Predicting Incomplete Uterine Rupture With Vaginal Sonography During the Late Second Trimester in Women With Prior Cesarean

HIDEO GOTOH, MD, HIDEAKI MASUZAKI, MD, ATSUSHI YOSHIDA, MD, SHUICHIRO YOSHIMURA, MD, TSUNETAKE MIYAMURA, MD, AND TADAYUKI ISHIMARU, MD, PhD

Objective: To evaluate the usefulness of serial transvaginal ultrasonographic measurement of the thickness of the lower uterine segment in the late second trimester for predicting the risk of intrapartum incomplete uterine rupture in women with previous cesarean delivery.

Methods: Serial transvaginal ultrasonography with full bladder was performed in 374 women without previous cesarean delivery (control group) and 348 women with previous cesarean delivery (cesarean group) from 19 to 39 weeks' gestation. The thickness of the lower uterine segment was measured in the longitudinal plane of the cervical canal.

Results: The thickness of the lower uterine segment decreased from 6.7 ± 2.4 mm (mean ± standard deviation [SD]) at 19 weeks' gestation to 3.0 ± 0.7 mm at 39 weeks' gestation in the control group, but the thickness was more than 2.0 mm throughout this period in each control subject. In the cesarean group, the thickness decreased from 6.8 ± 2.3 mm at 19 weeks' to 2.1 ± 0.7 mm at 39 weeks' gestation and was significantly thinner than that of the control group after 27 weeks' gestation (P < .05). Eleven of 12 women (91%) with lower uterine segment less than the mean control – 1 SD in the late second trimester had a very thin lower uterine segment at cesarean delivery with fetal hair being visible through the amniotic membrane, ie, incomplete uterine rupture. In 17 of 23 women (74%) with lower uterine segment less than 2.0 mm in thickness within 1 week (4 ± 3 days) before repeat cesarean delivery, intrapartum incomplete uterine rupture developed.

Conclusion: Transvaginal ultrasonography is useful for measurement of the uterine wall after previous cesarean delivery. (Obstet Gynecol 2000;95:596–600. © 2000 by The American College of Obstetricians and Gynecologists.)

Materials and Methods

The study population consisted of 374 pregnant women (374 measurements) without a history of cesarean delivery (control group) and 348 pregnant women (348 measurements) with a history of cesarean delivery (cesarean group).
measurements) with previous cesarean delivery (cesarean group). Only a single measurement was made for each fetus. Between January 1995 and December 1998, 722 women were examined prospectively by transvaginal ultrasonography between 19 and 39 weeks’ gestation to measure the thickness of the lower uterine segment and to detect the presence of any uterine defect with a full bladder. All mothers were healthy, with uncomplicated singleton pregnancies. Patients represented all women with uncomplicated pregnancies who attended the antenatal clinic at our department within the above time periods. None of the patients reported in this study attempted vaginal birth after cesarean (VBAC).

The thickness of the lower uterine segment was measured after the bladder was identified in the longitudinal plane of the cervical canal at transvaginal ultrasonography (Figure 1). Ultrasonography was performed by using Mochida equipment with a 7.5-MHz transvaginal transducer (Sonovista Ex model meu-1581, Mochida, Japan). This system provides clear freeze-frames and the use of on-screen calipers for direct measurements. All subjects were delivered after 37 weeks’ gestation. Measurement of the lower uterine segment was repeated at least three times in each examination, and the minimal value was reported (total: 722 measurements; control: 374; cesarean delivery: 348). Intraobserver and interobserver variabilities in the calculation of the thickness of the lower uterine segment obtained for the first 50 women in the control group were 4.7% and 5.5%, respectively. The sonographers were masked to the type of patient (control compared with cesarean) to eliminate any possible bias.

Sonographic results at antepartum were compared with direct intraoperative observation at cesarean delivery. Incomplete uterine rupture represented separation of the uterine wall and visceral peritoneum covering the uterus. We examined differences in the thickness of the lower uterine segment between control pregnant women and those with previous cesarean delivery at each gestational week, as well as the pattern of change in the lower uterine segment during pregnancy in each group. We also used the antenatal and intraoperative data to examine whether incomplete uterine rupture during delivery could be predicted from lower uterine segment measurement during pregnancy. The surgeons were masked to the sonographic findings at the time of cesarean delivery.

The study protocol was approved by the Ethics Review Committee of our institution, and a signed consent form was obtained from each subject. Data were expressed as mean ± standard deviation (SD), or median and range. Student t test and Mann-Whitney U test were used for comparison of continuous variables. Differences in uterine thickness between control group and cesarean group were evaluated by unpaired t test, and those between the second and third trimesters were evaluated by paired t test. Fisher exact test was used to examine the association between ultrasonographically determined thickness of the lower uterine segment at different stages of pregnancy and incomplete uterine rupture at the time of cesarean. Significance was considered P < .05. The sample size was sufficient to detect differences at 5% level of significance with 80% power.

Results

Patients in the cesarean group did not differ significantly from those in the control group with respect to maternal age, parity, gestational age at delivery, infant birth weight, and 1-minute and 5-minute Apgar scores (Table 1). The thickness of the lower uterine segment in the control group decreased steadily from 6.7 ± 2.4 mm at 19 weeks’ gestation to 3.0 ± 0.7 mm at 39 weeks’ gestation, but the thickness was greater than 2.0 mm in all cases (Figure 2). In the cesarean group, the thickness of the lower uterine segment decreased from 6.8 ± 2.3 mm at 19 weeks’ gestation to 2.1 ± 0.7 mm at 39 weeks’ gestation (Figure 2). Whereas the thickness of the lower uterine segment was not different between the two groups at 19–26 weeks’ and 28 weeks’ gestation, it was significantly thinner in the cesarean than in the control group at 27 weeks’ and every week after 29 weeks’ gestation (P < .05). Serial measurements of the lower uterine segment during pregnancy showed that in a subgroup of women with previous cesarean delivery, the uterine wall was persistently thin from the
second trimester until the termination of pregnancy (thin group: lower uterine segment was less than mean ± 1 SD, \( n = 12 \), Figure 3). In another group of women with previous cesarean delivery, the uterine wall decreased in thickness progressively, in a manner similar to that of the control group (nonthin group: lower uterine segment was mean ± 1 SD or greater, \( n = 27 \), Figure 3). Eleven of the 12 women (91%) with a lower uterine segment less than the mean control in the late second trimester had a surprisingly very thin uterine wall at cesarean delivery; the fetal hair was visible through the amniotic membrane. In all 27 women with lower uterine segment greater than the mean control ± 1 SD, an intrapartum incomplete uterine rupture at cesarean delivery did not develop (nonthin group, \( P < .001 \), Table 2).

Further analysis of transvaginal ultrasonographic findings at 7 days before cesarean delivery (4 ± 3 days) and those at cesarean delivery showed that 17 of 23 women (74%) with lower uterine segment less than 2.0 mm before repeat cesarean delivery had an incomplete uterine rupture at cesarean delivery. On the other hand, none of the 45 women with lower uterine segment of 2.0 mm or greater thickness demonstrated an incomplete uterine rupture at cesarean delivery (\( P < .001 \), Table 2).

Table 2. Association Between Ultrasonographically Determined Thickness of the Lower Uterine Segment at Different Stages of Pregnancy and Intrapartum Incomplete Uterine Rupture at Cesarean

<table>
<thead>
<tr>
<th>Thickness of lower uterine segment (mm)</th>
<th>Intrapartum incomplete uterine rupture (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>At second trimester</td>
<td></td>
</tr>
<tr>
<td>&lt; Mean control − 1 SD</td>
<td>11 (91)</td>
</tr>
<tr>
<td>≥ Mean control − 1 SD</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Within 7 d (4 ± 3 d) of cesarean</td>
<td></td>
</tr>
<tr>
<td>&lt; 2 mm</td>
<td>17 (74)</td>
</tr>
<tr>
<td>≥ 2 mm</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

SD = standard deviation.

(At second trimester and within 7 d of cesarean: \( P < .001 \).)

Figure 2. The mean thickness of the lower uterine segment in controls and women who have had a previous cesarean delivery. The thickness of the lower uterine segment was not different between the two groups at 19–26 weeks' and 28 weeks' gestation (*). The lower uterine segment was significantly thinner in the cesarean group than in the control group at 27 weeks' and 29 weeks' gestation (\( P < .05 \), unpaired t test) (**). The lower uterine segment was significantly thinner in the cesarean group than in the control group at every week after 30 weeks' gestation (\( P < .01 \), unpaired t test) (***). SD = standard deviation.

Figure 3. Correlation between thickness of the lower uterine segment at late second trimester and third trimester in the thin group and the nonthin group. Note that in subjects in whom the lower uterine segment was thin from the late second trimester, intrapartum incomplete uterine rupture was more likely to develop. NS = not significant.
Discussion

In 1988, ACOG recommended that carefully selected patients be encouraged to have a trial of labor after a single previous cesarean delivery. Several investigators have emphasized the efficacy and safety of vaginal birth after cesarean delivery in a large series of studies. The most common complication of vaginal delivery after a previous cesarean delivery is uterine rupture, and the frequency varies between 0.5 to 0.8% with previous lower uterine segment incision, as reported in a recent study. Although maternal mortality is rare, rupture of the uterus may be associated with significant morbidity for the mother and fetus in women with a history of low transverse cesarean delivery. Jones et al and Scott reported four perinatal deaths among 20 cases of uterine rupture with a previous low-segment cesarean scar. Two of these infants had long-term neurologic impairment, and three women required hysterectomy.

Several investigators have examined the accuracy of various diagnostic procedures in the detection of uterine rupture in women with previous cesarean delivery. Hysterography, pelvic examination, and amniography have been used, but their usefulness has not been confirmed. Hebisch et al compared the results of ultrasonography with those of magnetic resonance imaging (MRI). They demonstrated that vaginal ultrasonography provided more accurate information about the condition of the scarred myometrium of the isthmus than MRI. Other studies have shown that ultrasonography may predict uterine rupture in women with previous cesarean delivery. Rozenberg et al indicated that the risk of uterine rupture in the presence of a defective scar was related directly to the degree of thinning of the lower uterine segment as measured by transabdominal ultrasonography at or near 37 weeks' gestation. In particular, they demonstrated that this risk increased significantly when the thickness was 3.5 mm or less. The use of this cutoff value showed an excellent sensitivity (88.0%) for ultrasonography, with a negative predictive value of 99.3%. On the other hand, Fukuda et al examined 41 low-segment transverse cesarean delivery scars by transperineal and transvaginal longitudinal scans. A wall thickness of 2 mm or less was considered a sign of poor healing. At operation, they measured the thickness of the lower uterine segment by ophthalmic calipers just after incising the uterus and before rupture of the membranes, and reported no false-positive or false-negative results when using ultrasonography.

Our results showed that when the thickness measured by transvaginal ultrasonography is less than 2 mm within 1 week of delivery, the lower uterine segment may show an incomplete uterine rupture. The positive and negative predictive values were 73.9% and 100%, respectively. Furthermore, a thickness of less than the control mean-SD at the second trimester is highly predictive of the development of incomplete uterine rupture at delivery. The positive and negative predictive values were 91.7% and 100%, respectively. A careful examination of our results showed that the predictive value at full term was lower than that at the second trimester. This finding is probably due to further thinning of the lower uterine segment at term as the wall is stretched by the presenting part. Although the defects of the lower uterine segment can be detected in the second trimester, our results showed that the most clinically useful information regarding the status of the lower uterine segment is obtained when ultrasonography is performed before 36 weeks' gestation. Measurements obtained at that time avoid problems associated with engagement of the presenting part in the pelvis or the physiologic reduction in the volume of amniotic fluid occurring at later stages of pregnancy. Previous studies that examined the importance of detecting uterine rupture by ultrasonography emphasized the value of such evaluation at term, but our study stresses the importance of performing such measurement during the late second trimester. We showed that serial measurements of the lower uterine segment by transvaginal ultrasonography during the second trimester might predict incomplete uterine rupture at term.

Although none of our cases with incomplete uterine rupture progressed to a complete uterine rupture during labor, incomplete uterine rupture represents a high risk for complete uterine rupture because in some cases with incomplete uterine rupture, uterine contents are separated from the peritoneal cavity only by the visceral peritoneum covering the uterus.

In women with previous cesarean delivery, uterine rupture may occur after labor even in those with lower-uterine segmental incision. Thus, early prediction of uterine rupture before the onset of labor should also reduce the frequency of uterine rupture after delivery. Transvaginal ultrasonography could therefore be considered the standard diagnostic procedure that can predict accurately intrapartum uterine rupture in women with previous cesarean delivery. Our results emphasize the importance of measuring the uterine scar in the late second trimester in women with previous cesarean delivery.

References


Address reprint requests to:
Hideo Gotoh, MD
Department of Obstetrics and Gynecology
Nagasaki University School of Medicine
1-7-1 Sakamotomachi
Nagasaki, 852-8501
Japan

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