

Original Articles

Predicting the route of delivery in women with low-lying placenta using transvaginal ultrasonography: significance of placental migration and marginal sinus

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Abstract

Background/Aims: To examine the significance of placental migration and the presence of a placental marginal sinus to predicting the eventual route of delivery in low-lying placenta.

Methods: Forty-nine women with a low-lying placenta after 30 weeks' gestation were studied. The distance between the internal os and leading edge of the placenta was measured weekly using transvaginal ultrasonography until 37 weeks' gestation. The relationship between the rate of placental migration, the presence of a placental marginal sinus and the eventual mode of delivery was investigated.

Results: Although the cesarean section rate was 56.3 % (9/16) in the "slow" migration (0 – 2.0 mm/week) group, no patient (0/33) in the "fast" (more than 2.0 mm/week) migration group underwent a cesarean section ($p < 0.01$). The cesarean section rate was 71.4 % (5/7) in patients with a placental marginal sinus, significantly greater than the rate of 9.5 % (4/42) in patients without a marginal sinus ($p < 0.01$).

Conclusion: A decreased rate of placental migration until 37 weeks' gestation and the presence of a placental marginal sinus were associated with subsequent cesarean delivery because of antepartum vaginal bleeding. These parameters may be useful for predicting the route of delivery in women with a low-lying placenta.

Introduction

Although the mode of delivery in cases of placenta previa has been established as cesarean section, that in cases of low-lying placenta has been controversial. A low-lying placenta is one located close to the internal cervical os but whose edge does not cover the os; however, a precise definition in terms of proximity and gestational age at diagnosis, has not been established. In an initial study on the clinical consequences of low-lying placenta, Oppenheimer *et al.* reported that seven of eight patients with a placenta to internal os distance of ≤ 2 cm, measured using transvaginal ultrasonography (TVUS), delivered by cesarean section because of bleeding [1]. Although the sample size was small and gestational age at diagnosis was variable in this report, a cut-off value of 2cm has been used as a marker of a low-lying placenta. However, others have proposed a different cut-off value, such as 3 cm [2, 3], and a gestational age at diagnosis of ≥ 26 weeks [3]. In addition, the management of low-lying placenta, whether vaginal delivery or emergent/elective cesarean section, has not yet been standardized.

“Placental migration” is the translocation of the placental site to an upper uterine segment in the second and third trimesters [3-7]. Therefore, placental migration seems to be an important factor for predicting the final placental site and subsequent management of low-lying placenta. In this regard, three reports examined the rate of placental migration calculated according to the total distance migrated and the number of weeks between the first and last scans [3, 6, 7]. Two of these reports pointed out a relation between a low placental migration rate and an increased cesarean section rate, however, the studies included women with low-lying placenta who underwent an elective cesarean section without vaginal bleeding [3, 6].

Acute massive vaginal bleeding is a major factor in the choice of the

management in cases of low-lying placenta. Placental marginal sinus, which can be detected by ultrasound examination as an echo-free space in the lower edge of the placenta, is known to cause massive vaginal bleeding in placenta previa [8]. However, the risk of placental marginal sinus in patients with low-lying placenta has not yet been investigated. Therefore in this study, we also examined the significance of placental marginal sinus in the management of low-lying placenta in addition to placental migration.

Materials and Methods

This is a retrospective analysis of TVUS examinations performed at Shinshu University Hospital from April 2005 to November 2009. The location of the placenta and proximity of the placental edge to the internal cervical os was evaluated as a standard TVUS examination during the third trimester. We regarded a placenta located within 30 mm of the internal os after 30 weeks' gestation as low-lying according to a study by Predanic et al, because none of the cases of antepartum bleeding with a distance from the placental edge to internal os of over 30 mm were suspected to be caused by a low-lying placenta [6]. The cases of placenta previa where the placental edge overlapped the internal os were excluded. Cases with a low-lying placenta were tagged prospectively during performance of the examination, and were subsequently reviewed for this study. Sixty-four of 2518 women (2.54 %) who delivered babies during the study period were diagnosed with a low-lying placenta. Of the 64 women, eleven who underwent an elective cesarean section due to a previous cesarean delivery (7 cases) and giant myomas in the lower uterine segment (4 cases) were excluded. Four cases involving an emergent cesarean section because of non-reassuring fetal status were also excluded. Accordingly, 49 cases were

examined in the present study. The study was approved by the Ethics Committee of our institute, and verbal informed consent was obtained from each patient.

All ultrasound examinations were performed by three obstetrics-gynecology physicians (S.O., N.K., R.O.) with subspecialty training in maternal fetal medicine. The films of TVUS were later inspected for quality and accuracy by each other. The ultrasound equipment used included the Sonovista-C3000 (Mochida Siemens Medical Systems, Tokyo, Japan) and Voluson 730 Expert (GE Healthcare Japan, Tokyo, Japan). Because the aim of this study was to predict the eventual route of delivery in low-lying placenta from the data until 37 weeks of gestation, the distance between the center of the internal os and leading edge of the placenta was measured by TVUS weekly until 37 (or 36) weeks of gestation. These measurements were obtained from the portion of the placenta closest to the internal os. When the uterine contraction was observed, TVUS examination was postponed until the contraction disappeared. In cases when a marginal sinus identified as a hypoechoic area with slow and whirl-like blood flow was present, the distance between the internal os and the edge of the sinus was measured. The photocopies of TVUS were reviewed and the distance between the internal os and leading edge of the placenta was reevaluated by two independent observers (T.A., M.K.) unaware of the patient's course ([Fig. 1](#)). The rate of placental migration was calculated by dividing the total distance migrated by the number of weeks between the first and last scans. Patients with a low-lying placenta were divided into two groups according to the rate of placental migration, i.e., a "slow" group (0 – 2.0 mm/week) and a "fast" group (> 2.0 mm/week), because the mean rate of migration was approximately 2 mm/week according to a previous study [7]. To evaluate the effect of the rate of placental migration on cesarean section rates, a statistical analysis of the mode of delivery (cesarean vs. vaginal

delivery) and rate of migration (slow vs. fast) was performed with a 2×2 contingency table using Fisher's exact test. To evaluate the effect of the placental edge-internal os distance on cesarean section rates, a statistical analysis of the mode of delivery and placental edge distance at 36 or 37 weeks of gestation (0 – 20 vs. > 20 mm) was also performed. Moreover, patients were grouped by the presence or absence of a placental marginal sinus, and a statistical analysis of the mode of delivery and presence or absence of a marginal sinus was performed with a 2×2 contingency table using Fisher's exact test. The statistical analyses were performed using Stat View for Windows (SAS Institute, Inc., Cary, NC, USA). $P < 0.05$ was considered statistically significant.

Results

All 49 women in this study had singleton pregnancies, and delivered between 36 and 41 weeks of gestation. The maternal age of these patients was 32.8 ± 4.5 (mean \pm SD) years. The median of gravidity was 1 (range, 0-7) and the median of parity was 0 (range, 0-2). The median of gestational age at delivery was 40 weeks and 1 day (range, from 36 weeks and 3 days to 41 weeks and 5 days). Since spontaneous labor was attempted in all patients, none had inductions of labor. In [Fig. 2](#), each line indicates the distance from the internal os to the edge of the placenta plotted against gestational age in each case. The slope of the line indicates the rate of placental migration. The mean rate of migration for all cases was 5.7 ± 5.3 mm/week (95 % CI = 4.14-7.16), and there were no cases where the placental edge-internal os distance actually decreased and the rate of migration was negative. The fast migration group contained 33 patients with a mean rate of 7.9 ± 5.0 mm/week (95 % CI = 6.14-9.69). The slow migration group had 16 patients with a mean rate of 1.0 ± 0.8 mm/week (95 % CI = 0.57-1.37). According to the location of the

placenta (anterior or posterior wall), the mean rate of migration in the anterior wall group (n = 10) was 7.8 ± 5.8 mm/week (95 % CI = 3.67-11.99), whereas that in the posterior wall group (n = 36) was 4.7 ± 4.7 mm/week (95 % CI = 3.12-6.32) (p = 0.06).

Of the 49 patients, 40 delivered vaginally and 9 underwent an emergent cesarean section because of acute antepartum vaginal bleeding. The location of the placenta of all patients with an emergent cesarean section was posterior. If the amount of acute vaginal bleeding was 300 g or more, we performed an emergent cesarean section. The cesarean section rate was 44.4 % (8/18) in patients with a placental edge-internal os distance of less than 20 mm at 36 or 37 weeks of gestation. It was 3.2 % (1/31) when this distance was greater than 20 mm (p < 0.01). A cut-off point of ≤ 20 mm for the placental edge-internal os distance at 37 weeks predicted a cesarean section with 88.9 % sensitivity and 75.0 % specificity. The likelihood ratio was 3.56 (Table 1). Although the cesarean section rate was 56.3 % (9/16) in patients with slow migration, none of the fast migration patients (0/33) underwent a cesarean section (p < 0.01). A cut-off point of ≤ 2.0 mm/week for the rate of placental migration predicted a cesarean section with 100 % sensitivity and 82.5 % specificity. The likelihood ratio was 5.71 (Table 2).

The present study identified a total of seven patients with a placental marginal sinus. The location of the placenta of all patients with a marginal sinus was posterior. The cesarean section rate was 71.4 % (5/7) in those with a placental marginal sinus and 9.5 % (4/42) in those without (p < 0.01). The presence of the placental marginal sinus predicted cesarean section with 55.6 % sensitivity and 95.0 % specificity. The likelihood ratio was 11.1 (Table 3). Moreover, all 5 patients with slow migration and a marginal sinus required an emergent cesarean section because of acute massive vaginal bleeding. The cesarean section rate was 100 % (5/5) in patients with slow migration and a marginal sinus and

9.1 % (4/44) in the other patients ($p < 0.01$). Slow migration and a marginal sinus predicted cesarean section with 55.6 % sensitivity and 100 % specificity (Table 4). On the other hand, the cesarean section rate was 80 % (4/5) in patients with a placental edge-internal os distance of ≤ 20 mm and marginal sinus. An edge-internal os distance of ≤ 20 mm and the presence of a marginal sinus predicted cesarean section with 44.4 % sensitivity and 97.5 % specificity.

Discussion

The upper limit of the placental edge to internal os distance for use of the term “low-lying” is unclear and undefined. Dawson *et al.* [2] arbitrarily chose an upper limit of 30 mm. Another report also included cases where this distance was up to 30 mm on TVUS at ≥ 26 weeks of gestation [3]. In the present study, an upper limit of 30 mm at ≥ 30 weeks of gestation was used because none of the cases of antepartum hemorrhage with a placental edge to internal os distance of over 30 mm were suspected to be due to low-lying placenta, and the elongation of the lower portion of the uterus begins after 30 weeks of gestation [8]. Although the definition of low-lying placenta is based on the clinical interpretation of ultrasound findings, analysis of the current data set allows the establishment of guidelines for delivery.

Previous studies of low-lying placenta focused on the relationship between the placental edge-internal os distance and the eventual mode of delivery; the 20mm cut off mainly seems to have defined the mode of delivery. Three reports had proposed this cut off because the cesarean section rate was greater in patients with a placental edge-internal os distance of ≤ 20 mm [1, 2, 9]. In these studies, however, gestational age at the last scan was variable. Dawson *et al.* reported the average gestational age at the time of latest scan

to be 31.6 ± 5.4 weeks [2]. Bhide *et al.* reported the gestational age at last scan to range from 32 to 40 weeks [9]. Matsubara *et al.* also proposed a 20mm cut off, but the difference in the cesarean section rate between ≤ 20 mm and > 20 mm was not significant [10]. These results suggest limited diagnostic potential of the placental edge-internal os distance for predicting the mode of delivery.

In the present study, we found that a decreased rate of placental migration until 37 weeks of gestation was associated with subsequent cesarean delivery because of antepartum vaginal bleeding. Our search of the literature found three reports that examined the rate of placental migration [3, 6, 7]. Cho *et al.* evaluated the rate of placental migration in 62 cases of low-lying placenta, and divided them into two groups according to location (anterior vs. posterior) [7]. The mean migration rate between 32 and 37 weeks in the anterior group was 2.2 ± 1.3 mm/week, whereas that in the posterior group was 1.4 ± 0.9 mm/week, results consistent with our own. Cho *et al.* mentioned that the incidence of cesarean section was significantly higher in the posterior group, however, many cases of cesarean section had indications other than antepartum bleeding, i.e., previous cesarean section, abnormal fetal presentation, cephalopelvic disproportion, and maternal desire [7]. Oppenheimer *et al.* investigated the relationship between the rate of migration of the placenta previa or low-lying placenta during the third trimester and the route of delivery [3]. They divided the 36 cases into two groups according to the eventual mode of delivery (group 1; cesarean sections for placenta previa vs. group 2; vaginal delivery and cesarean section performed for other reasons). The mean migration rate in group 1 was 0.3 mm/week, whereas that in group 2 was 5.4 mm/week. However, group 2 contained cesarean sections performed for various reasons other than acute bleeding including elective surgery. Predanic et al. compared the rates and patterns of placental

migration with the mode of delivery [6]. In their study, if the mean rate of placental migration at 32 to 36 weeks of gestation was smaller than the rate at 28 to 32 weeks, this pattern was considered “deceleration”. They identified that significantly higher rates of cesarean section were associated with a deceleration pattern of placental migration. Collectively, these previous reports suggest an increased rate of cesarean section in cases of low-lying placenta, but the cesarean sections reported in these studies were performed for various reasons including those other than acute antepartum bleeding, which is the most important reason for emergent cesarean section. Thus, the actual role of low-lying placenta in the selection of delivery mode was not fully elucidated in these studies. In contrast, the present study clearly demonstrated that the decreased migration rate was correlated with an increased frequency of cesarean sections performed exclusively for acute antepartum bleeding, suggesting the migration rate to be a useful parameter for predicting the mode of delivery. Moreover, we consider that the last scan at 37 weeks of gestation is appropriate for the prediction of cesarean section before the occurrence of massive vaginal bleeding.

A sonographic echo-free space in the lower edge of the placenta, which is considered to be a placental marginal sinus, reportedly indicated the risk of sudden massive antepartum bleeding in a patient with placenta previa [8]. However, the significance of a marginal sinus in patients with low-lying placentas has not been evaluated. The present study also revealed that a placental marginal sinus was associated with subsequent cesarean delivery because of antepartum vaginal bleeding. We consider the acute bleeding to be due to a rupture of the marginal sinus near the internal os. To our knowledge, this is the first report to indicate a potential hemorrhagic risk with a subsequent emergent cesarean section in patients with a low-lying placenta. Moreover,

the importance of the marginal sinus is further enhanced when the migration rate is decreased as indicated in this study, because the sensitivity and specificity for predicting an emergent cesarean section was better with this combination than other parameters including the combination of a placental edge-internal os distance of ≤ 20 mm and presence of a marginal sinus. Therefore, we consider a combination of the two parameters, the rate of placental migration and the presence of a placental marginal sinus, useful for the prediction of clinical course and subsequent mode of delivery.

In conclusion, a “slow” placental migration until 37 weeks of gestation and the presence of a placental marginal sinus were associated with subsequent cesarean delivery because of antepartum vaginal bleeding. These parameters may be used to predict the route of delivery in cases of low-lying placenta. For patients in whom the rate of placental migration is 0 – 2.0 mm/week and the marginal sinus is detected by TVUS, elective cesarean section may be a better option.

References

1. Oppenheimer LW, Farine D, Ritchie JW, Lewinsky RM, Telford J, Fairbanks LA: What is low-lying placenta? *Am J Obstet Gynecol* 1991;165:1036-1038.
2. Dawson WB, Dumas MD, Romano WM, Gagnon R, Gratton RJ, Mowbray D: Translabial ultrasonography and placenta previa: does measurement of the os-placenta distance predict outcome? *J Ultrasound Med* 1996;15:441-446.
3. Oppenheimer L, Holmes P, Simpson N, Dabrowski A: Diagnosis of low-lying placenta: can migration in the third trimester predict outcome? *Ultrasound Obstet Gynecol* 2001;18:100-102.
4. Powers JS, Hill JM: Migrating placenta previa. *South Med J* 1976;69:1505-1506.
5. Ghourab S, Al-Jabari A: Placental migration and mode of delivery in placenta previa: transvaginal sonographic assessment during the third trimester. *Ann Saudi Med* 2000;20:382-385.
6. Predanic M, Perni SC, Baergen RN, Jean-Pierre C, Chasen ST, Chervenak FA: A sonographic assessment of different patterns of placenta previa "migration" in the third trimester of pregnancy. *J Ultrasound Med* 2005;24:773-780.
7. Cho JY, Lee YH, Moon MH, Lee JH: Difference in migration of placenta according to the location and type of placenta previa. *J Clin Ultrasound* 2008;36:79-84.

8. Saitoh M, Ishihara K, Sekiya T, Araki T: Anticipation of uterine bleeding in placenta previa based on vaginal sonographic evaluation. *Gynecol Obstet Invest* 2002;54:37-42.
9. Bhide A, Prefumo F, Moore J, Hollis B, Thilaganathan B: Placental edge to internal os distance in the late third trimester and mode of delivery in placenta praevia. *BJOG* 2003;110:860-864.
10. Matsubara S, Ohkuchi A, Kikkawa M, Izumi A, Kuwata T, Usui R, Watanabe T, Suzuki M: Blood loss in low-lying placenta: placental edge to cervical internal os distance of less vs. more 2 cm. *J Perinat Med* 2008;36:507-512.

Legends to figures

Figure 1: Ultrasound image showing measurement of the distance between the internal os and leading edge of the anterior placenta at gestational age of 35 weeks 3 day.

Figure 2: The distance from the internal os to the edge of the placenta plotted against gestational age in each case. The slope of each line indicates the rate of placental migration. The solid lines represent patients who underwent an emergent cesarean section because of acute antepartum vaginal bleeding (n = 9); the dotted lines represent those who did not (n = 40, vaginal delivery). The lines with asterisks represent patients in whom the placental marginal sinus was detected by TVUS (n = 7).

Table 1 Route of delivery according to the placental edge-internal os distance at 36 or 37 weeks of gestation

Mode of delivery	Placental edge-internal os distance	
	0 – 20 mm (n = 18)	> 20 mm (n = 31)
Vaginal	10 (55.6)	30 (96.8)
Cesarean	8 (44.4)*	1 (3.2)

Values are *n* (%). **p* < 0.01 vs. cesarean section in group of > 20 mm.

Table 2 Route of delivery according to the rate of migration until 36 or 37 weeks of gestation

Mode of delivery	Rate of migration	
	Slow migration group 0 – 2.0 mm/week (n = 16)	Fast migration group > 2.0 mm/week (n = 33)
Vaginal	7 (43.7)	33 (100)
Cesarean	9 (56.3)*	0 (0.0)

Values are *n* (%). **p* < 0.01 vs. cesarean section in group of > 2.0 mm/week.

Table 3 Route of delivery according to presence or absence of placental marginal sinus

Mode of delivery	Placental marginal sinus	
	Presence (n = 7)	Absence (n = 42)
Vaginal	2 (28.6)	38 (90.5)
Cesarean	5 (71.4)*	4 (9.5)

Values are *n* (%). **p* < 0.01 vs. cesarean section in group of absence.

Table 4 Route of delivery according to the rate of migration and the presence of placental marginal sinus

Mode of delivery	Slow migration+ marginal sinus (n = 5)	Other cases (n = 44)
Vaginal	0 (0.0)	40 (90.9)
Cesarean	5 (100)*	4 (9.1)

Values are *n* (%). * $p < 0.01$ vs. cesarean section in other cases.
 Slow migration; the rate of migration of 0 – 2.0 mm/week

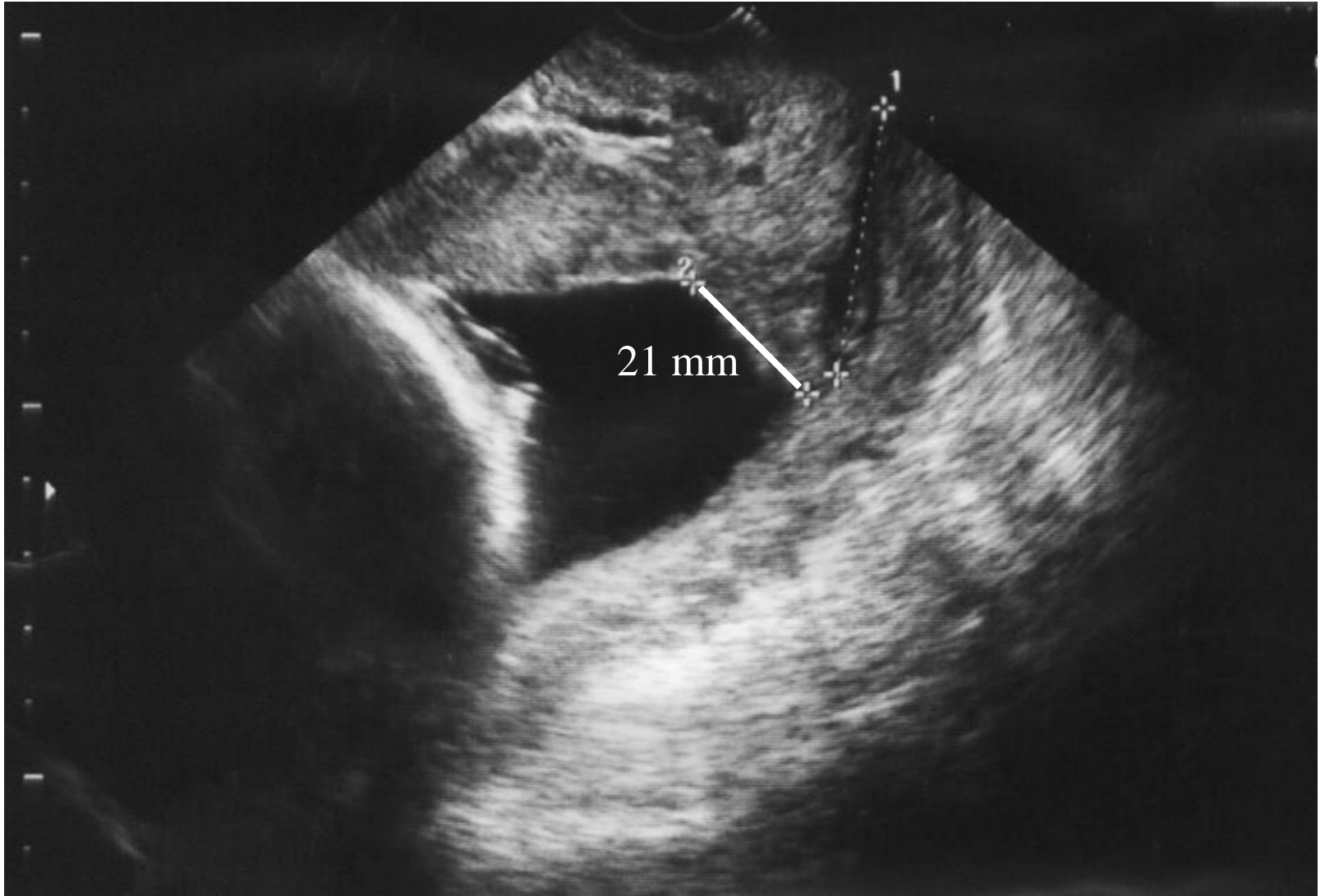


Figure 1

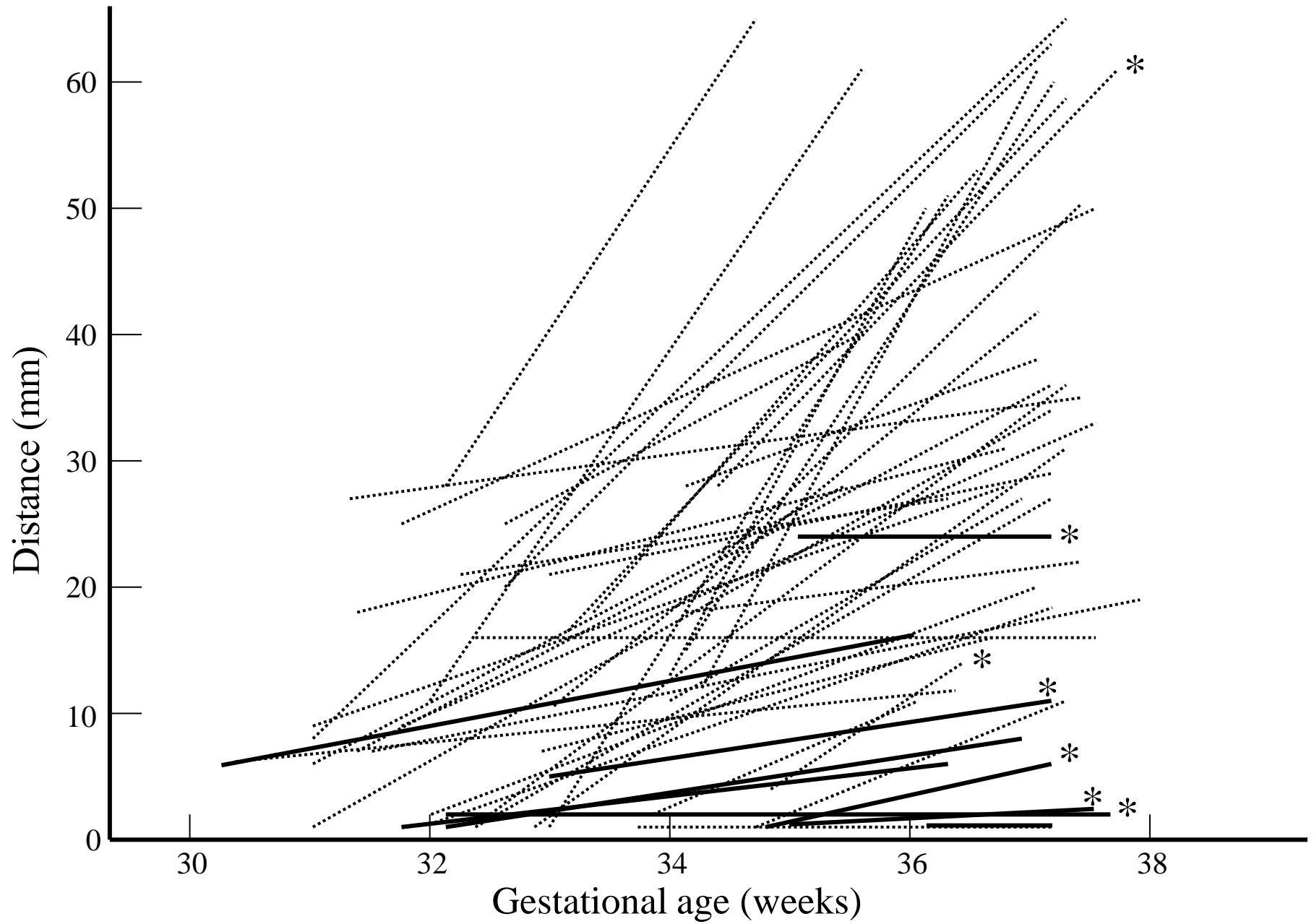


Figure 2