Provincial Clinical Knowledge Topic

Appendicitis, Adult – Emergency

V 1.0
## Revision History

<table>
<thead>
<tr>
<th>Version</th>
<th>Date of Revision</th>
<th>Description of Revision</th>
<th>Revised By</th>
</tr>
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<tbody>
<tr>
<td>1.0</td>
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<td>Topic completed and disseminated</td>
<td>See Acknowledgements</td>
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[Revision History](#)
Important Information Before You Begin

The recommendations contained in this knowledge topic have been provincially adjudicated and are based on best practice and available evidence. Clinicians applying these recommendations should, in consultation with the patient, use independent medical judgment in the context of individual clinical circumstances to direct care. This knowledge topic will be reviewed periodically and updated as best practice evidence and practice change.

The information in this topic strives to adhere to Institute for Safe Medication Practices (ISMP) safety standards and align with Quality and Safety initiatives and accreditation requirements such as the Required Organizational Practices. Some examples of these initiatives or groups are: Health Quality Council Alberta (HQCA), Choosing Wisely campaign, Safer Healthcare Now campaign etc.

Goals of Management

1. Ensure hemodynamic stability
   - If severe sepsis present, ensure early antibiotics, IV fluids, resuscitation, and source control (surgical intervention)
2. Identify emergent and urgent causes for RLQ pain, particularly those requiring surgical or specific medical intervention
   - Within this context, utilize history, physical examination and laboratory testing to determine likelihood of appendicitis to determine whether or not diagnostic imaging is required
3. Initiate specific management plan based on outcome of investigations
4. Manage pain / nausea as needed
5. Arrange for appropriate specialty consultation and patient disposition based on final diagnosis
Clinical Decision Support

Clinical Assessment Tools

Table 1. Alvarado score in acute appendicitis

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Value</th>
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<tr>
<td>Migration</td>
<td>1</td>
</tr>
<tr>
<td>Anorexia</td>
<td>1</td>
</tr>
<tr>
<td>Nausea-vomiting</td>
<td>1</td>
</tr>
<tr>
<td>Signs</td>
<td></td>
</tr>
<tr>
<td>Tenderness in right lower quadrant</td>
<td>2</td>
</tr>
<tr>
<td>Rebound pain</td>
<td>1</td>
</tr>
<tr>
<td>Elevation of temperature (37.3°C measured orally)</td>
<td>1</td>
</tr>
<tr>
<td>Laboratory</td>
<td></td>
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<tr>
<td>Leukocytosis (10,000/mm³)</td>
<td>2</td>
</tr>
<tr>
<td>Shift to the left (greater than or equal to 75% neutrophils)</td>
<td>1</td>
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Total Score: ____ / 10

1 to 3 Appendicitis unlikely
4 to 6 Appendicitis possible
Greater than or equal to 7 Appendicitis probable


Table 2. Test characteristics of clinical findings for appendicitis

<table>
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<tr>
<th>Clinical Feature</th>
<th>LR (+) (95% CI)</th>
<th>LR (-) (95% CI)</th>
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<tr>
<td>RLQ pain</td>
<td>(7.31 – 8.46)**</td>
<td>(0.00 – 0.28)**</td>
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<tr>
<td>Rigidity</td>
<td>3.76 (2.96 – 4.78)</td>
<td>0.82 (0.79 – 0.85)</td>
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<td>Migration</td>
<td>3.18 (2.41 – 4.21)</td>
<td>0.50 (0.42 – 0.59)</td>
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<tr>
<td>Pain before vomiting</td>
<td>2.76 (1.94 – 3.94)</td>
<td>0.00 ***</td>
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<tr>
<td>Psoas sign</td>
<td>2.38 (1.21 – 4.67)</td>
<td>0.90 (0.83 – 0.98)</td>
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<tr>
<td>Fever</td>
<td>1.94 (1.63 – 2.32)</td>
<td>0.58 (0.51 – 0.67)</td>
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<td>Rebound tenderness</td>
<td>(1.10 – 6.30)**</td>
<td>(0.00 – 0.86)**</td>
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<tr>
<td>Guarding</td>
<td>(1.65 – 1.78)**</td>
<td>(0.00 – 0.54)**</td>
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<tr>
<td>No similar pain previously</td>
<td>1.50 (1.36 – 1.66)</td>
<td>0.32 (0.25 – 0.42)</td>
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<tr>
<td>Anorexia</td>
<td>1.27 (1.16 – 1.38)</td>
<td>0.64 (0.54 – 0.75)</td>
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<tr>
<td>Nausea</td>
<td>(0.69 – 1.20)**</td>
<td>(0.70 – 0.84)**</td>
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<tr>
<td>Vomiting</td>
<td>0.92 (0.82 – 1.04)</td>
<td>1.12 (0.95 – 1.33)</td>
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LR(+) > 5 and LR(-) < 0.2 are generally considered diagnostically useful. No single clinical finding can conclusively rule the diagnosis of appendicitis in or out. Likelihood ratios may be applied consecutively, making combinations of clinical findings are more powerful than any single finding alone.

** 95% CI reported without point estimate for heterogeneous values
*** Based on single study

Adapted from: Wagner JM, McKinney WP, Carpenter JL. Does This Patient Have Appendicitis? JAMA. 1996;276(19):1589-1594
Figure 1. Appendicitis Clinical Pathway

Initial Assessment
Patient History
Physical Examination
Laboratory Testing

Low Risk
Alvarado Score 0 to 3

Moderate Risk
Alvarado Score 4 to 6

High Risk
Alvarado Score 7 or higher

Consider serial examination
vs.
Discharge home
vs.
Imaging

Worsening clinical picture

Imaging
See Clinical Decision Support section for guidance on modality selection

Surgical Consultation

Ultrasound (U/S)
Indeterminate
Computerized Tomography (CT)

Normal Appendix
Positive Appendicitis

Address other identifiable pathology and/or discharge home
Initial Decision Making

1. Unstable patient with RLQ pain:
   - Initiate hemodynamic resuscitation
     - IV fluids, blood, vasoactive medications as needed, targeting adequate end-organ perfusion
     - Early administration of broad spectrum antibiotics if concerned about intra-abdominal infection as source of shock
   - Consider early bedside ultrasound to rule out free fluid (FF), abdominal aortic aneurysm (AAA), and assess for intrauterine pregnancy
   - Early point of care bHCG in appropriate patients
   - Consider potential causes, including (but not limited to):
     - Septic / distributive shock
       - Appendicitis with perforation / abscess
       - UTI / Pyelonephritis
         **Note – appendicitis can present with pyuria
       - Pelvic inflammatory disease with tubo-ovarian abscess
       - Biliary sepsis (e.g. ascending cholangitis)
       - Colonic diverticulitis with perforation / abscess
       - Mesenteric / colonic ischemia with bacteremia / acidemia / multi-organ dysfunction
     - Hemorrhagic / hypovolemic shock
       - Ruptured ectopic pregnancy
       - Ruptured AAA / other intra-abdominal arterial aneurysm
       - Spontaneous retroperitoneal hemorrhage (consider in anticoagulated patients)
   - Consider immediate surgical consultation based on clinical presentation
     - Imaging confirmation may be indicated, based on consultation

2. Stable patient with RLQ pain suggestive of acute appendicitis:
   - Initiate laboratory testing based on clinical suspicions (see Lab Investigations)
   - Risk stratify probability of appendicitis based on clinical impression considering a combination of patient history, examination, lab tests, and Alvarado score (see Table 1 and Figure 1)
     - High risk patients should be considered for immediate surgical consultation
     - Moderate risk patients should be considered for emergent imaging
     - Low risk patients may be appropriate for:
       - Observation and serial examination, with subsequent imaging if the clinical picture progresses or remains equivocal or;
       - Discharge home with follow up or planned/optional return to ED if symptoms persist/worsen
Consider imaging options:

- Imaging is of particular use to rule appendicitis in or out in the following:
  - Females (larger number of clinical mimics of appendicitis)
  - Obese patients (difficult physical examination)
  - Elderly patients (non-specific presentations of appendicitis)
  - Immunocompromised state (subtle presentations of appendicitis)

- Timing of imaging is dependent on clinical risk stratification
  - Moderate / high risk patients should be considered for emergent (same-day) imaging
  - In low risk patients it may be appropriate to defer imaging in favour of serial clinical examinations to determine whether imaging will ultimately be necessary

- Ultrasound
  - Preferred first line diagnostic imaging modality in the following:
    - Females of childbearing age
    - Pregnant patients
    - Younger patients (age less than 40 years)
    - Thin body habitus
  - Cannot rule out appendicitis if appendix not visualized
  - Availability may be limited at certain hours and/or in some geographical locations

- Computed Tomography - CT (definitive test)
  - Consider as first line diagnostic imaging modality in the following:
    - Obese patients (e.g. BMI greater than 30)
    - Older patients (age greater than 40 years)
    - Severe illness / peritonitis NYD
  - Contrast enhancement protocol should be decided upon in consultation with local radiologist
    - Unenhanced CT abdomen may have similar sensitivity for appendicitis but accuracy may be impaired for alternative diagnoses if appendicitis not present

- Arrange for appropriate specialty consultation
  - Surgical consultation if appendicitis confirmed on imaging or strongly suspected on clinical grounds (see Figure 1)

- Antibiotics
  - Administer if perforation confirmed
Order Set: Appendicitis, Adult – Emergency

Order Set Components

Order Set Keywords: abdominal pain; RLQ pain; pelvic pain
Order Set Requirements: Allergies
Risk Assessment / Scoring Tools / Screening: see Clinical Decision Support section

Goals of Care Designation

☐ Goals of Care Designation: _______________

Diet / Nutrition

☐ NPO
☐ NPO – May Have Sips, May Take Meds
☐ Other Diet : ____________

Patient Care

☐ Vital Signs: These orders need to be re-evaluated when the patient stabilizes or by two hours, whichever occurs first.
  ☐ as per provincial guideline
  ☐ every _____ hourly
  ☐ every _____ minute(s)
  ☐ Continuous cardiac monitoring

Intravenous Therapy

☐ Intravenous Cannula – Insert: Initiate IV
☐ IV Peripheral Saline Flush/Lock: Saline Lock

IV bolus or rapid infusion

☐ 0.9% sodium chloride infusion _____ mL as fast as possible

Maintenance IV Solutions

☐ 0.9% sodium chloride infusion at _____ mL/hour
☐ dextrose 5% in water - 0.9% sodium chloride infusion at _____ mL/hour
☐ dextrose 5% in water - 0.45% sodium chloride infusion at _____ mL/hour
☐ Other: ________________________ at ____________ mL/hour

Lab Investigations

**No lab test can be used to absolutely rule the diagnosis of acute appendicitis in or out. White blood cell counts and C-reactive protein levels have been shown to be unreliable (even in combination) for ruling out appendicitis.**
Consider non-abdominal causes for abdominal pain when ordering lab tests (e.g. – myocardial ischemia in patients over 50 years with upper abdominal pain and vascular risk factors)

Hematology

☐ Complete Blood Count (CBC)
☐ INR
Transfusion Medicine
- Type and screen
- Crossmatch ___ Unit(s) on standby / to infuse

Chemistry
- Electrolytes (Na, K, Cl, CO2)
- Creatinine
- Glucose random level
- Urea
- C-Reactive Protein
- Alkaline Phosphatase
- ALT
- GGT
- Bilirubin Total
- Lipase
- Beta HCG
- Troponin

Blood Gases
- Venous blood gas

Microbiology
- Vaginal swabs
  - Chlamydia / gonorrhea
  - Trichomonas
  - Bacterial vaginosis
  - Yeast

Urine Tests
- Urine Dipstick Testing - POCT
- Pregnancy Test, Urine - POCT
- Urinalysis Random
- Urine Culture & Sensitivity
- Urine for Chlamydia and gonorrhea

Diagnostic Investigations
- X-ray Chest, 2 Projections (PA, Lateral)
- X-ray Abdomen, 2 or More Projections
- Ultrasound (US) Appendix
- Ultrasound (US) Abdomen
- Ultrasound (US) Pelvis
- CT Abdomen & Pelvis, Enhanced (with or without IV/oral contrast)
  - Consider expedited imaging in moderate – high risk patients
  - Contrast enhancement protocol to be established with consulting radiologist
    - Unenhanced CT may have similar sensitivity for appendicitis but lacks sensitivity for other potential diagnoses
- Electrocardiogram - 12 Lead
  - Consider for patients presenting with “epigastric” or abdominal pain with radiation, cardiac risk factors and/or over 50 years of age
Medications

Nonopiate Analgesia

Oral

☐ acetaminophen tab 975 or 1000 mg PO once
☐ acetaminophen tab 325 to 1000 mg PO q4h PRN for pain (maximum 3000 mg/day)
☐ acetaminophen tab ______ mg PO
**Suggest 325 to 650 mg for mild to moderate pain, 975 to 1000 mg for moderate to severe pain

☐ ibuprofen 400 mg PO once
☐ ibuprofen 200 to 400 mg PO q6h PRN for pain (maximum 1200 mg/day)
☐ ibuprofen ______ mg PO
**Suggest 200 mg for mild to moderate pain, 400 mg for moderate to severe pain

Parenteral

**Recommend restricting ketorolac use to actively vomiting patients and using lowest effective dose
☐ ketorolac 15 mg IV once
☐ ketorolac ______ mg IV

Opiate Analgesia

**For ‘susceptible patients’ defined as elderly, frail, low body mass, systemically unwell, or on medications known to cause sedation or lower blood pressure we recommend decreasing narcotic dosing by 50%.

☐ Contact physician or nurse practitioner for reassessment if pain not controlled after administration of maximum dosage.

Oral

☐ codeine 30 mg-acetaminophen 325 mg-cafeine 15 mg 2 tabs PO once
☐ codeine 30 mg-acetaminophen 325 mg-cafeine 15 mg 1 to 2 tabs PO q4h PRN for pain
☐ codeine 30 mg-acetaminophen 325 mg-cafeine 15 mg _____ tabs PO

☐ oxyCODONE 5 mg-acetaminophen 325 mg 2 tabs PO once
☐ oxyCODONE 5 mg-acetaminophen 325 mg 1 to 2 tabs PO q4h PRN for pain
☐ oxyCODONE 5 mg-acetaminophen 325 mg _____ tabs PO

☐ HYDROmorphine 1 mg PO once
☐ HYDROmorphine 1 to 2 mg PO q4h PRN for pain
☐ HYDROmorphine _____ mg PO
**Suggest 1 mg for moderate pain and 2 mg for severe pain

Parenteral

☐ HYDROmorphine 1 mg IV once
☐ HYDROmorphine 0.5 to 1 mg every 10 minutes PRN for pain (maximum 3 mg total)
☐ HYDROmorphine _____ mg IV
**Suggest 0.5 mg for moderate pain and 1 mg for severe pain

☐ morphine 5 mg IV once
☐ morphine 2.5 to 5 mg IV every 10 minutes PRN for pain (maximum 15 mg total)
morphine ______ mg IV

**Suggest 2.5 mg for moderate pain and 5 mg for severe pain

fentaNYL 50 mcg IV once
fentaNYL 25 to 50 mcg IV every 5 minutes PRN for pain (maximum 200 mcg total)
fentaNYL ______ mcg IV

**Suggest 25 mcg for moderate pain and 50 mcg for severe pain

Antiemetics

**Avoid dimenhyDRINATE in patients 65 years of age or older due to increased risk of side effects including delirium. Suggest 25 mg for mild/moderate nausea, 50 mg for moderate/severe nausea

dimenhyDRINATE 50 mg PO once
dimenhyDRINATE 25 to 50 mg PO q4h PRN for nausea/vomiting
dimenhyDRINATE ______ mg PO

**PO administration or slow infusion via IVPB are preferred for metoclopramide to reduce the risk of akathisia. Suggest 5 mg for mild/moderate nausea or if CrCl less than 40mL/min; 10 mg for moderate/severe nausea, and CrCl over 40mL/min

metoclopramide 10 mg PO once
metoclopramide 5 to 10 mg PO q6h PRN for nausea/vomiting
metoclopramide ______ mg PO

**4 mg starting dose recommended for IV ondansetron

ondansetron 4 mg IV once
ondansetron 4 mg IV to be repeated once 30 minutes after first dose PRN for nausea/vomiting
ondansetron 4 mg IV q8h PRN for nausea/vomiting
ondansetron ______ mg IV

**Due to high cost, recommend reserving ondansetron DISINTEGRATING tab for actively vomiting patients without an IV

ondansetron DISINTEGRATING tab 8 mg PO q8h PRN for nausea/vomiting
ondansetron DISINTEGRATING tab ______ mg PO
Antibiotics
**Use in suspected or proven perforation, risk of perforation is higher if symptom duration greater than 36 hours, patient age more than 55, or if tachycardic**
- cefTRIAXone 1 gram IV q24h
- AND
- metroNIDAZOLE 500 mg IV/PO q12h
- OR if cephalosporin or severe penicillin allergy
  - ciprofloxacin 400 mg IV q12h or 500 mg PO q12h
  - AND
  - metroNIDAZOLE 500 mg IV/PO q12h
- OR for cases of severe sepsis or septic shock
  - piperacillin - tazobactam 3.375 grams IV q6h

Consults
- Consult General Surgery

Disposition Planning
1. Considerations for admission
   - Diagnosis of appendicitis confirmed or strongly suspected on clinical grounds
   - Alternative diagnosis established which requires specialty admission / consultation
2. Considerations for discharge
   - Clinical presentation consistent with a low risk of appendicitis
   - Imaging (if performed) confirms absence of appendicitis
   - No alternative emergent cause of abdominal pain suspected
3. Outpatient follow-up
   - Patients with ongoing symptoms should follow up with their family physician next day
   - Patients with worsening or unresolved symptoms and unable to access their family physician should return to ED for reassessment
4. Patient education / discharge instructions
   - Patient Care Handout: Abdominal Pain Causes
   - Patient Care Handout: Abdominal Pain, Age 12 and Older
   - Possible Appendicitis: Care Instructions
Rural Considerations

1. If no local surgical capacity, for high risk patients need to refer to regional or urban center after discussion with accepting surgeon.

2. For moderate risk patients, may observe with serial exams for a few hours looking for resolution, however, if concerned or not resolving would be appropriate to refer to a regional or urban ED for assessment and probable advanced imaging to make a determination of the need for surgical consult or not.

Analytics

1. Key Outcomes
   - Clinical
     - Reduced use of imaging for patients at low risk for appendicitis
     - Reduced rates of unplanned return to ED for appendicitis within 72hr of discharge
   - Process
     - Reduced time to imaging in suspected appendicitis
     - Reduced time to consultation in suspected or confirmed appendicitis
     - Reduced time to surgery in suspected or confirmed appendicitis

2. Data Elements for Capture
   - Patient demographics
   - CEDIS presenting complaint and CTAS score
   - ED time markers (triage to physician, physician to consult and then to admission or physician to discharge) and outcome markers (admitted to OR, ward, ICU, or died)
   - ED diagnoses for appendicitis using ICD-10
   - Site and Zone identifiers
   - Alvarado scores
   - Use of imaging (CT, US, other)
   - Use of analgesia
   - Consultation for abdominal pain / suspected appendicitis / confirmed appendicitis (General Surgery, other)
   - Patients treated with surgery
   - Discharge destination (home, home care, family physician)
   - Discharge medications (analgesics, other)

3. Proposed Reports
   - Number (%) of ED patients triaged as abdominal pain or suspected appendicitis
   - Number (%) of ED patients (by site/zone/hospital type or location [e.g. inner city]) for whom this order set is applied
- Number (%) of ED patients (by site/zone/hospital type or location [e.g. inner city]) for whom imaging was completed (CT, US, other)
- Number (%) of ED abdominal pain or suspected appendicitis patients (by site/zone/hospital type or location [e.g. inner city]) treated with analgesia, antibiotics, and surgery
- Number (%) of ED headache patients (by site/zone/hospital type or location [e.g. inner city]) admitted from the ED to ward / ICU
- ED Length of stay for admitted and discharged patients with headache
- 72-hour 'unplanned' ED return visits for abdominal pain / suspected appendicitis / confirmed appendicitis and % of those which were admitted
References


Acknowledgements

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Additional Contributors

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