Acute appendicitis, as shown in an abdominal x-ray, frontal view

Appendicitis Review

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In which patients is the suspicion for appendicitis heightened? Do history and physical exam findings vary with patient age? Who is at increased risk for perforation? What treatments are recommended for uncomplicated versus complicated appendicitis, and are antibiotics alone ever the answer? Primary care clinicians must be well prepared to confront these and other questions when a patient presents with signs and symptoms of appendicitis.

CE/CME INFORMATION

TARGET AUDIENCE: This activity has been designed to meet the educational needs of physician assistants and nurse practitioners in primary care with patients who have signs and symptoms of appendicitis.

Original Release Date: January 2012
Expiration Date: January 31, 2013

PROGRAM OVERVIEW: The primary objective of this educational initiative is to provide clinicians in primary care with the most up-to-date information regarding the detection and management of appendicitis.

EDUCATIONAL OBJECTIVES: After completing this activity, the participant should be better able to:
- Describe features in the history, symptomatology, and physical examination that are most indicative of appendicitis in specific patient populations.
- List components in the patient evaluation that are helpful for ruling out other conditions that may mimic appendicitis.
- Specify the laboratory tests and imaging studies most likely to support a diagnosis of appendicitis.
- Discuss conventional management of uncomplicated and complicated appendicitis, as well as nonoperative options that require investigation in reliable clinical trials.

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ACCREDITATION STATEMENT: PHYSICIAN ASSISTANTS
This program has been reviewed and is approved for a maximum of 1.0 hour of American Academy of Physician Assistants (AAPA) Category I CME credit by the Physician Assistant Review Panel. Approval is valid for one year from the issue date of January 2012. Participants may submit the self-assessment at any time during that period.

This program was planned in accordance with AAPA’s CME Standards for Enduring Material Programs and for Commercial Support of Enduring Material Programs.

Successful completion of the self-assessment is required to earn Category I CME credit. Successful completion is defined as a cumulative score of at least 70% correct.

ACCREDITATION STATEMENT: NURSE PRACTITIONERS
This program has been approved by the Nurse Practitioner Association New York State (The NPA) for 1.0 contact hour.

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METHOD OF PARTICIPATION: The fee for participating and receiving CME credit for this activity is $10.00. During the period January 2012 through January 31, 2013, participants must 1) read the learning objectives and faculty disclosures; 2) study the educational activity; 3) go to www.clinicianreviews.com/CECourses.aspx, follow links to the posttest for this activity, and provide payment information via our secure server; 4) complete the 10-question posttest by recording the best answer to each question; and 5) record their response to each of the additional evaluation questions.

If you have any questions, e-mail CE.evaluations@qhc.com. Upon successful completion of an online posttest, with a score of 70% or better, and the completion of the online activity evaluation form, a statement of credit will be made available immediately.
Appendicitis is a transmural inflammatory process and a common cause of an acute abdomen. Inflammation that leads to perforation of the appendix, which is associated with increased morbidity and mortality, warrants prompt diagnosis. Etiology, clinical presentation, diagnostic studies, and the management of confirmed appendicitis will be addressed here.

Frequently, the etiology of appendicitis is luminal obstruction by a fecalith (the result of inspissated fecal material and inorganic salts), but the condition may also result from parasites, a malignancy, a foreign body, or fibrosis. In some instances, lymphoid hyperplasia, resulting from a viral or bacterial infection, has been targeted as the cause of luminal obstruction. Nevertheless, in one-third to one-half of patients, obstruction is not evident as a precipitating factor in the development of appendicitis. In such cases, the basis for the inflammation is unknown.

As the obstructed appendix becomes congested, the intraluminal pressure and venous pressure increase, leading to stasis and ischemia. The appendix becomes engorged with secretions. At this stage, the condition is considered uncomplicated, but if an inflamed appendix becomes gangrenous or perforates, the condition is then referred to as complicated appendicitis. Complicated appendicitis allows for invasion by intestinal bacteria of the abdominal cavity, potentially leading to peritonitis, septicaemia, abscess, or fistula formation.

Conventional teaching supports the concept that uncomplicated appendicitis, unless treated surgically, eventually evolves into complicated appendicitis. Recent research refutes this assumption, however, as different etiologies may be associated with differences in progression; whether uncomplicated and complicated appendicitis are attributable to different etiologies is a question requiring further research. Irrespective of the natural progression of the disease, the current standard of care for appendicitis is still an appendectomy. In US hospitals in 2007 (the most recent year for which data are available), appendectomy was performed on 326,000 patients, or 10.9 patients per 10,000 population.

**Epidemiology**

Appendicitis is most frequently seen in the second decade of life and occurs slightly more often in males than in females. Furthermore, according to data reported to the National Hospital Discharge Survey (1970 to 2004), the rate of nonperforated appendicitis is much higher in men than in women. In appendicitis, the risk for rupture is small within the first 36 hours of symptom onset. Beyond that point, there is a 5% increased risk for rupture with each ensuing 12-hour period.

In neonates and infants, appendicitis is rare. In children younger than 3 years, however, the rate of perforation is 80% to 100%. This high rate may be explained by the very young child’s limited ability to articulate his or her symptoms, or by caregiver reports that are typically limited to irritability or change in diet. According to Marudanayagam et al, who performed a retrospective study of 2,660 appendectomies during a six-year period, the perforation rate declined from 23.4% in patients age 10 or younger to 6.9% in those in their 20s, then rose steadily to more than 50% in patients 70 or older.

**PATIENT EVALUATION**

In most cases, a diagnosis of appendicitis can be made with a careful history, systematic physical exam, and a limited number of laboratory tests without special diagnostic modalities. The presence of symptoms and signs may help to rule in a diagnosis of appendicitis, but the absence of clinical findings often does not exclude its possibility. While adult and pediatric patients with appendicitis share many clinical findings (see Table 1), the occurrence rate of the various findings may differ among patient populations.

The median time from onset of symptoms until the patient presents for a medical evaluation averages 24 hours or less. Diagnosis in patients at extremes of age often proves more difficult than in other patients. Thus, a high level of suspicion must be maintained in these patient populations.

**The Symptom History**

The appendix is located in the posteromedial wall of the cecum, approximately 3 cm below the ileocecal valve. Initial pain perceived around the umbilicus represents a referred pain resulting from the visceral innervation of the midgut. As the inflammatory process within the appendix advances, the pain localizes to the anatomical position of the right lower quadrant (RLQ), with involvement of the surrounding parietal peritoneum.

This progression of symptoms, first recognized by John Benjamin Murphy in 1904, is considered a more reliable indicator of appendicitis than RLQ pain alone; in one large retrospective study, this migratory pain had the highest positive predictive value for pediatric and adult patients (94.2% and 89.6%, respectively). However, migration...
of pain occurs in only 50% to 60% of patients, and therefore may not be helpful.\(^1,2,3\)

According to results from other studies, unfortunately, this progression of symptoms is not often present in pediatric patients.\(^2\) The somatic RLQ pain is continuous and more severe than is the early visceral periumbilical pain.\(^1\) Since the anatomic position of the appendix can vary, a number of patients do not necessarily present with pain in the RLQ but elsewhere.\(^2\)

Certain clinical findings appear to be relatively age-dependent (see Table 2,\(^3,4,6\) page 24). Classic findings in the adult diagnosed with appendicitis, as described by Becker et al,\(^27\) begin with periumbilical pain, then nausea, followed by migration of the pain to the RLQ, then vomiting and fever. Abdominal pain and anorexia are the most common presenting symptoms.\(^2\) Nausea and vomiting that begin after the onset of abdominal pain are typical; in isolation, however, these manifestations have weak diagnostic predictability for appendicitis.\(^2\) In adults, if nausea and vomiting precede abdominal pain, consideration should be given to a diagnosis of gastroenteritis rather than appendicitis.\(^2\)

Among patients who are pregnant or elderly, RLQ pain remains a significant historical finding.\(^2\) In the pregnant woman, a diagnosis of appendicitis is often overlooked because of the discomforts common to pregnancy and the expanding gravid uterus.\(^3\) Elderly patients often present with vague or atypical symptoms, such as mild pain.\(^2\) In these patient populations, the diagnosis of appendicitis is often delayed.

In addition to obtaining a thorough history of the presentation of pain, it is important to conduct a complete review of the gastrointestinal, genitourinary, pulmonary, musculoskeletal, neurologic, and reproductive systems for possible alternate etiologies.

### Physical Examination

The number of physical findings varies among patients who present with appendicitis\(^3,8,20\) (see Table 3\(^3,4,25\)). A thorough physical examination is thus required to help the clinician exclude other diseases and establish the diagnosis of appendicitis. It is important to tailor the exam according to the patient’s age and developmental stage.\(^9\)

The cooperation of children undergoing the physical examination for appendicitis may vary. It may be helpful to instruct a young child to “show me with your finger where it hurts the most.” However, Bundy et al\(^1\) report that the presence of RLQ tenderness on palpation is of minimal value in children; rather, fever is the single most useful sign among pediatric patients and conversely, its absence reduces the risk.

Tachycardia is associated with risk for rupture.\(^26,29\) In the elderly patient, fever (>38°C) is also strongly correlated with an increased risk for rupture.\(^30\)

To alleviate pain, a patient with appendicitis may maintain the hips and knees in a slightly flexed position. While asking distracting questions, the examiner should observe the patient’s facial expressions to detect involuntary guarding.\(^3\) RLQ tenderness to percussion is often positive.

The patient may experience tenderness on palpation of the posterior abdominal wall (K sign) or right-side flank tenderness.\(^2\) Increased pain with coughing (Dunphy’s sign) or firm percussion of the heel (the heel-jar test) may be elicited.\(^28\) A number of additional peritoneal signs, resulting from an inflamed appendix, may occur (see Table 4\(^3,8,25\)), but examination techniques that elicit these signs should be minimized so as not to cause the patient any unnecessary pain.

Depending on the location of the appendix, rectal and vaginal exams may yield normal findings or may elicit tenderness.\(^2\) The rectal examination should be performed with considerable care, using the smallest digit possible for an adequate assessment, especially in the younger patient.\(^1\)

Several scoring systems have been designed for adults and children with suspected appendicitis, using findings from the history, the physical exam, and laboratory testing (see Table 5,\(^4\) page 26, for example). Despite their protocol-based approach, the scoring systems have yielded mixed results in clinical practice;\(^1,2,3\) and there is no scoring system for evaluation of the pregnant patient.\(^2\) Neither has there been any recommendation for or endorsement of a diagnostic guideline from any medical or professional organization.\(^2\) Thus, clinical gestalt is usually relied upon instead.

### Conditions to Rule Out

The patient with abdominal pain and suspected appendicitis should be evaluated for other causes during the physical examination (see Table 6,\(^1,3,8,39-42\) page 26). In addition to investigation for other abdominal etiologies, auscultation to the heart and lungs and an assessment of the peripheral vasculature are imperative. Auscultation of the lungs is important to rule out a right lower lobe pneumonia that may generate referred pain to the RLQ due to a shared T9 dermatome distribution.\(^2,3\)

In males, the patient with abdominal pain should be assessed for a testicular etiology, and a pelvic examination is indicated in any female with abdominal pain, to rule out a gynecologic origin.\(^2\)

In the infant with suspected appendicitis, a diagnosis of Hirschprung’s disease (a congenital obstruction of the colon) should also be considered.\(^7\)

### LABORATORY WORK-UP

Based on the patient’s history and physical exam findings, certain
laboratory and imaging studies can be useful in confirming the diagnosis of appendicitis. A white blood cell (WBC) count with differential is helpful in both diagnosis and exclusion of appendicitis. Appendicitis often leads to moderate leukocytosis (WBC, 10,000 to 20,000/μL) with neutrophilia. Similarly, the finding of a normal or low WBC and absent left shift helps to rule out appendicitis.

A C-reactive protein (CRP) value greater than 3.0 mg/dL, when combined with moderate leukocytosis, may increase the likelihood of appendicitis. Urinalysis may be indicated to exclude appendiceal pain of urinary tract etiology. In children, however, the classic clinical and laboratory findings are often less reliable in diagnosing appendicitis. Because negative findings in the β-hCG rule out intrauterine or ectopic pregnancy, this test should be ordered for all women capable of pregnancy who present with acute abdominal pain. Urinalysis may be indicated to exclude appendiceal pain of urinary tract etiology. Imaging Studies

Not all patients with a presumptive diagnosis of appendicitis require imaging. Such studies can be foregone in patients with low clinical suspicion for appendicitis, although they should be instructed to return if the pain worsens, changes, or does not resolve. Likewise, patients with a high clinical suspicion for appendicitis may be referred to a surgeon as early as possible (without imaging).

In children, however, theclassic clinical and laboratory findings are often less reliable in diagnosing appendicitis. Positive results on CT or ultrasound—that is, inflammation and distention of the appendix or free fluid in the abdomen—are associated with confirmed appendicitis more than 90% of the time. CT and ultrasound are currently considered the imaging studies of choice. Of the two, multidetector CT is more accurate for detecting inflammation of the appendix (sensitivity, 98.5%; specificity, 98%; 99.5% negative predictive value), especially in the obese patient. While CT use has increased, the overall negative appendectomy rate was similar in some clinical trials with or without CT use. Additionally, the cost, availability, length of test, and radiation exposure associated with CT have raised concern about this imaging choice.

Ultrasound is useful to confirm appendicitis, particularly in patients with limited abdominal fat, but it has limitations in ruling out the condition. These include its operator-dependent nature, limited ability to allow visualization of the appendix in obese patients, and lack of sensitivity in cases in which the appendix is perforated or only the distal tip is involved.

Plain radiographs are not used to diagnose appendicitis, although they may be helpful to evaluate patients with atypical symptoms or to rule out other causes of abdominal pain. For example, a chest x-ray may be used to rule out pneumonia or to look for free air under the diaphragm, suggesting a different etiology. Imaging studies can be helpful when differentiating between complicated versus uncomplicated appendicitis and ruling out other causes of the acute abdomen (e.g., gastroenteritis, diverticulitis, pelvic inflammatory disease). Alternatively, watchful observation is essential until the diagnosis becomes clearer or exploratory laparoscopic surgeries have been used to evaluate the acute abdomen.

TABLE 5

<table>
<thead>
<tr>
<th>Table 5: Alvarado Scoring System (MANTRELS Criteria)</th>
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</thead>
<tbody>
<tr>
<td>Migration of pain to the right lower quadrant</td>
</tr>
<tr>
<td>Anorexia</td>
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<tr>
<td>Nausea/vomiting</td>
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<tr>
<td>Tenderness in the right lower quadrant</td>
</tr>
<tr>
<td>Rebound pain</td>
</tr>
<tr>
<td>Elevation of temperature (≥ 37.3°C)</td>
</tr>
<tr>
<td>Leukocytosis (WBC &gt; 10 000/μL)</td>
</tr>
<tr>
<td>Shift of WBC count to the left (≥ 75% neutrophils)</td>
</tr>
<tr>
<td><strong>Maximum score:</strong></td>
</tr>
<tr>
<td><strong>Scoring</strong></td>
</tr>
<tr>
<td>1 – 4: Patient is not considered likely to have appendicitis</td>
</tr>
<tr>
<td>5 – 6: Diagnosis compatible with appendicitis but does not appear to require an immediate operation. Continue observation or further testing to rule out appendicitis</td>
</tr>
<tr>
<td>7 – 8: Probable appendicitis; surgical consultation needed</td>
</tr>
<tr>
<td>9 – 10: Very probable appendicitis and surgery should be performed</td>
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</table>


TABLE 6

Differential Diagnosis of Appendicitis

<table>
<thead>
<tr>
<th>Differential Diagnosis of Appendicitis</th>
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</thead>
<tbody>
<tr>
<td>Gastroenteritis</td>
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<tr>
<td>Bowel obstruction/ perforation</td>
</tr>
<tr>
<td>Mesenteric lymphadenitis</td>
</tr>
<tr>
<td>Constipation</td>
</tr>
<tr>
<td>Crohn’s disease</td>
</tr>
<tr>
<td>Diverticulitis</td>
</tr>
<tr>
<td>Intussusception</td>
</tr>
<tr>
<td>Pancreatitis</td>
</tr>
<tr>
<td>Ectopic pregnancy</td>
</tr>
<tr>
<td>Pelvic inflammatory disease</td>
</tr>
<tr>
<td>Endometriosis</td>
</tr>
<tr>
<td>Ovarian cyst/abscess/torsion</td>
</tr>
<tr>
<td>Testicular torsion</td>
</tr>
<tr>
<td>Pneumonia</td>
</tr>
<tr>
<td>Volvulus</td>
</tr>
<tr>
<td>Benign or malignant neoplasia</td>
</tr>
</tbody>
</table>


MANAGEMENT OF APPENDICITIS

Appendectomy remains the standard of care for appendicitis. While the clinical presentation often dictates what surgical approach should be taken, up to 76% of appendectomies are performed using a laparoscopic procedure rather than open surgery. Patients with uncomplicated appendicitis should be given nothing by mouth, but adequate hydration should be provided with IV fluids. IV analgesia should be considered if pain is causing distress to the patient. Current evidence suggests that administration of opioids does not alter the clinician’s diagnostic accuracy.

The treatment of a patient with complicated appendicitis who is hemodynamically stable is less clear. The conventional treatment is antibiotics and drainage, followed by appendectomy at a later date; this procedure is referred to as interval appendectomy. Some authorities suggest that in cases of appendicitis resolved with antibiotics, interval appendectomy...
should no longer be recommend-
ed.17,58 In 2011, Blakey et al19 re-
ported that in children with perfo-
rated appendicitis, early surgery results in reduced recovery time and fewer adverse events, com-
pared with delayed appendectomy.

Preoperative antibiotics have dem-onstrated efficacy in decreasing
postsurgical site infections in pa-
tients; therefore, they are typically prescribed to prevent
bacterial infections after surgery. Ne-Uroman- the timing of antibiotic ad-
ministration is critical to its effi-
cy.60,61 The first dose should be given within 60 minutes before
the incision is made to achieve ade-
quate antibiotic serum and tissue
levels. The antibiotic should be
discontinued 24 hours after the surgery has been completed.60,61

The agent selected for antibi-
otic prophylaxis should be effec-
tive against the most likely infect-
ing organism.17,61,62 In a patient with uncomplicated appendicitis, the antibiotic of choice should be
effective against gram-negative bacilli, such as Escherichia coli and Bacteroides fragilis.61,62 A single dose of cefoxitin, cefotetan, cefo-
taxime, or ampicillin/sulbactam is
typically prescribed to prevent
postsurgical site infections in pa-
tients with uncomplicated appendicitis (Table 7).61,62 For β-lactam-
allergic patients, an alternative
antibiotic regimen is metronida-
azole with an aminoglycoside.61,62

In Lieu of Surgery

As an alternative to surgery, se-
veral randomized studies have sug-
gested that antibiotics alone can be
used to treat uncomplicated appen-
dicitis.66-68 Recent evidence suggests
that a nonsurgical antibiotic ap-
proach may result in signifi-
cant cost savings,59 attributable to eliminat-
ing surgery and a reduced risk for complications. Of addi-
tional benefit is eliminating sur-
egery-associated morbidity and
mortality.

Because design limitations less-
en the reliability of the studies cit-
ed, however, appendectomy is still pre-
ferred, based on the current
evidence.13,14 More studies are
needed to determine the efficacy of antibiotic therapy alone, with
consideration of the surgical risks
associated with appendectomy.

POSTOPERATIVE CARE

Adequate pain control, advance-
ment of diet, and monitoring for
development of complications
constitute typical postoperative
care. Complications of appendicitis
include both short- and long-
term risks (eg, infection, adhe-
sions, obstruction) associated with
any surgical intervention.

CONCLUSION

Primary care providers should be
well versed in identifying the
symptoms and signs of appendici-
tis. In cases with equivocal find-
ings, imaging studies and/or labor-
atory tests should be ordered to
help confirm the diagnosis. The
standard of care is appendectomy;
therefore, a surgical consult is
needed. Recent evidence suggests
that a nonsurgical, antibiotic ap-
proach in the treatment of uncom-
plicated appendicitis may be benefi-
cial. However, large, randomized

<table>
<thead>
<tr>
<th>Medication</th>
<th>Pediatric dosing</th>
<th>Adult dosing</th>
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<tbody>
<tr>
<td><strong>Prophylaxis</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cefoxitin</td>
<td>20 – 40 mg/kg</td>
<td>1 – 2 g IV</td>
</tr>
<tr>
<td>Cefotetan</td>
<td>—</td>
<td>1 – 2 g IV</td>
</tr>
<tr>
<td>Cefotaxime</td>
<td>25 – 50 mg/kg</td>
<td>—</td>
</tr>
<tr>
<td>Ampicillin/sulbactam</td>
<td>—</td>
<td>3 g IV</td>
</tr>
<tr>
<td>Penicillin-allergic:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>plus Metronidazole</td>
<td>10 mg/kg/d</td>
<td>500 mg IV</td>
</tr>
<tr>
<td>plus Gentamicin</td>
<td>2 mg/kg/d</td>
<td>2 mg/kg</td>
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<tr>
<td><strong>Treatment</strong></td>
<td></td>
<td></td>
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<tr>
<td>Piperacillin/tazobactam</td>
<td>200 – 300 mg/kg/d</td>
<td>3.375 g/6 h</td>
</tr>
<tr>
<td>Ceftazidime</td>
<td>50 – 75 mg/kg/d</td>
<td>1 – 2 g/12 to 24 h</td>
</tr>
<tr>
<td>plus Metronidazole</td>
<td>30 – 40 mg/kg/d</td>
<td>500 mg/8 to 12 h or 1500 mg/24 h</td>
</tr>
<tr>
<td>Penicillin-allergic:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>plus Gentamicin</td>
<td>3 – 7.5 mg/kg/d</td>
<td>5 – 7 mg/kg/24 h</td>
</tr>
</tbody>
</table>

References:

2. Mandarajugam R, Williams GT, Rees BI. Review of the pathological results of 2660 appendectomy
5. Rubin R. The gastrointestinal tract. In: Rubin R, Travers K, eds. Rubin’s Pathology: Clinicopatho-
   Diagnosis and Treatment. 50th ed. McGraw Hill; 2011; 606-608.
7. Brennan GD. Pediatric appendicitis: pathophysiology and appropriate use of diagnostic imaging.
11. Anderson RE. The natural history and tradi-
tional management of appendicitis revisited: sporo-
taneous resolution and predominance of preop-
terative perforations imply that a correct diagnosis is
12. Livingston EH, Woodward WA, Sarosi GA, Haley RW. Disconnect between incidence of nonperfo-
   critical issues in the evaluation and management of emergency department patients with suspected
14. CDC. Number, rate, and standard error of all-
   listed surgical and nonsurgical procedures for dis-
   charges from short-stay hospitals, by selected pro-
   govsnhdls/data/hsds/appendices2009p40n4num
15. Lee SL, Ho HS. Acute appendicitis: is there a
   2006;5(72):409-413.
   How time affects the risk of rupture in appendicitis.
17. Monroe SE, Newman KD. Current management of
18. Nance ML, Adamson WT, Hedrick HL. Appendici-
sis in the young child: a continuing diagnostic chal-
19. Feinberg AN, Feinberg LA. The gastrointestinal
RADIOLOGY Review

Nandan R. Hichkad, PA-C, MMSc

After accidentally being run over by a vehicle, a 54-year-old man presents to the emergency department for evaluation of pain in his left elbow. He was leaning down behind the vehicle and was not seen when the driver backed up. The patient states that one of the tires went over his left shoulder and arm. Primary complaint is pain and decreased range of motion.

He denies any significant medical history, except for medication-controlled hypertension and gallbladder surgery. His vital signs are stable.

Examination of the left arm demonstrates some abrasions and contusions over the shoulder and forearm, as well as some swelling over the elbow. The patient has good color, distal pulses, and sensation. There is localized tenderness over the elbow and midforearm. Flexion of the elbow is somewhat limited secondary to pain.

Radiograph of the forearm is obtained and shown. What is your impression?

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