

# WebM&M

Morbidity and Mortality Rounds on the Web

## Spotlight

Uterine Artery Injury during Cesarean Delivery Leads to Cardiac Arrests and Emergency Hysterectomy



Agency for Healthcare Research and Quality  
Advancing Excellence in Health Care



## Source and Credits

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- This presentation is based on the March 2024 AHRQ WebM&M Spotlight Case
  - See the full article at <https://psnet.ahrq.gov/webmm>
  - CME credit is available
- Commentary by: Claudia López, MD and Véronique Taché, MD
- AHRQ WebM&M Editors in Chief: Patrick Romano, MD, MPH and Deb Bakerjian, PhD, APRN, RN
  - Spotlight Editors: Patrick Romano, MD, MPH and Amy Nichols, EdD, RN
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# Objectives

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*At the conclusion of this educational activity, participants should be able to:*

- Identify the importance of hemorrhage risk assessments throughout pregnancy
- Actively recognize MEWS - Maternal Early Warning Signs for obstetric hemorrhage.
- Understand the importance of early management of obstetric hemorrhage.
- Recognize the importance of standardized protocols and built-in alerts to help to address staggering racial and ethnic disparities in maternal morbidity and mortality.

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# UTERINE ARTERY INJURY DURING CESAREAN DELIVERY LEADS TO CARDIAC ARRESTS AND EMERGENCY HYSTERECTOMY

A case highlighting the risk factors for obstetric hemorrhage, how standardized risk assessments can alert for potential obstetric hemorrhage and the role of obstetric simulation training to improve team communication and performance

## Case Details (1)

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- An obese woman who was 39-weeks pregnant with her second child presented to the hospital in active labor with regular uterine contractions.
- The patient was admitted to the Labor and Delivery unit and confirmed to have a full-term singleton fetus in vertex presentation.
- External monitoring was initiated.
- After two hours, she was found to have no cervical change and she was started on oxytocin.
- After several hours, the cervix was fully effaced and dilated, the fetal head was still relatively high (+2 station), and deep variable decelerations with minimal variability were noted, suggesting intrauterine hypoxemia.

## Case Details (2)

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- The physician obtained informed consent and then attempted delivery using a vacuum.
- When the vacuum did not work, the obstetrician performed an emergency cesarean delivery.
- The procedure was complicated by the need to extend the lower uterine segment incision bilaterally for safe extraction of the fetus.
- The operator's note described post-delivery repair of the right uterine incision but did not comment on the left side.
- The neonate had reassuring Apgar scores.

## Case Details (3)

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- Following the delivery, the patient was hypotensive and tachycardic. She was seen by three physicians, all of whom documented a differential diagnosis that included sepsis and intra-abdominal hemorrhage.
- With laboratory tests and computed tomography (CT) pending, the patient went into cardiac arrest, requiring a round of chest compressions and resuscitative efforts.
- She regained spontaneous circulation after receiving fluids and epinephrine.

## Case Details (4)

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- She was taken to the operating room for an emergency exploratory laparotomy and found to have nearly three liters of blood in her abdomen, with complete transection of the left uterine artery.
- After a “massive transfusion protocol” (MTP) was ordered, the operating physician called in a gynecologic oncologist to assist with an emergency hysterectomy.
- Although the patient survived, she suffered another cardiac arrest with residual cognitive impairment.



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# UTERINE ARTERY INJURY DURING CESAREAN DELIVERY LEADS TO CARDIAC ARRESTS AND EMERGENCY HYSTERECTOMY

## THE COMMENTARY

By Claudia López, MD and Véronique Taché, MD

## Overview (1)

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- This is an unfortunate case of an obstetric hemorrhage with delayed recognition, resulting in permanent cognitive impairment.
- The emergent nature of the patient's cesarean delivery increased her risk for complications including damage to nearby structures.
  - Specifically, the surgeon extended the uterine incision at both sides to allow unobstructed delivery of the fetus, presumably in the setting of a fetal head that was deeply impacted in the maternal pelvis.
  - The operative note commented on repair of the right side of the hysterotomy after delivery of the fetus, and it is unclear whether the surgeon overlooked the left side before proceeding with abdominal closure.
  - The operative note is also unclear as to whether hemostasis was ensured before closing the abdomen.

## Overview (2)

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- After delivery, the patient became tachycardic and hypotensive, suggesting ongoing blood loss or sepsis.
- Although three physicians evaluated her and considered intra-abdominal hemorrhage in the differential diagnosis, there is no mention of urine output, physical examination findings (e.g., temperature, abdominal distention), or “stat” laboratory testing (e.g., hemoglobin/hematocrit, disseminated intravascular coagulation [DIC] panel, lactic acid).
- CT imaging is helpful if ongoing intraabdominal bleeding is occurring, but it is not a prerequisite to take someone back to the operating room when there is strong suspicion for ongoing hemorrhage, particularly when the patient is unstable.
- In this case, the patient’s blood loss was so rapid that she went into cardiac arrest while awaiting CT, and this cardiac arrest triggered her resuscitation and emergency laparotomy.

## Overview (3)

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- With the finding of massive intra-abdominal bleeding, source identification became paramount.
- On inspection of the surgical site, transection of her left uterine artery was identified.
- This artery is at risk for damage with extension of the uterine incision when delivering the fetal head and if damaged, can lead to rapid, life-threatening bleeding.
  - Blood flow to the uterus, via the uterine arteries, increases from 50 mL/min in the non-pregnant state to 1 L/min or more at term.
- Although this patient survived, she suffered cognitive impairment and loss of her uterus.
- There were multiple points when earlier recognition of the ongoing obstetric hemorrhage could have changed this outcome.

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# BACKGROUND

## Background (1)

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- Worldwide, including the United States, obstetric hemorrhage is the leading cause of severe maternal morbidity<sup>1</sup> and preventable maternal deaths, accounting for up to 70% of preventable deaths.<sup>2</sup>
- The American College of Obstetricians and Gynecologists (ACOG) defines obstetric hemorrhage as blood loss of 1000mL or greater, regardless of route of delivery.<sup>3</sup>
  - Blood volume increases throughout pregnancy to prepare for blood loss at delivery.
  - Obstetric patients are often young and healthy, with the ability to compensate for significant volume loss (about 1500mL, which is 25% of total circulating blood volume) before their vital signs show signs of hypovolemia.<sup>4</sup>
  - When obstetric hemorrhage occurs, action should be taken, with the goal of intervening *before* vital signs become abnormal.<sup>5</sup>

## Background (2)

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- Multiple protocols and clinical pathways have been developed to reduce maternal morbidity and mortality secondary to obstetric hemorrhage.
- One of these protocols is the California Maternal Quality Care Collaborative (CMQCC) Quality Improvement Toolkit, which standardizes guidelines for Labor & Delivery units across the state of California – although the toolkit is available to any hospital system.
  - In California hospitals that adopted these standards between 2014 and 2016, there was a 20.8% reduction in severe maternal morbidity and mortality related to obstetric hemorrhage, compared with only a 1.2% reduction in nonparticipating hospitals, demonstrating the value of quality and safety efforts.<sup>6</sup>

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# APPROACHES TO IMPROVING SAFETY



# Approaches to Improving Safety (1)

- In order to maximize maternal care quality improvement efforts, the CMQCC and the National Partnership for Maternal Safety recommend the **4R Framework: Readiness, Recognition, Response, and Reporting/Systems Learning**.<sup>7,8</sup>
  - **Readiness:** birthing facilities should implement obstetric hemorrhage risk assessment, manage and treat iron deficiency anemia, plan for patients who decline blood products, assess for inherited bleeding disorders of pregnancy, have obstetric hemorrhage carts readily available, and regularly practice obstetrics simulations and drills.
  - **Recognition:** birthing facilities should actively manage the third stage of labor, define early recognition and response for obstetric hemorrhage, and regularly practice quantifying blood loss.
  - **Response:** birthing facilities must be prepared to administer medications for prevention and treatment of postpartum hemorrhage, blood product replacement, uterine tamponade and uterine artery embolization.
  - **Reporting/Systems Learning:** birthing facilities should regularly conduct debriefs and actively use outcome metrics to analyze hemorrhage cases.

## Readiness: Electronic Health Record (EHR) Tools (1)

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- While intrapartum recognition of obstetric hemorrhage is key, preparation for obstetric hemorrhage is just as important.
- Obstetric patients should have a hemorrhage risk assessment performed antenatally, on admission to Labor & Delivery, continuously throughout their labor course, during the postpartum period, or anytime their condition changes.<sup>7, 8</sup>
- The patient's hemorrhage risk should be embedded in the EHR, easy to locate, and automatically included in physician and nursing handoffs.<sup>9</sup>
- In this case, the patient's hemorrhage risk changed from admission to delivery, with a higher hemorrhage risk at the time of delivery due to her emergent cesarean delivery while in the second stage of labor.

## Readiness: Obstetric Simulations (1)

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- Simulation offers multidisciplinary teams the opportunity to practice high-stress scenarios in a safe environment.
- The Joint Commission requires annual drills to identify areas of improvement and success, ultimately contributing to quality improvement.<sup>9, 10</sup>
- The Joint Commission also recommends stage-based management for postpartum hemorrhage, including algorithms that could be rehearsed during obstetric simulation.
- Simulations improve team communication and allow rehearsal of patient care sequences with the ultimate benefit of improving patient outcomes.<sup>11</sup>
  - Any obstetric hemorrhage simulation should be interdisciplinary and interprofessional (e.g., obstetrics, anesthesia, nursing, imaging technology, blood bank) with the goal of addressing workflow and patient safety barriers, thereby leading to quicker recognition and action during an obstetric hemorrhage.
  - Each labor unit should have easily accessible and findable supplies to treat hemorrhage.

## Recognition: Early Action on Obstetric Hemorrhage Triggers (1)

- Early identification of obstetric hemorrhage is key to mitigating poor outcome. The Maternal Early Warning Signs (MEWS) system aims to improve recognition of pregnant patients at risk of clinical deterioration and facilitate early intervention.<sup>12</sup> MEWS was designed to account for the normal physiological changes of pregnancy, with triggers leading to earlier recognition of conditions that can contribute to maternal morbidity and mortality, including hemorrhage.

### Common Parameters Used in Maternal Early Warning Signs (MEWS) System

<b>Maternal temperature</b>	>38C or <36C
<b>Oxygen saturation</b>	<93%
<b>Heart rate</b>	>110 or <50 beats/min (bpm)
<b>Respiratory rate</b>	>24 or <10/minute
<b>Blood pressure</b>	Systolic >155 or <80 mm Hg Diastolic >105 or <45 mm Hg
<b>Altered mental status</b>	
<i>Based on Shields et al. (2016)</i>	

## Recognition: Early Action on Obstetric Hemorrhage Triggers (2)

- Many institutions have implemented best practice alerts (BPA) or warnings when these triggers are recognized by the EHR.
  - Automation can enable early recognition of obstetric hemorrhage and associated decompensation.
  - Abnormal findings should trigger more thorough bedside evaluation, including history-taking and physical examination, with focus on the cardiorespiratory and abdominopelvic examination.<sup>13,14</sup>
  - Changing vital signs generating BPAs to the health care team should be linked to easy-to-access institutional protocols for obstetric hemorrhage, order sets, and guidelines.
- In this case, the patient had abnormal vital signs and multiple providers considered intra-abdominal hemorrhage yet no work-up was initiated.
  - An alert with the institution's protocol for abnormal obstetric vital signs could help prompt urgent bedside evaluation and a pre-defined order set, including laboratory testing and resuscitative efforts that would include initiation of a massive transfusion protocol (MTP).
  - Continued abnormal vital signs should prompt escalated diagnostic and therapeutic interventions.

## Recognition: Early Action on Obstetric Hemorrhage Triggers (3)

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- Although race is not identified in the case presented, it is important to acknowledge and address large racial disparities in maternal health outcomes, including maternal hemorrhage, in the US.
- These disparities are increasingly attributed to systemic racism, not race as a genetic construct or marker of socioeconomic status.<sup>15,16</sup>
- The Centers for Disease Control and Prevention has reported that:
  - Non-Hispanic Black women were 2.6 times more likely to have a pregnancy-related death than non-Hispanic white women in 2021.<sup>17</sup>
  - Among women with obstetric hemorrhage, non-Hispanic Black and Hispanic women are 4.7 and 3.7 times more likely to die than white women, respectively, in one large American state.<sup>18</sup>

## Recognition: Early Action on Obstetric Hemorrhage Triggers (4)

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- These staggering disparities cannot be explained by race, but rather by systemic racism affecting how pregnant patients are evaluated and treated.
- As health care providers, we must recognize our potential for implicit bias and acknowledge that patients are not all treated equally, even if such inequity is unintentional.
- Standardized protocols with built-in triggers for objective data provide the infrastructure that enables equitable treatment of all patients, regardless of their background.

## Response (1)

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- The most common cause of postpartum hemorrhage is uterine atony.
  - This patient was at high risk for uterine atony, as she was in labor prior to her emergency cesarean delivery.
  - It is unclear if there was a component of hemorrhage due to atony or if the blood loss was only due to the left uterine artery transection.
- The updated CMQCC guidelines on obstetric hemorrhage now include tranexamic acid (TXA) as an adjunctive therapy for obstetric hemorrhage, regardless of cause.
  - If given within three hours of an obstetric hemorrhage, TXA reduces maternal mortality.
  - TXA is best used in addition to other medications and blood products, as needed.<sup>7</sup>



# Reporting/Systems Learning (1)

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- A growth mindset should prevail when analyzing the response to an adverse event, including an obstetric hemorrhage.
- After each hemorrhage, a debrief should be performed to evaluate the effectiveness of response with as many health care personnel as possible who were involved in the event.
  - Areas for improvement may be added to future simulations.
- Utilizing EHR-derived data, such as estimating how often appropriate actions are taken when a BPA is triggered, and comparing the frequency with which various order sets are used or modified, can inform efforts to improve the quality and safety of obstetric patients by better targeting future improvement efforts.

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# TAKE HOME POINTS

## Take-Home Points

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- Evaluation for obstetric hemorrhage starts before a patient delivers.
- Health care providers must continuously evaluate the patient's hemorrhage risk throughout the labor and postpartum processes, and plan appropriate precautions.
- The Maternal Early Warning Signs (MEWS) system is a standardized assessment, using obstetrically relevant vital signs, that can be automated in the EHR to facilitate best practice alerts (BPAs) and trigger faster assessment and workup.
- Abnormal vital signs with clinical changes in the obstetric population can suggest significant morbidity and require immediate action to reduce maternal morbidity and mortality.
- Regular obstetric simulations can improve team communication, processes and collaboration, ultimately improving patient outcomes.
- Standardized protocols such as the CMQCC Obstetric Hemorrhage Toolkit, aligned with the National Partnership for Maternal Safety, facilitate efforts to improve disparities in maternal morbidity and mortality.

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