OBSTETRICS

# Risk factors for complete uterine rupture

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**BACKGROUND:** Complete uterine rupture is a rare peripartum complication associated with a catastrophic outcome. Because of its rarity, knowledge about its risk factors is not very accurate. Most previous studies were small and over a limited time interval. Moreover, international diagnostic coding was used in most studies. These codes are not able to differentiate between the catastrophic complete type and less catastrophic partial type. Complete uterine rupture is expected to increase as the rate of cesarean delivery increases. Thus, we need more accurate knowledge about the risk factors for this complication.

**OBJECTIVE:** The objective of the study was to estimate the incidence and risk factors for complete uterine rupture during childbirth in Norway.

**STUDY DESIGN:** This population-based study included women that gave birth after starting labor in 1967–2008. Data were from the Medical Birth Registry of Norway and Patient Administration System, complemented with information from medical records. We included 1,317,967 women without previous cesarean delivery and 57,859 with previous cesarean delivery. The outcome was complete uterine rupture (tearing of all uterine wall layers, including serosa and membranes). Risk factors were parameters related to demographics, pregnancy, and labor. Odds ratios for complete uterine rupture were computed with crude logistic regressions for each risk factor. Separate multivariable logistic regressions were performed to calculate the adjusted odds ratios and 95% confidence intervals.

**RESULTS:** Complete uterine rupture occurred in 51 cases without previous cesarean delivery (0.38 per 10,000) and 122 with previous cesarean delivery (21.1 per 10,000). The strongest risk factor was sequential labor induction with prostaglandins and oxytocin, compared with spontaneous labor, in those without previous cesarean delivery (adjusted odds ratio, 48.0, 95% confidence interval, 20.5–112.3) and those with previous cesarean delivery (adjusted odds ratio, 16.1, 95% confidence interval, 8.6–29.9). Other significant risk factors for those without and with previous cesarean delivery, respectively, included labor augmentation with oxytocin (adjusted odds ratio, 22.5, 95% confidence interval, 10.9–41.2; adjusted odds ratio, 4.4, 95% confidence interval, 2.9–6.6), antepartum fetal death (adjusted odds ratio, 15.0, 95% confidence interval, 6.2–36.6; adjusted odds ratio, 4.0, 95% confidence interval, 1.1–14.2), and previous first-trimester miscarriages (adjusted odds ratio, 9.6, 95% confidence interval, 5.7–17.4; adjusted odds ratio, 5.00, 95% confidence interval, 3.4–7.3). After a previous cesarean delivery, the risk of rupture was increased by an interdelivery interval <16 months (adjusted odds ratio, 2.3; 95% confidence interval, 1.1–5.4) and a previous cesarean delivery with severe postpartum hemorrhage (adjusted odds ratio, 5.6; 95% confidence interval, 2.4–13.2).

**CONCLUSION:** Sequential labor induction with prostaglandins and oxytocin and augmentation of labor with oxytocin are important risk factors for complete uterine rupture in intact and scarred uteri.

**Key words:** antepartum fetal death, augmentation of labor with oxytocin, complete uterine rupture, medical records, previous cesarean delivery, previous miscarriage, prostaglandin, risk factor, sequential induction of labor

Complete uterine rupture is a rare peripartum complication, often associated with a catastrophic outcome for both mother and child.[1] A scarred uterus, mostly because of a previous cesarean delivery (CD), substantially increases the risk of uterine rupture.[1,2]

In Norway, the incidence of complete uterine rupture has significantly increased in recent years in both women with and without previous CD.[3] This increase was partly explained by an increase in risk factors related to labor management, mainly induction and augmentation of labor.[3] Among mothers without a previous CD in Norway, labor is induced with prostaglandins, oxytocin, amniotomy, and other mechanical methods such as transcervical balloon catheter. Oxytocin induction was predominantly used in 1967–1977, with hardly any use of prostaglandins. Prostaglandins were increasingly used since 1978.[3]

All mothers with 1 previous CD are offered a trial of labor unless there is absolute contraindication against vaginal delivery. The trial of labor after previous CD is high in Norway, around 63.6%.[4] Among those with a trial of labor, there is 80% vaginal birth.[4] Prostaglandin E2 was used in induction in this group until 2004 when the transcervical balloon started dominating.

Augmentation of labor with oxytocin has increasingly been used in recent years in which almost one third of the women giving birth receive oxytocin.[3] Here we further explore factors that may be associated with complete uterine rupture.

This study aimed to identify risk factors for complete uterine rupture after starting labor in a validated population in Norway that gave birth in 1967–2008. We performed separate analyses for women with and without a previous CD.

## Materials and Methods

### Overview

This population-based registry study was complemented with information from corresponding medical records. The Regional Ethics Committee (2010/1609-4) and the Data Inspectorate of Norway approved the study.

We used 2 independent data sources to identify possible cases of uterine rupture.

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First, we searched the Medical Birth Registry of Norway (MBRN), established in 1967. This national registry contains information on all births in Norway after 16 weeks of gestation regarding maternal health, information about delivery and complications, and information about the newborn. The midwives attending a birth complete and send a standardized MBRN form within 7 days after delivery.

Second, we searched the Patient Administration System (PAS), which is a local registry at each maternity unit. These registries maintain records of all diagnoses for in-patients since 1970. We requested permission to perform a PAS registry search from all maternity units (n = 48) in Norway, and 21 units agreed to participate. These 21 units were distributed throughout Norway, and they exhibited a wide range of delivery rates, from <500/year to ≥3000/year. The target population included maternities recorded in these 21 units during 1967−2008 (n = 1,443,271), which represented 59.81% of the pregnant population in Norway. We excluded individuals with missing registration numbers in the MBRN (missing = 2,716) or missing gestational age (missing = 8303). Hence, the sample included 1,432,252 maternities.

In this study, we examined risk factors for complete uterine rupture after starting labor. Thus, we excluded all individuals who gave birth through a CD before starting labor. The final sample included 1,375,826 maternities. We studied risk factors for complete uterine rupture separately for women without a previous CD (all parities) (n = 1,317,967) and those with a previous CD (parities ≥1) (n = 57,859). In general, in Norway, pregnant mothers with 1 previous lower-segment CD are offered the opportunity to attempt a labor. The majority in this study had 1 low transverse segment incision. Few had low vertical incision or classical vertical incision. Single- or double-layer suturing of the uterus at a previous CD is not registered in the MBRN.

For mothers undergoing a second delivery with a history of CD in a first delivery (parity = 1; n = 34,550 mothers), we constructed a data set, in which the first 2 deliveries for these mothers were linked. This data set was used to calculate the risk of complete uterine rupture in the second delivery, based on the previous obstetric history.

After identifying potential cases of uterine rupture in the MBRN and in the PAS, we validated the diagnosis of complete uterine rupture with corresponding medical records, which were considered the gold standard.[5] The first author of the present study (I.A.-Z.) identified these cases and studied the medical records of mothers diagnosed with uterine rupture by visiting 16 maternity units and reading posted copies of records from 5 additional units. The medical records included detailed information about the mothers and their newborns.

## Measures

The outcome measure was complete uterine rupture, defined as a tear through all layers of the uterine wall, including the serosa and amniotic membranes. A partial uterine rupture was defined as a tear in the muscular layers, with intact serosa or amniotic membranes.[5] The diagnosis of uterine rupture was reported in plain text on the MBRN registration forms by the birth attendant, and the appropriate code was recorded in the electronic file by MBRN personnel.

Before 1999, the code used was 71; starting in 1999, the International Classification of Diseases (ICD), 10th revision, diagnostic codes were used (O710, O711).[6] Uterine rupture was identified in the PAS by the ICD, eighth revision, code: 956[7] (1967−1978); ICD 9 codes: 6650 and 6651[8] (1979−1998); and ICD, 10th revision, codes: O710 and O711 (1999−2008).[6] These codes did not specify rupture type. The type of rupture, whether complete or partial, was identified in the medical records. In this study we included data only from mothers with complete ruptures.

The risk factors were identified, after being recorded in registration forms in plain text or by marking prespecified tick boxes. They included demographic factors, previous miscarriage, pregnancy factors, and obstetric factors. Demographic factors included maternal age, grouped as <35 years or ≥35 years; parity, grouped as <3 or ≥3; the mother's country of birth, grouped as Western (Europe, North America, and Australia) or non-Western; and the decade of delivery, grouped by the 4 decades included in the study: first decade (1967−1977), second decade (1978−1988), third decade (1989-1999), or fourth and most recent decade (2000−2008); the fourth decade was taken as the reference.

Maternal age and parity were analyzed first as continuous variables, but there was no significant difference seen before the cutoff level mentioned in the previous text, and these were therefore grouped into categorical variables. A previous miscarriage was defined as 1 or more miscarriages that occurred in the first trimester.

Pregnancy factors included gestational age in weeks, grouped as 37−40 (reference), ≥41, or 24−36 weeks; fetal presentation, grouped as occipitoanterior vertex (reference), non−occipitoanterior, or a breech or transverse lie; antepartum fetal death, and birthweight, grouped as <4000 or ≥4000 g.

Obstetric factors included labor start, grouped as spontaneous or induced labor; augmentation of labor (defined as augmentation of contractions after an established spontaneous or induced labor), grouped as no oxytocin use or oxytocin use; and induction methods, grouped as spontaneous labor, induction with prostaglandins or oxytocin (each used with or without amniotomy or other methods), other methods (sweeping of membranes, transcervical balloon catheters, or unspecified methods), and sequential induction (prostaglandins and oxytocin combined with or without amniotomy or other methods).

The prostaglandins administered were mainly vaginal dinoprostone (prostaglandin E2); however, misoprostol (prostaglandin E1) was increasingly used in unscarred uteri, starting in 2004; also, gemeprost was used occasionally for the termination of pregnancy for those treated in the first 3 decades of the study. The maximum and total doses and the duration of prostaglandins or oxytocin administered are not registered in the MBRN form. Other labor factors included breech extraction and manual removal of the placenta after vaginal delivery.