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Prediction of Uterine Dehiscence by Measuring Lower Uterine Segment Thickness Prior to the Onset of Labor

Evaluation by Transvaginal Ultrasonography

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Abstract

Objective: Lower uterine segment thickness was measured by transvaginal ultrasound examination and its correlations with the occurrence of uterine dehiscence and rupture was examined.

Methods: The thickness of the muscular layer of the lower uterine segment was measured in 186 term gravidas with previous uterine scars and its correlation with uterine dehiscence/rupture was investigated.

Results: Uterine dehiscence was found in 9 cases or 4.7%. There were no cases of the uterine rupture. The thickness of the lower uterine segment among the gravidas with dehiscence was significantly less in than those without dehiscence ($p<0.01$). The cut-off value for the thickness of the lower uterine segment was 1.6 mm as calculated by the receiver operating characteristic curve. The sensitivity was 77.8%; specificity 88.6%; positive predictive value 25.9%; negative predictive value 98.7%.

Conclusion: Measurement of the lower uterine segment is useful in predicting the absence of dehiscence among gravidas with previous cesarean section. If the thickness of the lower uterine segment is more than 1.6 mm, the possibility of dehiscence during the subsequent trials of labor is very small. (J Nippon Med Sch 2000; 67: 352—356)

Key words; uterine dehiscence, uterine rupture, ultrasonogrphy, lower uterine segment, VBAC

Introduction

The safety of vaginal birth after cesarean, or vaginal birth after cesarean section (VBAC), has been confirmed in various clinical trials[1-7]. However, the possibility of uterine rupture exists with an incidence of 0.3～2.3%[1-7]. Uterine rupture requires immediate surgical intervention and outcomes for infants and mothers are often disastrous[2,8,9].

Therefore, if uterine rupture can be predicted, the trials of labor in VBAC candidates may be managed more safely. There have been a few attempts to evaluate the strength of the uterine scar during a trial labor by measuring the thickness of the lower uterine segment[10-14]. Fukuda et al[11] reported that when the lower uterine segment was less than 2 mm in full thickness, histology of the scar tissue showed a higher incidence of disturbed healing. Rozenberg et al[12] measured the lower uterine segment thickness of 642

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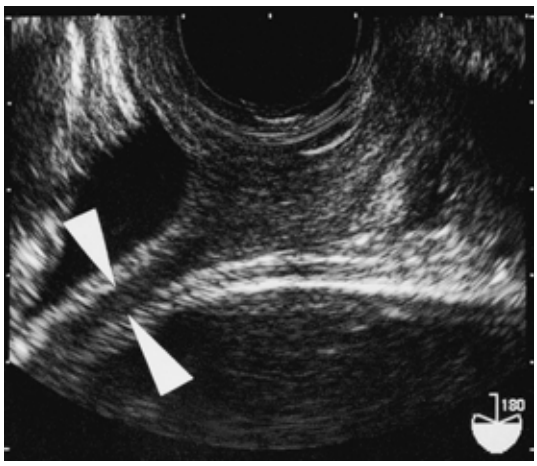

Fig. 1 The portion indicated between the two triangles is a muscular layer of the lower uterine segment.

gravidas with previous sections. They concluded that if the thickness of the lower uterine segment was 3.5 mm or greater, the trials of labor could be uandergone with reasonable confidence.

It is of note that full thickness measurements were performed in this study using transabdominal ultrasonography. In performing ultrasound measurements by a transabdominal approach, the bladder must be full, which, in turn, may stretch the lower uterine segment affecting true measurements. Further the descent of the fetal vertex may interfere with measurements. When measurements are performed using a transvaginal approach, clearer visualization may improve the accuracy of the measurements. Recent reports did not show this[13,14].

In this study, we employed vaginal probes for ultrasonographic measurements of the lower uterine segment. In order to increase accuracy, only the muscle layer of the anterior lower segment was measured.

Materials and Methods

The study period was from April 1995 to May 1999. 186 gravidas with previous cesarean section were studied. Ultrasonographic measurements were performed between 37 and 40 weeks of gestation. 132 patients underwent labor while 54 underwent a repeat cesarean section.

Repeat cesarean section was performed, without labor trials, for indications including cephalopelvic disproportion, placenta previa, history of two or more cesarean sections, febrile episodes after previous sections indicating disruption of wound healing processes due to possible infection, and uterine anomalies.

The attending obstetricians were not aware of the ultrasonographic findings. Decisions for repeat cesareans without labor trials or emergency sections were performed for obstetrical indications only.

In no patients was, labor induced. However, augmentation of labor was using oxcitocin in 20 out of 132 patients, or 15.1%.

Gravidas with abnormal fetal presentation, or who were in labor at the time of ultrasonographic examinations were excluded from the study. Gravidas who gave birth to small-for-date and large-for-date infants were excluded.

(1) *Ultrasonographic measurements*

After obtaining informed consent, ultrasonographic measurements of the lower uterine segment were performed using a 6.0 MHz vaginal probe (SONOVISA-MSC, Mochida, Tokyo, Japan) within 20 minutes of voiding. Gestational weeks of all the gravidas ranged between 37 and 40 weeks.

The lower uterine segment was defined as the portion of the anterior uterine wall directly adjacent to the overlying bladder. When observed with a vaginal probe, three distinct layers can be distinguished in the lower uterine segment. The outermost layer is directly outside the muscular layer and adjacent to the bladder above. The second layer is the muscular layer. The third layer is located directly inside and under the muscular layer and contains the decidual layer of the endometrium (**Fig. 1**). Only the muscle layer was measured at its thinnest portion. The measurements were repeated three times and a mean was obtained. Difference of each measurement was 11.0 ± 10.8%.

It is of note that in most cases the vaginal probe could not visualize the cesarean scar tissue. At the time of cesarean sections, it was repeatedly confirmed that the measured portion of the lower uterine segment was generally 1～2 cm caudal to the cesarean section scar.

Actual measurements were made only once in each patient after confirming the absence of uterine con-

Table 1 Comparison of obstetrical profiles between groups with and without uterine dehiscence

	Utereine dehiscence(+) (n=9)	Uterine dehiscence(−) (n=177)	Significance
Age	29.0 ± 3.5	30.2 ± 3.5	N.S.
Parity	1.0 ± 0	1.1 ± 0.4	N.S.
Gestational weeks at the measurement	37.5 ± 1.4	38.0 ± 1.7	N.S.
Gestational weeks at delivery	40.5 ± 0.7	39.9 ± 1.7	N.S.
Neonatal birth weight(g)	3,453 ± 232	3,362 ± 432	N.S.
Apgar score < 7 at 5 min	0	2	N.S.
Trial of labor	7	125	N.S.
VBAC	1	62	N.S.
Emergency cesarean	6	63	$p < 0.05$
Repeat cesarean	2	52	N.S.
Augmentaion of labor	2	18	N.S.

traction. The sonographers were limited to three experienced physicians.

(2) *Definition of uterine dehiscence or rupture*

The presence or absence of uterine rupture or dehiscence was always evaluated at the time of cesarean section. Uterine dehiscence was defined as a separation of the muscular layer with an intact serosa. The separation of the muscular layer was evaluated both by inspection and palpation. The mere thinning of the uterine wall without separation of the muscular layer was not regarded as dehiscence. In VBAC cases, the mucosal side of the lower uterine segment was explored digitally following delivery. Uterine dehiscence was diagnosed when digital examinations palpated the serosa without an intervening muscular layer. When this occurred, digital contact with the serosa was confirmed by the use of transabdominal ultrasound.

(3) *Analysis of data*

Comparison of the data was made utilizing the Man-Whitney U test. Data on ratios were analyzed for the Chai square test with Yate's correction. Statistical significance was set at when $p<0.05$. Data were expressed as mean ± SD.

The Receiver operating characteristic curve was used to find the upper limit and cut-off value for various measurements of the lower uterine segment.

Results

1. Comparison of obstetrical profiles between groups with and without uterine dehiscence

Uterine dehiscence was found in nine cases. **Table 1** shows the comparison of the two groups with dehiscence and without dehiscence. Six cases were found at the time of emergency sections, two cases at scheduled repeat sections and one after VBAC.

The presence of uterine dehiscence was not related to maternal age, parity, gestational age at delivery, birth weight or the incidence of an Apgar score of less than 7 at five minutes.

The incidence labor trials and the trial labor success ratio were not significantly different among the two groups with and without dehiscence.

The incidence of emergency section in the group with dehiscence was 66.7% (6/9), which was significantly higher than the incidence of 35.6% in the group without dehiscence ($p<0.05$). Cesarean sections were done performed in cases of failed labor trials without fetal distress in 66.7% (4/6) of the group with dehiscence and in 60.6% (37/63) it the group without dehiscence. Fetal distress was the indication for emergency sections in 33.3% of the former and 40.0% of the latter group. The differences were not significant between the two groups.

No correlation was found between augmentation of labor and the occurrence of the uterine dehiscence.

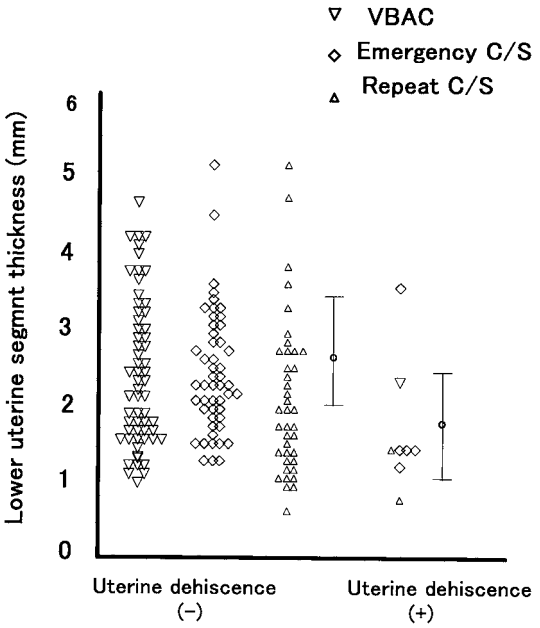

Fig. 2 Lower uterine segment thickness in groups with or without dehiscence is shown. The Vertical bar shows the mean and 1 standard deviation of each group. ▽, ◇ and △ express data obtained from gravidas whose present deliveries were VBAC, emergency and repeat cesarean section, respectively.

The incidence of uterine dehiscence was not significantly correlated with repeat cesarean sections. Two cases of dehiscence were found in patients who had uandergone two previous sections.

2. Lower uterine segment thickness

Ultrasonographic measurements of the lower uterine segment thickness were compared betweens dehiscence and non-dehiscence groups. In the group with dehiscence, the thickness was 1.7 ± 0.7 mm. In the group without uterine dehiscence, it was 2.6 ± 0.8 mm. The difference was significant ($p<0.01$) (**Fig. 2**).

3. Prediction of uterine dehiscence by measuring the lower uterine segment thickness

The receiver operating characteristic curve defined the sensitivity and specificity for each measurement value (**Fig. 3**). When the cut-off value was chosen at 1.6 mm, sensitivity was 77.8% and the specificity 88.6 %. The positive predictive value was 25.9%, while the negative predictive value was 98.7%. When lower uterine segment thickness is more than 1.6 mm, dehiscence will occur in fewer than 1.3% of cases.

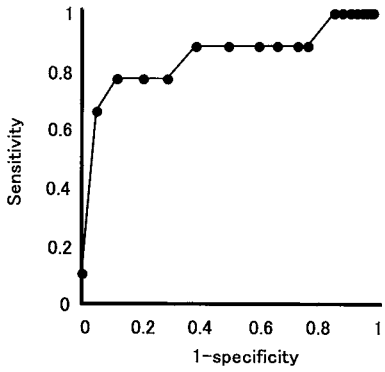

Fig. 3 Receiver operating characteristic curve is shown. Sensitivity and specificity are calculated at 0.2 mm intervals of the lower uterine segment thickness starting of 1.2 mm.

Discussion

Uterine dehiscence occurs in 0.4%～4.6% of VBAC cases during labor trials[7]. Uterine dehiscense is known to be asymptomatic and not life threatening[7]. This was shown among the uterine dehiscense cases reported here.

However, uterine dehiscence may exist prior to the onset of labor. In our study subjects, uterine dehiscences were found at the time of repeat sections prior to the onset of labor. Other report, have shown that uterine dehiscence is a high-risk condition for uterine rupture[15]. Therefore, measurement of the lower uterine segment prior to the onset of labor may have clinical significance if it can identify uterine dehiscence.

The thickness of the lower uterine segments of subjects whose dehiscence was found at delivery was significantly smaller than that of those without uterine dehiscence. The tissues adjacent to the uterine scar tend to be thinner in gravidas with previous cesarean sections than in those without cesarean sections[11−14]. Thinning of the lower uterine segment is considered to be a result of stretching in a portion of the lower uterine segment caused by gestation itself, which does not occur in the scarred tissue. Scarred tissue is rigid and does not stretch[12]. Furthermore, during labor, the descent of the fetal head may stretch the lower uterine segment further and make the lower uterine segment thinner, possibly leading to uterine rupture.

In a uterus with disturbed healing, the lower uter-

ine segment may become extremely thin during gestation[11]. Thus, the quality and integrity of the lower uterine segment can be evaluated by lower uterine segment thickness.

In this study, the cut-off value of the measurement was found to be 1.6 mm where only the muscle layer of the lower uterine segment was measured with a vaginal probe. This is comparable to be 3.5 mm of the full thickness measurement with an abdominal probe, as reported by Rozenberg et al[12], in its predictive values.

In our study, measuring only the muscular layer and using a cut-off point of 1.6 mm, the sensitivity was 77.8% and the specificity 88.6%. In Rozenberg's study, measuring the full thickness and using a cut-off point of 3.5 mm, the sensitivity was 88.0%, and the specificity 73.2%. These figures are comparable. The positive predictive values are 22.6% (ours) and 15.7% (Rozenberg's), respectively. Therefore, the prediction of dehiscence/rupture is not highly reliable. Probably factors other than lower uterine segment thickness may be involved in causing dehiscence/rupture[6,16]. On the other hand, the high negative predictive values in the two studies show that the safety of a labor trial can be predicted with reasonable certainty when thickness is above the cut-off point.

The uterine scar tissue cannot usually be observed with a vaginal probe. The studies done at the time of cesarean section showed that the portion we observed by vaginal sonography was actually 1～2 cm caudal to the scar tissue. Even by abdominal ultrasonography previous cesarean scar cannot always be demonstrated until uterine rupture occurs[13,16]. Moreover, when the cut-off value is applied for patients, it is of note that, due to an intraobsever error of 11.0 ± 10.8%, the ultrasonographic measurement of 1.6 mm may range from 1.3 mm to 1.9 mm when error of mean +SD is applied. The variation is relatively large for measurements of the 'thin' lower uterine segment. This is anather drawback of ultrasound measurements in addition to the lack of direct visualization of the scar tissue in predicting uterine dehiscence leading to rupture.

Measuring only the muscular layer of the lower uterine segment by transvaginal ultrasound did not semese this drawback.

References

1. Stoval TG, Shaver DC, Solomon SK, Anderson GD: Trial of labor in previous cesarean section patients, excluding classical cesarean sections. Obstet Gynecol 1987; 170: 713–717.
2. Phelan JP, Clark S. L, Diaz F, Paul RH: Vaginal birth after cesarean. Am J Obstet Gynecol 1987; 157: 1510–1515.
3. Cowan RK, Kinch RAH, Ellis B, Anderson R: Trial of labor following cesarean delivery. Obstet Gynecol 1994; 83: 933–936.
4. Miller DA, Diaz FG, Paul RH: Vaginal birth after cesarean: A 10-year experience. Obstet Gynecol 1994; 84: 255–258.
5. Flamm BL, Goings JR, Liu Y, Wolde-Tsadik G: Elective repeat cesarean delivery versus trial of labour: A prospective multicenter study. Obstet Gynecol 1994; 83: 927–932.
6. Rosen MG, Dickinson JC, Westhoff CL: Vaginal birth after cesarean: A meta-analysis of morbidity and mortality. Obstet Gynecol 1991; 77: 465–470.
7. Howitz BJ, Edelsetein SW, Lippman L: Once a cesarean always a cesarean. Obstet Gynecol 1991; 36: 592–598.
8. Leung AS, Leung EK, Paul RH: Uterine rupture after previous cesarean delivery: Maternal and fetal consequence. Am J Obstet Gynecol 1993; 169: 945–950.
9. Nielsen TF, Ljungblad ULF, Hagberg H: Rupture and dehiscence of cesarean section scar during pregnancy and delivery. Am J Obstet Gynecol 1989; 160: 569–573.
10. Martin ME: Vaginal birth after cesarean delivery. Clin in Peronatol 1996; 23: 141–153.
11. Fukuda M, Shimizu Y, Ihara Y, Fukuda K, Natsuyama E, Mochizuki M: Ultrasound examination of caesarean section scars during pregnancy. Arch Gynecol Obstet 1991; 248: 129–138.
12. Rozenberg P, Goffinet F, Philippe HJ, Nisand I: Ultrasonographic measurement of lower uterine segment to assess risk of defects of scarred uterus. Lancet 1996; 347: 281–284.
13. Tanik A, Ustun C, Cil E, Arslan A: Sonographic evaluation of the wall thickness of the lower uterine segment in patients with previous cesarean section. J Clin Ultrasound 1996; 24: 355–357.
14. Qureshis B, Inafuku K, Oshima K, Masamoto H, Kanazawa K: Ultrasonographic evaluation of lower uterine segment to predict the integrity and quality of cesarean scars during pregnancy: A prospective study. Tohoku J Exp Med 1997; 183(1): 55–65.
15. Chapman K, Meire H, Chapman R: The value of serial ultrasounds in the management of recurrent uterine scar rupture. Brit J Obstet Gynecol 1994; 101: 549–551.
16. Lavin JP, Stephen RJ, Miodovnik M, Barden TP: Vaginal delivery in patients with a prior cesarean section. Obstet Gynecol 1982; 59: 135–148.

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