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An 18 Month-Old-Boy with Vomiting

In *Bouncebacks*, we provide the documentation of an actual patient encounter, discuss patient safety and risk-management principles, and then reveal the patient's bounceback diagnosis. This case is from the book *Bouncebacks!*, available at www.anadem.com and www.amazon.com.

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History of Present Illness

John is a healthy 18-month-old boy. One morning shortly after Christmas, he awoke with cough and congestion. After breakfast, he had an episode of vomiting. His symptoms remained mild for 3 days, though he continued to vomit. Two days later, he developed copious diarrhea; when his mother noticed it had red specks in it, she took him to the ED.

Initial Presentation—ED Visit #1

Mother's statement:
"There's something not right with my child; he won't drink. I've seen him sick before, but never this sick. He usually drinks when he's sick. He loves popsicles and juice, but he won't take either."

ED Documentation

Nursing note:
Child well appearing. Happy with mom and wants to be held. Rash on face and under Rt arm. Abdomen soft. Smiles at me once. Zofran administered. Awaiting MD review.

Physician note:
Chief complaint: Blood in stool

History of Present Illness (Per MD)
Mom reports 3 days of diarrhea and vomiting preceded by cough/congestion. Last diaper had specs of blood. In daycare with sick contacts. Zofran given in triage and now tolerating PO.

Review of Systems
Unless otherwise stated in this report 10 reviewed and negative.

Past Medical History: (blank)

Allergies: NKDA
Medications: None

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PMH: None
Social History: Lives with mom and dad
Examination:
Vital signs (time 11:00): temp (F) 100.4 TM; Rt 188; pulse 32; resp (blank); syst (blank); diast (blank)
Constitutional: Alert and well developed
Mental status/psychiatric: Age-appropriately responsive to mother
Head: NCAT, soft fontanelle
Eyes: PERRL, EOMI, no discharge or conjunctival injection.
Ears: TMs clear.
Nose: Mild yellow rhinorrhea.
Throat: no lesions or erythema
Neck: Full range of motion, no lymphadenopathy
Lung: Clear to auscultation and breath sounds equal.
Heart: No murmur.
ABD: Soft, Non tender to palpation, no guarding.
Neurological: Grossly non focal.

ED Course

11:15 – Zofran 2 mg ODT. Tolerating po.

DIAGNOSIS: Vomiting, gastroenteritis.

Disposition (12:00): Patient was discharged home by the ED physician. Instructions: follow up with your pediatrician in 2-3 days "if continued vomiting." Condition upon discharge ____ *(blank)*. Rx for Zofran ODT. Return to ER if symptoms change.

The Bounceback

ED VISIT #2 *(2 days after initial ED visit)*

- **RN note:** Sick appearing child, severely dehydrated, with gross blood noticed in diaper. Temperature 102.4. Mom reports abdominal pain and bloody diarrhea for 5 days. Petechiae on face decreased per mom.
- **MD notes:**

HPI: Mom reports child has had 5 days of diarrhea with blood and vomiting. Some abdominal pain, colicky in nature. Not tolerating fluids today. Seen by PCP this morning and had some juice from cup after Phenergan.
PE: T, 102.4; HR, 190; RR, 40; BP, 79/45; Sat, 94%. Child moderately sick appearing dehydrated, sunken eyes dry mucosal membranes. Not playful. Abdomen tender to palpation all quadrants. Gross blood in diaper with diarrhea. (No mention of petechiae.)
ED course: CBC (WBC: 17, H/H: 10/31 Plt: "PND" Pending), Chemistry (Creatinine-1.2, Glucose-80), Stool sent for culture, O&P, leukocytes and C. Diff. 20 cc/kg IV bolus x 2 administered. 2 mg IV Zofran given.
Testing: US (indication r/o intussusception). Negative
MDM: Patient improved after bolus and tolerating oral Gatorade and part of a Popsicle. Called GI to arrange outpatient follow-up for continued bloody diarrhea. Nuclear Medicine Tech is on vacation and Meckel's scan can be done Tuesday. Left message for the patient's PCP to follow up stool studies. Bleeding around IV site has stopped.
Diagnosis: Diarrhea, vomiting, abdominal pain unknown etiology

- **RN Note prior to dc:** Pt improved, tolerated part of a Popsicle and 4 oz of Gatorade. One bowel movement prior to discharge with scant blood and diarrhea. Discharge delayed 15min for bleeding at IV site, controlled with 10 min of pressure

ED VISIT #3 *(3 days after initial ED visit)*

- John arrives via EMS intubated for respiratory failure, cyanosis, and a heart rate of 45. Compressions were started prior to arrival, but were stopped after a code dose of epinephrine was administered and heart rate had increased to 85 and SBP improved from 50 to 75.
- Initial vitals HR 65, respirations 20 (intubated), temperature 96.8 and SBP 70.
- Dopamine drip was started after fluids
- CT scan of the brain ordered to r/o abuse is negative. CXR showed atelectasis and no signs of infection
- ABG revealed a concomitant metabolic and respiratory acidosis thought to be due to cardiac arrest and having had multiple days of diarrhea
- EKG shows only bradycardia
- Blood work reveals leukocytosis of 25 with a left shift, lactate of 5.6, Hb-6, Platelets-25, Creatinine-2.6, ScVO2-50 and a K-2.9
- Non-blanching petechiae visualized
- Vancomycin and Rocephin are started for empiric tx of suspected meningitis
- LP was deferred because the ER team felt patient was too unstable
- The patient was paralyzed while the hypothermia protocol was induced
- Pt transferred to the ICU

ICU Course

- Multiple rounds of epinephrine and atropine were given for bradycardia
- Dopamine 35 mcg/kg/min and epinephrine 1 mcg/kg/min is started
- John codes with PEA arrest followed by asystole

- After 40 minutes of resuscitative efforts John is pronounced dead

Final Diagnosis and Cause Of Death

- Hemolytic uremic syndrome/Thrombotic thrombocytopenic purpura (HUS/TTP)
- Stool cultures tested positive for Stx2 Shiga toxin and O157:H7 E.Coli

Medical Discussion: Hemolytic Uremic Syndrome

Hemolytic uremic syndrome (HUS) and thrombotic thrombocytopenic purpura (TTP) share many features and are widely believed to exist on a continuum, with HUS much more common in pediatrics. Either syndrome can be seen at any age, but the majority of HUS cases are found between 7 months and 6 years of age. Traditional HUS is defined by the triad of:

1. Microangiopathic hemolytic anemia (MAHA)
2. Thrombocytopenia
3. Acute renal failure

HUS is characterized by endothelial cell injury, intravascular platelet–fibrin thrombi, and vascular damage. The continuation of the disease progresses to include:

4. neurologic changes and
5. fever

This completes the pentad of TTP.[1,2]

The classic D+ HUS (D for diarrhea) is caused by the deadly Shiga toxin *Escherichia coli* and is often preceded by colitis. Shiga toxin Stx2 is more likely than Stx1 to be associated with D+ HUS. HUS occurs in ≤15% of patients infected with the 0157:H7 Shiga toxin producing *E coli*. Most cases come after outbreaks in places with multiple children in close contact. The most common food-borne cause of HUS is ingestion of undercooked meat, with cattle being the most common animal reservoir.[1,3]

The D-HUS (no diarrhea HUS) is thought to be mediated by the complement system or familial factors.[7] The most common D- HUS (atypical HUS or aHUS) syndrome is associated with both lung and CNS infections. It is primarily caused by strep pneumonia with other etiologies suspected, including drugs and sepsis.[8-9] Unfortunately, atypical HUS is frequently caused by strains of strep pneumonia that are not included in the standard 7-valent or 23-valent vaccines, such as serotype 19A.[1] D- HUS accounts for up to 15% of HUS.[4] There are no diarrhea-inducing bacterial toxins released, but rather direct endothelial injury from the offending drug/illness which causes a complement factor mutation resulting in aHUS and TTP. Another form of atypical HUS, familial HUS, is caused by a genetic mutation affecting the complement regulatory proteins.[5]

The deficiency of the enzyme ADAMTS-13 plays a special role in TTP. Note the job of von Willebrand factor (vWF) is to promote platelet aggregation, while the ADAMTS-13's job is to degrade vWF before it can induce unnecessary clots. With a deficiency of ADAMTS-13, many unstable platelet-based clots form and are not degraded, so the clotting continues. These platelet aggregations get stuck in the kidneys, causing the acute renal failure seen in HUS/TTP. The subsequent kidney injury may be so severe that dialysis is needed. A similar mechanism is thought to be responsible for the waxing and waning neurologic disturbances seen with the disease.[6] Clots obstruct cerebrovascular flow and then dissolve, resulting in fluctuating mental status. Colonic ischemia and perforation are also possible from these same microemboli. The clots in the vascular system are thought to cause red blood cells to fragment into schistocytes which are pathognomonic for MAHA when found on a peripheral smear. This is a key point: finding schistocytes on a peripheral smear is pathognomonic for HUS.

Mortality rate has dropped to <5% with treatment, but remains as high as 75% in underdeveloped countries. Unfortunately, the diagnosis remains difficult because the onset is so rapid in seemingly otherwise healthy children.[2]

The cornerstone of treatment for HUS/TTP is plasma exchange (plasmapheresis with fresh frozen plasma exchange). Decreased time to initiation of treatment is directly linked to improved outcomes. RBC transfusion may be considered with severe bleeding when plasma exchange is not immediately available. Platelet transfusion is associated with increased morbidity and mortality, and should be avoided unless directed in consultation with hematology in an acutely life-threatening situation. Aggressive fluid resuscitation is critical to avoid oligoanuric states that are associated with the more serious complications. Ultimately however, dialysis may be required if kidney injury progresses.[7] ■

References

1. Trachtman H. HUS and TTP in children. *Pediatr Clin North Am.* 2013;60(6):1513-1526.
2. George JN. Thrombotic thrombocytopenic purpura. *N Engl J Med.* 2006;354(18):1927-1935.
3. Tarr PI, et al. Shiga-toxin-producing Escherichia coli and haemolytic uraemic syndrome. *Lancet.* 2005;365(9464):1073-1086.
4. Spinale JM, et al. Update on Streptococcus pneumoniae-associated hemolytic uremic syndrome. *Curr Opin Pediatr.* 2013;25(2):203-208.
5. Lemaire M, et al. Recessive mutations in DGKE cause atypical hemolytic-uremic syndrome. *Nat Genet.* 2013;45(5):531-536.
6. Paliwal PR, et al.. Association between reversible cerebral vasoconstriction syndrome and thrombotic thrombocytopenic purpura. *J Neurol Sci.* 2014;338(1-2):223-225.
7. Ake JA, et al. Relative nephroprotection during Escherichia coli O157:H7 infections: association with intravenous volume expansion. *Pediatrics.* 2005;115(6):e673-680.
8. Karim F, et al. Deficiency of ADAMTS-13 in pediatric patients with severe sepsis and impact on in-hospital mortality. *BMC Pediatr.* 2013;13(1):44.
9. Ariceta G, et al. Guideline for the investigation and initial therapy of diarrhea-negative hemolytic uremic syndrome. *Pediatr Nephrol.* 2009;24(4):687-696.