Results of the National Study of Vaginal Birth After Cesarean in Birth Centers

Ellice Lieberman, MD, DrPH, Eunice K. Ernst, CNM, MPH, Judith P. Rooks, CNM, MPH, Susan Stapleton, CNM, MS, and Bruce Flamm, MD

OBJECTIVE: Some women wish to avoid a repeat cesarean delivery and believe that a midwife-supported vaginal birth after cesarean (VBAC) in a nonhospital setting represents their best chance to do so; there is a small, persistent demand for out-of-hospital VBACs. We conducted a study to obtain the data necessary to formulate an evidence-based policy on this practice.

METHODS. We prospectively collected data on pregnancy outcomes of 1,913 women intending to attempt VBACs in 41 participating birth centers between 1990 and 2000.

RESULTS: A total of 1,453 of the 1,913 women presented to the birth center in labor. Twenty-four percent of them were transferred to hospitals during labor; 87% of these had vaginal births. There were 6 uterine ruptures (0.4%), 1 hysterectomy (0.1%), 15 infants with 5-minute Apgar scores less than 7 (1.0%), and 7 fetal/neonatal deaths (0.5%). Most fetal deaths (5/7) occurred in women who did not have uterine ruptures. Half of uterine ruptures and 57% of perinatal deaths involved the 10% of women with more than 1 previous cesarean delivery or who had reached a gestational age of 42 weeks. Rates of uterine rupture and fetal/neonatal death were 0.2% each in women with neither of these risks.

CONCLUSION: Despite a high rate of vaginal births and few uterine ruptures among women attempting VBACs in birth centers, a cesarean-scarred uterus was associated with increases in complications that require hospital management. Therefore, birth centers should refer women who have undergone previous cesarean deliveries to hospitals for delivery. Hospitals should increase access to in-hospital care provided by midwife/obstetrician teams during VBACs. (Obstet Gynecol 2004;104:933–42. © 2004 by The American College of Obstetricians and Gynecologists.)

LEVEL OF EVIDENCE: III

In the 1980s, a vaginal birth after cesarean (VBAC) was considered an important tool in avoiding potentially unnecessary surgery. Studies suggested that trials of labor after cesarean delivery among women with a single low transverse uterine incision were safe, and the rate of VBACs rose continuously from 3% in 1980 to 20% in 1990. This trend was supported by a 1988 opinion issued by The American College of Obstetricians and Gynecologists (ACOG), which suggested that the concept of routine repeat cesarean delivery should be abandoned and that, in the absence of a specific contraindication, a woman with a single cesarean and a low transverse incision should be encouraged to attempt labor in her subsequent pregnancy.[1]

During that same time period, the number of birth centers grew. Birth centers are nonhospital facilities designed to provide maternity care to women who are at low risk of obstetrical complications. The first licensed and accredited urban birth center was established in New York City in 1975, and approximately 160 birth centers were operating in the United States by 1987.[2] The National Birth Center Study, a study of almost 12,000 women who were admitted for labor and birth at birth centers throughout the United States between 1985 and 1987, concluded that adverse outcomes among women giving birth in these birth centers were similar to those reported in large studies of low-risk hospital births, establishing the safety of the birth center setting for women perceived to be at low risk.[2] However, when the National Birth Center Study was conducted few, if any, birth centers were accepting women with a history of

From the Department of Obstetrics and Gynecology, Brigham and Women's Hospital, Boston, Massachusetts; National Association of Childbearing Centers, Perkiomenville, Pennsylvania; Frontier School of Midwifery and Family Nursing, Hyden, Kentucky; University of South Florida College of Public Health, Tampa, Florida; Reading Birth and Women's Center, Reading, Pennsylvania; and Department of Obstetrics and Gynecology, University of California, Irvine, California.

Supported by the National Association of Childbearing Centers (NACC) Foundation.

The authors thank the nurses and midwives at participating birth centers who volunteered to conduct the study, including Janice R. Goings, CNM, and Cara Osborne, CNM. We also thank members of the Scientific Advisory Board who provided input into the conduct of the study and interpretation of the results: Charles Mahan, MD (Professor of Obstetrics and Gynecology, University of South Florida College of Medicine and Professor of Maternal and Child Health, University of South Florida College of Public Health); Fred Howard, MD (Professor of Obstetrics and Gynecology, University of Rochester School of Medicine and Dentistry); Audrey Graham, MD (attending obstetrician, Baylor University Medical Center); and John Kennell, MD (Professor of Pediatrics at Case University School of Medicine).

0029-7844/04/$30.00
doi:10.1097/01.AOG.0000143257.29471.82

previous cesarean delivery, and no women with uterine scars were included in that study.[2,3]

In light of the 1988 ACOG statement supporting VBAC and reports by birth centers of increasing numbers of women asking for VBAC in their centers, the National Association of Childbearing Centers asked its Standards Committee to consider whether trials of labor after cesarean delivery should be performed in birth centers. In 1990, the Committee recommended that VBACS could be offered in birth centers if 1) appropriate informed consent was obtained from the client, 2) there was strong support from the collaborative physicians and institution, and 3) emergency care could be initiated within 30 minutes of the recognition of a problem as recommended by ACOG. In addition, because there were no data on outcomes of VBAC in birth centers on which to base policy, centers offering VBAC were strongly encouraged to participate in a national study to provide data for formulation of an evidence-based policy. Data collection for the study was started in 1990.

During the late 1990s, reports of increases in the number of uterine ruptures in Massachusetts, New York, Pennsylvania, and Florida[4] increased concern about the potential morbidity that may accompany a trial of labor after cesarean delivery, especially the risk of uterine rupture, which can have serious consequences for mother and child.[5,6] In 1999, ACOG issued a new set of guidelines recommending that VBACs should be attempted "only in institutions equipped to respond to emergencies with physicians immediately available to provide emergency care."[7]

Data collection for the National Association of Childbearing Centers study of VBAC in birth centers continued for 10 years. This report presents the findings of that study and evidence-based recommendations regarding the advisability of performing trials of labor after cesarean delivery in birth centers.

MATERIALS AND METHODS

The study was conducted from 1990 to 2000. The study analysis was approved by the Institutional Review Board at Brigham and Women's Hospital. All 123 birth centers known to the National Association of Childbearing Centers in 1990 were invited to participate. When the earlier study of outcomes in birth centers (National Birth Center Study) was conducted, the National Association of Childbearing Centers had obtained lists of all birth centers known to the state health authorities and compared that list with the list of birth centers known to them. Most states knew of either exactly the same birth centers or fewer birth centers than those known to the National Association of Childbearing Centers, which knew of 88% of the birth centers identified by either source.[2] Seventy-four birth centers expressed interest in participating in the VBAC study. Of those, 52 agreed to participate; the other 22 did not participate because VBACs were not being performed at their birth centers.

All women registering at the birth center during the prenatal period who intended to attempt a VBAC at the birth center were included in the study. Data were collected on standard study forms. Demographic data and obstetric history were collected at the first prenatal visit, and additional information was recorded after the birth and at 6 weeks' postpartum.

Of the 52 centers participating, 27 closed during the study period. The 25 birth centers still in operation were visited at the conclusion of the study to check the completeness and reliability of their data. The certified nurse midwives performing the site visits compared the study log with the birth center delivery log to be sure all women admitted to the center for a trial of labor after cesarean delivery had been included in the study. For all subjects, the site visitors also compared data entered from the study form with that reported in the medical record for key variables. The variables verified included those that provided information on key outcomes evaluated in the study, such as date of delivery; timing of and reasons for antepartum and intrapartum transfer; mode of delivery; Apgar scores; fetal and neonatal death; maternal morbidity, including uterine rupture; and hysterectomy. Sixteen of the 27 centers that closed had notified study staff; the completeness and reliability of their data were checked and any questions dealt with by telephone. Data from these centers were included in the analysis. Because the completeness and reliability of the data from the other 11 closed centers could not be verified, data from those centers were not included, resulting in the exclusion of 82 of the 1,995 forms (4%) for eligible women returned to the study investigators.

There were 1,913 women with trials of labor from the 41 included centers. Of those, 1,649 (86.2%) were from centers that had an in-person site visit, and 264 (13.8%) were from centers that had closed but where checks of data validity were performed. Women seen at centers with and without in-person site visits were similar with regard to obstetric history, the proportion of women referred to another source of care before the onset of labor, the proportion transferred during labor, and the cesarean rate for the current trial of labor. Given the similarities in these 2 populations, the data were combined for all analyses.

Of the 1,913 women from included centers, 460 did not go to the birth center for care during labor. The primary reason was medical conditions leading to ante-

partum referral to another source of care (n = 223), most commonly premature rupture of the membranes, postdates pregnancy, suspected fetal macrosomia, breech presentation, and pregnancy-induced hypertension. The most common nonmedical reason for not going to the birth center in labor was that the woman changed her mind (n = 122); other reasons included spontaneous or therapeutic abortions (n = 20), geographic relocation (n = 38), financial considerations (n = 14), a labor that was too rapid (n = 15), and unknown reasons (n = 28). The current analysis was limited to the 1,453 women who presented to the birth centers during labor.

We evaluated a number of outcomes, including the occurrence of complications, method of delivery, place of delivery, and indications for transfer to the hospital. Reasons for intrapartum transfer were classified into 1 of 6 categories. Categorization was hierarchical, with each woman included in the first category to which she belonged: 1) fetal condition (such as nonreassuring fetal status, abnormal fetal heart tracing, and meconium-stained amniotic fluid); 2) placenta/umbilical cord problems (such as placental abruption, prolapsed cord, vasa previa); 3) maternal complications (such as fever and hypertension); 4) delivery issues (such as breech presentation not diagnosed until labor, unengaged head, or the need for assisted vaginal delivery); 5) failure to progress; and 6) maternal "elective" transfers (women who changed their minds, became anxious, or wanted epidural analgesia). Postpartum reasons for transfer were categorized as being primarily maternal or neonatal in origin.

We evaluated the frequency of uterine rupture as well as the occurrence of other outcomes that have the potential for serious long-term adverse consequences for mother or infant. Specifically, we included as other serious adverse outcomes: 1) maternal or perinatal death (intrapartum fetal or neonatal); 2) a hysterectomy (because it prevents the mother from having additional children); or 3) a 5-minute Apgar score of less than 7 (which might indicate a poor prognosis for the child). The frequency of uterine rupture or other serious adverse outcomes was calculated overall and according to the length of time between admission to the birth center and either the birth or initiation of transfer to a hospital, whichever came first. For this calculation, the number of serious adverse outcomes during each time period (<6 hours, 6–12 hours, 12–18 hours, >18 hours) was divided by the number of women in the birth center at the start of that time period. Finally, we examined the occurrence of serious adverse outcomes according to obstetric history (previous vaginal delivery and number of previous cesarean deliveries) and characteristics of the current pregnancy (birth weight and gestational age).

Table 1. Characteristics of the Population Presenting to Birth Centers for Labor (N = 1,453)

Maternal age	
< 20 y	.8
20–24 y	9.6
25–34 y	61.7
35–39 y	23.2
≥ 40 y	4.8
Years of education	
< 12	6.3
12	26.9
13–15	26.0
16+	40.8
Race and ethnicity	
White	88.7
Black	3.7
Hispanic	3.5
Other/unknown	4.1
Gestational age	
< 36 wk	0.3
36–41 wk	96.5
≥ 42 wk	3.2
Mean birth weight (g)	3,687 (± 494)
< 3,000	6.2
3,000–3,999	70.6
4,000–4,499	17.4
> 4,500	5.8
Number previous cesarean deliveries*	
1	93.0
2	6.6
3	0.4
Number previous vaginal deliveries*	
0	54.0
1	24.9
≥ 2	21.2

Data are presented as percentages, except where otherwise indicated.
* Among women with known parity (n = 1,408).

Statistical comparisons were performed using χ^2 or the Fisher exact test for categorical variables, as appropriate. A logistic regression analysis was used to evaluate the association of adverse events with length of time in the birth center; $P < .05$ was considered statistically significant.

RESULTS

The characteristics of the 1,453 women presenting to the birth centers for labor are presented in Table 1. The mean age of the women was 31.2 years, and the population was primarily white (88.7%), with a high proportion of college graduates (40.8%). Most women (93.0%) had only had 1 previous cesarean delivery, and many (46.0%) had also had a previous vaginal birth. Although there were no women with documented vertical scars, the scar type of 8 women (0.6%) was not known to their birth center caregivers, in addition to 24 women (1.7%) whose scar type was not recorded on the study form.

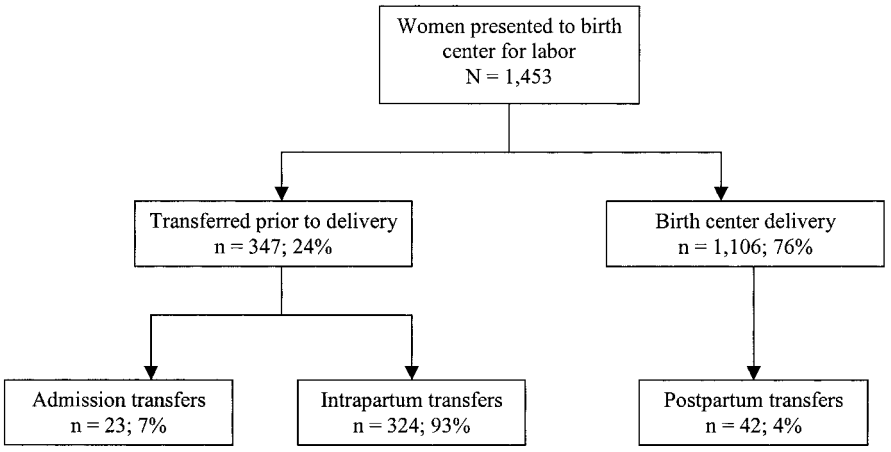

Fig. 1. Place of delivery and transfers to the hospital for the population of women presenting to birth centers in labor.

Lieberman. VBAC in Birth Centers. Obstet Gynecol 2004.

The mean gestational age was 39.8 weeks, and the mean birth weight was 3,687 g. Four women presented to the birth center at less than 36 weeks of gestation. Two of them (25 and 30 weeks of gestation) were transferred to a hospital immediately after their initial assessment at the birth center; the other 2 infants (31 and 34 weeks of gestation) were delivered in the birth center.

Eighty-seven percent of women laboring at the birth center had a vaginal delivery. Having had a previous vaginal delivery was associated with an increased chance of successful vaginal delivery in the current trial of labor (94.4% versus 80.9% for women with no previous vaginal birth; $P < .001$). The rate of successful vaginal delivery was not significantly different for the 1,309 women with only 1 prior cesarean (87.4% vaginal delivery) compared with the 99 women with more than 1 (83.7%, $P = .3$).

Nearly one fourth (347/1,453 = 24%) of women presenting to the birth center in labor were transferred to a hospital before delivery (Fig. 1). Twenty-three women had complications noted at admission to the birth center and were transferred immediately. Failure to progress was the reason for approximately half of intrapartum transfers; other reasons are listed in Table 2. The intrapartum transfer rate was lower for women with a previous vaginal delivery (11% versus 35% for those with no vaginal delivery; $P < .001$), but there was no difference in the rate of transfer for women with 1 as compared with more than 1 previous cesarean delivery (23.8% 1 cesarean, 25.3% > 1 cesarean, $P = .8$).

Thirty-seven of the 347 intrapartum transfers (11%) were coded as emergencies. The time from the decision to transfer to arrival at the hospital was available for 30 of them. The median time to arrival was 15 minutes (range 3–60 minutes), and 90% arrived within 25 minutes. For 15 of the 37 women, the time from arrival at the hospital to treatment was also available. Nine of the 15 women were delivered via cesarean. For those women, the median time from decision to transfer to cesarean was 35 minutes (range 24–120 minutes). Fifty-six percent (5/9) were longer than 30 minutes. The remaining 6 women delivered vaginally. For those women, the median time from the decision to transfer to the start of treatment was 34 minutes (range 25–45 minutes). Half (3/6) of the times were longer than 30 minutes.

Of the 1,106 women who delivered in the birth centers, 42 (3.8%) were transferred to a hospital after the birth, approximately half for maternal indications (n =

Table 2. Reasons for Intrapartum and Postpartum Transfer From the Birth Center

	Transfers [% (n)]*
Intrapartum transfer (n = 347)†	
Fetal condition	16 (56)
Placental/cord complications	1 (4)
Maternal complications	17 (59)
Delivery issues	3 (11)
Failure to progress	51 (177)
Elective transfer	12 (40)
Postpartum maternal (n = 22)	
Laceration repair	36 (8)
Retained placenta	14 (3)
Placenta accreta	9 (2)
Vaginal hematoma	9 (2)
Postpartum hemorrhage/atony	9 (2)
Uterine rupture	5 (1)
Other	18 (4)
Postpartum neonatal (n = 20)	
Respiratory symptoms	50 (10)
Meconium aspiration	10 (2)
Pneumothorax	10 (2)
Status post shoulder dystocia	15 (3)
Other	15 (3)

* Percentage of transfers adds to 100% within each category (intrapartum, postpartum maternal, postpartum neonatal).

† Categories are listed hierarchically. Each woman was included in the first category to which she belonged.

22) and half for neonatal indications (n = 20). The most common reason for maternal transfer was the need to repair lacerations, and the most common reason for neonatal transfer was respiratory symptoms. Other reasons are shown in Table 2.

There were 6 uterine ruptures among the 1,453 women (0.4%, Table 3). The gestational ages of the women with uterine rupture ranged from 39 to 41 weeks, and the birth weights of their infants from 2,977 to 3,969 g. Their time in the birth center ranged from 0.5 to 18.8 hours. Five of the women were transferred to a hospital during labor, 3 during the first stage, and 2 during the second stage. The indication for transfer in all 5 cases was concern about fetal status. All 5 were delivered by cesarean. The sixth woman was transferred 1.5 hours postpartum for bleeding. Only 2 of the 6 women with uterine rupture experienced 1 of the other 3 serious adverse outcomes (perinatal death, hysterectomy, or 5-minute Apgar score < 7; Table 3).

Among the 1,453 women who went to the birth centers for care during labor, there were 7 perinatal deaths (5 intrapartum intrauterine fetal deaths and 2 neonatal deaths; Table 4) for a rate of 0.5%, 1 hysterectomy (0.1%), and 15 liveborn infants with 5-minute Apgar scores less than 7 (1.0%). The proportion of women who had any of these 3 serious adverse outcomes was 1.4% (n = 21). Only 2 of the 7 perinatal deaths involved women who had a uterine rupture.

Overall, 25 women (1.7%) experienced either a uterine rupture or another serious adverse outcome. There was only 1 adverse outcome among the infants born to the 4 women who presented to the birth center in labor before 36 weeks of gestation. An infant of 30 weeks' gestation (whose mother was transferred at presentation to the birth center) had a 5-minute Apgar score of less than 7.

The incidence of serious adverse outcomes did not increase with longer stays in the birth center. Information on time in the birth center was available for 98% of women (n = 1,417). Adverse outcomes occurred in 1.1% (16/1,417) of women between admission and 6 hours, in 1.5% (8/548) of women between 6 and 12 hours, in no women (0/151) between 12 and 18 hours, and in 2.3% (1/43) of women who were in the birth center for >18 hours. Four of the 16 adverse outcomes before 6 hours occurred among women with complications noted at admission to the birth center. Women transferred immediately upon presentation to the birth center were included because going to the birth center delayed arrival at the hospital for treatment, possibly influencing outcome. Excluding those immediate transfers, serious adverse outcomes occurred in 0.9% (12/1,394). A logistic regression found that length of time in the birth center did not predict the occurrence of serious adverse outcomes (odds ratio 0.9; 95% confidence interval 0.9–1.04).

Among the women with known obstetric history (N = 1,408), there were 99 (7%) with more than 1 previous cesarean delivery and 648 (46%) with at least 1 previous vaginal delivery. Women with more than 1 cesarean delivery were significantly more likely than women with only 1 previous cesarean delivery to have a uterine rupture (3% versus 0.2%; $P = .006$). The proportion of women with other serious adverse events was also somewhat higher with more than 1 cesarean delivery (4% versus 1.3%), although this difference did not quite reach statistical significance ($P = .05$).

Previous vaginal delivery was not significantly associated with the occurrence of uterine rupture (0.3% previous vaginal, 0.5% no previous vaginal, $P = .7$) or other serious adverse outcomes (1.6% previous vaginal, 1.4% no previous vaginal, $P = .8$).

Finally, we examined the role of high birth weight and a gestational age of at least 42 weeks as predictors of uterine rupture and other serious adverse outcomes. There were 46 women (3.2%) of at least 42 weeks' gestation. There were no ruptures in that group. However, the occurrence of other serious adverse outcomes was increased (6.5% versus 1.6% <42 weeks; $P = .04$), primarily because of the higher rate of perinatal death (4.3% versus 0.4% <42 weeks; $P = .02$).

Of the 1,418 women with known birth weight, 329 had infants with birth weights of at least 4,000 g. Although none of these women had uterine ruptures, 6 of them (1.8%) suffered other serious adverse outcomes. This was similar to the rate of other serious adverse outcomes among women whose infants weighed less than 4,000 g (1.4%; $P = .6$). The rate of other adverse outcomes among the 82 women with an infant weighing more than 4,500 g was 2.4% (n = 2), which is not significantly higher than among women whose infants weighed less than 4,000 g. ($P = .3$).

In this population, a history of more than 1 prior cesarean delivery and a gestational age of at least 42 weeks were both important predictors of serious adverse outcomes. Overall, 50% of uterine ruptures (3/6) and 57% of perinatal deaths (4/7) involved the 10% of women with 1 of these risk factors. In the 1,271 women with neither of these risks, the rate of uterine rupture and the rate of perinatal mortality were each 0.2%. The rate of uterine rupture or other serious adverse outcomes occurring was 1.3% (Fig. 2).

DISCUSSION

Vaginal birth after cesarean represents an important option for women wishing to avoid another surgical

Table 3. Cases of Uterine Rupture Among Women Laboring at the Birth Centers

	Obstetric data			Transfer			
Case No.	Previous cesareans (n)	Previous vaginal births (n)	Gestation (wk)/ birth weight (g)	Time in labor in BC (h)	Transfer reason	Emergency (Y/N)	Stage of labor at transfer
1	2	1	40/3,317	0.5	Bleeding at admission to birth center, fetal bradycardia	Y	1
2	1	1	40/3,685	7.0	Fetal bradycardia	Y	1
3	1	0	39/3,062	0.5	Thick meconium	N	1
4	2	0	41/3,969	11.5	Undetectable FHR	Y	2
5	2	0	40/3,710	19.0	Uterine rupture Decreased FHR	Y	2
6	1	0	40/2,977	5.5*	Bleeding 1.5 hours postpartum	Y	Postpartum

BC, birth center; Rx, treatment; FHR, fetal heart rate; IUFD, intrauterine fetal death.
* 3.75 hours antepartum, 1.75 hours postpartum.

delivery. Our study examines outcomes in a large group of women who chose to attempt a VBAC outside of the hospital setting. We found a low rate of uterine rupture (0.4%) among women undergoing a trial of labor after cesarean delivery in birth centers. This low rate is not surprising because women who are high risk for labor complications are referred for a hospital birth during the antenatal period. In addition, women laboring in a birth center do not have their labor induced, an intervention that has been associated with increased rate of uterine rupture in some studies.[8–10]

In addition to uterine rupture, we examined the occurrence of other serious adverse outcomes, including maternal or perinatal death (intrapartum fetal or neonatal), a hysterectomy (because that prevents the mother from having additional children), or a 5-minute Apgar score less than 7 (which might indicate a poor prognosis for the child). Overall, 1.4% of labors resulted in at least 1 serious adverse event other than uterine rupture. There were no maternal deaths, but there were 7 perinatal deaths (5 fetal deaths, 2 neonatal), a rate of 0.5%. Only 2 of those deaths (1 fetal death, 1 neonatal) involved women who also had a uterine rupture.

We found a higher rate of adverse outcomes among women who had more than 1 previous cesarean delivery or who had reached at least 42 weeks of gestation. A higher rate of rupture with more than 1 cesarean has been reported previously.[11–13] In addition, a higher rate of stillbirth with postdates pregnancy has been observed in multiple studies.[14,15] When women with either factor were excluded, the remaining lower-risk group (90% of the original study population) had a rupture rate of only 0.2% (3/1,271), a perinatal death rate of 0.2% (3/1,271), and a serious adverse event rate of 1.3%.

The interpretation of these findings rests in part upon the standard of care. Research findings and obstetric opinion about VBACs changed dramatically during the study period (1990–2000). The 1988 ACOG guidelines on VBACs called for sites in which a VBAC would be attempted to have the capacity to respond to acute

Table 4. Intrapartum Fetal Deaths and Neonatal Deaths Among Women Laboring at the Birth Centers

		Obstetric data			Transfer	
Case No.	IUFD/Neonatal death	Previous cesareans (n)	Previous vaginal births (n)	Gestation (wk)/ birth weight (g)	Time in labor in BC (h)	Reason for transfer and death
1	IUFD	1	0	42/3,459	. . .	Fetal bradycardia on arrival at birth center; true knot in cord
2	IUFD	1	0	42/5,075	4.75	Failure to progress; fetal bradycardia developed during transfer
3	IUFD	2	0	41/3,969	11.5	Absent fetal heart tones
4	IUFD	1	0	39/3,550	0.3	Blood tinged amniotic fluid; likely marginal abruption
5	IUFD	1	0	40/4,649	7.0*	Repair of 4th degree; status post–shoulder dystocia
6	Neonatal	1	1	40/3,657	. . .	Breech, prolapsed cord on arrival at birth center
7	Neonatal	2	0	40/3,710	18.8	Fetal bradycardia; suspected uterine rupture

IUFD, intrauterine fetal death; BC, birth center
* 6.5 hours antepartum; 0.5 hour postpartum.

Response time			Outcome			
Recognition to arrival at hospital (min)	Arrival to incision or other Rx (min)	Recognition to incision or other Rx (min)	Delivery type	Perinatal death	Apgar Score (1 min/5 min)	Hysterectomy
12	14	26	C/S		3/8	
3	19	22	C/S		8/9	
. . .	. . .	. . .	C/S		8/9	
5	30	35	C/S	IUFD	0/0	Yes
30	15	45	C/S	Neonatal	1/4	
15	30	45	Vaginal		7/8	

intrapartum obstetric emergencies, including performing a cesarean delivery within 30 minutes from the time the decision was made.[1] In 1999, ACOG dramatically altered that recommendation, stating that VBAC should be attempted only in institutions in which physicians were constantly available to provide immediate emergency care. Almost all of the births in this study occurred before ACOG announced these new guidelines. However, because we intended to use the findings from this study as a basis for recommendations regarding future attempts to conduct VBACs in birth centers, we chose to compare the birth center outcomes from an earlier period to VBAC outcomes in hospitals that meet the current standards, that is, in-house access to obstetricians and anesthesiologists who are immediately available to intervene.

Studies of VBACS have tended not to report separately the rates of adverse events for women who were similar to the lower-risk women in our study. A data set of all women who had a trial of labor after cesarean delivery during a 12-year period at Brigham and Women's Hospital in Boston was analyzed to determine the rates of adverse outcomes for only those women who had spontaneous labor at 37 weeks' gestation or greater (n = 3,265).[16] This population is not identical to that in birth centers because it includes some women who would probably have been triaged out of birth center on the basis of medical risks. The rate of uterine rupture in this tertiary care setting was 0.7%, and the proportion of women with other serious adverse outcomes (intrapartum fetal death, neonatal death, hysterectomy, or 5-minute Apgar score < 7) was 1.4%, the same as the rate for VBAC attempts in birth centers. However, there were no intrapartum fetal deaths or neonatal deaths among the population attempting VBAC in this tertiary care center.

Other studies of in-hospital VBAC also have demonstrated low rates of perinatal mortality. A study of VBACs in a community hospital with in-house obstetrics and anesthesia in which the population was not limited by gestational age or medical risk reported a uterine rupture rate of 0.9% (5/580) and no perinatal deaths among the subgroup with spontaneous labor.[17] A perinatal mortality rate of 0.1% was reported in a population-

Transfer		Response time			Outcome		
Emergency (Y/N)	Stage of labor at transfer	Recognition to arrival at hospital (min)	Arrival at hospital to incision (min)	Recognition to incision (min)	Delivery type	Rupture	Hysterectomy
. . .	1	. . .	. . .	. . .	Cesarean		
N	1	. . .	. . .	. . .	Cesarean		
Y	2	5	30	35	Cesarean	Yes	Yes
Y	1	60	60	120	Cesarean		
Y	Postpartum	. . .	. . .	. . .	Vaginal		
Y	1	3	24	27	Cesarean		
Y	2	30	15	45	Cesarean	Yes	

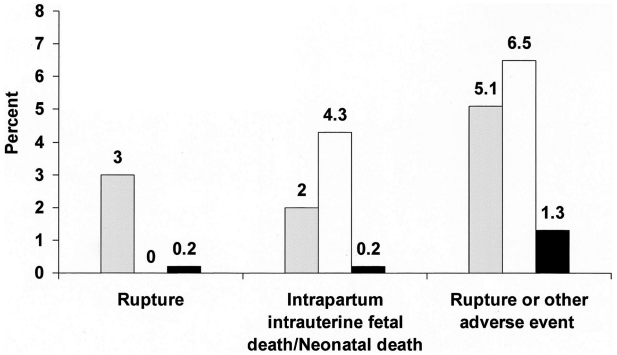

Fig. 2. Proportion of women with uterine rupture and other serious adverse outcomes (fetal/neonatal death, hysterectomy, 5-minute Apgar score < 7) according to pregnancy characteristics. Gray bars, > 1 cesarean delivery; white bars, ≥ 42 weeks; black bars, neither.

Lieberman. VBAC in Birth Centers. Obstet Gynecol 2004.

based cohort of 15,515 women with singleton pregnancies undergoing a trial of spontaneous or induced labor after cesarean delivery at 37 to 43 weeks of gestation.[18] Finally, Flamm et al[19] reported only 2 perinatal deaths (1 fetal death and 1 neonatal death of a very preterm infant) among 1,776 women undergoing a trial of spontaneous or induced labor (0.1%). The perinatal mortality rates (intrapartum fetal and neonatal) in these studies were lower than those in the birth centers (0.5% overall and 0.2% for women less than 42 weeks of gestation with only 1 prior cesarean delivery), although the populations were likely to be at somewhat higher risk than the birth center clients in our study.

Other published studies have found that, in addition to uterine rupture, women with a previous cesarean delivery are at increased risk for other complications compared with parous women who have never had a cesarean delivery. Several studies have reported higher rates of placenta previa, placenta accreta, and placental abruption.[20–24] Rageth et al[9] studied a Swiss cohort that included 29,046 women with a previous cesarean delivery and reported that, compared with other parous women, those with a prior cesarean delivery had higher rates of neonatal complications, thromboembolic complications, and maternal febrile morbidity whether they chose a trial of labor or elected a repeat cesarean delivery. In addition, a sophisticated evaluation by Smith et al[25] reported a 2-fold increased risk of unexplained stillbirth during the second pregnancy among women whose first baby was delivered by cesarean compared with women who underwent a previous vaginal delivery. The authors concluded that the risk of antepartum stillbirth at or after 39 weeks of gestation among women with 1 previous cesarean delivery is about double the risk of stillbirth or neonatal death caused by uterine rupture.[25]

Results from existing literature, as well as findings from this study, suggest that pregnancies among women with prior cesarean deliveries may be at higher than average risk of a variety of complications. Given that adverse outcomes are somewhat increased, women undergoing a trial of labor after cesarean cannot be considered completely low risk and are therefore best cared for in a hospital with physician care that is available immediately. Birth center care was designed for the care of low-risk women who anticipate uncomplicated births and has been demonstrated to result in good outcomes for that group of women.[2] Birth centers are not prepared to provide optimal care to women and newborns who experience sudden life-threatening complications. The inability of birth centers to provide ideal management of the serious complications associated with childbirth among women with cesarean scars may be responsible for the higher rate of intrapartum fetal deaths and neonatal deaths observed in our study.

Our study has some limitations. Women enrolled in the study were cared for in a variety of birth centers. We took many measures, including site visits, to assure complete ascertainment of cases in which the woman had a previous cesarean delivery. Centers where compliance could not be assured were excluded from the data set, resulting in the exclusion of 4% of potential subjects. The validity and reliability of data for key variables also were confirmed by in-person or telephone site visits to participating centers. Another inevitable factor in a study with a large number of sites and practitioners is variation in management practices and populations served. Our results represent an average outcome for participating sites. There were an inadequate number of births at each site to allow for meaningful comparisons. In addition, there was variation in the distance between the birth center and the nearest hospital. Four of the birth centers were physically connected to hospitals, whereas others were a distance away. The National Association of Childbearing Centers guidelines for VBACs in birth centers issued at the start of the study included the stipulation that centers be close enough to a hospital that treatment could be initiated within 30 minutes, as recommended by the ACOG guidelines at that time. However, in our study only approximately half of the women with emergency transfers received treatment within 30 minutes. We were unable to evaluate the reasons why the time to treatment was longer than expected. Finally, although a large number of centers were included, some birth centers chose not to participate, and outcomes at those sites may differ. Although many nonparticipating centers did not perform trials of labor after cesarean,

some centers performing VBACs may have chosen not to participate. If sites with better outcomes were more likely to participate, then our results represent a best-case scenario. However, it is probably also true that the hospitals publishing much of the data we use for comparison are likely to be those with better-than-average outcomes.

On the basis of these findings, we advise both birth centers and women with prior cesarean deliveries against attempting VBACs in any nonhospital setting. We make this recommendation even more strongly for women who are at least 42 weeks of gestation or have had more than 1 cesarean delivery. Although women who underwent a previous cesarean should be cared for in hospitals, only issues of safety should limit the options available to them in that setting. The desire for care by a midwife may be one motivation for choosing an out-of-hospital birth. Because out-of-hospital birth is not a safe choice for women with prior cesarean deliveries, hospitals should provide the option of care by a midwife/obstetrician team for women seeking VBAC within the hospital setting.

We also encourage more hospitals to offer VBACS so that women who want to avoid another cesarean have a safe place to deliver. If a medically safe environment is not available, women with a strong desire for a vaginal delivery may choose to give birth in less safe settings, including the home. There are no studies documenting outcomes among populations of women attempting a home birth after cesarean, although several cases resulting in fetal and maternal deaths have been reported.[26,27] Although individual case reports cannot establish safety or lack of safety, the increased rate of adverse outcomes in women with previous cesarean deliveries suggests that complications requiring management that can only be provided in a hospital will occur more often in this group than among other women choosing home births. The higher rate of adverse outcomes among women with a previous cesarean, regardless of their choice for method of delivery, underscores the importance of implementing policies and management strategies that avoid unnecessary primary cesarean deliveries.

REFERENCES

1. American College of Obstetricians and Gynecologists. Guidelines for vaginal birth after a previous cesarean. ACOG Committee Opinion 64. Washington, DC: ACOG; 1988.
2. Rooks JP, Weatherby NL, Ernst EK, Stapleton S, Rosen D, Rosenfield A. Outcomes of care in birth centers. The National Birth Center Study. N Engl J Med 1989;321:1804–11.
3. Rooks JP, Weatherby NL, Ernst EK. The National Birth Center Study. Part I. Methodology and prenatal care and referrals. J Nurse Midwifery 1992;37:222–53.
4. Sachs BP, Kobelin C, Castro MA, Frigoletto F. The risks of lowering the cesarean delivery rate. N Engl J Med 1999;340:54–7.
5. Jones RO, Nagashima AW, Hartnett-Goodman MM, Goodlin RC. Rupture of low transverse cesarean scars during trial of labor. Obstet Gynecol 1991;77:815–7.
6. Scott JR. Mandatory trial of labor after cesarean delivery: an alternative viewpoint. Obstet Gynecol 1991;77:811–4.
7. American College of Obstetricians and Gynecologists. Vaginal birth after previous cesarean. ACOG Practice Bulletin 5. Washington, DC: ACOG; 1999.
8. Zelop CM, Shipp TD, Repke JT, Cohen A, Caughey AB, Lieberman E. Uterine rupture during induced or augmented labor in gravid women with one prior cesarean delivery. Am J Obstet Gynecol 1999;181:882–6.
9. Rageth JC, Juzi C, Grossenbacher H. Delivery after previous cesarean: a risk evaluation. Swiss Working Group of Obstetric and Gynecologic Institutions. Obstet Gynecol 1999;93:332–7.
10. Lydon-Rochelle M, Holt VL, Easterling TR, Martin DP. Risk of uterine rupture during labor among women with a prior cesarean delivery. N Engl J Med 2001;345:3–8.
11. Miller DA, Diaz FG, Paul RH. Vaginal birth after cesarean: a 10-year experience. Obstet Gynecol 1994;84:255–8.
12. Caughey AB, Shipp TD, Repke JT, Zelop CM, Cohen A, Lieberman E. Rate of uterine rupture during a trial of labor in women with one or two prior cesarean deliveries. Am J Obstet Gynecol 1999;181:872–6.
13. Leung AS, Farmer RM, Leung EK, Medearis AL, Paul RH. Risk factors associated with uterine rupture during trial of labor after cesarean delivery: a case-control study. Am J Obstet Gynecol 1993;168:1358–63.
14. Ingemarsson I, Kallen K. Stillbirths and rate of neonatal deaths in 76,761 postterm pregnancies in Sweden, 1982–1991: a register study [review]. Acta Obstet Gynecol Scand 1997;76:658–62.
15. Hilder L, Costeloe K, Thilaganathan B. Prolonged pregnancy: evaluating gestation-specific risks of fetal and infant mortality. Br J Obstet Gynaecol 1998;105:169–73.
16. Shipp TD, Zelop CM, Repke JT, Cohen A, Caughey AB, Lieberman E. Intrapartum uterine rupture and dehiscence in patients with prior lower uterine segment vertical and transverse incisions. Obstet Gynecol 1999;94:735–40.
17. Blanchette H, Blanchette M, McCabe J, Vincent S. Is vaginal birth after cesarean safe? Experience at a community hospital. Am J Obstet Gynecol 2001;184:1478–84; discussion 84–7.
18. Smith GC, Pell JP, Cameron AD, Dobbie R. Risk of perinatal death associated with labor after previous cesarean delivery in uncomplicated term pregnancies. JAMA 2002;287:2684–90.
19. Flamm BL, Lim OW, Jones C, Fallon D, Newman LA,

Mantis JK. Vaginal birth after cesarean section: results of a multicenter study. Am J Obstet Gynecol 1988;158:1079–84.
20. Clark SL, Koonings PP, Phelan JP. Placenta previa/accreta and prior cesarean section. Obstet Gynecol 1985;66:89–92.
21. Ananth CV, Smulian JC, Vintzileos AM. The association of placenta previa with history of cesarean delivery and abortion: a meta-analysis. Am J Obstet Gynecol 1997;177:1071–8.
22. Miller DA, Chollet JA, Goodwin TM. Clinical risk factors for placenta previa-placenta accreta. Am J Obstet Gynecol 1997;177:210–4.
23. Lydon-Rochelle M, Holt VL, Easterling TR, Martin DP. First-birth cesarean and placental abruption or previa at second birth(1). Obstet Gynecol 2001;97:765–9.
24. Kastner ES, Figueroa R, Garry D, Maulik D. Emergency peripartum hysterectomy: experience at a community teaching hospital. Obstet Gynecol 2002;99:971–5.
25. Smith GC, Pell JP, Dobbie R. Caesarean section and risk of unexplained stillbirth in subsequent pregnancy. Lancet 2003;362:1779–84.
26. Flamm BL, Newman LA, Thomas SJ, Fallon D, Yoshida MM. Vaginal birth after cesarean delivery: results of a 5-year multicenter collaborative study. Obstet Gynecol 1990;76:750–4.
27. Catanzarite VA, Foster E, Robinette P, Cousins LM, Schneider JM. Maternal death due to rupture of a low transverse cesarean section incision during labor at home. West J Med 1992;157:454–5.

Address reprint requests to: Ellice Lieberman, MD, DrPH, Department of Obstetrics and Gynecology, Brigham and Women's Hospital, 75 Francis Street, Boston, MA 02115; e-mail: elieberman@partners.org.

Received May 18, 2004. Received in revised form July 16, 2004. Accepted July 22, 2004.