The death of a mother during or after childbirth is one of the most tragic events in medicine. We have identified 10 specific recurrent errors that account for a disproportionate share of maternal deaths, primarily related to pulmonary embolism, severe preeclampsia, cardiac disease, and postpartum hemorrhage. Attention to these principles and the development and adoption of local or regional clinical protocols that address these issues will help reduce the likelihood and effect of error and of maternal mortality. (Obstet Gynecol 2012;119:360–4) DOI: 10.1097/AOG.0b013e3182411907

In medicine, a clinical pearl is a short aphorism meant to assist the clinician faced with a complex clinical situation in cutting to the essence of the matter and making a correct decision. For example, the thousands of extant published pages discussing the differential diagnosis of term bleeding, the difficulty in early diagnosis of placental abruption using even the most sophisticated tools, the rapid and unheralded manner in which an abruption can progress, and the potential devastating consequences of placental abruption are all easily summed up in seven words by the classic clinical pearl, “unexplained vaginal bleeding at term equals delivery.” Such “pearls” are intended to be default approaches of high value and low risk that the wise clinician will automatically incorporate into practice as a matter of course, barring some exceptional clinical circumstance. As with many important choices, the experienced clinician will have made the decision of how to act before faced with the actual situation.

Our experience with the management of critically ill patients and the performance of quality improvement-related reviews of cases of maternal death is extensive. Against this background, we are alarmed that a small number of errors continue to contribute to a large percentage of avoidable maternal deaths. We present here 10 such aphorisms, elevated to diamond status by virtue of their ability to prevent what is perhaps the most tragic event in all of medicine and by their universal applicability to nearly every patient, every time.

A Pregnant Patient Reporting Acute Chest Pain Always Should Undergo an Immediate Computed Tomography Angiogram

Pulmonary embolism remains a leading cause of death in pregnant women. Recent recommendations by the American College of Obstetricians and Gynecologists advocate the routine use of the pneumatic compression device in all women undergoing cesarean delivery who are not already receiving medical prophylaxis. However, fatal pulmonary embolism may present in any trimester. Importantly, 30% of women with pulmonary embolism have no associated clinical evidence of deep venous thrombosis; thus, in a woman presenting with acute chest pain, the absence of signs of deep venous thrombosis is not particularly reassuring. There are many causes of chest pain in pregnancy, most of them benign. However, for a pregnant woman reporting acute chest pain, no combination of clinical experience or judgment, history, physical examination, or laboratory tests can exclude pulmonary embolism during pregnancy with sufficient sensitivity to obviate the need for a definitive test. Further, an effective treatment is readily available; the risk of death from pulmonary embolism is extremely low once the patient has been adequately anticoagulated. In a disturbing number of cases of death attributable to pulmonary embolism,
chest pain was ignored or definitive diagnosis and treatment were delayed by unnecessary consultation or meaningless nondiagnostic testing. In a clinically stable pregnant patient reporting acute chest pain, move directly to computed tomography angiogram with contrast or an equivalent diagnostic test. If clinical suspicion is high, a loading dose of heparin may also be warranted pending the results of the definitive test.

A Patient With Preeclampsia Reporting Shortness of Breath Should Undergo a Chest X-ray Immediately

Shortness of breath is common, especially in late pregnancy, and, in isolation, it is rarely of clinical consequence. A physician-elicited affirmative response to the question, “are you having any shortness of breath” during a routine examination justifies the use of clinical judgment regarding the need for additional testing, if any. However, a patient who volunteers a report of shortness of breath needs more careful evaluation. This is especially true in hospitalized women with preeclampsia who are particularly prone to the development of pulmonary edema after the administration of intravenous fluids during the labor process. Undiagnosed pulmonary edema is a leading cause of preventable maternal death; in most cases, reports of shortness of breath were not taken seriously or evaluated promptly. Although the auscultation of rales remains a valuable diagnostic tool, few obstetricians or obstetric nurses will have the opportunity to detect pulmonary rales even once in a decade. Thus, in most cases, a physical finding of “clear lungs” by such clinicians is insufficient when the risk of pulmonary edema is high, and a simple and inexpensive test (chest X-ray) is available that will detect all cases of life-threatening pulmonary edema. While waiting for the chest X-ray, pulse oximetry will assure the clinician of adequate oxygenation and determine the need for oxygen supplementation.

Any Hospitalized Patient With Preeclampsia Experiencing Either a Systolic Blood Pressure of 160 or a Diastolic Pressure of 110 Should Receive an Intravenous Antihypertensive Agent Within 15 Minutes

Cerebral hemorrhage secondary to uncontrolled hypertension remains a leading cause of death in women with preeclampsia. In all too many cases, chart review reveals untreated blood pressures significantly exceeding 160/110 mm Hg preceding the event. This is particularly tragic given the widespread availability of effective antihypertensive agents, including labetolol, nifedipine, and hydralazine. We have found that delayed treatment often stems from confusion. Must both systolic and diastolic pressures exceed these levels to justify treatment? Should the clinician first repeat the blood pressure assessment and, if so, how long must such values persist to justify treatment? Are these pressures of equal significance in the patient with chronic hypertension and superimposed preeclampsia? And how about the risk of “bottoming out” the blood pressure and causing fetal hypoperfusion? Although such questions are all reasonable, they can generally be easily dealt with by the realization that no hospitalized pregnant woman with a blood pressure of either 160 systolic or 110 diastolic will be harmed by a single intravenous bolus of 5–10 mg of hydralazine or 20 mg of labetolol. Yet, many women will benefit. There is just no reason to withhold such therapy. We recommend making this one an automatic response. The need for and timing of subsequent doses can be determined by the initial clinical response. Protocols are available to guide such therapy.

Angiographic Embolization Is Not Meant to Be Used for Acute, Massive Postpartum Hemorrhage

Angiographic embolization is a valuable tool in which the bleeding vessel can be visualized radiographically and then occluded intravenously. In many cases, the use of this technique allows the clinician to achieve hemostasis while avoiding laparotomy and hysterectomy. Unfortunately, outside of select tertiary care institutions, a considerable period of time is generally necessary to arrange for and perform such vascular catheterization and embolization. We continue to see cases in which preventable maternal death results when the clinician fails to move rapidly to definitive surgical treatment of hemorrhage after medical therapy has proven ineffective and instead gets a radiology consultation as the patient exsanguinates. Thus, although this procedure is of immense value in the patient with low-grade ongoing intraabdominal or retroperitoneal hemorrhage, it is of little value in acute, massive postpartum bleeding when death may result in minutes not hours. We also would observe that in the latter situation, attempts to second-guess a decision for life-saving hysterectomy by individuals not present at the bedside must be viewed only with contempt.
Cardiac disease in pregnancy is uncommon, yet is a leading cause of serious morbidity and maternal death. Few general obstetricians or even cardiologists will have sufficient experience with complex heart disease in pregnancy to accurately assess a woman’s risk or to recommend a management plan that takes into account the complex interactions between the physiologic changes of pregnancy, the underlying cardiac condition, and the interaction of both with fetal physiology. In addition, some conditions thought to be stable for years (for example, an unrepaired ventricular septal defect) may, in fact, have evolved to the point at which life-threatening secondary complications may exist that will first manifest themselves clinically in response to the physiologic changes of pregnancy (for example, secondary pulmonary hypertension). At times, a simple telephone call with an experienced maternal–fetal medicine specialist will suffice; at other times, hands-on consultation will be preferred. When significant distances are involved, or when an experienced maternal–fetal medicine specialist is not available locally, remote transmission of data or images to an individual with such expertise may facilitate the consultation. Many cardiac conditions are well-tolerated and may be managed even in a small facility. However, currently, heart disease in pregnancy is too uncommon and complex, and the stakes are too high to do so without experienced maternal–fetal medicine input.

If More Than A Single Dose of Medication Is Necessary to Treat Uterine Atony, Go to the Patient’s Bedside Until the Atony Has Resolved

Uterine atony remains a leading cause of postpartum hemorrhage, and deaths continue to occur despite the availability of potent agents to combat this condition. In a recent review of more than one million births, all deaths from postpartum hemorrhage were deemed to have been preventable with better care. Unfortunately, communication remains a major patient safety issue in medicine, and it is difficult for the obstetrician to obtain a true picture of the nature and degree of the bleeding and the stability of the patient from telephone reports alone. We are disturbed at the frequency with which we see the telephonic ordering of repeat doses of uterotonic agents in a bleeding patient. If the patient needs more than a single dose of methergine or prostaglandins for the treatment of postpartum atony, she needs an evaluation by an obstetrician at the bedside.

Never Treat “Postpartum Hemorrhage” Without Simultaneously Pursuing an Actual Clinical Diagnosis

Postpartum hemorrhage is not a diagnosis. It is a clinical sign of an underlying condition that is amenable to diagnosis. Thus, making the diagnosis of postpartum hemorrhage in a bleeding patient is akin to making the diagnosis of fever in a septic patient. Certainly, a high fever may call for cooling measures while the underlying cause of the sepsis is investigated and specific therapeutic measures directed at the cause of sepsis are undertaken. Similarly, hemorrhage often calls for blood and component therapy while the underlying cause of the bleeding is investigated and treated. In both situations, however, definitive diagnosis of the cause of fever or hemorrhage is ultimately necessary. Postpartum hemorrhage has a short differential diagnosis—uterine atony, retained placenta and placenta accreta, genital tract lacerations, and coagulopathy. After extensive hemorrhage without adequate replacement of clotting components, or in the presence of significant prolonged tissue hypoperfusion, coagulopathy may also complicate one of the three primary diagnoses. Making the diagnosis is essential because the treatment for each of these conditions is different. We continue to see avoidable maternal deaths resulting from a clinician giving repeated doses of prostaglandins for the treatment of “postpartum hemorrhage” for what is ultimately determined at autopsy to be uterine rupture or placenta accreta. When confronted with the clinical sign of postpartum hemorrhage, aggressively pursue a specific diagnosis and give appropriate specific therapy for that diagnosis while supporting the patient with blood and component therapy as necessary.

In the Postpartum Patient Who Is Bleeding or Who Recently Has Stopped Bleeding and Is Oliguric, Furosamide Is Not the Answer

Furosamide (Lasix) is an important drug and will reliably result in increased urine output, at least in the short-term, in almost any pregnant or recently delivered woman. This comes, of course, at the expense of intravascular volume. Whereas this is exactly the desired effect in women with pulmonary edema or fluid overload, diminished intravascular volume is not good in a patient who has lost or who is losing significant blood. The authors continue to see maternal deaths in which a patient with postpartum hem-
or hemorrhage becomes oliguric and is administered furosemide, leading to cardiac arrest. In most cases, this error does not occur in isolation but is superimposed on delays in diagnosis and therapy and insufficient blood and volume replacement. In some cases, this error is made by a well-meaning internist who has been called in to consult or, in some cases, to manage the patient with postpartum hemorrhage. Two observations are pertinent in this regard. First, the kidneys of a young healthy woman will generally tolerate many hours of oliguria; resolution of this condition per se is not of paramount importance in a patient with massive hemorrhage. Second, oliguria in this setting most commonly is prerenal (ie, it indicates continued hypovolemia) and is best-addressed by additional fluid or blood replacement (or both). Thus, when any uncertainty exists regarding the etiology of the oliguria, avoid the administration of diuretics, pending a thorough work-up; acute tubular necrosis is usually reversible and is always preferable to hypovolemia-induced cardiac arrest. We also venture to add a third point, the management of acute postpartum hemorrhage should be well within the capabilities of any well-trained obstetrician. If help is needed in the management of such a patient, another obstetrician, anesthesiologist, general surgeon, or trauma specialist experienced in the management of hemorrhagic shock should be called, rather than relying on a nonsurgical specialist with little experience in the critical surgical considerations necessary in the management of postpartum bleeding.

Any Woman With Placental Previa and One or More Cesarean Deliveries Should Be Evaluated and Delivered in a Tertiary Care Medical Center

The relationship between placenta previa with previous cesarean deliveries and placenta accreta has been well-known for decades. The incidence of placenta accreta is increasing as a result of the ongoing increase in the rate of cesarean delivery. Available diagnostic tools such as color or power Doppler ultrasonography and magnetic resonance imaging are useful in the investigation of possible placenta accreta in patients fitting this clinical description. However, in our experience, no current diagnostic technique has sufficient negative predictive value to justify the delivery of a woman with placenta previa and one or more previous cesarean deliveries in a center without full blood-banking capabilities, dedicated anesthesia support, and the availability of other surgical specialists. The management of such patients in specialized centers is associated with improved maternal outcomes.

Both of the authors are experienced surgeons who have personally managed numerous cases of placenta accreta and its variants. Yet, we agree that perhaps our greatest clinical nightmare would be to find ourselves managing such a case in a small facility without the type of clinical and laboratory back-up described. Despite patient inconvenience, some cases in any realm of medicine just have to be managed in a tertiary care center. This is one of them.

If Your Labor and Delivery Unit Does Not Have a Recently Updated Massive Transfusion Protocol Based on Established Trauma Protocols, Get One Today

Most obstetricians were trained in an era in which blood-component therapy was guided primarily by the results of laboratory testing. Recent data, however, suggest that standard coagulation tests often are not clinically relevant because they do not reflect the in vivo hemostatic capacity in a bleeding patient and because the results often are delayed. Improved outcomes have been demonstrated in massively transfused patients who receive less crystalloid replacement and earlier and more aggressive infusion of red cells, platelets, and especially fresh-frozen plasma in ratios that approximate those of whole blood (1:1:1). Such therapy may mitigate the lethal triad of acidosis, hypothermia, and coagulopathy, which often leads to death in massively transfused patients. A complete discussion of the rationale behind such protocols and their details is beyond the scope of this discussion but is available elsewhere. Such trauma-based transfusion protocols are particularly useful in obstetrics, because obstetric hemorrhage and trauma are in a class by themselves in terms of volume and acuity of blood loss. These published protocols may be readily adapted to the obstetric patient. If the labor and delivery unit does not have such a trauma protocol-based policy, we urge that any of the available well-constructed massive transfusion protocols should be accessed, adapted, and adopted. This recent change in thinking regarding the early use of component therapy also makes a great topic for departmental continuing medical education.

We emphasize that these “clinical diamonds” do not represent an exclusive standard of care. As with any guidelines, unusual or atypical situations may arise in which alternative care is equally acceptable. We fully recognize that adherence to such maxims will often require more time and, in some cases, expense than turns out, in retrospect, to have been necessary. However, a key feature of these maxims is the addition of a critical margin of safety and a
relative lack of significant additional risk, a key feature of any patient safety program. In addition, many of the errors described may be avoided by adoption of facility policies and procedures that serve to automatically direct care in the appropriate direction, barring a specific physician order to the contrary. Such a systems-based approach is a key feature of patient safety and high-reliability efforts.24,25 We urge all clinicians to seriously consider the incorporation of these approaches to care into their practice.

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