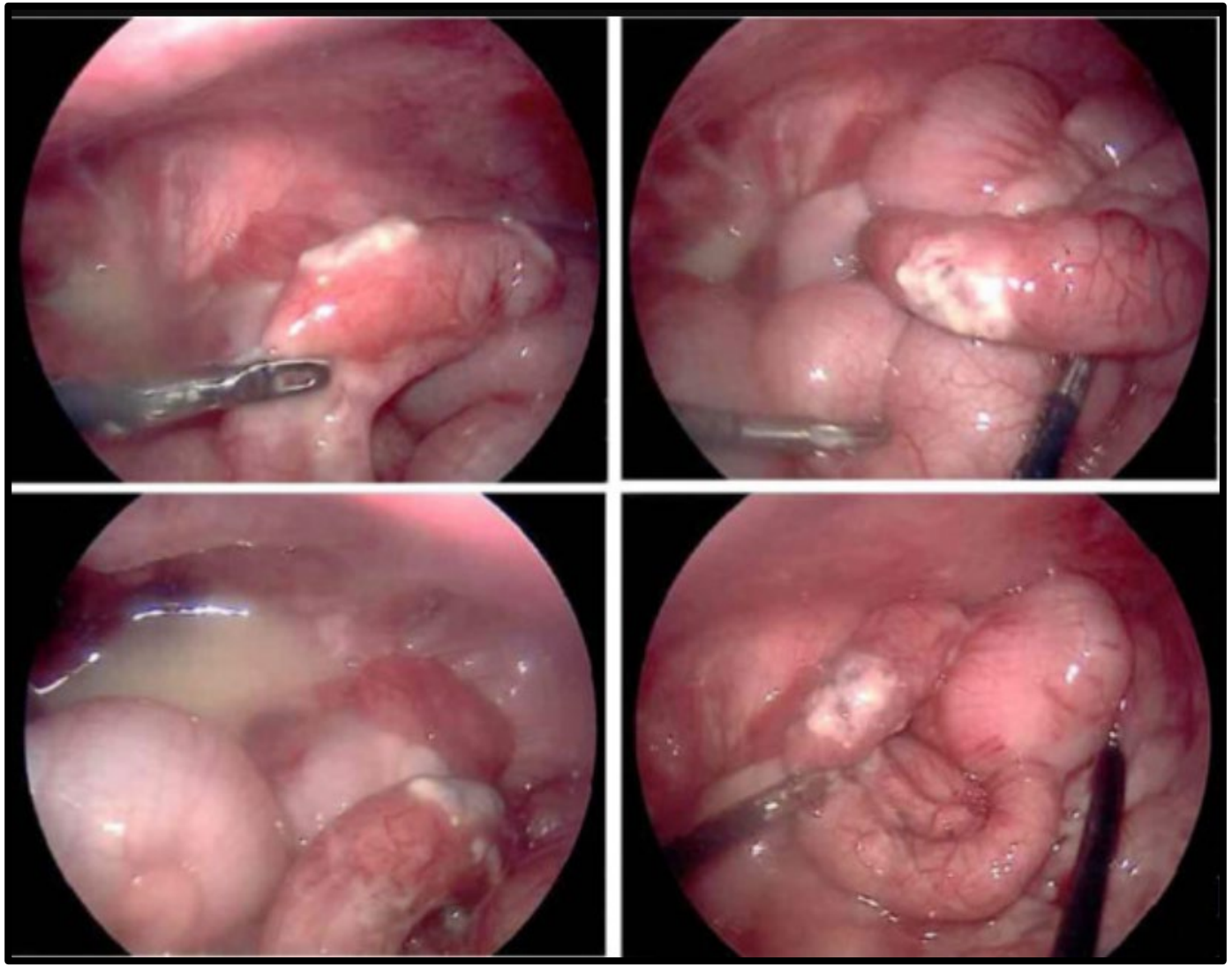
- Serial abdominal exams
- Bowel rest
- IV fluids until tolerating oral intake
- IV antibiotics for 48-72 hours
- 7-10 days PO antibiotics: Augmentin 875-125 mg BID

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NON-OPERATIVE MANAGEMENT OF ACUTE APPENDICITIS

WHEN DO YOU KNOW IT'S FAILED?

- **48-72 hours:**
  - **Worsening/ ongoing symptoms**
  - **Continued Fever**
  - **Worsening leukocytosis**



K.W. Gonzalez et al. / J Ped Surg Case Reports 3 (2015) 158e159 159

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NON-OPERATIVE MANAGEMENT OF ACUTE APPENDICITIS

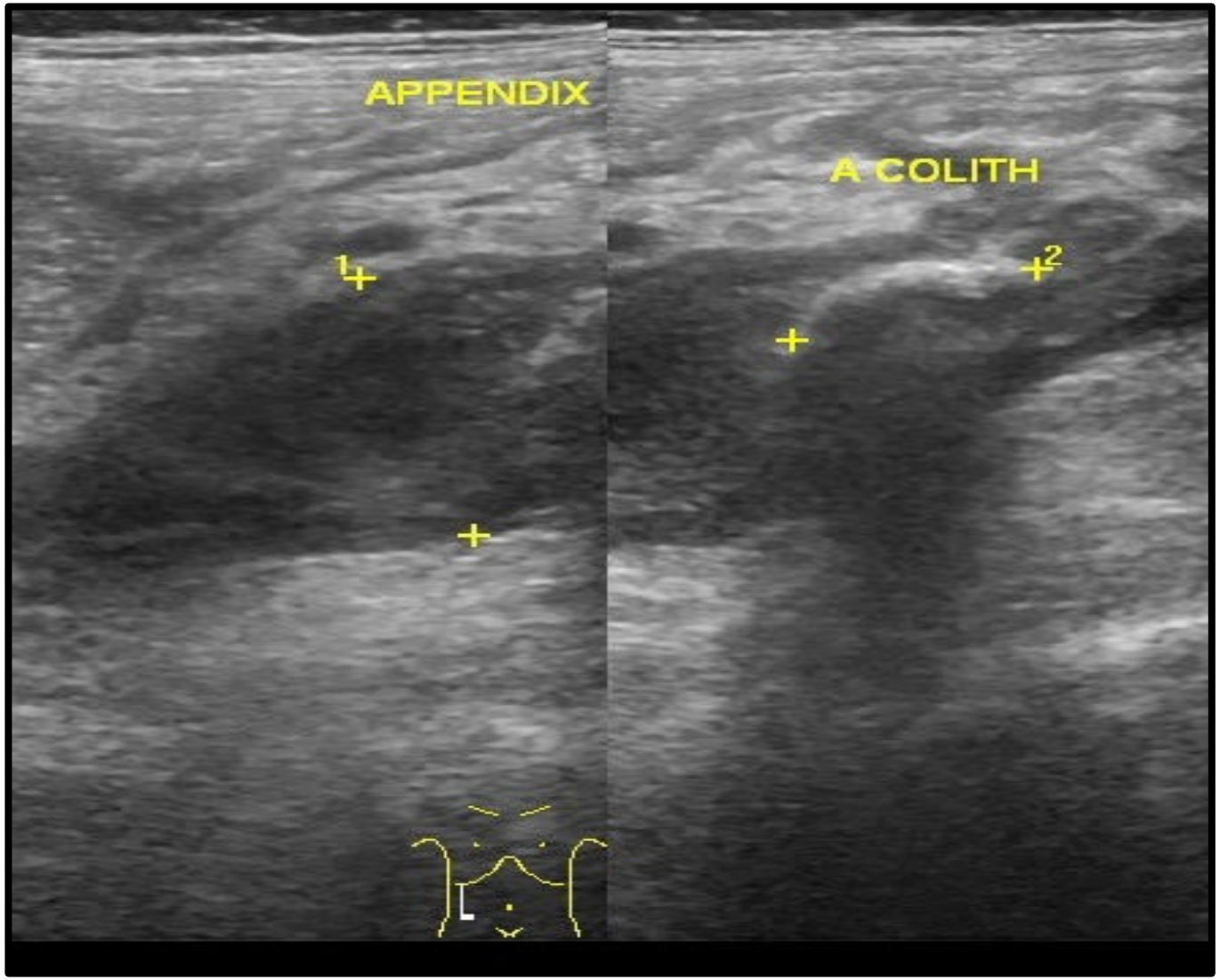
FOLLOW UP- INTERVAL APPENDECTOMY

- High Recurrence Risk:
  - Appendicolith
  - Male patients
  - Recurrent appendicitis
- Patients ≥ 40 years → Colonoscopy at 8-10 weeks
  - *All patients- rule out malignancy*
- CT Abdomen and Pelvis → 12 weeks
- Interval Appendectomy → 12 weeks
- Consider patient preference!

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Case #2:

- 70-year-old male presents to the ED with 72 hours of generalized abdominal pain that is now localized in the RLQ, nausea, vomiting, and fever.
- Hemodynamically stable
- PMH: Type 2 diabetes, Hypertension, Hyperlipidemia, Hypothyroid



Case courtesy of Dr Maulik S Patel, Radiopaedia.org, rID: 12824

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Case #2: Workup

- Labs:
  - Leukocytes 16.0
  - K- 3.0, Cl 96
- CT Scan



Perforated Appendicitis with 5.0 cm Abscess!

Case courtesy of Dr Naim K, Radiopaedia.org, rID: 84147

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COMPLICATED APPENDICITIS

PERFORATED WITH DRAINABLE ABSCESS

- CT or U/S Guided Drain → abscess > 3.0 cm
- IV Antibiotics until WBC downtrends → switch to PO
  - Continue for 4-days post source control
- Worsening exam, rising WBC, fever → Repeat CT Scan
- Bowel rest, IV fluids
- Advance diet as condition allows
- Discharge: discussion of interval appendectomy

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COMPLICATED APPENDICITIS

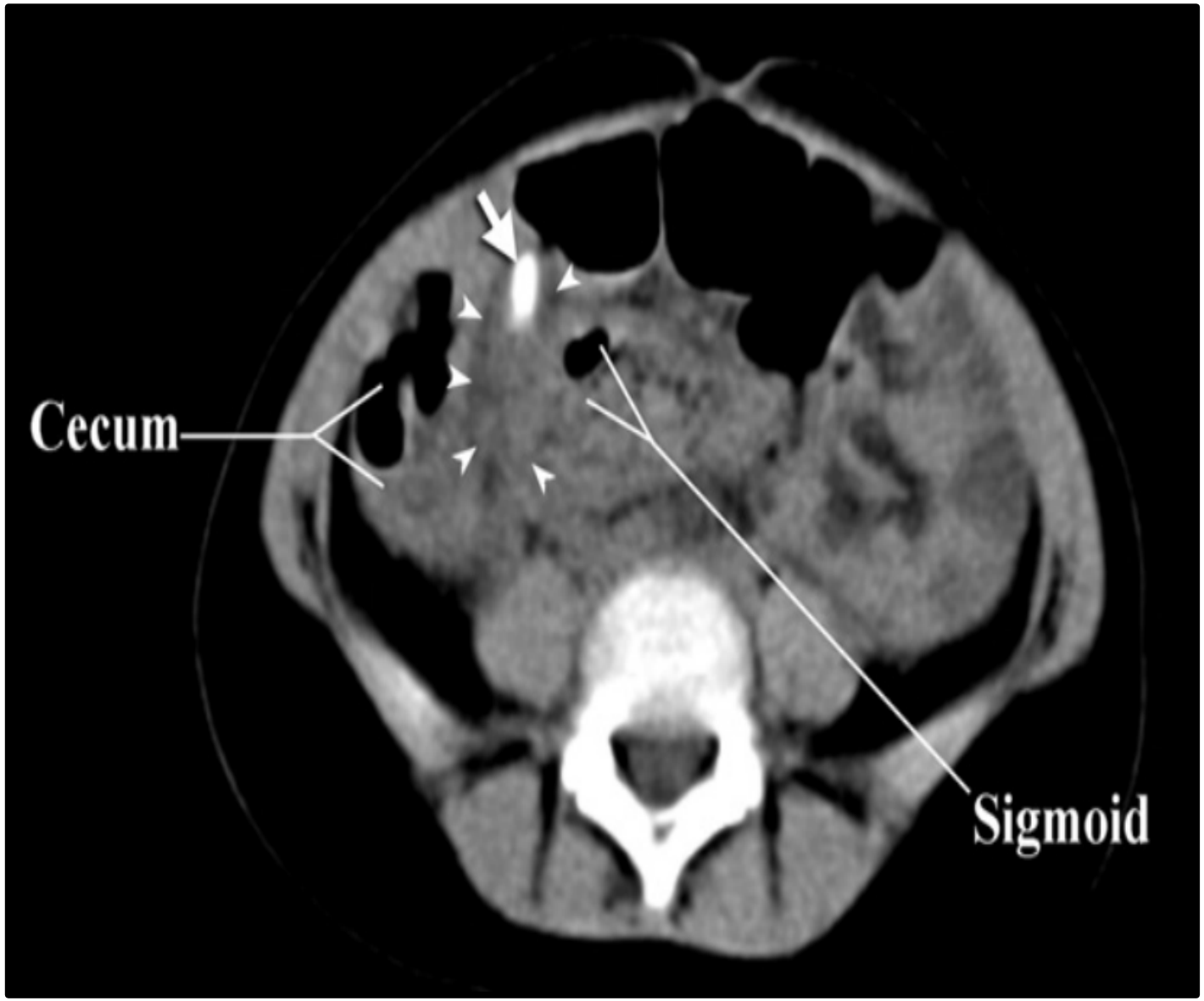
PERFORATED WITH NON- DRAINABLE ABSCESS

- **CT or U/S Guided Drain → abscess ≤ 3.0 cm**
- **Consider immediate appendectomy**
- **Antibiotics for 3-5 days from source control**
  - **Consider IV antibiotics x 3 days**
  - **PO when tolerating diet**
  - **Tailor antibiotics to susceptibilities**

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Case #3:

- 17-year-old female presents with 5 days of generalized abdominal pain, nausea, vomiting
- Managed as presumed viral illness
- Presented to local ED due to escalation of pain, fever, and anorexia
- **Phlegmon! → → →**



A. Mentessidou, P. Mirilas / Journal of Pediatric Surgery 50 (2015) 1224–1226

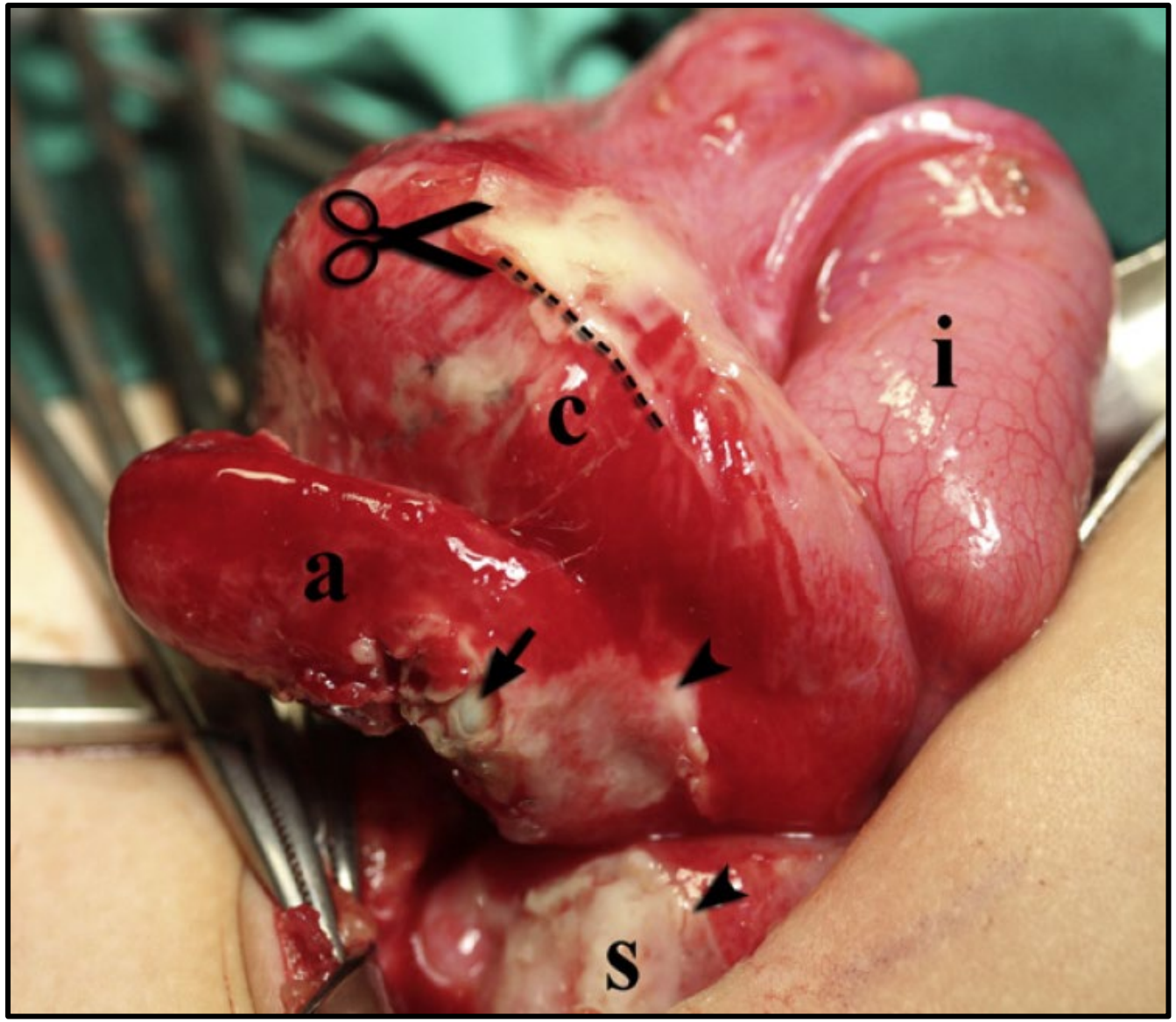
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COMPLICATED APPENDICITIS

PHLEGMON

Case #3: Management

- Low risk of ileocecectomy → Operate
- High risk of ileocecectomy → Antibiotics
  - IV → PO
- Consider interval appendectomy
  - 3 months
  - Repeat imaging

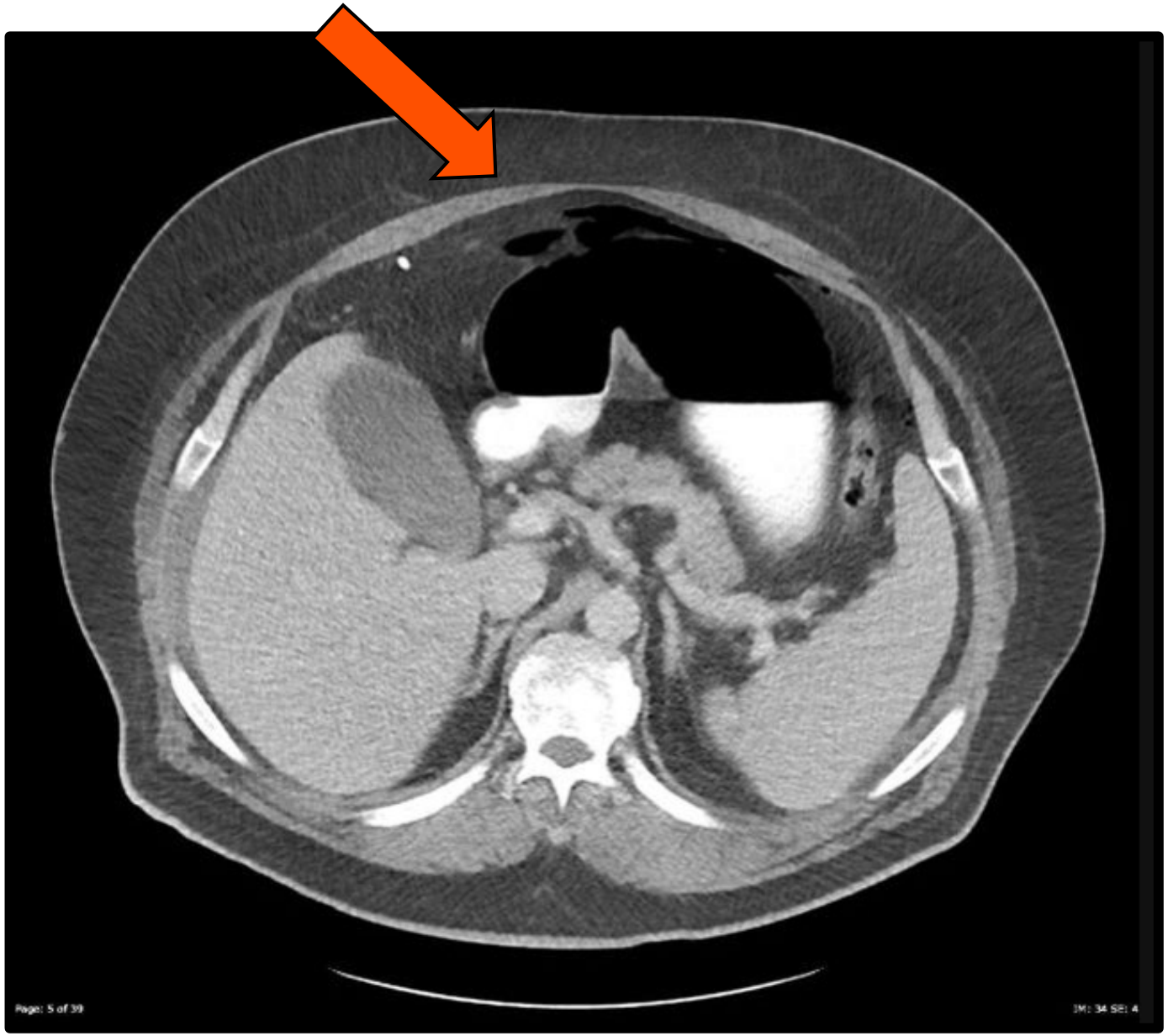


A. Mentessidou, P. Mirilas / Journal of Pediatric Surgery 50 (2015) 1224–1226

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Case #4:

- 75-year-old male presents to the ED with severe diffuse abdominal pain.
- Pain began one week ago and has escalated.
- Systolic blood pressures are in the 80s
- Involuntary guarding on exam
- PMH: rheumatoid arthritis (on prednisone 5 mg daily), HTN, HLD



Case courtesy of Assoc Prof Frank Gaillard, Radiopaedia.org, rID: 23983

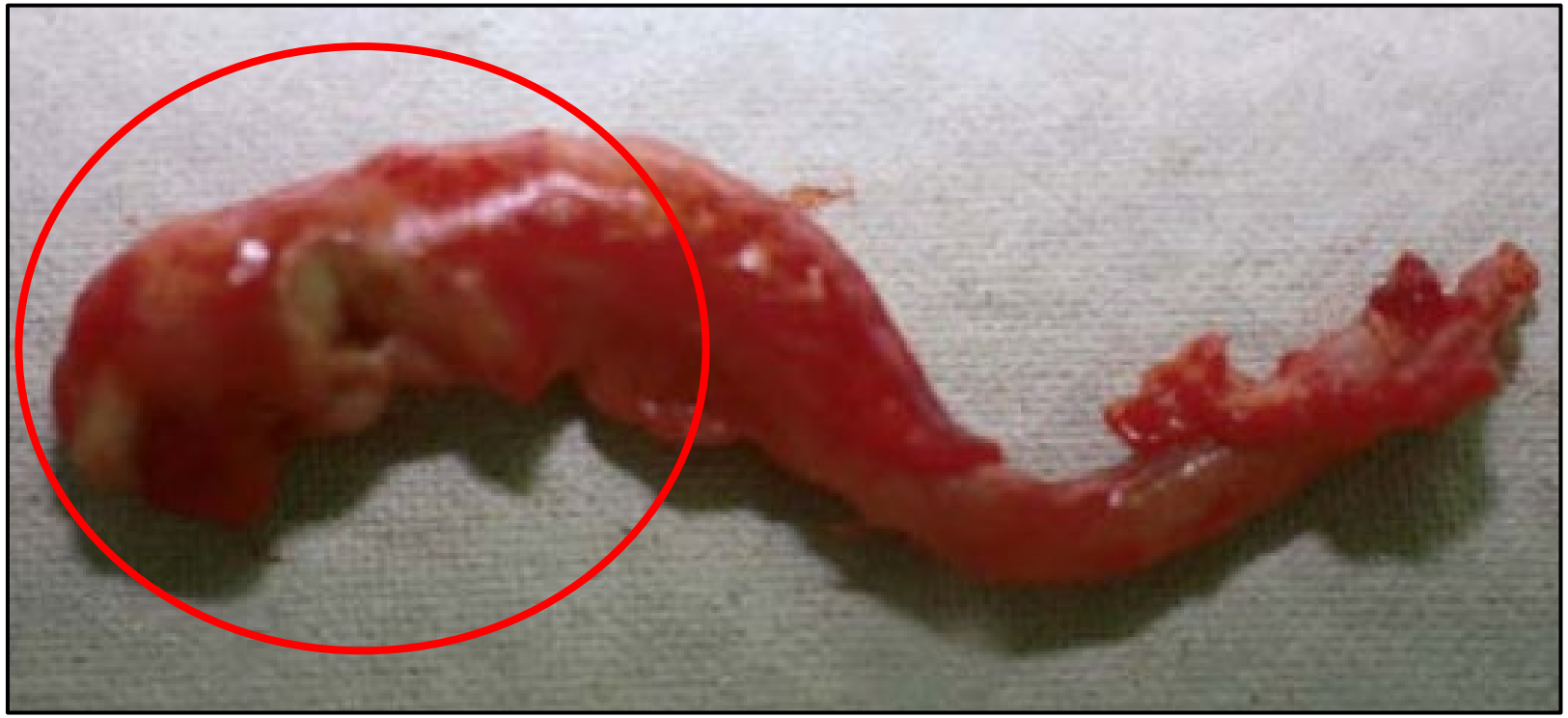
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COMPLICATED APPENDICITIS

FREE PERFORATION

Case #4

- **Resuscitation**
- **Antibiotics**
- **Operating Room!**



Kurosh Paya; Appendicitis, Pediatric Surgery Diagnosis and Management. 2008.

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APPENDICITIS
DURING PREGNANCY

Case #5

- 34-year-old female G2P0 who is 25 weeks pregnant presents with vague abdominal pain, low grade fevers and diarrhea.
- No significant medical problems
- Uncomplicated pregnancy



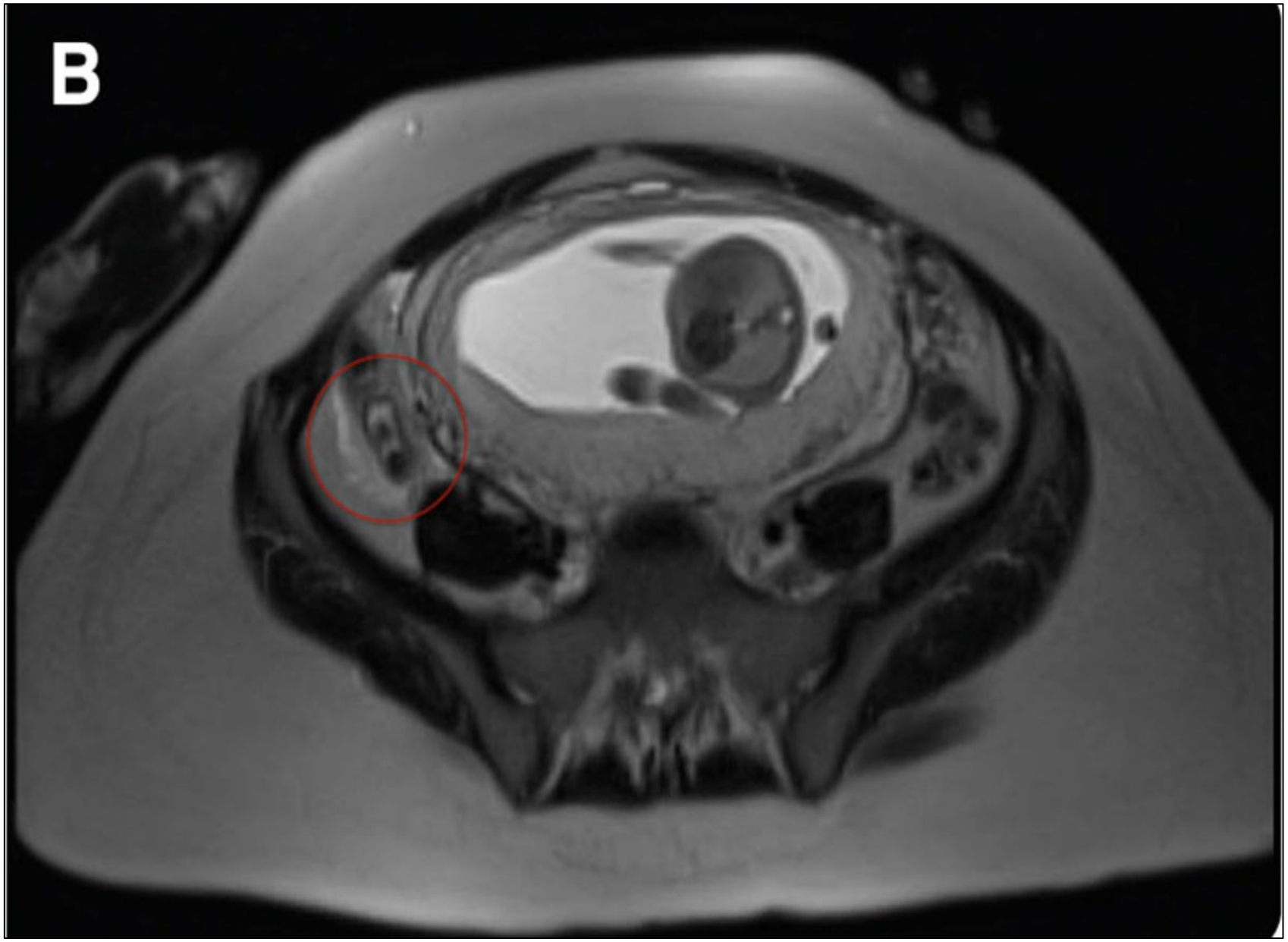
Burke et al, American Journal of Obstetrics & Gynecology, November 2015 693.e3

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APPENDICITIS
DURING PREGNANCY

Case #5

- **Ultrasound: inconclusive**
- **MRI: acute appendicitis**
- **Appendectomy!**



Burke et al, American Journal of Obstetrics & Gynecology, November 2015 693.e3

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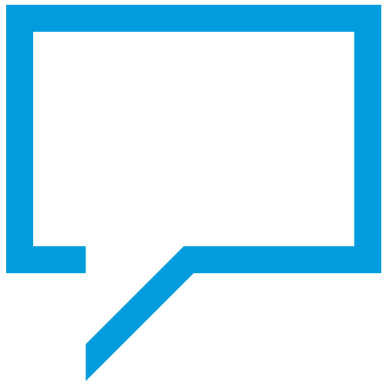
APPENDICITIS

OTHER CONSIDERATIONS

- Stump Appendicitis
- Negative Appendectomy
- Appendicitis Mimickers
- Chronic Appendicitis

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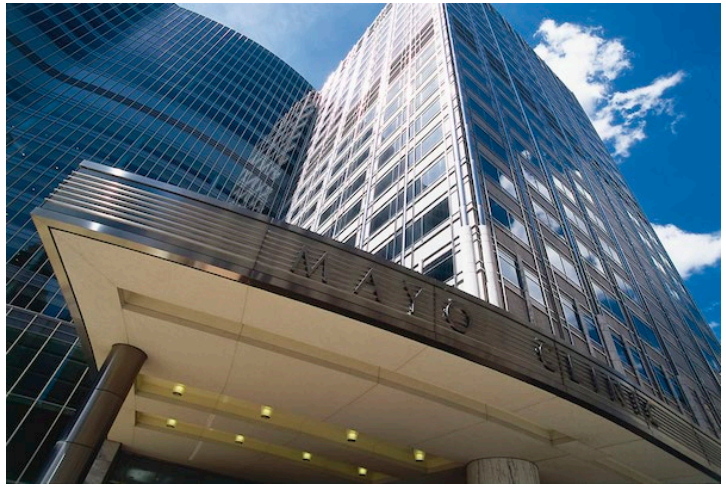
QUESTIONS & DISCUSSION



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