



# The Risk of Uterine Rupture in Labour Induction of Women With Previous Cesarean Delivery

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## Abstract

**Objective:** Due to the increased number of labour inductions in women with previous cesarean section, the risk of uterine rupture leading to maternal and fetal mortality is also increasing. In this manuscript, we aimed to review the risk of uterine rupture in labour induction of women with prior cesarean section.

**Materials and Methods:** Data from 48 reports belonging to the years 1994 through 2015, obtained via a search on various internet sources by the words “labour induction”, “previous cesarean”, “uterine scar”, “uterine rupture” were used to characterize the risk factors, methods and complications of labour induction in women with previous cesarean section.

**Results:** The success of labour induction after a previous cesarean section is related to a history of prior vaginal delivery, the indication of prior cesarean delivery, age, body mass index and ethnicity. The risk of uterine rupture is lower with mechanical dilators compared to prostaglandins when they are used for cervical ripening. Oxytocin is associated with an increased risk of uterine rupture in such women but induction and augmentation of labor is an option for all women undergoing a trial of labor after cesarean section. Although some guidelines discourage the use of prostaglandin E1, some others support the use of prostaglandin E1 or E2 for induction of labor in rare situations provided that the women be informed of the higher risk of uterine rupture.

**Conclusions:** Previous uterine surgery is the most common underlying reason for an increased risk of uterine rupture in subsequent trial of labour. When indicated, before considering a labour induction in these patients, a risk assessment should be performed based on various parameters. For prediction of uterine rupture, lower uterine segment may be measured by ultrasonography. Individually selected methods for labour induction should be discussed with the patients since they are mostly associated with increased risk of uterine rupture.

**Keywords:** Uterine rupture, Labour induction, Pregnancy, Vaginal birth after cesarean

## Uterine Rupture and its Relation With Previous Uterine Scar

Uterine rupture is a full-thickness separation of the uterine wall and the overlying serosa. It is a visible or palpable anatomic finding, not a health consequence and is an important reason of maternal and perinatal morbidity and mortality. Uterine rupture is directly associated with vaginal delivery after cesarean section and divided into two groups as complete and incomplete. In complete uterine rupture, uterine wall is totally ruptured and uterine cavity is connected with the abdominal cavity (Figure 1). It may result from a trauma or may occur spontaneously during pregnancy or labour. Incomplete uterine rupture is also named as uterine dehiscence, silent rupture or occult rupture and only serosal layer of uterine wall is intact, all the other layers are ruptured (1).

In the article published by Sahin et al in 2008 (2), which was the updated version of the already published article

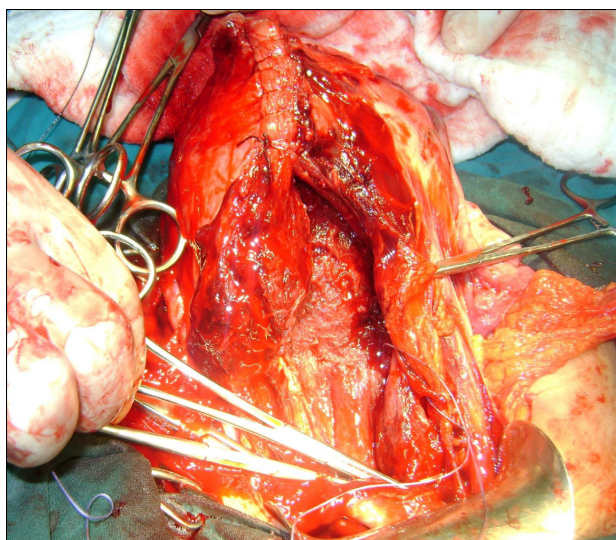
in 2005 (3), fetal death was more prominent in the group with complete uterine rupture (54.16%) compared to that with incomplete uterine rupture (11.11%). In the same article, it was also reported that 41.66% of the patients in the complete uterine rupture group had scarred uteri. In the group of patients with incomplete uterine rupture, the percentage of scarred uteri was 33.3%.

Twenty peer-reviewed publications between 1976-2009 revealed 1864 cases of uterine rupture in a total of 2 863 330 pregnant women. In general, the incidence of uterine rupture is 1/1536 (0.07%). In patients in unscarred uteri, the incidence is very low (0.0033%) and 86% of them is observed during labour of grand multiparous women and 14% before labour. The incidence is also lower in urban areas (0.012%) compared to the rural areas (0.11%) (4). In patients with an already scarred uterus, uterine rupture is observed in approximately less than 1% of the cases (5). In an article of Kolusari et al, uterine rupture was found to be

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**Figure 1.** A complete uterine rupture which is being repaired.

the reason of maternal mortality in 5.51% of the cases (6). The main risk factors of uterine rupture during pregnancy are previous classical cesarean section, previous hysterectomy (very rare), previous myomectomy, placenta accreta, motor vehicle accidents, Mullerian anomalies of uterus, hysteroscopic metroplasty, difficult curettage for miscarriage. Ehler-Danlos syndrome, chronic steroid use and the use of cocaine are the other rare causes of uterine rupture. The main risk factors of uterine rupture during labour are previous cesarean section, previous myomectomy, grand multiparity, malpresentation, unrecognised cephalopelvic disproportion, obstructed labour, prostaglandin and oxytocin augmentation in women with high parity and previous cesarean section, use of high doses of misoprostol in parous women during labour induction and assisted breech deliveries. Tumours obstructing the birth canal and pelvic deformity are the other rare causes of uterine rupture. After delivery, precipitate labour, manual removal of placenta, uterine manipulation (intrauterine balloon) and placenta akreta are the risk factors (7). In patients with no antenatal care, the trial of delivery of a hydrocephalic or macrosomic fetus may result in rupture of an unscarred uterus. Assisted fundal pressure may also lead to an atypical rupture of an unscarred uterus during delivery of the baby in the second stage of labour (8). In very complicated cases, the rupture of ureter may also accompany (9).

The symptoms and signs of uterine rupture are fetal distress (abnormalities in fetal heart rate) (78%-87%), diminished baseline uterine pressure, loss of uterine contractility, abdominal pain (13%-60%), recession of the presenting fetal part, hemorrhage (11%-67%), shock (29%-46%), sudden onset gross haematuria (1). In the diagnosis, pathological retraction ring and the "staircase" sign on fetal monitorization are also important (10,11). When, a hematoma accompanies to the uterine rupture, especially in cases in atypical ruptures with tears beneath the uterine serosa together with a hematoma within broad ligament, uterus may deviate to the opposite side. This should

be also regarded as an alarming sign if the patient has a vertical rather than a Pfannenstiel scar on the skin for a previous cesarean section (12). However, a Pfannenstiel scar is not always an indirect sign of low transverse uterine incision which is less associated with uterine rupture compared to a low vertical and classical uterine incision. Treatment of uterine rupture is emergent laparotomy with a vertical abdominal incision and either primary repair of uterine wall or hysterectomy. Decision depends on the site of the rupture, extend of the lesion, involvement of the other organs, whether the defect is single or multiple, whether easily repaired or not. The possible findings on exploration may include vertical tear with horizontal extension, tear entering bladder, large hematoma in parametrium, rupture in the posterior wall, uterus almost divided in two, rupture of a classical cesarean section scar (12).

In the analysis by Sahin et al in 2008, primary repair could be accomplished in nearly half of the cases (54.54%). Internal iliac artery was ligated in 21.21% of the cases. In 42.42% of the cases, hysterectomy was performed (subtotal in half). As the complications, bladder injury (3.03%), blood transfusion over 2 units (48.48%), intensive care unit requirement (21.1%), febrile morbidity (9.09%), sepsis (6.06%), hospital stay over 7 days (36.36%), maternal death (15.15%), fetal death (42.42%) may be observed (2). Although severe postpartum haemorrhage due to uterine rupture may result in Sheehan syndrome, an isolated impairment of posterior pituitary function was also reported (13). Fetal hypoxia or anoxia, fetal acidosis, admission to a neonatal intensive care unit and fetal or neonatal death are the expected complication for the fetuses (1).

As a summary, uterine rupture is a rare and often catastrophic complication with a high incidence of fetal and maternal morbidity. Uterine surgery is the most common underlying reason, but the risk increases in multiparous women without scar in dystocia. In recent years, maternal mortality tends to decrease although the increasing rates of cesarean section. We have to be very careful when vaginal delivery is tried after cesarean section and induction/augmentation is performed in multiparous women.

#### **Uterine Rupture: Sonographic Prediction in Women With Previous Uterine Scar**

Before deciding to perform labour induction in a pregnant woman with previous uterine scar, firstly we decide whether we will try a labour in such a patient. For prediction of uterine rupture, measuring thickness of the lower uterine segment (LUS) during pregnancy by ultrasound is a logical way.

This measurement is performed either transabdominally or transvaginally. Full LUS thickness and/or thickness of the myometrial layer are measured (Figure 2). However, no consensus exists on measurement technique. Especially, the degree of bladder filling, the site of measurement, the placement of the callipers, the number of measurements taken and the measurement selected to be representative if more than one was taken are the issues which are mostly discussed (14). According to the technique of

Bujold et al, the measurement should be performed when the woman feels bladder fullness, at least three measurements should be taken and the lowest one should be accepted to be representative (15).

According to Jastrow et al, interobserver agreement is better when transvaginal ultrasound is used (16). In the evaluation of LUS, a strong index of correlation (96%) between transabdominal sonography and transvaginal sonography was also reported (17). However, according to Marasinghe et al, transvaginal sonography is a more accurate method of assessing the thickness of the LUS compared with transabdominal sonography (18).

What is the thickness of 'normal' LUS as measured by ultrasound at 35-40 gestational weeks? In the study performed by Cheung et al, the thickness of the myometrium at 36-38 gestational weeks was found as  $2.3 \pm 1.1$  mm (1.1-5.5) in nulliparous women,  $3.4 \pm 2.2$  mm (1.0-10.3) in parous women and  $1.9 \pm 1.4$  mm (0-9.0) in women with caesarean hysterotomy scar(s) (19).

When the sonographic appearances of the LUS in the women with previous cesarean section are evaluated, we may face with the normal, typical dehiscence, increased echogenicity in the outer layer with myometrial thinning and extremely thin LUS (19).

What is the cut-off for the sonographic thickness of the LUS? In the systematic review of Jastrow et al, there are two important studies in which full LUS was evaluated (20). In the study of Rozenberg et al, the number of participants was very high ( $n=642$ ) compared to the other studies and quality of the study design was good. All measurements were performed transabdominally. They found that with 88% sensitivity and 73% specificity, the cut-off value may be 3.5 mm (21). In the study of Bujold et al, the measurement was performed by either transabdominal or transvaginal ultrasonography and the cut-off value ranged between 2 and 3.5 mm, however they could not propose a cut-off exactly. Also, for myometrial layer of LUS, the cut-off values ranged between 1 and 2 mm (15). In the study Rozenberg et al, when the cut-off for the thickness of LUS was determined as 3.5 mm, no defect was detected in emergent cesarean sections and only 2 defects were detected during elective cesarean sections (21). In the study of Bujold et al, the rupture and dehiscence rates were 1.3% (3/236) and 2.5% (6/236), respectively. By logistic regression analysis for factors that were associated with uterine scar defect, full LUS thickness less than 2.3 mm increased the risk 4.66 times after adjustment (15). In a study from Turkey, the cut-off value for the thickness of the LUS was calculated as 1.8 mm. The sensitivity was 73.6%, specificity was 87.5%, false negative rate was 26.3% and false positive rate was 12.5% for the prediction of cases with thin lower segment below this level (22). In a meta-analysis including 21 studies reporting on 2776 women, for the occurrence of a defect during trial of labour, a full LUS thickness cut-off of 3.1-5.1 mm and a myometrium thickness cut-off of 2.1-4.0 mm have a strong negative value while a myometrium thickness cut-off of 0.6-2.0 mm had a strong positive predictive value (23). In a study, translucent LUS



**Figure 2.** Transabdominal measurement of low uterine segment as full thickness (long distance) and thickness of the myometrial layer (short distance).

with visible content and well circumscribed defects, either dehiscence or rupture were detected in cases with full LUS thickness  $<3.0$  mm and myometrial thickness  $<1.5$  mm (sensitivity: 100%, specificity: 85%, positive predictive value: 45%, negative predictive value: 100%). Measuring only the myometrium layer did not add anything to the positive predictive value for uterine dehiscence in patients with a LUS thickness of  $>3.0$  mm. When the LUS thickness was close to the cut-off values, if a myometrial thickness was more than 1.5 mm, the patient was not found at risk for uterine dehiscence (24).

Ultrasound appearance of cesarean hysterotomy scar in the uterus of a non-pregnant woman was also proposed as a predictor of uterine rupture or dehiscence in a subsequent pregnancy. When the remaining myometrial tissue thickness above a cesarean scar is designated as "r," it may be seen differently when sonohysterography is performed or not (25,26). During transvaginal sonographies of the women with 1 previous cesarean section which was performed with and without sonohysterography, a large scar defect was defined as  $r < 2.2$  mm and  $r < 2.5$  mm, respectively. For the women with 2 or more previous cesarean sections, these values were defined as  $r < 1.9$  mm and  $r < 2.3$  mm, respectively (27). In a study, 162 women who had their hysterotomy scar examined with ultrasound 6-9 months after a caesarean delivery were followed up for 3-4 years and when they came for delivery they and their physicians were double blind to the USG results. Fifty-nine deliveries occurred and 4 rupture/dehiscence were encountered (7%). When the records were evaluated retrospectively, 1/19 (5%) of the defects were in women with no/a small scar defect and 3/7 (43%) were in women with large scar defect (27).

Martins et al stated that ultrasonographic measurement of the LUS muscular thickness transvaginally appears more reliable than that of the entire LUS thickness measured transabdominally. The use of three-dimensional ultrasound improved significantly the reliability of this measurement (28). Cheung et al reported that compared with the 2D approach, 3D transabdominal sonography does not seem to improve the reliability of LUS measurement.

2D measurement of myometrial thickness transabdominally seems to be most reliable between different observers (29). It has also been proposed that full LUS thickness measured with 3D TVS data sets has excellent intraobserver and interobserver reliability. 3D TVS has good reproducibility with 2D TVS when the full LUS thickness is less than 3.0 mm (30).

In summary, the most recent meta-analyses provide support for the use of antenatal LUS measurements in the prediction of a uterine defect during trial of labour. Sonographically, the thinner the LUS at 35-40 weeks, the higher the risk of uterine rupture or dehiscence. Clinical applicability of the techniques should be assessed in prospective observational studies using a standardized method of measurement. No thickness cut-off for the sonographic thickness of the LUS can be recommended (3.5 mm). The thickness of the remaining myometrium over a cesarean hysterotomy scar defect in non-pregnant women seems to be related to the risk of uterine rupture in subsequent pregnancy, but this method is not ready for clinical use. 3D and 2D US are associated with good reliability and 3D US may be a promising clinical tool for evaluating uterine scars among women with a history of cesarean delivery.

#### **Labour Induction in Women with Uterine Scar**

The incidence of labour induction is increased within years (31). The risk of uterine rupture is also increased. It is reported in 0.5%-1% of patients attempting vaginal births after cesarean section (VBAC) (32). The risks of trial of labour after cesarean delivery (TOLAC) are hysterectomy, transfusion, fetal ischemic encephalopathy and fetal death (33). Uterine scars are the main risk factors for uterine rupture and abnormal placental insertion. It is very important to choose a candidate woman with previous cesarean section for vaginal delivery. Congenital anomalies of pelvis, placenta or vasa previa and history of uterine rupture should be excluded. Appropriate candidate for TOLAC is a woman with a single cesarean delivery by low transverse incision. Some studies show that women with 2 prior low transverse incision have greater risk of uterine rupture than women with a single low transverse incision (34,35). However, Landon et al found no difference in the risk of uterine rupture when comparing patients with a single versus 2 low transverse incisions (36).

For the success of TOLAC, the candidates should be chosen appropriately. Benefit and risk ratio should be calculated and each woman should be counselled individually. The variables determining the success of VBAC are history of prior vaginal delivery, the indication of prior cesarean delivery, age, body mass index and ethnicity (37). Common indications for labour induction are post-term pregnancy, intrauterine growth retardation of fetus, prelabour rupture of membranes, hypertensive disorders. A lot of methods are available for labour induction: Pharmacological methods (prostaglandin analogues, oxytocin) and mechanical methods (for example, Foley catheters) (38). The studies show an increased risk for women with prior cesarean delivery if prostaglandins are used for cervical

ripening (39,40). The risk of uterine rupture is lower with mechanical dilators compared to prostaglandins when they are used for cervical ripening (32,41). The large retrospective study including 20 000 women, reported an association between the risk of uterine rupture and mode of delivery. The risk of uterine rupture without labour is 1.6 per 1000, with spontaneous onset of labour 5.2 per 1000, with induction of labour with prostaglandins, it is 7.7 per 1000. However, the study did not differentiate dinoprostone and misoprostol (40). Gyamfi et al showed that induction of labour had no effect on VBAC outcome, but the authors did not explain the details of the study (42). Macones et al reported that sequential use of prostaglandins and oxytocin was associated with uterine rupture (OR: 3.07; 95% CI: 0.98-9.88) (43). American guidelines discourage the use of prostaglandin E2 for induction of labour (44). Canadian guidelines reported prostaglandin E1 is associated with a high risk of uterine rupture. Cervical ripening with a Foley catheter may be safe (45). Miller and Davis also reported the use of double balloon catheter for cervical ripening in a small case series (46).

As a summary; American College of Obstetricians and Gynecologists (ACOG), The Society of Obstetricians and Gynecology of Canada (SOGC) and the Royal College of Obstetricians and Gynecologists (RCOG) acknowledge an increased risk of uterine rupture with oxytocin, induction and augmentation of labour is an option for all women undergoing a TOLAC. ACOG and SOGC discourage prostaglandin E1 in induction of labour but SOGC supports the use of prostaglandin E2 in rare situations. RCOG allows both prostaglandin E1 and E2, but recommends women be informed of the higher risk of uterine rupture (47).

As a conclusion, cesarean rates have increased in the past years due to different reasons such as having a history of previous cesarean section, medical indications for cesarean, cultural beliefs, the fear of labor pain and disturbing the genital anatomy (48). In the near future, in order to decrease the high cesarean rates, labor induction in the women with previous cesarean deliveries will continue to be an important issue with the accompanying increased risk of uterine rupture.

#### **Ethical issues**

We have no ethical issues to declare.

#### **Conflict of interests**

The authors declare that they have no conflict of interest.

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