



Abstract:

A female adolescent presented to the emergency department with altered level of consciousness, fever, and hypotension. Initial management was focused on acute resuscitation. Shortly after arrival, the search for the cause of the patient's shock became acutely focused due to the finding of a positive urine pregnancy test result, but the ultimate etiology of her decompensation was not fully determined until days later in the intensive care unit.

Keywords:

shock; ectopic pregnancy; septic abortion

Sixteen-Year-Old Female Adolescent With Fever and Altered Mental Status

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At 4:30 AM, an ambulance arrived to the pediatric emergency department (PED) with a 16-year-old female adolescent found to be unresponsive at home. The patient had an initial Glasgow Coma Score of 4 (verbal response of moaning with painful stimuli). Her vital signs included a temperature of 39.6°C, heart rate (HR) of 132 beats per minute, respiratory rate of 44 breaths per minute, and blood pressure of 58/25 mm Hg, and her pulse oximetry was 100% on a nonrebreather mask. She had faint erythematous marks on her forehead with no areas of swelling or step off noted. Her pupils were small (2 mm), equal, and reactive bilaterally. She was tachycardic with regular rhythm; no murmurs were appreciated. Her lungs were clear bilaterally. The abdomen was slightly full but soft with normal bowel sounds. No organomegaly was noted. She had scant dark blood noted on a sanitary pad. Her extremities were warm, with brisk cap refill.

Her initial resuscitation included placement of 2 peripheral IVs, endotracheal intubation with placement confirmed by end-tidal CO₂ and chest radiograph, orogastric tube placement, and urinary catheter placement. Two liters of normal saline was pushed during which time her blood pressure improved to the 120s/70s. Laboratory tests were sent including venous blood gas, complete blood count, blood cultures, urine pregnancy test, and urine toxicology screen. Ceftriaxone was given. Initial venous blood gas prior to intubation showed pH 7.44, pCO₂ 28, pO₂ 61, HCO₃ 19, base excess -4.3, glucose 201, and lactate 43.6 mg/dL (normal 6.3-18.9).

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On brief history from the patient's parents, they reported that she woke up at around 2:00 AM complaining of right hip and back pain, and per the mother, she felt hot to touch. She was given ibuprofen and went back to sleep. She woke up again around 4:00 AM, at which point the parents reported that she was confused and saying things that did not make sense. For example, per her mother, the patient appeared to be dancing and told parents she was in London. The parents called 911, and when EMS arrived to the scene 6 minutes later, they reported that the patient was unresponsive with a Glasgow Coma Score of 3.

Parents reported that she was in her usual state of health prior to these overnight events. They denied any recent illnesses, fevers, or complaints of pain. They reported that she had no chronic medical conditions, had no allergies, and was not taking any medications. To their knowledge, she did not drink alcohol or use any illicit substances.

Upon stabilization in the ED, the patient was transported to radiology for a computerized tomography (CT) scan, and on arrival, the charge nurse ran over to report that the patient had a positive urine pregnancy test result. While in CT, the patient had continued tachycardia with an HR of 144 beats per minute, and she developed an elevated blood pressure of 137/97, with movement of her arms noted. She was given fentanyl and versed for sedation. The head CT was obtained, and the patient was brought back to the ED.

With this information and in the setting of improving vital signs, the process was started to transport the patient to an adult facility with obstetric services. Because of the critical nature of the patient, her positive pregnancy test result was disclosed to her parents. They reported that they were unaware of the pregnancy, and asked that no other family members be made aware in fear that the patient's older brothers would try to harm her boyfriend.

A bedside point-of-care ultrasound (US) was done which did not show evidence of an intrauterine pregnancy (IUP) but did show some free fluid in the pelvis. Bedside cardiac US showed no pericardial effusion but did show signs of decreased function. Transvaginal US was ordered, and pediatric surgery was consulted and came to the ED to evaluate the patient. A serum quantitative β -human chorionic gonadotropin (HCG) was sent. The patient's blood pressure decreased to 70s/30s, with an HR in the 110s, and an additional 2 L of normal saline was pushed.

Additional available laboratory data at this time included the CBC with a WBC 7.48, with 88.5%

neutrophils and 3.5% bands, hemoglobin 11.9, hematocrit 36.2, and platelets 231. Metabolic panel showed Na 137, K 3.7, chloride 100, CO₂ 19, BUN 10, creatinine 1.28, glucose 193, and C-reactive protein 5.6 mg/dL (normal 0.0-0.9).

Transvaginal US showed no evidence of an IUP, with free fluid adjacent to the left adnexa. Repeat hemoglobin less than 2 hours from initial laboratory tests was 9.4, and the patient was given O negative blood. Hypotension recurred despite continued fluid boluses, and a norepinephrine drip was started. Vancomycin and zosyn were added. At this time, the patient was deemed too unstable for transfer to an outside facility, and surgery planned for an exploratory laparotomy.

En route to the operating room (OR), in the ED hallway, the patient's HR dropped to 50 and she lost peripheral pulses. She was brought back into the ED, and pediatric advanced life support was initiated for pulseless electrical activity. She received chest compressions and 2 doses of epinephrine and had return of spontaneous circulation. A femoral line was placed during this time. She continued to be hypotensive, and an epinephrine drip was added. The patient was then prepared for transport, and just prior to leaving for the OR, the serum quantitative β -HCG resulted at 82 mIU/mL.

In the OR, patient had an exploratory laparotomy and a transesophageal echocardiogram which showed normal cardiac anatomy, normal origins of coronary arteries, and no evidence of a pericardial effusion. Her left ventricle was dilated with left ventricular ejection fraction of 22-23%. The exploratory laparotomy showed a small amount of clear peritoneal fluid with no blood noted. The entire gastrointestinal tract was examined without evidence of perforation. The appendix and gallbladder were normal. The uterus was noted to be hyperemic with an intact cul de sac. The fallopian tubes did not have evidence of ectopic pregnancy. The patient's abdomen was closed, and she was transported to the ICU in critical condition, where the definitive diagnosis was made 2 days later from a laboratory result and some crucial additional history.

DIFFERENTIAL DIAGNOSIS

This case depicts an adolescent female who presented to the ED with altered level of consciousness and vital signs consistent with uncompensated shock. When presented with a patient in shock, the initial focus should be on early recognition and aggressive management.¹ Although determining the type of shock is critical to guiding that initial

management, this can be challenging because initial vital signs may be similar and clues from the history or examination can be difficult to obtain in the critically ill or unresponsive patient. The types of shock that could feasibly explain this patient's presentation and therefore drive the differential diagnosis include hypovolemic, distributive, and cardiogenic shock.

Considering the presence of fever, septic shock (a form of distributive shock) would likely be high on the differential. Although infants have a much higher rate of sepsis compared to older children and adolescents, sepsis is a cause of significant morbidity and mortality for all pediatric age groups.² As a previously healthy immunized adolescent, causes of sepsis would include urosepsis; this patient was complaining of back pain prior to her decompensation at home, which could have been indicative of pyelonephritis. Intra-abdominal causes of sepsis such as ruptured appendicitis would also be on the differential.

Especially for a female adolescent, toxic shock syndrome (TSS) must also be considered. TSS is a toxin-mediated disease associated most often with *Staphylococcus aureus* and group A *Streptococcus*. Patients with TSS can present with fever and erythroderma or diffuse maculopapular rash, and can progress rapidly to shock within 48 hours. Complications can develop, especially in the absence of prompt recognition and treatment, including disseminated intravascular coagulation (DIC), acute respiratory distress syndrome, and acute kidney injury. Treatment includes broad-spectrum antibiotics that would generally be used for septic shock in this population (such as ceftriaxone and vancomycin) with the addition of clindamycin for toxin inhibition.³

Another etiology of sepsis to consider in the previously healthy adolescent population is sepsis secondary to community-acquired methicillin-resistant *S aureus*. There has been an increasing prevalence of severe illness secondary to methicillin-resistant *S aureus* in otherwise healthy adolescents in some communities. These patients often present with or develop skin, bone, joint, and/or pulmonary involvement.⁴

When the finding of a positive pregnancy test result is factored in, all of the above etiologies of sepsis would still apply, but one must also consider pregnancy specific causes. In particular, septic abortion would be on the differential. Septic abortion includes infection in the setting of incomplete spontaneous abortion (miscarriage), or induced surgical or medical abortion.⁵ Causes of sepsis in these scenarios may be secondary to

retained tissue that serves as a nidus of infection vs surgical complications such as uterine perforation.

Another form of distributive shock that must be considered in this patient is toxic ingestion. Considering the acute presentation with no reported preceding symptoms, drug ingestion or overdose would be consistent. The patient's elevated temperature could in fact have been hyperthermia in the setting of drug ingestion, and there are multiple types of toxic substances that can cause hyperthermia. Sympathomimetics, such as cocaine and 3,4-methylenedioxymethamphetamine, cause increased heat production, whereas anticholinergics, such as antihistamines and tricyclic antidepressants, cause decreased ability to dissipate heat from the body.⁶ Both of these categories of drugs also cause hypertension, which would be less consistent with this case because this patient presented with profound hypotension.

Salicylate poisoning can also cause elevated temperature. Depending on the amount ingested, neurologic effects can range from agitation to lethargy to coma. Laboratory tests done in the acute evaluation of salicylate overdose generally show a combined respiratory alkalosis and metabolic acidosis, unless the patient has significant central nervous system and respiratory depression, in which case both metabolic and respiratory acidosis would be present.⁷

Hypovolemic shock would also be high on the differential and specifically hemorrhagic shock in the setting of ruptured ectopic pregnancy. Ectopic pregnancy is the leading cause of pregnancy-related death in the first half of pregnancy in the United States, and adolescents with ectopic pregnancy have a higher rate of mortality than other age groups, likely because they wait longer to seek medical attention.⁸

In a hemodynamically unstable patient with a positive pregnancy test result and no visible IUP, ruptured ectopic pregnancy must be presumed until proven otherwise. This is a life-threatening emergency, and initial resuscitative measures include fluid resuscitation; laboratory tests including hemoglobin, serum quantitative HCG, and Rhesus (Rh) screening; and packed red blood cell transfusion.⁸ Immediate surgical intervention is warranted in this scenario and may be the only definitive way to rule out ruptured ectopic pregnancy.⁹

Other etiologies of shock that would be in the differential include other causes of hemorrhagic shock, such as trauma, although there was no known history in this case. Hypovolemic shock secondary to fluid losses could also be possible, although it seems less consistent with the clinical

presentation and the lack of preceding symptoms. Finally, considering the patient had a point-of-care US that showed decreased cardiac function, cardiogenic shock, for example, in the case of a previously undiagnosed myocarditis, must also be considered. Decreased function in this case could also be secondary to the acute decompensation and uncompensated shock itself.

CASE PROGRESSION AND DIAGNOSIS

On arrival to the ICU, the patient continued to be unstable in critical condition on norepinephrine and epinephrine drips, and a dopamine drip was also added. She had pink frothy endotracheal secretions, thought to be secondary to cardiogenic pulmonary edema. She was placed on vancomycin, meropenem, and gentamicin.

On hospital day 1, her blood culture grew *Escherichia coli* at 10 hours. The infectious disease service was consulted. During this initial day in the ICU, she also developed DIC. Overnight, she had progressive hypoxemia and was ultimately placed on high-frequency oscillatory ventilation. After some improvement initially, her arterial saturations declined and inhaled nitric oxide was added. On hospital day 1, the patient was started on continuous venovenous hemodialysis for worsening renal failure.

On hospital day 3, a gynecologist from an affiliated institution was consulted and came to evaluate the patient. On the same day, the patient's boyfriend was able to come to the hospital for the first time and provide further history. Gynecology spoke with the boyfriend and the patient's mother. The patient's boyfriend reported that he and the patient were aware of the pregnancy. He reported that 3-4 weeks prior to this presentation, the patient was seen in a clinic and took an abortifacient medication. She was supposed to follow up in clinic 2 weeks later but did not go to that appointment. Per her boyfriend, the patient had actually been having nausea, fevers, and abdominal pain for approximately 1 week prior to this acute decompensation.

Quantitative β -HCG was initially 82; repeat values were 50 and 70 mIU/mL on days 2 and 3 of hospitalization. With this information and the new history, repeat transvaginal US was done which showed an endometrial stripe thickened to 1.5 cm with echogenic material and increased vascularity, consistent with retained products of conception (Figure 1). The patient then proceeded to have a dilatation and curettage with evacuation of the uterus, done at the bedside in the ICU as the patient was deemed too unstable to be transported

to the OR. Tissue was sent to pathology, which later resulted as immature chorionic villi with hydropic changes, gestational endometrium, and decidual tissue with degeneration, consistent with retained products of conception.

In the next 2 days, the patient began to stabilize in regard to her cardiorespiratory status. Her antibiotics were narrowed to zosyn to cover *E coli* as well as potential polymicrobial sepsis considering retained products of conception. On hospital day 6, she was weaned off pressors and continuous venovenous hemodialysis was discontinued. On hospital day 7, the patient was extubated, after which she was alert, answering questions and following commands. Repeat echocardiogram showed normal right and left ventricular systolic function. She did continue to have significant elevation in her creatinine during her admission. On hospital day 16, the patient was discharged home. At the time of discharge, she was neurologically intact, and on follow-up laboratory tests a few months after discharge, her renal function had returned to normal.

CASE DISCUSSION

This patient was in uncompensated septic shock on arrival, and the diagnosis was initially confirmed by the finding of *E coli* bacteremia. Ultimately, the etiology of sepsis in this case was found to be retained products of conception, or septic abortion. Septic abortion is an infection of the placenta and fetal tissue and can follow spontaneous abortion, surgical abortion, or medically induced abortion, as in this case. Although septic abortion is very rare in the United States, worldwide abortion causes approximately 14% of maternal deaths, and the majority of these are related to unsafe abortion.¹⁰

The pathophysiology of septic abortion involves bacteria from the vaginal canal entering the uterus in the setting of surgical instrumentation or uterine bleeding. Once bacteria enter the maternal intervillous space of the placenta, infection can spread, and bacteremia and sepsis can result. Bacteremia is found in approximately 60% of septic abortion cases.¹⁰

Septic abortion is likely polymicrobial in nature; the specific organisms involved include vaginal flora as well as anaerobes. Septic abortions that involve toxin-producing bacteria, such as *Clostridium* species and group A *Streptococcus*, are associated with increased severity and higher mortality.¹⁰ Of note, a specific organism, *Clostridium sordellii*, causes a toxic shock syndrome and has been implicated as a causative agent in a number of septic abortion



Figure 1. Pelvic ultrasound showing endometrium with echogenic debris, consistent with retained products of conception, as well as associated pelvic ascites.

deaths in the United States.^{11,12} Women with septic abortion often present with vaginal bleeding, fevers, abdominal pain, chills, vomiting, malaise, and oliguria.¹³ In contrast, cases with *C sordellii* have generally presented without fever.¹⁰ If there is a delay in seeking care or if the symptoms develop days or weeks after a spontaneous or induced abortion, the presentation may be severe, and patients can present in compensated or uncompensated shock.

Initial evaluation and management of septic abortion depend on the severity of presentation; if a patient presents in septic shock, general sepsis protocols including early recognition, aggressive fluid resuscitation, and broad-spectrum antibiotic administration are key. Specific laboratory evaluation in these cases should include blood cultures, complete blood count, lactate, creatinine, Rh screening, and DIC panel. Ultrasound can be used to assess for evidence of retained products.¹⁰ Appropriate IV antibiotic regimens include aerobic and anaerobic coverage, such as piperacillin-tazobactam or gentamicin/clindamycin.

In addition to standard treatment for sepsis, in the case of septic abortion, surgical evacuation of any retained products of conception by uterine curettage is critical. Because the retained infected tissue in these cases is devitalized, IV antibiotics cannot

penetrate the tissue adequately, which is why prompt surgical removal is so important. This was evident in this case, as the patient did not show significant clinical improvement until after the curettage was performed.

SUMMARY

This case centers around a patient who presented with undifferentiated uncompensated shock in the setting of having a positive pregnancy test result. The subsequent course of this patient in the ED and the ICU illustrates the importance of early recognition and aggressive management of shock, while also exemplifying how it is equally important to continually reassess and refine the differential diagnosis as more information becomes available.

This case also highlights that even in the setting of a critically ill patient who requires immediate resuscitation, a detailed history is still crucial. In this case, much focus was placed on the reported history that the patient had no preceding symptoms prior to the night she decompensated, when ultimately her boyfriend provided a revised history that she did in fact have symptoms that were consistent with septic abortion. When caring for the adolescent patient, obtaining a history from the patient alone is ideal, and if the patient cannot

provide a history themselves, keep in mind that the patient's parents may not be the only, or best, source of ancillary information. ❏

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