CHAPTER 1

Abdominal/Gastroenterology Emergencies

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NECROTIZING ENTEROCOLITIS

Educational Goals

Learning Objectives

1. Demonstrate focused examination of a neonate (MK, PC).
2. Differentiate between normal neonatal behavior and pathological signs/symptoms that require further workup (MK, PC).
3. Recognize the need for imaging (MK, PC)
4. Demonstrate appropriate care for necrotizing enterocolitis (*NEC*) including nil per os (*NPO*) status and initiation of intravenous (IV) fluids and IV antibiotics (MK, PC).
5. Communicate effectively with team members to facilitate patient care (ICS, P).
6. Identify need for intensive care and pediatric surgery consultations (MK, P, SBP).
7. Demonstrate empathy and maintain family involvement when treating a pediatric patient (P, ICS).

Emergency Medicine Simulation Workbook: A Tool for Bringing the Curriculum to Life, Second Edition. Edited by Traci L. Thoureen and Sara B. Scott.

Companion website: www.wiley.com/go/thoureen/simulation/workbook2e

Critical Actions Checklist

☐ Obtain a full set of vital signs (PC)
☐ Obtain heelstick glucose (PC)
☐ Order appropriate blood tests and imaging studies to evaluate for obstruction, free air, and sepsis (MK).
☐ Early resuscitation with IV fluids and IV antibiotics (PC, MK).
☐ If no IV access, recognition that intraosseous (*IO*) is also an option (MK, PC).
☐ Appropriate consultation with pediatric surgery and critical care team (MK, SBP).

Simulation Set-Up

Environment: Emergency department

Mannequin: Newborn simulator mannequin, wearing a diaper with a onesie over top. Diaper is smeared with activated charcoal to simulate black stool. The simulator may have a weak cry, if this option is available.

Props: To be displayed on a computer/TV screen in the room, or printed out and handed to learners throughout the simulation. Should only be offered to learners if ordered/requested:

- Images (see online component for NEC, Scenario 1.1 at `https://www.wiley.com/go/thoureen/simulation/workbook2e`):
  - Abdominal x-ray showing distended bowel with early intraluminal gas (Figure 1.1).
  - Abdominal ultrasound showing pneumatosis (Figure 1.2).
  - Radiology interpretation of abdominal x-ray concerning for NEC (Figure 1.3).
  - Radiology interpretation of abdominal ultrasound showing pneumatosis (Figure 1.4).

> Imaging that is not provided but is requested by learners can be reported as normal.

- Laboratory tests (see online component as above):
  - Heelstick glucose (Table 1.1).
  - Complete blood count (Table 1.2).
  - Basic metabolic panel (Table 1.3).
  - Liver function panel (Table 1.4).
  - Lipase (Table 1.5).
  - Coagulation panel (Table 1.6).
  - Lactic acid (Table 1.7).

- C-reactive protein (Table 1.8).
- Troponin (Table 1.9).
- Urinalysis (Table 1.10).
- Urine microscopy (Table 1.11).

Available supplies:

- Pediatric code cart and basic airway supplies, including supplies for intubation.
- Pediatric length-based tape.
- Medications:
  - IV fluid bags: 0.9% saline, lactated Ringer's solution (*LR*), PlasmaLyte®.
- Pre-labeled bags:
  - Vasopressors (e.g. norepinephrine, dopamine, vasopressin).
- Pre-labeled syringes:
  - Dextrose (10 and 25%) in water.
  - Morphine.
  - Antiemetic.
  - Antibiotics (broad spectrum).
  - Intubation medications (sedatives and paralytics of choice at your facility).
- IO device (optional).

Distractor(s): None.

Actors

- Patient's parent provides history.
- Emergency department (ED) nurse: can help to place the patient on monitor, obtain IV access (IO should be done by learners, if needed), and administer medications/fluids. May cue learners if needed.
- Respiratory therapy (available when requested in ED).
- Pediatric/neonatal intensive care (PICU/NICU) team member via phone consultation.
- Pediatric surgery consultant via phone consultation.

Case Narrative

Scenario Background

A four-week-old preterm, female infant born by spontaneous vaginal delivery at 33 weeks of gestation, (birth weight 4 lbs (1.81 kg) presents to the ED for lethargy,

decreased feeding, and vomiting with feeds. The patient was in NICU for four weeks but discharged to home three days ago. The patient's hospital stay was complicated by neonatal jaundice and temperature dysregulation, both of which were resolved prior to discharge. For the past two days, the patient's mother has noticed increased difficulty with feeding (formula fed), decreased PO intake, vomiting after feeds, and general sleepiness.

Chief complaint:	Lethargy, decreased feeding, vomiting.
Patient's medical history:	Ex-33 week, four-day preemie (current age 37 weeks of gestational age, actual age 4 weeks 3 days).
Surgical history:	None.
Allergies:	None.
Medictions:	Vitamin D supplementation.
Social history:	Not in daycare, lives at home with mom; no siblings.
Family history:	None.

Initial Scenario Conditions

Parent is holding the neonate. Patient has a weak cry.

Vital signs:	T 102.4°F (39.1°C) rectal, HR 215, RR 60, BP 70/35, SpO_2 97% on room air.
Weight:	2.7 kg.
Head:	Atraumatic, normocephalic, fontanelle soft.
Eyes:	Pupils 4 mm bilaterally and reactive to light.
Neck:	Supple, full range of motion, no meningismus.
Heart:	Tachycardic, regular, no murmurs/rubs/gallops.
Lungs:	Tachypnea, clear to auscultation bilaterally.
Abdomen:	Moderately distended with high-pitched bowel sounds; patient screams when abdomen is palpated in all quadrants. No palpable masses. Dark black soft stool in diaper (hemoccult positive, if asked).
Extremities:	No gross deformities; warm extremities with capillary refill two to three seconds.
Skin:	Warm, no rashes, no mottling.
Neurologic:	Moves all extremities spontaneously; weak cry that increases with palpation of the abdomen.

> Physical exam findings that are not available on your mannequin may be offered verbally to learners if they ask (e.g., rectal exam and hemoccult testing can be reported if specifically requested by learners).

See flow diagram (Figure 1.5) for further scenario changes described.

Case Narrative, Continued

During the initial minutes of the scenario, learners of all levels should collect a thorough history from the patient's parent/s and perform a complete physical exam. Initial lab tests and imaging studies should be ordered after this assessment is complete. All learners should request a heelstick glucose (prompted by the nurse if the learner fails to request it).

Over the next five minutes, the patient will deteriorate regardless of interventions, becoming less responsive with hypotension, increased respiratory rate, and hypoxia. Eventually, there will be episodes of bradycardia with short apneic episodes.

For novice learners, not trained to perform intubation on infants, the use of bag–valve mask (*BVM*) ventilation for supplemental oxygen will stabilize the patient until the NICU team arrives. They may consult anesthesiology as well.

For more advanced learners, intubation will be required because of impending respiratory failure and worsening lethargy.

If there is a delay in providing advanced airway interventions (BVM and/or intubation), the patient will progress into a pulseless electrical activity (*PEA*) rhythm and require cardiopulmonary resuscitation (*CPR*). After two minutes of appropriate pediatric CPR, the patient will regain pulses.

Advanced learners will need to initiate vasopressors for persistent hypotension. If the learners do not order vasopressors, the nurse may prompt them by mentioning that the blood pressure remains abnormally low and the full IV fluid bolus has already been given.

Once the airway and hypotension are addressed (or upon finishing CPR), the learners will receive any remaining results not yet reported. They should then communicate their concern for NEC with pediatric surgery as well as the NICU/PICU team for admission and intervention. The case will end upon appropriate consultation with these teams.

Instructor Notes

Epidemiology

- NEC is more common in premature neonates:
  - Only around 10% occurs in full-term neonates.
  - Higher risk in lower birth weights.
  - Timing of onset is the inverse of gestational age (e.g. born close to term presents earlier postnatally than if born more prematurely).

Pathophysiology

- Etiology unclear:
  - Possibly related to intestinal ischemia with an immature gut barrier that predisposes to infectious agents.
  - Cytokines and growth factor implicated in pathogenesis.

- Bacteria in intestinal lumen ferment carbohydrates and produce hydrogen gas that leads to pneumatosis and portal venous gas.

Clinical Features

- Variable presentation.
- Historical features:
  - Increasing lethargy.
  - Forceful/projectile vomiting.
  - Presence of bloody or bilious vomit [1].
- May present similar to sepsis:
  - Hypo/hyperthermia, lethargy, apneic episodes, bradycardia, hypotension, poor glucose regulation.
- Gastrointestinal signs/symptoms:
  - Abdominal distension, bloody stools, vomiting, a palpable abdominal mass (intestinal loops) or abdominal wall redness or crepitus.
  - Scrotal discoloration (males).

Differential Diagnosis for Vomiting Neonate

- Gastrointestinal causes:
  - Overfeeding.
  - Gastroenteritis.
  - Malrotation with midgut volvulus.
  - NEC.
  - Intussusception.
  - Intestinal atresia.
  - Gastroesophageal reflux.
  - Pyloric stenosis.
  - Hirschsprung disease.
- Non-gastrointestinal causes:
  - Central nervous system diseases.
  - Metabolic/endocrine disorders.
  - Trauma.

Diagnosis

- Laboratory abnormalities may include:
  - Thrombocytopenia.
  - Hyponatremia.
  - Metabolic acidosis with elevated lactate.
  - Neutropenia or leukocytosis.

- Abdominal radiographs (anteroposterior and lateral) may show:
  - Pneumatosis intestinalis.
  - Portal venous gas.
  - Non-specific gas-filled loops of bowel.

Management [2–5]

- NPO.
- Gastric decompression with an orogastric tube
- Broad-spectrum intravenous antibiotics.
- Intravenous fluids.
- Surgical intervention, if pneumatosis is present.
- Survival rates depend on disease severity:
  - Those requiring surgical management have worse outcomes with mortality, around 35%.
  - If treated medically, mortality is around 20%.

Debriefing Plan

Allow approximately 20–30 minutes for debriefing after this scenario.

Potential Questions for Discussion

- What are pertinent history and physical exam findings in a vomiting neonate/infant?
- What is the differential diagnosis of bilious compared with nonbilious vomiting in neonates?
- If unable to obtain peripheral IV access in an infant, what alternatives are available for fluid resuscitation?
- What is the management for an infant with NEC?

REFERENCES FOR NECROTIZING ENTEROCOLITIS

1. Shields, T.M. and Lightdale, J.R. (2018). Vomiting in children. *Pediatr. Rev.* 39 (7): 342–358.
2. Rich, B. and Dolgin, S. (2017). Necrotizing enterocolitis. *Pediatr. Rev.* 38 (12): 552–559.
3. Burge, D. (2016). The management of bilious vomiting in the neonate. *Early Hum. Dev.* 102: 41–45.
4. Frost, B., Modi, B., Jaksic, T. et al. (2017). New medical and surgical insights into neonatal necrotizing enterocolitis. *JAMA Pediatr.* 171 (1): 83.
5. Ratnayake, K. and Kim, T.Y. (2014). Evidence-based management of neonatal vomiting in the emergency department. *Pediatr. Emerg. Med. Pract.* 11 (11): 1–20.

ACUTE ASCENDING CHOLANGITIS

Educational Goals

Learning Objectives

1. Demonstrate focused history and physical examination skills (PC, MK).
2. Identify the need for blood work and imaging studies (MK).
3. Recognize signs and symptoms of sepsis (MK).
4. Initiate appropriate management of sepsis (MK, PC).
5. Demonstrate appropriate consultation for acute cholangitis (MK, ICS, P, SBP)
6. Demonstrate ability to obtain collateral history from family members, emergency medical services (EMS), and/or nursing home staff, for a patient who is unable to provide a history (ICS, P, SBP).

Critical Actions Checklist

☐ Obtain IV access (PC).
☐ Administer IV fluids (30 cc/kg IV fluid bolus) (MK, PC).
☐ Administer broad-spectrum IV antibiotics (MK, PC).
☐ Obtain computed tomography (CT) to evaluate for causes of acute abdominal pain and to rule out life-threatening pathology (MK, PC).
☐ Consult general surgery and/or gastroenterology (ICS, P, SBP).

Simulation Set-Up

Environment: Emergency department resuscitation room.

> This scenario may begin on scene at the patient's home with EMS gathering information from family, then transition to the ED.

Mannequin: Adult male simulator mannequin, with wig (gray hair if possible), fully dressed. Sclera should be icteric; this can be moulaged using a yellow erasable marker or removable yellow translucent film.

Props: To be displayed on screen or given as handouts when asked for/returned from lab:

- Images (see online component for acute cholangitis, Scenario 1.2 at `https://www.wiley.com/go/thoureen/simulation/workbook2e`):
  - Chest x-ray showing no active pulmonary disease (Figure 1.6).

- Radiology reading of chest x-ray (normal) (Figure 1.7).
- Head CT (static image 1-cut) showing no intracranial abnormality (Figure 1.8).
- Radiology read CT head (normal) (Figure 1.9).
- Ultrasound of right upper quadrant (static image) showing biliary dilation (Figure 1.10).
- Radiology read showing biliary dilation concerning for choledocholithiasis (Figure 1.11).
- CT abdomen/pelvis with IV contrast (static image, 1-cut) showing grossly dilated common bile duct (Figure 1.12).
- CT read concerning for acute cholangitis (Figure 1.13).
- Electrocardiogram (ECG) showing sinus tachycardia (Figure 1.14).

- Laboratory tests (see online component as above):
  - Complete blood count (Table 1.12).
  - Basic metabolic panel (Table 1.13).
  - Liver function panel (Table 1.14).
  - Lipase (Table 1.15).
  - Lactic acid (Table 1.16).
  - Coagulation panel (Table 1.17).
  - Troponin (Table 1.18).
  - Type and screen (Table 1.19).
  - Urinalysis (Table 1.20).
  - Urine microscopy (Table 1.21).

Available supplies:

- Adult code cart with basic airway supplies.
- Central line kit (triple lumen).
- Medications:
  - 0.9% saline, LR IV bags.
  - Pre-labeled IV bags.
    - IV vasopressor infusion (norepinephrine or similar).
    - Broad-spectrum antibiotics.
  - Pre-labeled syringes:
    - Antiemetics (ondansetron, metoclopramide).
    - Analgesic medications (morphine, fentanyl, hydromorphone).
    - Rapid sequence intubation medications (sedative/paralytics typical to your institution).

Distractor: none

Actors

- The patient is slightly confused as to the timeline of events/illness, but able to answer some questions. Occasionally moans due to abdominal pain. May have dry heaving if no antiemetics are ordered.
- EMS to share information gathered from family regarding how long he has been sick, what symptoms they have noticed (significantly less energetic and interactive, slow to respond to basic questions).
- ED nurse can cue the learners if needed to progress the case.
- Family member (patient's adult child) available by phone.
- General surgery and/or gastroenterology available for phone consultation.
- Admitting physician available for phone consultation.

Case Narrative

Scenario Background

A 60-year-old man presents for gradually worsening confusion over the course of two to three days. He reports having mild diffuse abdominal pain that is most severe in the upper abdomen. Over the course of the past one to two days, pain has become worse and he has begun to have vomiting and increased confusion.

Chief complaint:	Confusion.
Patient's medical history:	Hypertension, diabetes, stroke.
Surgical istory:	Appendectomy, hernia repair.
Allergies:	None.
Social history:	Previous cigarette smoker; no alcohol or drug use.
Family history:	Non-contributory.
Medications:	Lisinopril, metformin, aspirin, clopidogrel.

Initial Scenario Conditions

A 60-year-old man is brought in by EMS from home. Patient is moaning due to abdominal pain, complaining of feeling sick.

Vital signs:	Temp 102.5°F (39.2°C), HR 125, RR 22, BP 80/60, SpO2 99% on room air.
Head:	Atraumatic, normocephalic.
Eyes:	Icteric sclerae; pupils 4 mm bilaterally and reactive to light; extra-ocular movement intact without nystagmus.
Ears/nose/mouth:	Dry mucous membranes, with subungual icterus (if asked).
Neck:	Supple, full range of movement, no meningeal signs.
Heart:	Tachycardic, regular, no murmurs/rubs/gallops.

Lungs:	Clear to auscultation bilaterally (patient reports worsening belly pain when taking deep breaths).
Abdomen:	Distended, with hypoactive bowel sounds. Tender to palpation in the upper abdomen, most significant in the right upper quadrant and epigastric region. No rebound. Voluntary guarding in all quadrants.
Extremities:	No edema, cyanosis, or clubbing.
Skin:	Warm to the touch.
Neurologic:	Alert and oriented to person and place, but not to time. Answers most questions appropriately but seems confused and takes a while to respond to simple questions. No focal deficits. Cranial nerves intact. No asterixis.

Physical exam findings that are not available on your mannequin may be offered verbally to learners if they ask (e.g. if unable to simulate icteric sclera, can verbally report the scleral exam to the learners if they specifically ask for this information).

See flow diagram (Figure 1.15) for scenario changes based on learner actions.

Case Narrative, Continued

For all learners, the case should begin with obtaining a complete history as well as performing a thorough physical exam. The nurse can help the learners to set the patient up on the monitor to obtain vital signs. This should also include obtaining a fingerstick glucose, in light of the patient's slightly altered mental state.

Learners should order initial labs, imaging, IV fluids and medications.

If there is inadequate fluid resuscitation, the patient's hypotension will worsen. Continued failure to appropriately fluid resuscitate will lead to PEA, requiring CPR.

For novice learners, administration of an appropriate fluid bolus (30 cc/kg) will cause the patient's blood pressure to increase to a mean arterial pressure greater than 65 mmHg and his heart rate will slowly lower. With these improvements, the patient's mental status will also improve. Laboratory tests and imaging will then be available for review and appropriate consultation should be made with general surgery/GI, as well as an admitting physician. The case will end after appropriate disposition and consultation have occurred.

For advanced learners, despite initiation of IV fluids and broad-spectrum antibiotics, the patient will continue to be hypotensive and altered, requiring initiation of vasopressors and intubation. Failure to do so will result in PEA arrest. Once intubation is performed and vasopressors are initiated, the patient will stabilize. Consultation with general surgery/GI and the intensive care admitting physician should then occur. The case will end after appropriate disposition and consultation have occurred.

Instructor Notes

Pathophysiology

- Acute (or ascending) cholangitis results from inflammation and infection of the biliary system, often related to a blockage of the bile ducts or hepatic ducts:
  - Biliary obstruction leads to bacterial growth within the bile and subsequent infection.
  - Common causes of blockage include choledocholithiasis, malignancy, strictures, primary sclerosing cholangitis, and AIDS-related cholangiopathy.
- Most frequent pathogens found in acute cholangitis include *Escherichia coli*, *Klebsiella spp.*, *Enterococcus spp.*, and *Enterobacter spp.*
- Anaerobes such as *Bacteroides fragilis* and *Clostridium perfringens* have also been accountable, often in elderly patients or those with prior biliary surgery [1].

Clinical Features

- Charcot's triad:
  - Fever, right upper-quadrant abdominal pain, and jaundice.
  - "Classic" presentation, although it is only around 25% sensitive for acute cholangitis to have all three, 80–90% of patients with acute cholangitis will have fever and/or abdominal pain [2].
- Reynold's pentad:
  - Charcot's triad plus hypotension and altered mental state.
  - Severe presentation, but only seen in 5–7% of cases [2].

Diagnosis

- Laboratory tests that may support diagnosis:
  - Leukocytosis (with neutrophilic predominance).
  - Transaminitis.
  - Hyperbilirubinemia (conjugated).
  - Elevated alkaline phosphatase.
  - Elevated gamma-glutamyl transferase level.
- Imaging:
  - Ultrasound:
    - Best initial study. Can detect dilation of the common bile duct, gallstones, and other evidence of pathology.
  - CT with IV contrast:
    - Helpful for looking at other potential causes of biliary obstruction.
    - May show complications such as hepatic abscesses.
    - CT findings that may support the diagnosis of cholangitis include dilation of intra- or extra-hepatic biliary ducts, thickening of the ductal walls, presence of gallstones.

- Magnetic resonance cholangiopancreatography:
  - Sensitive imaging modality
  - May not be readily available at all institutions.

Management

- Resuscitation:
  - IV fluid administration.
  - Broad-spectrum IV antibiotics (with Gram-negative and anaerobic coverage).
  - Vasopressor administration (if needed).
- Analgesia.
- Specialist consultation (general surgery and/or gastroenterology) for intervention:
  - The type of intervention will depend on etiology:
    - Endoscopic retrograde cholangiopancreatography for biliary drainage, sphincterotomy, stone extraction, biliary stent placement.
    - Open surgical drainage.
  - If a patient is initially seen at a facility without these consult services, transfer to the nearest facility that has these resources should be undertaken [2, 3].

Debriefing Plan

Allow approximately 20–30 minutes for debriefing after this scenario.

Potential Questions for Discussion

- What are signs that a patient may have sepsis?
- What is the appropriate management of a patient with sepsis?
- How can you assess for end-organ dysfunction in a patient with sepsis?
- What are the indications for vasopressor initiation in sepsis?
- What is Charcot's triad?
- What is Reynold's pentad?

REFERENCES FOR SEPSIS

1. Ahmed, M. (2018). Acute cholangitis – an update. *World J. Gastrointest. Pathophysiol.* 9 (1): 1–7.
2. Ely, R., Long, B., and Koyfman, A. (2018). The emergency medicine—focused review of cholangitis. *J. Emerg. Med.* 54 (1): 64–72.
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SIGMOID VOLVULUS

Educational Goals

Learning Objectives

1. Assess a patient presenting with acute abdominal pain, utilizing a focused history and physical exam (MK, PC).
2. Formulate a differential diagnosis for acute abdominal pain (MK).
3. Recognize the signs and symptoms of a possible intestinal obstruction (MK).
4. Demonstrate appropriate utilization of lab tests and imaging studies to evaluate abdominal pain (MK, PC).
5. Recognize an agitated patient and use verbal de-escalation and negotiation skills (ICS, P).
6. Demonstrate professionalism while treating a patient with behavioral issues (P, ICS).
7. Demonstrate appropriate surgical consultation (P, ICS, SBP).

Critical Actions Checklist

☐ Recognize clinical signs of obstruction (MK).
☐ Obtain appropriate IV access (PC).
☐ Obtain imaging (MK).
☐ Administer analgesic medication and antiemetics for patient's symptoms (PC).
☐ Recognize an abnormal bowel gas pattern (concerning for obstruction) on x-ray and/or CT (MK).
☐ Maintain a calm and professional composure while communicating with a difficult, disruptive patient (PC, ICS, P).
☐ Consult general surgery for emergent management of volvulus (P, ICS, SBP).

Simulation Set-Up

Environment: ED treatment room.

Mannequin: Adult, male, simulator mannequin moulaged to appear disheveled (e.g. clothes may be slightly dirty and/or torn or used in appearance).

Props:

- Images (see online component for sigmoid volvulus, Scenario 1.3 at `https://www.wiley.com/go/thoureen/simulation/workbook2e`):
  - Abdominal x-ray showing evidence of distended sigmoid colon (Figure 1.16).
  - Radiology report of abdominal x-ray (Figure 1.17).
  - CT abdomen/pelvis with IV contrast (static image 1-cut) (Figure 1.18).

  - Radiology report of sigmoid volvulus (Figure 1.19).
  - ECG showing sinus tachycardia (Figure 1.20).
- Laboratory tests (see online component as above):
  - Complete blood count (Table 1.22).
  - Basic metabolic panel (Table 1.23).
  - Liver function panel (Table 1.24).
  - Lipase (Table 1.25).
  - Lactic acid (Table 1.26).
  - Troponin (Table 1.27).
  - Coagulation panel (Table 1.28).
  - Urinalysis (Table 1.29).
  - Urine microscopy (Table 1.30).

Available supplies:

- Adult code cart with basic airway supplies.
- Medications:
  - 0.9% saline/LR IV bags.
  - Pre-labeled IV bags:
    - Broad-spectrum antibiotics.
  - Pre-labeled syringes:
    - Analgesic medications (e.g. morphine, fentanyl, hydromorphone)
    - Antiemetics (e.g. metoclopramide, ondansetron)
    - Antipsychotics (typical of your institution examples include haloperidol, risperidone, etc.)
    - Benzodiazepines (lorazepam, diazepam, midazolam).
  - Optional: emesis basin.

Distractor: The patient's behavior is a distractor and the learner must demonstrate de-escalation and redirection techniques to obtain history and physical exam.

Actors

- Patient has chronic, poorly controlled schizophrenia. He is uncooperative and agitated with all the questioning and will require redirection and verbal de-escalation throughout the scenario. He is difficult to obtain history from, stating: "I am sick of answering all these questions." Eventually he will comply with the team's treatment plan (i.e., IV access, imaging, etc.).
- ED nurse is experienced and can cue the learners as needed.
- EMS may be an actor or may provide report via the phone (as a radio call from the field).
- General surgery consultant available via phone consultation.

Case Narrative

Scenario Background

A 50 year-old-man presents with worsening abdominal pain for the past two days. It is associated with intractable nausea and vomiting. He has not had a bowel movement for the past three days, which is unusual for him. His group home called because he has been vomiting and his pain is getting worse. He has no reported fever, chest discomfort, shortness of breath, or urinary difficulties.

Patient's medical history:	Paranoid schizophrenia, hypertension, anxiety.
Surgical history:	Hernia repair, tonsillectomy as a child.
Allergies:	haloperidol.
Medications:	Risperidone, trazodone, lorazepam.
Social history:	Previous cigarette smoker, no alcohol or drug use. Patient lives in a group living environment.
Family history:	Non-contributory.

Initial Scenario Conditions

A 50 year-old man lying on a hospital stretcher is moaning in pain. Patient is occasionally retching into a basin.

Vital signs:	T 98.7°F (37.1°C), P 115, RR 14, BP 110/60, SpO^2 99% on room air.
Head:	Atraumatic, normocephalic.
Eyes:	Pupils equal and reactive, extraocular muscles intact.
Ears/nose/mouth:	Dry mucous membranes.
Neck:	Supple, full range of motion, no meningismus.
Heart:	Tachycardic, regular, no murmurs/rubs/gallops.
Lungs:	Clear to auscultation bilaterally, no wheezes/rales/rhonchi.
Abdomen:	Distended, with hyperactive bowel sounds. Tender to palpation in all quadrants, no rebound/guarding/rigidity. Moans with deep palpation.
Extremities:	No edema, cyanosis, or clubbing.
Skin:	Warm and well-perfused, no rashes.
Neurologic:	Alert and oriented to self, place, and time. No focal deficits. Cranial nerves intact. No nystagmus.
Psychiatric:	Patient very rude and uncooperative, with agitated affect. Denies SI/HI/active hallucinations.

See flow diagram (Figure 1.21) for scenario changes based on learner actions.

Case Narrative, Continued

For all learners, the case should begin with obtaining a complete history, and performing a thorough physical exam. The nurse can help the learners to set the patient up on the monitor.

The learners should order laboratories, imaging studies, and appropriate medications (such as IV fluids, antiemetics, and pain control).

Throughout the scenario, the patient will be very disagreeable to the plan of care. He will be difficult to obtain history from and will be angry during the examination, "because that hurts me!" He will also initially refuse IV access and will require discussion about why this is necessary. He will then become hostile about the possibility of needing a CT scan because, "Aren't you a doctor? Can't you just figure it out based on what I've told you?" Ultimately he will require multiple efforts at verbal de-escalation before agreeing.

After the learner discusses the diagnosis of volvulus and the need for surgical evaluation with the patient, he will become upset and frustrated. He will calm down if the learner takes the time to listen to him and acknowledge his frustrations.

The trigger for the end of the case will be consultation with surgery for intervention and admission.

Instructor Notes

Epidemiology

- Third leading cause of large bowel obstruction worldwide, following cancer and complications of diverticulitis [1].
- Risk factors:
  - Elderly.
  - Individuals with chronic constipation and/or a high fiber diet.
  - Nursing home or long-term care facility patients [2], including patients with chronic psychiatric disorders and dementia.

Pathophysiology

- Sigmoid colon becomes stretched, attachments to the abdominal wall loosen, allowing colon to twist.
- Ischemia occurs, which can progress to gangrene and perforation.

Clinical Features

- Common symptoms:
  - Abdominal pain.
  - Bloating.
  - Constipation/obstipation.
  - Nausea/vomiting (may be feculent).
- Exam findings:
  - Pain on palpation.
  - Abdominal distension.
  - High-pitched bowel sounds.

Diagnosis

- Lab tests not diagnostic.
- Imaging:
  - Abdominal radiographs:
    - Distended loops of colon with or without air-fluid levels
    - "Bent inner tube sign" of distended colon in a U-shaped pattern and extending from the pelvis toward the right upper quadrant.
    - Paucity of gas in the rectum.
    - Free air under the diaphragm, if perforation has occurred.
  - Abdominal CT:
    - Dilated loops of bowel with evidence of obstruction.
    - "Whirl sign" or twisting of the mesentery.
    - "Bird's beak" sign if rectal contrast has been given.
    - Absence of gas in the rectum.
    - Transition point within the bowel.
    - Late findings that may indicate bowel necrosis or perforation: pneumatosis intestinalis, portal venous gas, loss of bowel wall enhancement.

Management

- Analgesia.
- Antiemetics.
- IV fluid resuscitation.
- IV antibiotics:

Recommended for signs of peritonitis, perforation or sepsis.

- Emergent surgical consultation:
  - Flexible sigmoidoscopy.

- Recommended initial treatment strategy.
- Can be both diagnostic and therapeutic unless patients have perforation or significant ischemia.

- Laparotomy:
  - If detorsion with endoscopy is not able to be performed, may be required.

Debriefing Plan

Provide approximately 20–30 minutes for debriefing after this scenario.

Potential Questions for Discussion

- What are some helpful strategies for dealing with difficult patients or patients with behavioral issues?
- What are risk factors for sigmoid volvulus?
- What abnormalities can be seen on abdominal x-ray in a patient with sigmoid volvulus?
- What is the management for a patient diagnosed with sigmoid volvulus? Is surgery always required?

REFERENCES FOR SIGMOID VOLVULUS

1. Bauman, Z.M. and Evans, C.H. (2018). Volvulus. *Surg. Clin. North Am.* 98 (5): 973–993.
2. Gingold, D. and Murrell, Z. (2012). Management of colonic volvulus. *Clin. Colon Rectal Surg.* 25 (4): 236–244.

SELECTED READING FOR SIGMOID VOLVULUS

Vestal, H.S., Sowden, G., Nejad, S. et al. (2017). Simulation-based training for residents in the management of acute agitation: a cluster randomized controlled trial. *Acad. Psychiatry* 41 (1): 62–67.

APPENDIX

FIGURE 1.1 Abdominal x-ray showing distended bowel with early intraluminal gas.

FIGURE 1.2 Abdominal ultrasound showing pneumatosis.

INDICATION: Nausea and vomiting, newborn

COMPARISON: None

TECHNIQUE: AP portable and lateral decubitus views of the chest and abdomen.

FINDINGS:

Lines and tubes: Nasogastric tube terminates in the stomach. ET tube is in the lower thoracic trachea. Left upper extremity PICC tip in the mid SVC.

Chest: Heart size is normal. Lungs are hypoinflated with diffuse coarse heterogeneous lung markings. Patchy airspace opacities in bilateral upper and left lower lobes with associated air bronchograms and left-sided volume loss (mediastinal shift and elevated left hemidiaphragm), compatible with atelectasis.

Abdomen: Abnormal bowel gas pattern demonstrating relative paucity of bowel gas with few distended bowel loops in the midabdomen and right lower quadrant. Bubbly lucencies in the right lower quadrant coalesce into intraluminal gas on the lateral decubitus view. Bubbly lucencies in the left mid abdomen on the supine view are not visible on the decubitus view. No portal venous gas or free air.

Osseous structures: Osteopenia without fracture.

IMPRESSION:

1. Abnormal bowel gas pattern with relative paucity of bowel gas. No free air, pneumatosis or portal venous gas.

FIGURE 1.3 Radiological interpretation of abdominal x-ray of concern for necrotizing enterocolitis.

INDICATION: Nausea/vomiting, prematurity

EXAMINATION: Abdominal sonogram with grayscale and color Doppler.

COMPARISON: None.

FINDINGS:

Liver: Normal contour and echotexure without cyst or mass. There is normal color-flow in the hepatic and portal veins. There is no biliary ductal dilation. No portal venous gas.
Gallbladder: Well distended without wall thickening. There are no gallstones. There is no pericholecystic fluid.

Spleen: Normal

Pancreas: Not well evaluated due to limited window.

Adrenals: Normal

Kidneys: Normal contour and echotexture without cyst or mass. There is no hydronephrosis or stone. Right kidney length 3.2 cm; left kidney length 2.9 cm

Diffusely hyperperistaltic bowel loops with echogenic content is noted. Complete evaluation of bowel peristals is limited in this study as a dedicated bowel ultrasound with focused cine images have not provided.

There are mild wall thickening at the of the bowel loops measuring up to 3 to 4 mm in thickness. Mild ascites. Although no significant convincing pneumatosis is appreciated in majority of bowel loops, I could see at least in one of the bowel loop nondependent foci along the wall (cine images performed at 10:26:33 AM) concerning for pneumatosis. Limited color Doppler images provided demonstrate some vascularity along the bowel wall at places.

Aorta/IVC: The aorta and inferior vena cava have normal caliber.

Bladder: The urinary bladder is appropriately distended without wall thickening.

IMPRESSION: Diffuse hypoperistalsic/aperistaltic bowel loops with mild wall thickening and possible pneumatosis at places. Mild ascites. Overall features are concerning for necrotizing enterocolitis. Recommend clinical correlation.

FIGURE 1.4 Radiological interpretation of abdominal ultrasound showing pneumatosis.

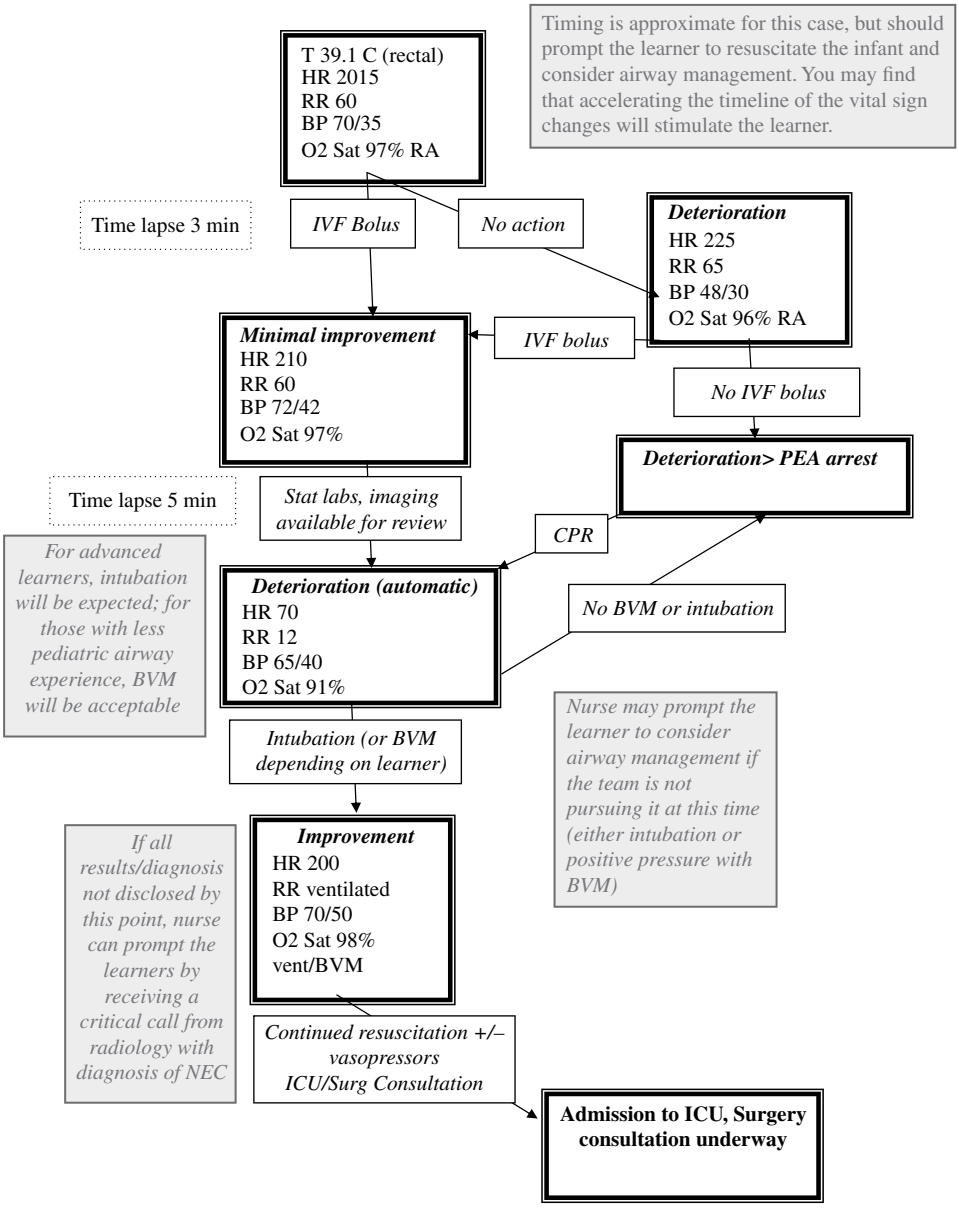

FIGURE 1.5 Flow diagram: necrotizing enterocolitis.

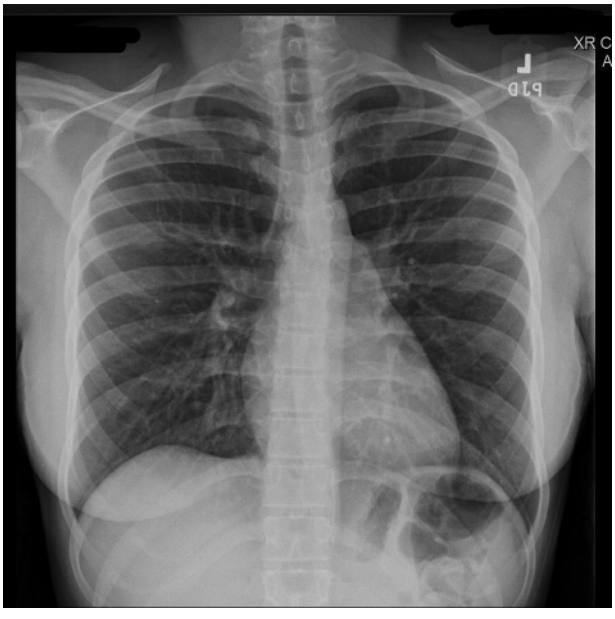

FIGURE 1.6 Chest x-ray showing no active pulmonary disease.

Clinical: Shortness of breath

TECHNIQUE: Single frontal view the chest

COMPARISON: None

FINDINGS:

No acute infiltrate, effusion, or pneumothorax. Cardiac mediastinal contours within normal limits. No evidence of acute osseous pathology. Visualized upper abdomen is unremarkable.

IMPRESSION:

As above

FIGURE 1.7 Radiological reading of chest x-ray (normal).

FIGURE 1.8 Head computed tomography (static image 1-cut) showing no intracranial abnormality.

CT HEAD WITHOUT CONTRAST.

INDICATION: Altered mental status

COMPARISON: CT, 04/07/2019

TECHNIQUE: Contiguous 3 mm axial noncontrast CT images of the brain were obtained along with 2-D multiplanar reformatted images in the coronal plane

This CT scan was performed with one or more of the following dose optimization techniques: iterative reconstruction, automatic exposure control, and/or manual adjustment of mAs and kVp according to the patients size.

FINDINGS:

The ventricles and cortical sulci are normal.

No evidence of hemorrhage, acute territorial infarction, mass effect, midline shift, hydrocephalus, or extra-axial collections.

No hyperdense arterial or venous sign.

Clear paranasal sinuses, mastoid air cells, and middle ear cavities.

The calvarium and overlying soft tissues are unremarkable.

IMPRESSION:

1. No acute intracranial process

FIGURE 1.9 Radiology read computed tomography of the head (normal).

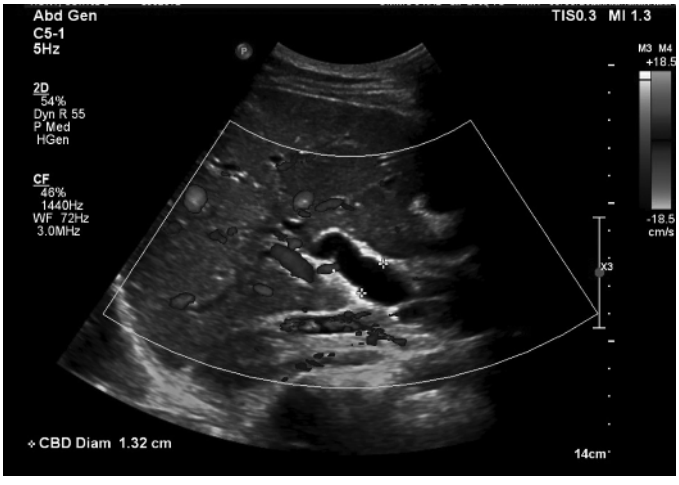

FIGURE 1.10 Ultrasound of right upper quadrant (static image) showing biliary dilation.

INDICATION: Abdominal Pain, confusion

TECHNIQUE: Grayscale and color Doppler ultrasound imaging of the right upper quadrant of the abdomen.

COMPARISON: None

FINDINGS:

Liver: Normal liver size and echogeniciy. it measures up to 14.9 cm in longest dimension. No fluid collections. Main portal vein is patent.

Bile ducts: There is proximal dilatation of the common bile duct measuring 8 mm and continues to dilate distally measuring up to 1.5 cm. There is also mild dilatation of central intrahepatic biliary radicals. No visualized stones within the proximal duct. Distal most CBD is not well included in this provided image probably related to technical limitaion.

Gallbladder: Multiple gallstones and gallbladder sludge with a positive Murphy sign. There is no pericholecystic fluid. Suggestion of minimal gallbladder wall thickening.

Pancreas: The visualized pancreas is unremarkable.

Right kidney: There is a cystic lesion in the interpolar region of the right kidney with an internal echogenic focus.

IMPRESSION:

1. Gallbladder calculus and sludge with subtle wall thickening. The findings are somewhat equivocal for acute cholecystitis. Recommend clinical correlation to rule out acute cholecystitis or cholangitis.

2. Dilated common bile duct concerning for a distal CBD calculus.

FIGURE 1.11 Radiology read showing biliary dilation concerning for choledocholithiasis.

FIGURE 1.12 Computed tomography of the abdomen/pelvis with intravenous contrast (static image, 1-cut) showing grossly dilated common bile duct.

Indication: Abdominal pain, confusion

Exam Type: CT of the ABDOMEN and PELVIS

Technique: Multidetector CT axial images were obtained following the administration of nonionic intravenous contrast. Images were obtained in the portal venous phase. Sagittal and coronal reconstructions were subsequently obtained.

Findings:

Note that this was a single phase CT scan study. An arterial phase study was not performed, any vascular injury/active extravasation is not assessed in this study.

LOWER CHEST:
Normal.

ABDOMEN and PELVIS:

LIVER: No focal lesions. Normal size and density. Patent vasculature.

BILE DUCTS: The common bile duct measures up to 15 mm in diameter. The wall is thickened and enhancing.

GALLBLADDER: The gallbladder is contracted. There is wall enhancement, wall thickening and questionable mild pericholecystic fluid.

PANCREAS: Normal.

SPLEEN: Normal.

ADRENALS: Normal.

KIDNEYS/URETERS: Hypodense cyst in the midpole the right kidney measuring 10 mm without any septation and nodular component representing a simple cyst.

BLADDER: Normal.

BOWEL: The stomach is non distended. No evidence of bowel obstruction or wall thickening. The appendix is not visualized.

PERITONEUM/RETROPERITONEUM: Trace free fluid in the pelvis. No pneumoperitoneum.

LYMPH NODES: No adenopathy.

VESSELS: Normal.

ABDOMINAL WALL: Unremarkable.

IMPRESSION:

1. Contracted gallbladder with wall thickening and hyperenhancement, representing mild inflammation.
2. Minimal wall thickening and enhancement along the common bile duct concerning for acute cholangitis.
3. A simple cyst in the right kidney.

FIGURE 1.13 Computed tomography read concerning for acute cholangitis.

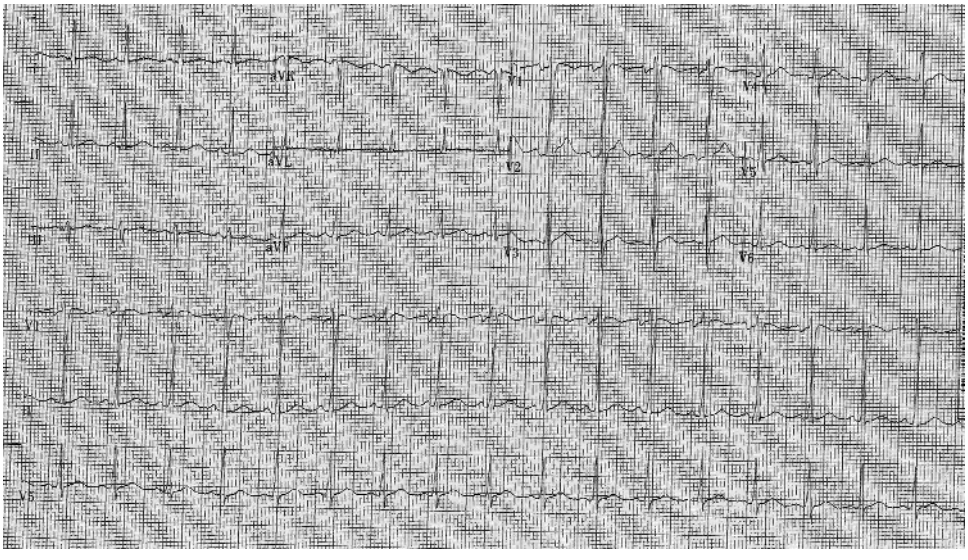

FIGURE 1.14 Electrocardiogram showing sinus tachycardia.

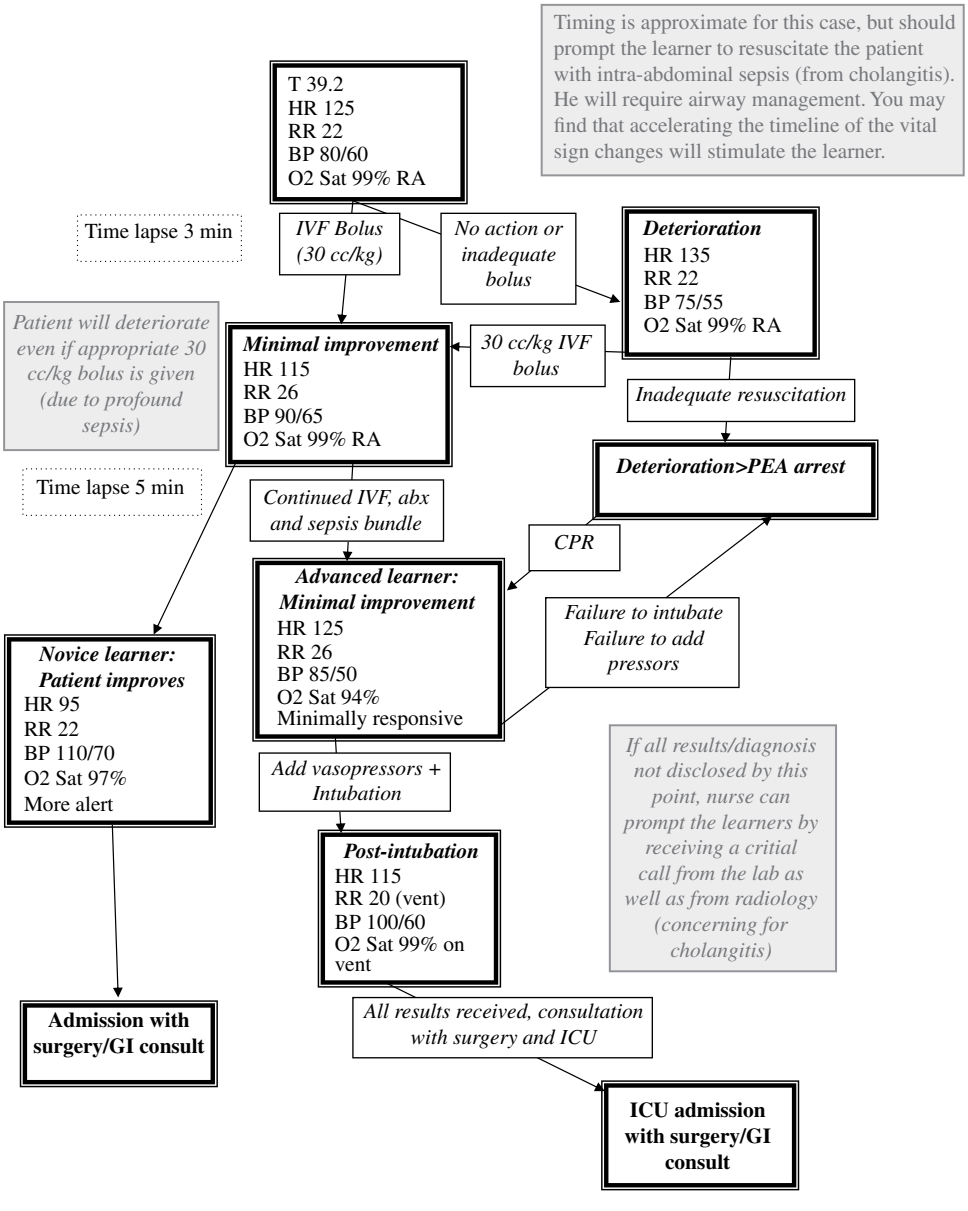

FIGURE 1.15 Flow diagram: ascending cholangitis.

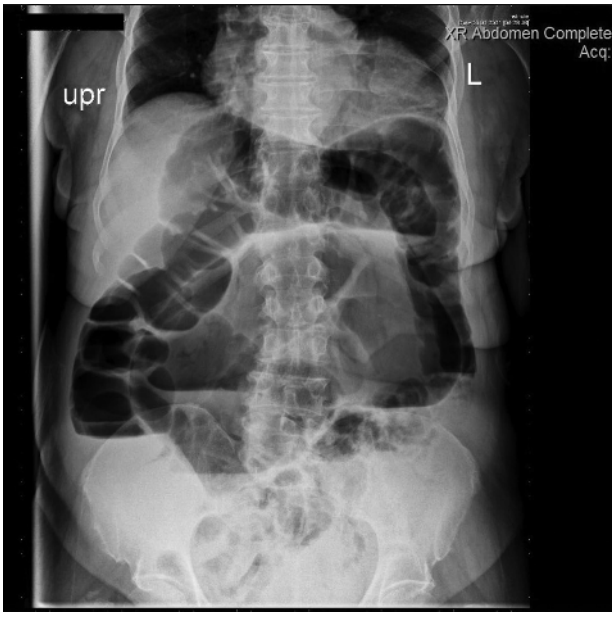

FIGURE 1.16 Abdominal x-ray showing evidence of distended sigmoid colon.

HISTORY: Bowel obstruction and volvulus.

EXAM: X-ray KUB.

COMPARISON: CT scan of the abdomen and pelvis from same day.

FINDINGS: An seen is marked distention of the sigmoid colon measuring approximately 7.7 cm. No definite transition zone is seen. There is no evidence of peritoneal free air or organomegaly or intra-abdominal calcifications. The visualized lung fields are clear. The cardiac silhouette is mildly enlarged.

IMPRESSION: Persistent marked distention of the colon. Recommend sigmoidoscopy and/or GI consultation.

FIGURE 1.17 Radiological report of abdominal x-ray.

FIGURE 1.18 Computed tomography of the abdomen/pelvis with intravenous contrast (static image 1-cut).

CT ABDOMEN AND PELVIS WITH CONTRAST

CLINICAL HISTORY: Abdominal pain

COMPARISON: None.

TECHNIQUE: Multiple 3 mm axial images were obtained following the uneventful intravenous administration of 100 cc of Omnipaque 350. In addition, sagittal and coronal reformatted were also obtained.

This CT scan was performed with one or more of the following dose optimization techniques: iterative reconstruction, automatic exposure control, and/or manual adjustment of mAs and kVp according to the patient's size.

FINDINGS:

Mild bibasilar subsegmental atelectasis.
The heart is mildly enlarged.
Small hiatal hernia.

CT ABDOMEN:

The liver, spleen, pancreas, and adrenal glands are of normal size and attenuation. The gallbladder is normal in size without evidence of gallstones.
The kidneys are normal in size with a lobulated contour bilaterally.
Mild dilatation of the renal collecting systems bilaterally.
No evidence of nephrolithiasis or ureterolithiasis.
The aorta, IVC, and portal venous system are unremarkable.
No evidence of retroperitoneal hemorrhage or retroperitoneal lymphadenopathy.
There is twisting of the mesentery within the left lower quadrant with a large inverted distended U shaped segment of the sigmoid colon within the right upper quadrant that is consistent with a sigmoid volvulus.
Large amount of stool within the cecum and ascending colon.
No free air or free fluid within the peritoneal cavity.

CT PELVIS:

The bladder and rectum are unremarkable.
Mild degenerative changes of the spine.
The osseous structures demonstrate no acute abnormality.

IMPRESSION:

1. Sigmoid volvulus
2. No free air or free fluid

FIGURE 1.19 Radiological report of computed tomography showing sigmoid volvulus.

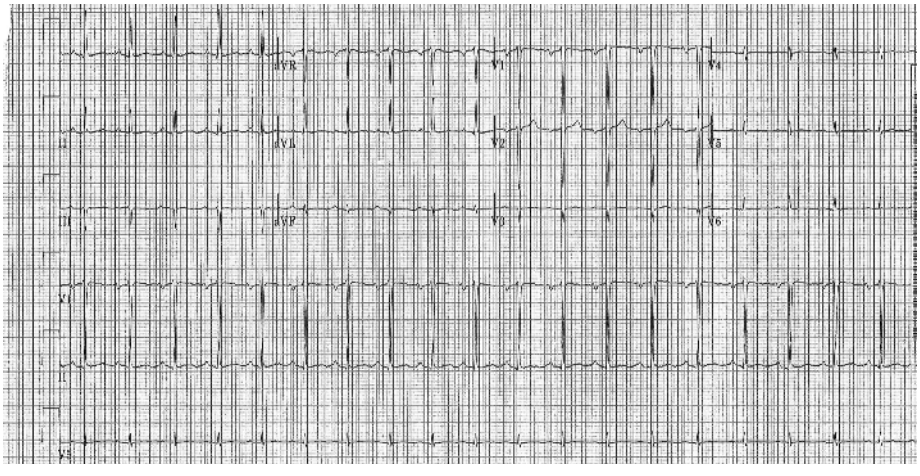

FIGURE 1.20 Electrocardiogram showing sinus tachycardia.

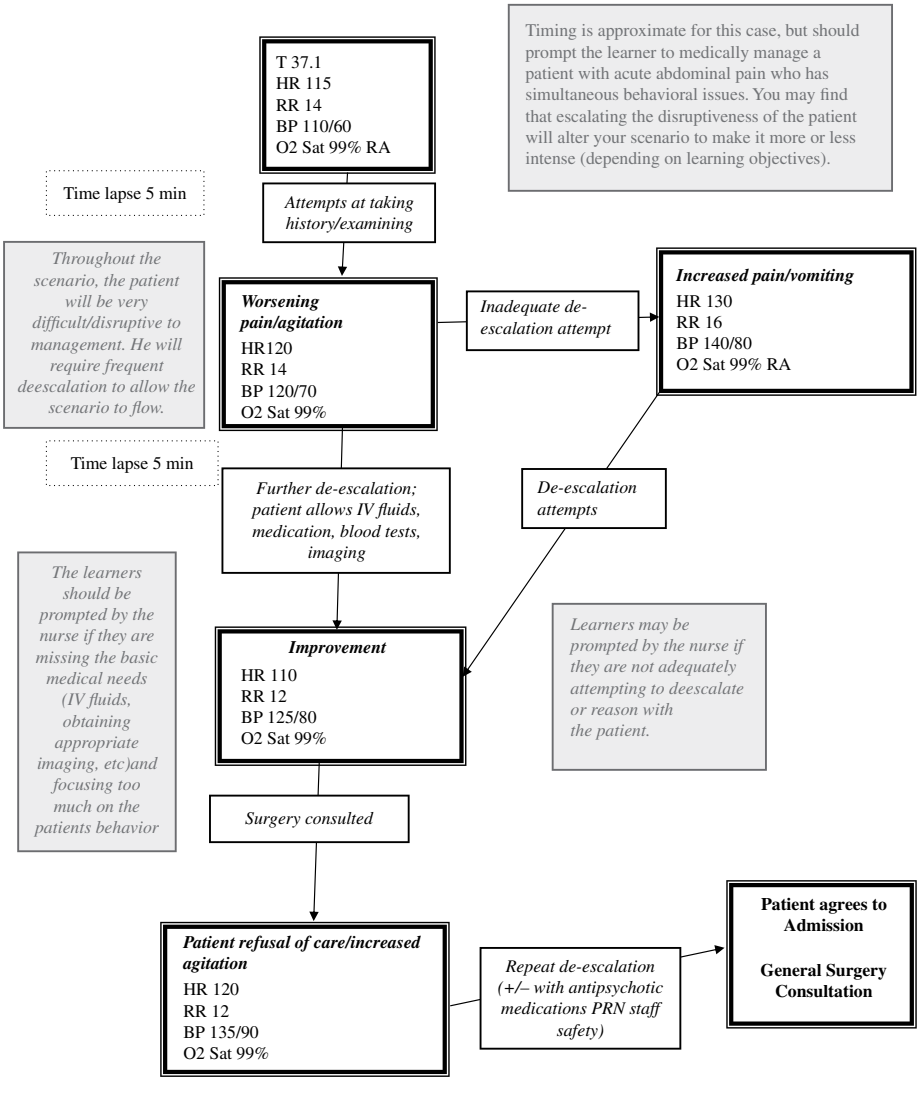

FIGURE 1.21 Flow diagram: sigmoid volvulus.

TABLE 1.1 Heelstick glucose.

Test	Value	Reference range
Heelstick glucose (mg/dl)	80	70–100

TABLE 1.2 Complete blood count.

Test	Value	Reference range
White blood cells (× 10 000/μl)	26.8	4.5–10.6
Hemoglobin (g/dl)	11	13.7–15.6
Hematocrit (%)	39	41–47
Platelets (× 10^3/μl)	90	150–475

TABLE 1.3 Basic metabolic panel.

Test	Value	Reference range
Sodium (mmol/l)	132	136–145
Potassium (mmol/l)	3.1	3.5–5.1
Chloride (mmol/l)	95	98–107
CO_2 (mmol/l)	14	22–29
Blood urea nitrogen (mg/dl)	30	6–23
Creatinine (mg/dl)	1.2	0.7–1.2
Glucose (mg/dl)	78	70–100

TABLE 1.4 Liver function panel.

Test	Value	Reference range
Aspartate aminotransferase (iu/l)	35	5–40
Alanine aminotransferase (iu/l)	38	5–41
Alkaline phosphatase (iu/l)	100	40–129
Total bilirubin (mg/dl)	0.6	0.2–1
Albumin (g/dl)	3.2	3.5–4.2

TABLE 1.5 Lipase.

Test	Value	Reference range
Lipase (iu/l)	25	7–60

TABLE 1.6 Coagulation panel.

Test	Value	Reference range
Prothrombin time (seconds)	12	11.0–15.0
International normalized ratio	1	0–4
Partial thromboplastin time (seconds)	28	24.0–36.0

TABLE 1.7 Lactic acid.

Test	Value	Reference range
Lactic acid (mmol/l)	2.6	0–2

TABLE 1.8 C-reactive protein.

Test	Value	Reference range
C-reactive protein (mg/l)	12	0–3

TABLE 1.9 Troponin.

Test	Value	Reference range
Troponin (ng/ml)	< 0.01	0–0.4

TABLE 1.10 Urinalysis.

Test	Value	Reference range
Specific gravity	1.030	1.001–1.030
Ketones	3+	Negative
Bilirubin	Negative	Negative
Leukocyte esterase	Negative	Negative
Nitrite	Negative	Negative
Glucose	Negative	Negative
Urobilinogen (mg/dl)	1.0	0.2–1.0
Color	Dark	
Appearance	Yellow	
Protein	Negative	Negative
pH	7.0	5.0–8.0
Blood	Negative	Negative

TABLE 1.11 Urine microscopy.

Test	Value	Reference range
White blood cells (/hpf)	2	1–5
Red blood cells (/hpf)	Negative	1–5
squamous epithelial cells	Rare	None
Bacteria	Rare	Negative

TABLE 1.12 Complete blood count.

Test	Value	Reference range
White blood cells (× 10 000/μl)	22.5	4.5–10.6
Hemoglobin (g/dl)	12.8	13.7–15.6
Hematocrit (%)	41	41–47
Platelets (× 10^3/μl)	168	150 000–475

TABLE 1.13 Basic metabolic panel.

Test	Value	Reference range
Sodium (mmol/l)	142	136–145
Potassium (mmol/l)	3.1	3.5–5.1
Chloride (mmol/l)	97	98–107
CO_2 (mmol/l)	18	22–29
Blood urea nitrogen (mg/dl)	38	6–23
Creatinine (mg/dl)	1.9	0.7–1.2
Glucose (mg/dl)	80	70–100

TABLE 1.14 Liver function panel.

Test	Value	Reference range
Aspartate aminotransferase (iu/l)	65	5–40
Alanine aminotransferase (iu/l)	68	5–41
Alkaline phosphatase (iu/l)	165	40–129
Total bilirubin (mg/dl)	3.0	0.2–1
Albumin (g/dl)	4	3.5–4.2

TABLE 1.15 Lipase.

Test	Value	Reference range
Lipase (iu/l)	65	7–60

TABLE 1.16 Lactate.

Test	Value	Reference range
Lactic acid (mmol/l)	3.5	0–2

TABLE 1.17 Coagulation panel.

Test	Value	Reference range
Prothrombin time (seconds)	12	11.0–15.0
International normalized ratio	1	0–4
Partial thromboplastin time (seconds)	28	24.0–36.0

TABLE 1.18 Troponin.

Test	Value	Reference range
Troponin (ng/ml)	< 0.01	0–0.4

TABLE 1.19 Type and screen.

Test	Result
Blood type	AB+

TABLE 1.20 Urinalysis.

Test	Value	Reference range
Specific gravity	1.030	1.001–1.030
Ketones	1+	Negative
Bilirubin	Negative	Negative
Leukocyte esterase	Negative	Negative
Nitrite	Negative	Negative
Glucose	Negative	Negative
Urobilinogen	1.2	0.2–1.0
Color	Clear	
Appearance	Yellow	
Protein	Negative	Negative
pH	7.0	5.0–8.0
Blood	Negative	Negative

TABLE 1.21 Urine microscopy.

Test	Value	Reference range
White blood cells (/hpf)	Negative	1–5
Red blood cells (/hpf)	Negative	1–5
Squamous epithelial cells	Rare	
Bacteria	Rare	Negative

HPF, high power field.

TABLE 1.22 Complete blood count.

Test	Value	Reference range
White blood cells (× 10 000/μl)	11.2	4.5–10.6
Hemoglobin (g/dl)	14	13.7–15.6
Hematocrit (%)	41	41–47
Platelets (× 10^3/μl)	450	150 000–475

TABLE 1.23 Basic metabolic panel.

Test	Value	Reference range
Sodium (mmol/l)	145	136–145
Potassium (mmol/l)	2.9	3.5–5.1
Chloride (mmol/l)	95	98–107
CO_2 (mmol/l)	20	22–29
Blood urea nitrogen (mg/dl)	38	6–23
Creatinine (mg/dl)	1.9	0.7–1.2
Glucose (mg/dl)	75	70–100

TABLE 1.24 Liver function panel.

Test	Value	Reference range
Aspartate aminotransferase (iu/l)	35	5–40
Alanine aminotransferase (iu/l)	38	5–41
Alkaline phosphatase (iu/l)	100	40–129
Total bilirubin (mg/dl)	0.6	0.2–1
Albumin (g/dl)	3	3.5–4.2

TABLE 1.25 Lipase.

Test	Value	Reference range
Lipase (iu/l)	25	7–60

TABLE 1.26 Troponin.

Test	Value	Reference range
Troponin (ng/ml)	< 0.01	0–0.4

TABLE 1.27 Lactic acid.

Test	Value	Reference range
Lactic acid (mmol/l)	2.1	0–2

TABLE 1.28 Coagulation panel.

Test	Value	Reference range
Prothombin time (seconds)	12	11.0–15.0
International normalized ratio	1	0–4
Partial thromboplastin time (seconds)	28	24.0–36.0

TABLE 1.29 Urinalysis.

Test	Value	Reference range
Specific gravity	1.030	1.001–1.030
Ketones	2+	Negative
Bilirubin	Negative	Negative
Leukocyte esterase	Negative	Negative
Nitrite	Negative	Negative
Glucose	Negative	Negative
Urobilinogen (mg/dl)	1.2	0.2–1.0
Color	Dark	
Appearance	Yellow	
Protein	1+	Negative
pH	7.0	5.0–8.0
Blood	Negative	Negative

TABLE 1.30 Urine microscopy.

Test	Value	Reference range
White blood cells (/hpf)	Negative	1–5
Red blood cells (/hpf)	Negative	1–5/
Squamous epithelial cells	Rare	
Bacteria	Rare	Negative

HPF, high power field