

## OBSTETRICS

# Effects of onset of labor and mode of delivery on severe postpartum hemorrhage

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**OBJECTIVE:** Our purpose was to study the impact of labor onset and delivery mode on the risk of severe postpartum hemorrhage.

**STUDY DESIGN:** This was a population-based study of 307,415 mothers who were registered in the Medical Birth Registry of Norway from 1999-2004.

**RESULTS:** Severe postpartum hemorrhage occurred in 1.1% of all mothers and in 2.1% of those mothers with previous cesarean section delivery (CS). Compared with spontaneous labor, hemorrhage risk was higher for induction (odds ratio [OR], 1.71; 95% confidence interval [CI], 1.56–1.88) and prelabor CS (OR, 2.05; 95% CI, 1.84–2.29). The

risk was 55% higher for emergency CS and half that for vaginal deliveries (OR, 0.48; 95% CI, 0.43–0.53), compared with prelabor CS. The highest risk was for emergency CS after induction in mothers with previous CS (OR, 6.57; 95% CI, 4.25–10.13), compared with spontaneous vaginal delivery in mothers with no previous CS.

**CONCLUSION:** Induction and prelabor CS should be practiced with caution because of the increased risk of severe postpartum hemorrhage.

**Key words:** delivery mode, emergency CS, labor onset, prelabor CS, severe postpartum hemorrhage

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Severe postpartum hemorrhage is a major cause of maternal death worldwide.<sup>1</sup> Although severe postpartum hemorrhage is not the main cause of maternal deaths in most developed countries, the morbidity that is associated with severe hemorrhage remains a major problem.<sup>2-6</sup>

The onset of labor and mode of delivery, especially delivery by cesarean section (CS), are prominent risk factors that are associated with severe postpartum hemorrhage.<sup>2,6-8</sup> There is strong evidence that CS delivery is associated with an increased risk of peripartum hysterectomy.<sup>9-12</sup> Even in the absence of abnormal placentation, blood loss is higher for CS delivery than for vaginal delivery.<sup>13</sup> However, it has been proposed that the induction of labor and the underlying indications of CS delivery might be the real causes of hemorrhage, rather than the procedure itself.<sup>14,15</sup> The estimation of hemorrhage risk for CS delivery that is performed before labor after adjustment for other risk factors may reveal the risk of severe postpartum hemorrhage that is related to the procedure itself.

As in other developed countries, the CS delivery rate in Norway has increased significantly in recent decades, from 1.8% in 1967 to 16.4% in 2005.<sup>16</sup> Previous CS delivery and mothers' explicit requests account for 9% and 8%, respectively, of all indications for CS delivery.<sup>17</sup> Our aim was to study the impact of labor onset and delivery mode on the risk of severe postpartum hemorrhage. All types of labor onsets and delivery modes, including prelabor CS, were analyzed.

Results that were obtained would be useful when counseling pregnant women who request CS delivery, especially those with previous CS delivery.

## MATERIALS AND METHODS

We used data from the Medical Birth Registry of Norway for 307,415 women with pregnancies from 16 weeks of gestation who gave birth between January 1, 1999-April 30, 2004. Birth notification to the Medical Birth Registry of Norway is compulsory. Midwives or physicians who attend a birth must complete a standardized form within 7 days after delivery. The form contains information on maternal health before and during pregnancy, detailed information about the delivery and complications that occurred in the intrapartum or postpartum period, and information about the newborn infant. The population was divided further into 2 groups, based on the presence or absence of previous CS delivery: (1) 291,604 mothers with no previous CS delivery and (2) 15,811 mothers with previous CS delivery, which included any woman who had at least 1 CS delivery before the current pregnancy.

The study was approved by the Regional Ethical Committee for Medical Research, the Norwegian Data Inspec-

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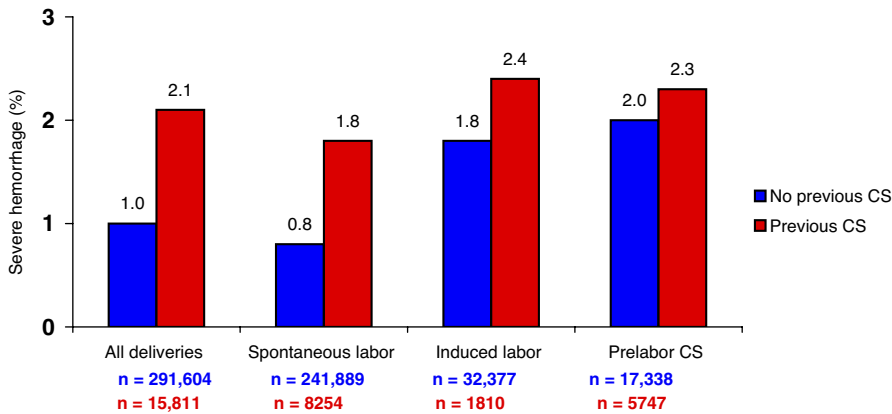
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**FIGURE 1**  
**Prevalence of severe postpartum hemorrhage for the onset of different labor modes**



CS, cesarean section.

Al-Zirqi. Labor and delivery effects on severe postpartum hemorrhage. *Am J Obstet Gynecol* 2009.

torate, and the Norwegian Directorate of Health.

The main outcome measure was *severe postpartum hemorrhage*, which was defined as a visually estimated blood loss of >1500 mL within 24 hours after delivery or the need for a blood transfusion after delivery, regardless of the amount of blood loss, which was coded as “yes” or “no.” Blood transfusion after delivery was given only when there were clinical symptoms and signs of acute anemia. According to Norwegian guidelines, blood transfusion rarely is given to mothers with a hemoglobin level of  $\geq 7$  gm/dL.<sup>18</sup> Severe postpartum hemorrhage was identified in a ticked box on the birth registration form.

The explanatory variables included *onset of labor*, which was defined as spontaneous labor onset, induced labor onset, and prelabor CS delivery (CS performed before labor onset) and *mode of delivery*, which was defined as spontaneous vaginal delivery, operative vaginal delivery, emergency CS delivery (CS performed after labor onset), and prelabor CS delivery. Complete information on the onset of labor and mode of delivery was available. All the explanatory variables were identified through ticked boxes on the birth registration form.

The confounding variables included demographic, medical, and obstetric factors, which might be underlying reasons

for performing a CS delivery or inducing labor and which, at the same time, might be contributing factors to severe hemorrhage. The following demographic variables were used: age in years at the time of delivery (missing data for 74 mothers), parity (missing data for 478 mothers; 0.2%), and ethnicity, which was categorized into European, Middle Eastern, Southeast Asian, sub-Saharan African, and others (missing data for 8255 mothers; 2.7%). The medical variables included medical diseases before pregnancy, such as cardiac disease, epilepsy, and diabetes mellitus. The pregnancy-related obstetric variables included multiple pregnancies, HELLP (hemolysis, elevated liver enzymes, and low platelet count) syndrome, preeclampsia, gestational diabetes mellitus, polyhydramnios, and gestational age calculated by ultrasound measurements at 18 weeks of pregnancy (missing data for 2340 mothers; 0.8%). The labor-related obstetric variables included prolonged labor, augmentation by oxytocin, macrosomia, intrapartum pyrexia, and uterine rupture.

Frequency analysis was used to measure the prevalence of severe postpartum hemorrhage. Cross-tabulation was used to quantify the prevalence of severe postpartum hemorrhage that was related to different onsets of labor and modes of delivery. The association between severe

postpartum hemorrhage and labor onset was analyzed with 3 logistic regression models: (1) spontaneous labor onset (reference) vs induced labor onset, (2) spontaneous labor onset (reference) vs prelabor CS delivery, and (3) induced labor onset (reference) vs prelabor CS delivery. The association between severe postpartum hemorrhage and mode of delivery was analyzed with 4 logistic regression models, with prelabor CS delivery as reference: (1) prelabor CS delivery vs spontaneous vaginal delivery, (2) prelabor CS delivery vs operative vaginal delivery, (3) prelabor CS delivery vs all vaginal deliveries (spontaneous and operative), and (4) prelabor CS delivery vs emergency CS delivery.

Cross-tabulations were used to identify causes of severe postpartum hemorrhage at different delivery modes.

Finally, the association between severe postpartum hemorrhage and delivery mode after both spontaneous and induced labor was analyzed with logistic regression in 3 separate groups: (1) primiparous women, (2) multiparous women with no previous CS delivery, and (3) mothers with previous CS delivery. The odds ratios (ORs) for each model were adjusted for the confounding variables mentioned earlier. The level of significance was set at a probability value of  $< .05$ ; data were analyzed with SPSS statistical software (version 15; SPSS, Inc, Chicago, IL).

## RESULTS

Severe postpartum hemorrhage was observed in 3333 mothers of the total population (prevalence, 1.1%). Cases were identified in 330 of mothers (2.1%) with and in 3003 of mothers (1.0%) with no previous CS delivery. The prevalence was higher at prelabor CS delivery and induction than at spontaneous labor onset (Figure 1). Induction of labor increased the prevalence of severe postpartum hemorrhage at every mode of delivery (Figure 2). Compared with spontaneous labor onset, induction significantly increased the rate of both emergency CS delivery (OR, 3.69; 95% confidence interval [CI], 3.57–3.82) and uterine rup-

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