Mechanisms of Hemostasis at Cesarean Delivery

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KEYWORDS

• Hemostasis • Hemorrhage • Cesarean delivery • Uterine atony
• Medical therapy • Uterotonic agents • Surgical therapy

Postpartum hemorrhage constitutes a major cause of maternal morbidity and mortality worldwide. Annually, obstetric hemorrhage causes an estimated 140,000 maternal deaths.[1–3] Most of these deaths occur in Africa and Asia, primarily as a result of postpartum hemorrhage.[1,2] Decreasing maternal mortality is an important and continued focus of international public health efforts. In the last century, maternal deaths from hemorrhage in the developed world have decreased significantly. The introductions of blood product replacement, improved surgical techniques, and advances in critical care medicine have contributed to this welcome decline. Hemorrhage remains the second most common cause of pregnancy-related mortality in the United States, however, and accounts for approximately 17% of all maternal deaths.[4]

Prompt recognition and proper management of hemorrhage at the time of cesarean delivery are becoming increasingly more important for providers of obstetrics. In the last decade alone, the cesarean delivery rate has increased more than 50% in the United States—from 20.7% in 1996 to 31.1% in 2006.[5,6] Many factors have been implicated in this rise, including obstetric factors (eg, the decline in vaginal birth after cesarean delivery and operative vaginal delivery), maternal factors (eg, the increasing rates of obesity and mothers of advanced maternal age), and medicolegal concerns. Similar trends have been seen in many other areas of the world, from the United Kingdom to China.[7,8]

This article focuses on the etiology, risk factors, and management of hemorrhage at the time of cesarean delivery. Medical and surgical interventions can improve maternal outcomes of obstetric hemorrhage after cesarean delivery.

DEFINITION

There is no precise definition for postpartum hemorrhage. The lack of a standardized method of defining and measuring obstetric hemorrhage affects clinical practice and

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hinders research efforts into this condition. The average blood loss after cesarean delivery has been shown to be 1000 mL.[9] Traditionally, postpartum hemorrhage after cesarean delivery has been defined as any loss more than this amount. Clinical estimation of blood loss at delivery is notoriously inaccurate, however. Visual estimation has been shown to be inexact; this assessment is further complicated by the presence of amniotic fluid.[10,11] Estimates of blood loss are usually underestimated, with greater discrepancies occurring as blood loss increases.

A decline in hematocrit level of 10% after delivery has been proposed as a definition of postpartum hemorrhage.[12] Although potentially useful for quality assurance and research, this retrospective laboratory diagnosis is not valuable in the acute management of obstetric hemorrhage. Hemoconcentration resulting from intrapartum dehydration or pre-eclampsia also may lead to a significant fall in hematocrit in the postpartum period in the absence of significant blood loss. In addition, this degree of decline may not lead to symptoms in all patients.

Severe hemorrhage can also be defined by the requirement of blood transfusion or excessive bleeding that results in symptoms (dizziness, syncope) or signs (hypotension, tachycardia, oliguria) of hypovolemia. Both of these definitions are influenced by a patient's overall health and preoperative status, but they represent the best descriptions available. In most cases, the degree of hemodynamic compromise or shock parallels the volume of blood lost. Most women experience only mild symptoms with no signs of hypovolemia after blood loss of 1000 mL (15% of blood volume). Conversely, a loss of 3000 mL (45% of blood volume) leads to severe shock and cardiovascular collapse in most patients, however.

FREQUENCY OF HEMORRHAGE

The incidence of postpartum hemorrhage varies greatly and depends on the criteria used to define this condition. Primary postpartum hemorrhage, hemorrhage within the first 24 hours after delivery, occurs after approximately 4% to 6% of all deliveries.[12] Excessive bleeding after this time is referred to as secondary postpartum hemorrhage. Primary postpartum hemorrhage is generally associated with more significant bleeding and greater morbidity and is the focus of this article.

In the large prospective cohort study on cesarean delivery by the Maternal Fetal Medicine Units Network, 2.6% of approximately 57,000 women studied received a transfusion.[13] More women received a blood transfusion after primary cesarean delivery (3.2%) than repeat cesarean delivery (2.2%), probably because women who undergo a primary cesarean delivery have other risk factors for hemorrhage, including the presence of labor. These relatively low cesarean-associated transfusion rates are similar to previous studies.

IMPACT OF PREGNANCY ON HEMOSTASIS

Several physiologic changes occur over the course of pregnancy in anticipation of blood loss at delivery. Maternal blood volume expands by 40% to 50% during pregnancy as the result of increases in plasma volume and red cell mass. Fibrinogen increases markedly, as do several other procoagulant factors, which leads to the hypercoagulable state of pregnancy. These changes protect the mother from consequences of blood loss and facilitate hemostasis postpartum.[9]

Blood flow to the gravid uterus at term is approximately 800 to 1000 mL/min. Without an efficient mechanism of decreasing this flow, the previously mentioned adaptations would be insufficient to prevent maternal exsanguination. Control of postpartum bleeding occurs primarily through contraction of the myometrium surrounding