Appendicitis

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What is a Clinical Pathway?

An evidence-based guideline that decreases unnecessary variation and helps promote safe, effective, and consistent patient care.
Objectives of Pathway

- To standardize care of patients with both acute simple (non-perforated) appendicitis, complicated (acute perforated) appendicitis in the pediatric population
- To delineate guidelines on when to consider operative vs non-operative management
- To standardize care of patients with operative and non-operative management
- To provide evidence-based recommendations for key elements of care for appendicitis
- To clearly delineate discharge criteria and instructions
Abdominal pain is a common reason for presentation to the Emergency Department, pediatric and surgical offices.

Appendicitis is a common surgical etiology for this type of pain.

American Pediatric Surgical Association has altered their guidelines to help decrease the following:
- number of CT scans used for diagnosis
- inappropriate antibiotic choices and duration
- need for inpatient management post-operatively

Pathway was developed to ensure an optimal consistent approach to the surgical management of children who present with appendicitis.
Epidemiology of Appendicitis

• Overall lifetime risk is 8.6% in males, 6.7% in females

• Luminal obstruction that subsequently leads to infection
  • Fecaliths are the most common cause; however the cause of the obstruction may not always be clear
  • Hyperplasia of appendiceal lymphoid follicles
    • Associated with:
      • Bacterial Infections: Yersinia, Salmonella, Schistosoma, Enterobius, Ascaris
      • Viral Infections: Measles, Chicken Pox, CMV
• Improved outcomes ≠ Increased resource utilization

• Good evidence-based recommendations to guide care include:
  o Ultrasound is first line imaging approach for diagnosis
  o Once daily dosing for antibiotics (ceftriaxone/metronidazole)
  o Post-op labs/imaging should be minimized
  o TPN is not beneficial in the majority of cases
This is the Appendicitis Clinical Pathway.

We will be reviewing each component in the following slides.
Inclusion Criteria: Abdominal pain suspicious for appendicitis

Initial management in ED

- Labs: CBC with diff, CRP, iStat chem 7 (if female: add U/A, bHCG)
- Analgesics: consider Morphine IV 0.1 mg/kg x1 PRN pain (max 5 mg/dose)
- Studies: consider ultrasound

Consider alternative diagnosis
If appendicitis is suspected, surgery is to be consulted to confirm the diagnosis.

Surgery will decide on operative vs non-operative management based on certain criteria.

Non-surgical management should be considered based on duration of symptoms and reassuring WBC and CRP.

Criteria have been outlined for when non-operative management would NOT be appropriate.
Operative Management

- Surgery to give the “OK” for ED provider to order Ceftriaxone AND Metronidazole prior to incision
  - If Penicillin and/or Ceftriaxone allergy, use Ciprofloxacin AND Metronidazole
- Peri-operative pain control includes Ketorolac

Antibiotics to be started promptly:
- Ceftriaxone 50 mg/kg q24hr (max 2 g/dose) AND Metronidazole 30 mg/kg q24hr (max 1.5 g/dose)

If Ceftriaxone allergy:
- Ciprofloxacin 10 mg/kg/dose q8hr (max 400 mg/dose) AND Metronidazole 30 mg/kg q24hr (max 1.5 g/dose)

Pain control (Peri-operative – pre-op, OR, PACU):
- Ketorolac 0.5 mg/kg/dose (max 30 mg/dose)
Operative Management

- After laparoscopic appendectomy, post-op antibiotics are only given if there is a perforated appendicitis. Otherwise, antibiotics are not indicated and should be discontinued.
- It is important to continue to assess pain level and adjust medications as needed.
- Diet should be advanced as tolerated; miralax should be started and continued until the patient is stooling.

Post-Op Antibiotics:

If simple appendicitis: Stop all antibiotics
If perforated appendicitis:
- Ceftriaxone 50 mg/kg q24hr (max 2 g/dose) AND Metronidazole 30 mg/kg q24hr (max 1.5 g/dose)
  - If Ceftriaxone allergy: Ciprofloxacin 10 mg/kg/dose q8hr (max 400 mg/dose) AND Metronidazole 30 mg/kg q24hr (max 1.5 g/dose)

Post-Op Pain Control:

Initial:
- Ketorolac 0.5 mg/kg/dose (max 30 mg/dose) IV q6hr
- Morphine 0.1 mg/kg/dose (max 5 mg/ dose) IV q3hr PRN pain

When Pain Well Controlled:
- Change Ketorolac to Ibuprofen 10 mg/kg PO q4-6 hr ATC x48 hrs then PRN pain (max 600 mg q6hr)
- Change Morphine to: Hydrocodone/Acetaminophen (325 mg) 0.2 mg Hydrocodone/kg/dose PO q4hr PRN pain (max 5-10 mg hydrocodone/dose; max acetaminophen 4000 mg/day or 75 mg/kg/day) OR Oxycodone/Acetaminophen (325 mg) 0.1 mg oxycodone/kg/dose PO q4hr PRN pain (max 5-10 mg oxycodone/dose; max acetaminophen 4000 mg/day or 75 mg/kg/day)

FEN/GI:
- Clears, advance to regular diet as tolerated
- Once taking diet: Miralax 1g/kg/day to a max of 17g a day until stooling
Non-Operative Management

Admit for 23 hour observation

- IV Antibiotics started promptly: Ceftriaxone and Metronidazole
- Clear liquid diet, advance as tolerated
- Pain Control: Tylenol, Ketorolac
- Reassessment every 6-12 hrs after IV antibiotics given

Antibiotics to be started promptly:
Reassess for clinical improvement 6-12 hours after IV antibiotics are given
- Ceftriaxone IV 50 mg/kg x 1 dose (max 2 g/dose) AND
- Metronidazole IV 30 mg/kg x 1 (max 1.5 g/dose)

Diet:
- Clear liquid diet, advance as tolerated

Pain control:
- Tylenol PO 15 mg/kg q6hr (max 1000 mg/dose, max 75 mg/kg/day, not to exceed 4000 mg/day)
- Ketorolac IV 0.5 mg/kg/dose q6hr (max 30 mg/dose)

DISCHARGE CRITERIA:
Operative Management:
- Afebrile >24 hrs, tolerating diet, pain controlled on PO pain medication, <60 ml/day from drain if applicable
- Non-operative Management:
  - Afebrile, no worsening pain or nausea, tolerating diet

DISCHARGE INSTRUCTIONS:
Pain control:
Ibuprofen PO 10 mg/kg q4-6hr then PRN pain (max 800 mg q4hr); Acetaminophen PO 15 mg/kg q4-6 hr ATC x24hr then PRN pain (max 75 mg/kg/day OR 4000 mg/day)

FEN/GI:
Miralax 1 g/kg/day to max of 17 g/day until stooling

Antibiotics x 7 days:
(for perforated appendicitis or non-operative management ONLY)
- <30 kg or unable to take tablets: Augmentin PO (250 mg/5 mL): 40 mg/kg/day div TID (max 500 mg/dose); or (600 mg/5 mL) ES: 90 mg/kg/day div BID (max 1000 mg/dose);
- >30 kg and able to take tablets: Augmentin 875 mg BID

Follow Up:
Operative Management:
Simple Appendicitis: phone call in 2 weeks or office visit within 4 weeks
Perforated Appendicitis: office visit within 4 weeks scheduled
Non-operative Management:
Phone follow up at 24 hours to ensure no symptom recurrence.
- If worsening pain/inability to tolerate PO return to hospital for appendectomy without additional imaging.
- If course after discharge is uneventful: phone f/u in 2-4 weeks
- If symptoms recur after 7 days of PO antibiotics, this is considered treatment failure and an appendectomy should be completed.
Simple Appendicitis Non-Operative Management:

During surgery the appendix is noted to be normal, inflamed, or abnormal without perforation

- Remember that there are no additional antibiotics post-op
- There will be a conditional discharge order for nurses that includes:
  - Tolerating clears
  - Pain is controlled
  - And family is comfortable with plan

DISCHARGE CRITERIA:
Operative Management:
Afebrile >24 hrs, tolerating diet, pain controlled on PO pain medication, <40 ml/day from drain if applicable

Non-operative Management:
Afebrile, no worsening pain or nausea, tolerating diet

DISCHARGE INSTRUCTIONS:
Pain control:
Operative Management:
Ibuprofen PO 10 mg/kg q4-6hr x48hr then PRN pain (max 600 mg q6hr); Acetaminophen PO 15 mg/kg q4-6 hr ATC x24hr then PRN pain (max 75 mg/kg/day OR 4000 mg/day)

Non-operative management:
Ibuprofen PO q6hr PRN; Acetaminophen PO q4-6hr PRN

FEN/GI:
Operative Management:
Miralax 1 g/kg/day to max of 17 g/day until stooling

Antibiotics x7 days:
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Phone follow up at 24 hours to ensure no symptom recurrence.
- If worsening pain/inability to tolerate PO: return to hospital for appendectomy without additional imaging.
  - If course after discharge is uneventful: phone f/u in 2-4 weeks
  - If symptoms recur after 7 days of PO antibiotics, this is considered treatment failure and an appendectomy should be completed.
Simple Appendicitis Post-Op Management:

- **Pain control:**
  - Ketorolac
  - Morphine

- Change to oral pain regimen once pain well controlled
  - Ketorolac → Ibuprofen
  - Morphine → Hydrocodone/acetaminophen OR Oxycodone/acetaminophen

**Post-Op Antibiotics:**

**If simple appendicitis:** Stop all antibiotics

**If perforated appendicitis:**
- Ceftriaxone 50 mg/kg q24hr (max 2 g/dose) AND Metronidazole 30 mg/kg q24hr (max 1.5 g/dose)
  - **If Ceftriaxone allergy:** Ciprofloxacin 10 mg/kg/dose q8hr (max 400 mg/dose) AND Metronidazole 30 mg/kg q24hr (max 1.5 g/dose)

**Post-Op Pain Control:**

**Initial:**
- Ketorolac 0.5 mg/kg/dose (max 30 mg/dose) IV q6hr
- Morphine 0.1 mg/kg/dose (max 5 mg/dose) IV q3hr PRN pain

**When Pain Well Controlled:**
- Change Ketorolac to Ibuprofen 10 mg/kg PO q4-6 hr ATC x48 hrs then PRN pain (max 600 mg q6hr)
- Change Morphine to: Hydrocodone/Acetaminophen (325 mg) 0.2 mg Hydrocodone/kg/dose PO q4hr PRN pain (max 5-10 mg hydrocodone/dose; max acetaminophen 4000 mg/day or 75 mg/kg/day) OR Oxycodone/Acetaminophen (325 mg) 0.1 mg oxycodone/kg/dose PO q4hr PRN pain (max 5-10 mg oxycodone/dose; max acetaminophen 4000 mg/day or 75 mg/kg/day)

**FEN/GI:**
- Clear liquids, advance to regular diet as tolerated
- Once taking diet: Miralax 1g/kg/day to a max of 17g a day until stooling

**Conditional discharge order for nurses:**
- Tolerating clear liquids, pain controlled, family is comfortable with plan
- See discharge circle
Perforated Appendicitis:

Either on imaging or during surgery, the appendix is noted to be ruptured. There is often purulent fluid in the abdomen

- Antibiotics to continue for a TOTAL of 7 days of therapy
  - Ceftriaxone AND Metronidazole to be used while inpatient
  - Change to Augmentin when patient being discharged
- Pain control – same as simple appendicitis
- Diet – clear liquids, may advance as tolerated.
- Start bowel regimen of Miralax daily until stooling

Post-Op Antibiotics:

If simple appendicitis: Stop all antibiotics
If perforated appendicitis:

- Ceftriaxone 50 mg/kg q24hr (max 2 g/dose) AND Metronidazole 30 mg/kg q24hr (max 1.5 g/dose)
  - If Ceftriaxone allergy: Ciprofloxacin 10 mg/kg/dose q8hr (max 400 mg/dose) AND Metronidazole 30 mg/kg q24hr (max 1.5 g/dose)

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FEN/GI:

- Clears, advance to regular diet as tolerated
- Once taking diet: Miralax 1g/kg/day to a max of 17g a day until stooling

Perforated appendicitis
Perforated Appendicitis: Patient Improving?

Yes

- On POD #5, obtain CRP
- Labs improved from Pre-op?
  Yes
    - Proceed to Discharge Criteria
    - Consider imaging
    - Continue antimicrobial therapy
  No

- Proceed to Discharge Criteria

No

- Proceed to Discharge Criteria

CRP

Labs improved from Pre-op?

Yes

No

DISCHARGE CRITERIA:
Operative Management:
- Afebrile >24 hrs, tolerating diet, pain controlled on PO pain medication,
- <40 mL/day from drain if applicable

Non-operative Management:
- Afebrile, no worsening pain or nausea, tolerating diet

DISCHARGE INSTRUCTIONS:
Pain control:
Operative Management:
Ibuprofen PO 10 mg/kg q4-6hr ATC x24hr then PRN pain
(max 600 mg q6hr); Acetaminophen PO 15 mg/kg q4-6 hr ATC x24hr
then PRN pain (max 75 mg/kg/day or 4000 mg/day)

Non-operative management:
Ibuprofen PO q4hr PRN; Acetaminophen PO q4-6hr PRN

FEN/GI:
Operative Management:
Miralax 1 g/kg/day to max of 17 g/day until stooling

Antibiotics 7 days:
- <30 kg or unable to take tablets: Augmentin PO (250 mg/5 mL): 40 mg/kg/day qd TID (max 500 mg/dose); or (600 mg/5 mL) ES: 90 mg/kg/day qd BID (max 1000 mg/dose);
- >30 kg and able to take tablets: Augmentin 875 mg BID

Follow Up:
Operative Management:
- Simple Appendicitis: phone call in 2 weeks or office visit within 4 weeks
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Non-operative Management:
Phone follow up at 24 hours to ensure no symptom recurrence.
- If worsening pain/inability to tolerate PO: return to hospital for appendectomy without additional imaging.
- If course after discharge is uneventful: phone f/u in 2-4 weeks
- If symptoms recur after 7 days of PO antibiotics, this is considered treatment failure and an appendectomy should be completed.
**Discharge Criteria:** For Simple and Perforated Appendicitis

- Afebrile for 24 hours
- Tolerating a regular diet
- Pain adequately controlled with oral medication regimen
  - Acetaminophen and Ibuprofen on discharge
- If JP drain present: Less than 40 mL/day of drain output
- Drain will be removed prior to discharge

**DISCHARGE INSTRUCTIONS:**

**Pain control:**

**Operative Management:**
- Ibuprofen PO 10 mg/kg q4-6hr ATC x48hr then PRN pain (max 600 mg q6hr); Acetaminophen PO 15 mg/kg q4-6 hr ATC x24hr then PRN pain (max 75 mg/kg/day OR 4000 mg/day)
- Non-operative management:
  - Ibuprofen PO q6hr PRN; Acetaminophen PO q4-6hr PRN

**FEN/GI:**
- Operative Management:
  - Miralax 1 g/kg/day to max of 17 g/day until stooling

**Antibiotics x7 days:**

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**Follow Up:**

- Operative Management:
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Review of Key Points

• Once pediatric surgeon attending has confirmed diagnosis of appendicitis, Ceftriaxone (or Ciprofloxacin) AND Metronidazole should be given promptly
  o Antibiotics should be given prior to surgery
• There are certain situations where non-operative management may be appropriate
• Simple appendicitis does not require additional antibiotic therapy post-operatively
• Duration of antibiotics for perforated appendicitis is 7 days
• Pain relief should include Ketorolac, and should be transitioned to oral medication as soon as patient is tolerating a regular diet
• Uncomplicated patients with simple appendicitis may have a conditional discharge order placed in the PACU
Quality Metrics

• Percentage of eligible patients treated per pathway
• Percentage of eligible patients with appendicitis order set usage
• Percentage of patients with appropriate post-op antibiotic selection
• Average duration of post-op antibiotic course (days) for complicated appendicitis
• Mean length of stay (simple, complicated stratified)
Pathway Contacts

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  - Department of Pediatric Surgery and Trauma

About Connecticut Children’s Clinical Pathways Program

The Clinical Pathways Program at Connecticut Children’s aims to improve the quality of care our patients receive, across both ambulatory and acute care settings. We have implemented a standardized process for clinical pathway development and maintenance to ensure meaningful improvements to patient care as well as systematic continual improvement. Development of a clinical pathway includes a multidisciplinary team, which may include doctors, advanced practitioners, nurses, pharmacists, other specialists, and even patients/families. Each clinical pathway has a flow algorithm, an educational module for end-user education, associated order set(s) in the electronic medical record, and quality metrics that are evaluated regularly to measure the pathway’s effectiveness. Additionally, clinical pathways are reviewed annually and updated to ensure alignment with the most up to date evidence. These pathways serve as a guide for providers and do not replace clinical judgment.