Case 83: Abdominal Pain

- **Chief complaint**
  - 4-year-old boy presents with abdominal pain and diarrhea.

- **Vital signs**
  - HR: 100 BP: **139/72** RR: 19 Sat: 100% on RA T: **38.4°C** Wt: 20 kg

- **Patient appearance**
  - Patient appears to be a developmentally typical, interactive child in mild distress.

- **Primary survey**
  - Airway: speaking normally
  - Breathing: no respiratory distress, clear lungs, comfortable work of breathing
  - Circulation: warm extremities, distal pulses strong

- **Action**
  - Place patient on the monitor
  - Obtain IV access (draw rainbow top)
  - POC glucose (93, if asked for)
  - Consider repeat blood pressure (should note HTN given patient's age, **repeat 135/70**)
  - Antipyretic (acetaminophen 12.5-15 mg/kg or ibuprofen 10 mg/kg are reasonable)

- **History**
  - Source: Patient, parents
  - HPI: A 4-year-old male presents with 5 days of abdominal pain, watery diarrhea, and occasional nonbilious, non-bloody vomiting. He has felt warm on occasion and received acetaminophen (recommended dosing) with little improvement. He has complained of lower abdominal pain that his mom thought was related to the diarrhea, and she thought he just had the "stomach flu." He has been lying around all day today, whereas typically he would be playing outside with his friends. When he started complaining that his urine looked funny, she brought him to the ED. He reports that his poop has been "red" over the past few days. Otherwise ROS is negative.
  - PMHx: bronchiolitis
  - PSHx: none
  - Immunizations: UTD on all routine immunizations
  - Allergies: penicillin (rash)
  - Meds: none

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- Social: Lives in a rural area with mom and dad. Has one younger sister. Attends kindergarten.
- FHx: non-contributory
- PMD: Dr. Lawrence

- **Instructor Prompt:** learners should discuss the differential diagnosis of bloody diarrhea in a school-aged child
  - Exceptionally broad differential, considerations including acute infectious diarrhea (viral, bacterial, parasitic), intussusception, colitis (infectious, autoimmune), HUS, HSP, juvenile polyp, eosinophilic colitis, vascular abnormalities, celiac disease, Meckel diverticulum, upper GI bleed source (ulcer, gastritis, eosinophilic disease, swallowed blood)

- **Physical Exam**
  - **General:** normally developed boy in **mild distress**, interacts and participates during exam
  - **HEENT:** (must ask) **pale conjunctiva, dry mucous membranes**, otherwise normal
  - Neck: normal
  - Chest: nontender
  - Heart**:** normal
  - Lungs: normal
  - **Abdomen:** (must ask specifics) soft, nondistended, **mild, non-focal tenderness in lower abdomen**, without guarding or rebound
  - **Rectal:** (must ask specifics) no gross blood or obvious source of bleeding
  - Urogenital: (must ask specifics) circumcised, no lesions, bilateral descended testes, no hernias
  - **Extremities**: (must ask specifics) **1+ edema to all extremities**, otherwise normal
  - Back: normal
  - Neuro: normal
  - **Skin:** (must ask specifics) **pale, scattered petechiae and ecchymoses on trunk and extremities**
  - Lymph: normal

- **Action**
  - Order Labs
    - CBC, CMP, coagulation studies, blood type and screen, urinalysis, stool culture, stool guaiac
    - Consider peripheral blood smear, hemolysis labs (LDH, haptoglobin, fibrinogen, Coombs test)
  - Consider EKG due to HTN
  - Order Meds
    - IV hydration (20cc/kg NS or LR bolus, isotonic crystalloid should be used)
    - PO or IV pain medication if not given previously
    - PO or IV antiemetic (ondansetron 4 mg)
  - Consider additional point of IV access

- **Response/Results**
    - Patient reevaluation and repeat vitals:
        - Vitals unchanged, remains hypertensive
        - Patent: still with abdominal discomfort; has had an episode of bloody diarrhea during time in the ED. Feels better after antiemetic given.
    - **Case 83 Lab Results** (significant for below)
        - CBC: **WBC 13.1**, **Hb 7.1, Plt 35**
        - CMP: **CO2 19, Cr 2.3, T.bili 2.5, D.bili 0.3**
        - UA: **+protein, +bilirubin, +RBCs**
    - Other Results: **stool guaiac positive**, **helmet and burr cells** seen on peripheral blood smear (**Figure 83.2**)
    - ECG (**Figure 83.1**- Normal Sinus Rhythm, TWI V1-V4, normal for age)
    - If abdominal XR ordered, report as "negative"
    - If abdominal CT ordered, should prompt consideration of radiation exposure and limited utility. IV contrast contraindicated due to reduced eGFR, oral contrast not possible due to symptomatology.

- **Instructor Prompt:** provide learners with blood smear **Figure 83.2** and discuss key findings as they contribute to case (hemolytic anemia) and narrowed differential

- **Action**
    - Consider maintenance fluids (isotonic IVF)
    - Consult
        - Nephrology for hypertension, acute kidney injury, oliguria
        - Hematology for discussion of plasmapheresis if symptoms worsen (note: controversial – see teaching point below)
    - Admit to general pediatrics
    - Discuss diagnosis with family

- **Diagnosis**
    - Hemolytic uremic syndrome (HUS)

- **Critical actions**
    - IV access and fluid bolus
    - Discussion with family
    - NO antibiotics
    - NO antimotility agent
    - NO transfusion
    - Consultation with pediatric nephrology, pediatric hematology
    - Admission

- **Instructor Guide**

- This is a case of a child with diarrheal illness (classically, *Escherichia coli* O157:H7) complicated by hemolytic uremic syndrome (HUS). The clinical history and a thorough physical exam will be key in making the diagnosis. The learner should note that the patient is hypertensive, especially for his age. Important early actions include IV access and IVF with a minimum workup to include a CBC and BMP. Although the labs will show anemia and thrombocytopenia, the patient should not be transfused and hematology should be consulted. If transfusion is ordered the parents will decline transfusion "until we talk to the specialist." AKI in this patient should prompt a nephrology consult. The patient should be admitted for hydration and close monitoring.

- **Case Teaching Points**
  - The differential for abdominal pain and diarrhea in a child is broad. It should include common etiologies like infectious diarrheal illness (for example, gastroenteritis or colitis caused by norovirus), but also "can't miss" diagnoses like intussusception, hernias, hemolytic uremic syndrome, and inflammatory bowel disease. However, even constipation can lead to abdominal pain and diarrhea, as liquid stool moves around partially impacted stool. A focused history, including assessing for any dietary changes, sick contacts, travel history, and associated symptoms such as hematochezia, is important to narrow down the differential diagnosis, in addition to a focused physical exam.

- **Discussion Topic: Pediatric hypertension**
  - Hypertension in children and adolescents is defined in reference to age- and sex-specific percentiles. Pre-hypertension is defined as a systolic or diastolic blood pressure >90th percentile but <95th, and hypertension is >95th percentile.
  - Secondary hypertension is common, with renal parenchymal disease being the most common etiology in children of all ages. In general, younger age at presentation and severity of hypertension are indicative of a secondary cause.
  - Most common causes ages 1-6 y: renal artery stenosis, renal parenchymal disease, aortic coarctation, iatrogenic
  - Most common causes ages 6-12 y: renal parenchymal disease, renovascular disease, primary hypertension, aortic coarctation, endocrinopathies, iatrogenic

- **Discussion Topic: Is it blood?**
  - The child in this story described his diarrhea as "red." Except in cases of frank hematochezia, chemical testing should generally be done to confirm the presence of blood in pediatric cases. Common mimics of blood in stool include red-colored drinks, foot coloring, tomatoes, beets, red-colored candies, red-colored medications. Mimics of melena include bismuth preparations, iron preparations, spinach, blueberries, grapes, and licorice candies.
  - Stool guaiac is a simple test that can be performed at the bedside or on stool in a diaper.

- **Discussion Topic: HUS overview**

- Diagnosis of HUS is made clinically with supportive laboratory features. The diagnostic triad is microangiopathic hemolytic anemia, thrombocytopenia, and renal injury.
- HUS is the leading cause of renal failure in otherwise normal hosts in the US, particularly in children 3 years and younger. Children of any age can be affected, but generally affects children 5 years and younger.
- Can be subdivided into typical HUS (D+) which includes the majority of cases and is preceded by an GI-like illness, and atypical HUS (D-) which is a heterogenous illness that can be triggered by various drugs, non-enteric infections, bone marrow transplant, HIV, and others.
- The most common cause, accounting for approximately 90% of cases in the U.S., is Shiga-toxin producing E. coli (STEC), specifically serotype O157:H7.

- **Discussion Topic: Natural History of HUS**
  - Typical symptoms include watery diarrhea evolving into grossly bloody diarrhea, vomiting, abdominal pain.
  - In the most common form of the disease, HUS develops in 5-10 days following a prodromal diarrheal illness. Median onset is 6 days.
  - In addition to the characteristic laboratory findings, oliguric renal failure is common and children may be anuric for up to 3 days.
  - Case-fatality rate is about 3-5%, with most cases attributable to CNS involvement, cardiac failure, or multiorgan failure.
  - About 60-70% of children recover fully with no long-term sequelae.

- **Discussion Topic: E. coli O157:H7**
  - This is responsible for most U.S. cases and occurs sporadically with occasional outbreaks.
  - Infection occurs via contact with undercooked meat (particularly ground beef), unpasteurized milk or dairy products, or exposure to contaminated water, fruits, or vegetables. Direct person-to-person transmission can occur through daycares and similar settings.
  - Approximately 10% of O157:H7 STEC infections will result in HUS.

- **Discussion Topic: Treatment of HUS**
  - Treatment is supportive only. Intravascular volume depletion can be managed by IVF titrated to urine output.
  - There is *no* role for antibiotics. HUS typically develops in the post-diarrheal phase and antibiotics have not been shown to reduce the risk even in cases of culture-confirmed O157:H7. There is a theoretical risk of worsening disease by release of toxin with bactericidal agents.
  - Antimotility agents such as loperamide (Imodium) may increase the risk of HUS and neurologic sequelae and did not reduce the duration of diarrhea in an observational trial. They should *not* be used.
  - Packed red blood cells can be transfused to standard transfusion thresholds if anemia is severe.

- Although thrombocytopenia can be severe, bleeding is uncommon. Platelet transfusion is generally ineffective given the consumptive MAHA and will not sustainably raise platelet levels. Platelets can be considered in cases of life-threatening hemorrhage or planned invasive procedures.
- Up to 50% of children may require RRT during the acute phase of illness. About 5-10% will develop chronic kidney disease with gradual progression to end-stage renal disease.

- **Discussion Topic: Relationship to TTP**
  - In the acute setting, HUS and TTP may be difficult to distinguish. Demographic, clinical, and contextual factors can aid in distinguishing the two.
  - The laboratory profile of TTP and HUS are nearly identical: decreased platelets, normal PT/aPTT, MAHA, normal fibrinogen, impaired renal function.
  - The pathophysiology is different however, in that >90% of HUS is toxin-mediated, whereas TTP is caused by deficiency of ADAMTS13.
  - Plasma exchange/plasmapheresis are therapeutic in TTP but controversial in HUS. The practice is based on similarities between the two disease processes in the dysfunctional coagulation parameters, however the available observational data suggest limited utility. Its use is considered in cases of HUS with severe neurologic manifestations (e.g. stroke and seizure). Additional emerging therapies include Eculizimab, an anti-C5 monoclonal antibody that may limit the complement-mediated cellular damage in forms of HUS, particularly in non-STEC related HUS.
  - Most cases of HUS occur during childhood, particularly 5 years and younger. Most TTP cases occur in adulthood.
  - For historical interest, the first ever case of TTP was described in 1924 in a 16-year old.

- **Attributions**
  - **Author:** Dr. Geoff Kelly
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  - **References:**
    - Medscape, emedicine “Hemolytic Uremic Syndrome” (Author: Dr. Malvinder S Parmar)
    - Weaver DJ. Hypertension in children and adolescents. Pediatr Rev 2017;38(8):369-82.
    - Fiorino EK, Raffaelli RM. Hemolytic-uremic syndrome. Pediatr Rev 2006;27(10):398-399.
    - Burns RA, Kaplan RA. Renal and electrolyte abnormalities. In: Shaw KN, Bachur RG, Chamberlain JM, et al (Eds.) (2016). Fleisher & Ludwig's textbook of pediatric emergency medicine. 7th edition. Philadelphia, PA: Wolters Kluwer.
    - Joly BS, Veyradier A. Thrombotic thrombocytopenic purpura. Blood 2017;129:2836-46.

- Rizzoni G, Claris-Appiani A, Edefonti A, et al. Plasma infusion for hemolytic-uremic syndrome in children: results of a multicenter controlled trial. J Pediatr 1998;(112):284-90.
- Loos S, Ahlenstiel T, Kranz B, et al. An outbreak of Shiga-toxin producing Escherichia coli O104:H4 hemolytic uremic syndrome in Germany: a presentation and short-term outcome in children. Clin Infect Dis 2012;55:753-9.
- Kotch C, Yusuf Z. Oncology. In: Kahl L, Hughes H (Eds.) (2018) The Harriet Lane Handbook: a manual for pediatric house officers. 8th edition. Philadelphia, PA: Mosby Elsevier.
- Dixon A, Stauffer B. Chapter 137: Renal Emergencies in Children. In: Judith E. Tintinalli, O. John Ma, et al, editors. Tintinalli's Emergency Medicine: A Comprehensive Study Guide (9th ed). New York: McGraw-Hill; 2020.
- McCollough M, Rose E. Chapter 173: Genitourinary and Renal Tract Disorders. In: Ron Walls, Robert Hockberger, Marianne Gausche-Hill et al, editors. Rosen's Emergency Medicine: Concepts and Clinical Practice (9th ed). Philadelphia: Elsevier, Inc; 2018.
- Image References
    - ECG from Google Images (http://www.cmej.org.za/index.php/cmej/article/view/2283/2048)
    - Peripheral smear from Google images (https://commons.wikimedia.org/wiki/File:Crenated_Red_Cells.jpg)

Case 83 Lab Results

Basic Metabolic Panel:

Na	130 mEq/L
K	4.8 mEq/L
Cl	101 mEq/L
CO_2	19 mEq/L
BUN	18 mg/dL
Cr	2.3 mg/dL
Gluc	89 mg/dL

Liver Function Panel:

AST	32 U/L
ALT	14 U/L
Alk Phos	42 U/L
T bili	2.5 mg/dL
D bili	0.3 mg/dL
Amylase	50 U/L
Lipase	25 U/L
Albumin	4.5 g/dL

Complete Blood Count:

WBC	13.6 x 10^3/uL
Hb	7.1 g/dL
Hct	21.5%
Plt	34 x 10^3/uL

Urinalysis:

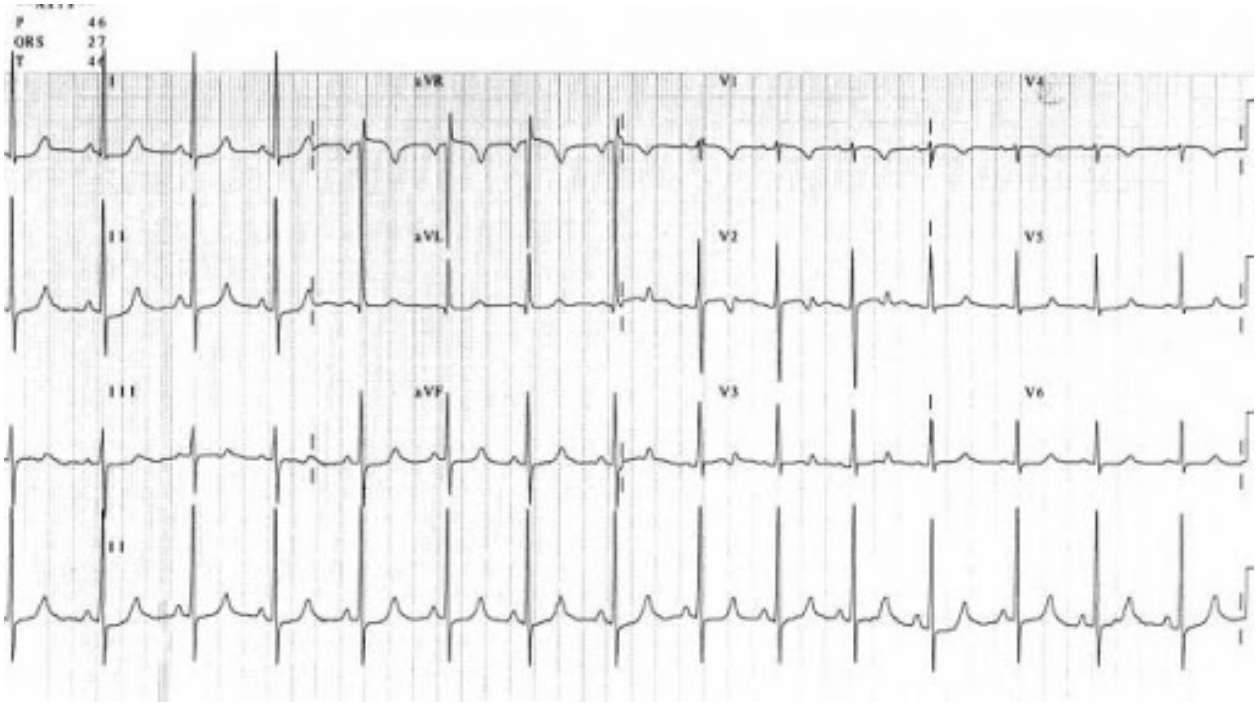
SG	1.018
pH	6.8
Prot	2+
Gluc	Neg
Ketones	Neg
Bili	Pos
Blood	Pos
LE	Neg
Nitrite	Neg
Color	Brown

Coagulation Panel:

PT	13.1 sec
INR	1.0
PTT	28 sec

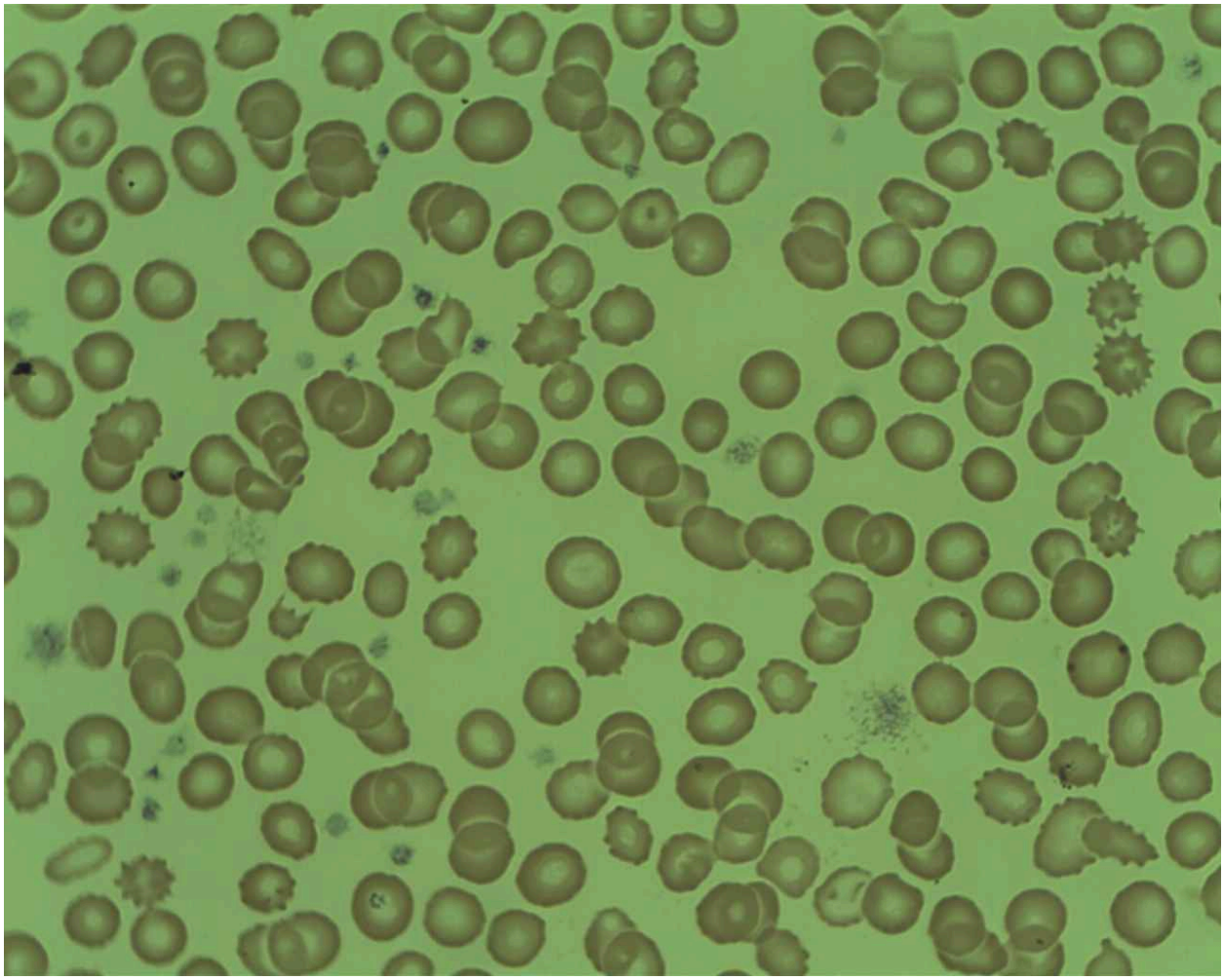
Back to case

Figure 83.1- ECG



Back to case

Figure 83.2- Peripheral blood smear



Base to case