

The Association between Intended Mode of Delivery and Maternal Morbidity in Twin Pregnancies

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Abstract

Objective To compare maternal morbidity between women undergoing delivery of twins who intend to labor with those women who do not intend to labor.

Study Design This was a retrospective cohort study of women undergoing delivery of twins in a single maternal–fetal medicine practice between January 2005 and February 2018. We identified women with a twin delivery at gestational age ≥ 24 weeks and determined if they intended or did not intend to labor. Maternal outcomes were compared between the groups.

Results A total of 788 patients were included, of whom 404 (51.3%) intended to labor and 384 (48.7%) did not intend to labor. Women who intended to labor had a high rate of vaginal delivery (VD; 79.7%). Overall, 45 (5.7%) women required blood transfusion; this was not significantly different between the groups (6.2 vs. 5.2%, $p = 0.54$). Women who intended to labor had a shorter hospital stay and lower blood loss. There were no significant differences for all other maternal outcomes.

Conclusion In patients undergoing twin delivery, women who intend to labor have similar maternal morbidity compared with women who do not intend to labor. This supports current guidelines recommending providers offer a trial of VD for twin pregnancies.

Keywords

- ▶ gestational
- ▶ cesarean delivery
- ▶ maternal morbidity
- ▶ mode of delivery
- ▶ complications

The prevalence of twin pregnancies has increased in the United States over the past two decades, representing 3% of all deliveries.¹ The optimal mode of delivery for twin births continues to be debated. Many obstetricians offer cesarean delivery (CD) for twin deliveries due to concern for neonatal complications with vaginal delivery (VD), including cord prolapse, placental abruption, and hypoxic injury to the nonpresenting twin.² Recent studies, however, have shown that planned CD does not reduce the risk of short- or long-term neonatal morbidity compared with VD.^{3–6} Based on these findings, the American College of Obstetricians and Gynecologists recommends offering a VD for patients with-

out contraindications to labor.⁷ Although neonatal outcomes have been well investigated, it is not yet clear which mode of delivery is associated with superior maternal outcomes.

When compared with singleton deliveries, twin deliveries have an increased risk of serious maternal complications including postpartum hemorrhage, hysterectomy, and a small but increased risk of death.^{2,8} Identifying the optimal mode of delivery is critical to minimizing the risk of these adverse outcomes. Some obstetricians suggest that twin pregnancies should be managed with planned CD to avoid complications of intrapartum or emergency CD.⁹ Other providers, however, cite the increased risk of hemorrhage,

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increased risk of infectious morbidity, and longer hospital stays associated with CD in singleton pregnancies and, therefore, recommend VD for women with twin pregnancies who are eligible to labor.^{10,11}

Data regarding maternal morbidity in twin pregnancies by mode of delivery are limited. One randomized controlled trial on women with twin pregnancies showed no differences in maternal outcomes among those women who intended to labor compared with those with planned CD.³ A more recent retrospective study, however, found increased maternal morbidity among those women who intended to labor compared with those who had planned CD.¹² There have been few other trials that have examined this association.

Despite evidence suggesting comparable neonatal outcomes by mode of delivery in twin pregnancies, the rate of twin CD in the United States continues to increase. As many as 75% of twins today are delivered by CD, attributed to rising rates of elective planned CD in this population.¹⁰ Given this trend, more data are needed on the association between maternal outcomes and mode of delivery.

In this study, we sought to compare maternal outcomes among women with twin pregnancies by intended mode of delivery.

Materials and Methods

This was a retrospective cohort study of all women who were delivered by a single maternal–fetal medicine practice between July 2005 (when our computerized medical record was created) and February 2018. We included all women who delivered live twins ≥ 24 weeks' gestational age (GA). We excluded women with intrauterine fetal death of either twin, twin–twin transfusion syndrome, monochorionic–monoamniotic twins, women with placenta previa, vasa previa, and history of prior CD or myomectomy.

Decisions concerning mode of delivery, timing of delivery, and labor management were made clinically according to contemporary guidelines and best practices. Our practice protocol for twin delivery has been previously described.¹³ Briefly, women are considered candidates for VD if the first twin is in cephalic presentation with no other contraindications to vaginal birth. If the second twin is noncephalic, the estimated fetal weight for the second twin must be $\geq 1,500$ g and the estimated fetal weight discordancy must be $<20\%$ to be eligible for vaginal birth. There must be no other contraindications to labor. In our practice, we utilize active management of the second stage for twin deliveries which includes breech extraction of the noncephalic second twin, as well as internal podalic version and breech extraction of a cephalic but unengaged second twin.

We categorized patients by their intention to labor, which was determined by review of the patient records. Women who intended to labor were compared with women who did not intend to labor. Women who were eligible for VD, but elected to have a CD were classified in the group not intending to labor. Women who were not eligible for VD were also classified in the group not intending to labor. Maternal baseline characteristics, delivery information,

and hospitalization course were obtained by review of the medical record. All patients were delivered at the Mount Sinai Hospital, which is a large tertiary academic medical center in New York City. GA was determined by last menstrual period and confirmed by ultrasound in all patients. The pregnancy was redated if there was a more than 5-day discrepancy up to 14 weeks or a more than 7-day discrepancy after 14 weeks. If the pregnancy was the result of in vitro fertilization (IVF), GA was determined from IVF dating.

We compared maternal outcomes between women who intended to labor with those who did not intend to labor. Our primary outcome was blood transfusion prior to hospital discharge. Secondary outcomes included mode of delivery, mean maternal length of stay (LOS) after delivery, readmission, estimated blood loss (EBL), $EBL \geq 1,000$, $EBL \geq 1,500$, third or fourth degree lacerations, endometritis (defined clinically as postpartum fever requiring antibiotics), thrombosis, wound complications (separation requiring packing or reclosure, or infection requiring antibiotics), hysterectomy, bowel or bladder injury, intensive care unit (ICU) admission, maternal death, and finally composite maternal morbidity (combining thrombosis, hysterectomy, bowel or bladder injury, ICU admission, and maternal death). We repeated this analysis, excluding women with malpresentation of the presenting twin among women who did not intend to labor. We also performed a secondary analysis stratifying by parity.

We compared baseline characteristics between the two groups using chi-square test and Student's *t*-test as appropriate (IBM SPSS for Windows 22.0, IBM Corp.). A *p*-value of ≤ 0.05 was considered statistically significant. Multiple regression analysis was performed to control for differences in baseline characteristics between the groups.

This project was approved by the Biomedical Research Alliance of New York Institutional Review Board.

Results

A total of 788 patients met inclusion criteria, of whom 404 (51.3%) intended to labor and 384 (48.7%) did not intend to labor. The most common indication for not intending to labor was malpresentation of the presenting twin, occurring in 227 (59.1%) of deliveries, while 69 (18.0%) women opted for an elective CD. The baseline characteristics of both groups are shown in ► **Table 1**. Women who intended to labor were more likely to be younger, white, parous, have a spontaneous twin pregnancy, have no fibroids, and have a later GA at delivery. Among women who intended to labor, 227 (56.2%) underwent labor induction.

Maternal outcomes are shown in ► **Table 2**. Almost all women who did not intend to labor had a CD (99.0%). Among women who intended to labor, the rate of VD was very high, with 322 (79.7%) successfully delivering both twins vaginally. In both groups, the rate of vaginal–cesarean delivery (VD–CD) indicating VD of the presenting twin and CD of the nonpresenting twin was low (1.0 vs. 0.5%). Women who intended to labor had a significantly shorter postpartum LOS than women who did not intend to labor (2.4 vs. 3.9 days, $p < 0.001$). There were no maternal deaths in either group.

Table 1 Baseline characteristics of women having twin deliveries by intended mode of delivery

Baseline characteristics	Labor not intended (n = 384)	Labor intended (n = 404)	p-Value
Maternal age (y)	35.1 ± 6.3	32.7 ± 6.0	<0.001
White race	314 (81.8%)	352 (87.1%)	0.04
Prepregnancy BMI	23.7 ± 4.4	23.1 ± 4.3	0.06
In vitro fertilization	244 (63.5%)	208 (51.5%)	0.001
Nulliparity	303 (78.9%)	236 (58.4%)	<0.001
Receiving anticoagulation	13 (7.0%)	13 (6.3%)	0.79
Fibroids	27 (7.0%)	11 (2.7%)	0.01
Chorionicity			
Monochorionic-diamniotic	52 (13.5%)	69 (17.1%)	0.17
Dichorionic-diamniotic	332 (86.5%)	335 (82.9%)	
Gestational age at delivery (wk)	35.3 ± 2.8	36.5 ± 1.9	<0.001
Induction of labor	–	227 (56.2%)	–

Abbreviation: BMI, body mass index.

Overall, 45 women (5.7%) required transfusion; the rate of transfusion was not significantly different between women who intended or did not intend to labor (6.2 vs. 5.2%, $p = 0.54$). Women who did not intend to labor, however, had a significantly higher EBL and EBL $\geq 1,000$ mL. Nine women (1.1%) had an event captured by the composite maternal morbidity. The rate of composite maternal morbidity was not significantly different between the groups (0.5 vs. 1.7%, $p = 0.18$). All other maternal outcomes including readmission, EBL $\geq 1,500$ mL, endometritis, wound complications, thrombosis, hysterectomy, bowel/bladder injury, and ICU admission were rare and not significantly different between the groups. We repeated this analysis excluding women with malpresentation of the presenting twin among women who did not intend to labor and obtain similar results; women who intended to labor had a shorter LOS and lower mean EBL but with no significant differences in transfusion (6.2 vs. 5.0%, $p = 0.50$) and all other outcomes.

We performed a regression analysis to estimate the association between intended mode of delivery and maternal outcomes, adjusting for variables found to be different in the univariable analysis (► **Table 3**). After adjusting for maternal age, white race, IVF, nulliparity, fibroids, and GA at delivery, women who intended to labor still had a significantly shorter postpartum LOS ($\beta = -1.01$, 95% confidence interval [CI]: $-1.20, -0.83$) and had a significantly lower EBL ($\beta = -238.58$, 95% CI: $-319.34, -157.82$). EBL $\geq 1,000$ mL was less likely in the group that intended to labor (adjusted odds ratio = 0.34, 95% CI: 0.20–0.57). All other outcomes, including composite maternal morbidity, transfusion, EBL $\geq 1,500$ mL, endometritis, wound complications, hysterectomy, and ICU admission were not significantly different between the groups after adjustment.

Table 2 Maternal outcomes of women having twin deliveries by intended mode of delivery

Maternal outcomes	Labor not intended (n = 384)	Labor intended (n = 404)	p-Value
Mode of delivery			
VD	0 (0.0%)	322 (79.7%)	<0.001
VD-CD	4 (1.0%)	2 (0.5%)	
CD	380 (99.0%)	80 (19.8%)	
Transfusion	20 (5.2%)	25 (6.2%)	0.54
Length of stay postpartum (d)	3.9 ± 0.8	2.4 ± 0.8	<0.001
EBL (mL)	924.6 ± 270.3	626.3 ± 369.0	<0.001
EBL $\geq 1,000$ mL	161 (41.9%)	57 (14.3%)	<0.001
EBL $\geq 1,500$ mL	21 (5.5%)	20 (5.0%)	0.78
Third/fourth degree laceration	0 (0.0%)	4 (1.0%)	0.13
Endometritis	8 (2.1%)	8 (2.0%)	0.92
Wound complications	3 (0.8%)	3 (0.7%)	0.99
Composite maternal morbidity ^a	2 (0.5%)	7 (1.7%)	0.18
Thrombosis	0 (0.0%)	2 (0.5%)	0.50
Hysterectomy	1 (0.3%)	2 (0.5%)	0.99
Bowel/bladder injury	0 (0.0%)	0 (0.0%)	0.99
ICU admission	2 (0.5%)	4 (1.0%)	0.69
Maternal death	0 (0.0%)	0 (0.0%)	0.99

Abbreviations: CD, cesarean delivery; EBL, estimated blood loss; ICU, intensive care unit; VD, vaginal delivery; VD-CD, vaginal-cesarean delivery.

^aComposite maternal morbidity includes thrombosis, hysterectomy, bowel or bladder injury, intensive care unit admission, and maternal death.

Finally, we performed a subanalysis of maternal outcomes by intended mode of delivery, stratified by parity (► **Table 4**). Among nulliparous women, there was a significantly higher rate of transfusion among women who intended to labor than those who did not intend to labor (8.6 vs. 4.3%, $p = 0.04$). Among parous women, there was a lower rate of transfusion among women who intended to labor than those who did not intend to labor (3.0 vs. 8.6%, $p = 0.05$). EBL $\geq 1,000$ mL was significantly more likely among women who did not intend to labor, both for nulliparous and parous women. There were no significant differences seen in any other outcomes by parity.

We performed a post hoc power analysis for our primary outcome, transfusion. With 788 patients, we had 80% power at 5% significance to detect a twofold increase in the rate of transfusion from 6% in women who did not labor to 12% in women who did labor.

Table 3 Odds of maternal morbidity for women who intended to labor versus not intended to labor

Maternal outcome	Adjusted OR/ β coefficient ^a (95% CI)
Length of stay postpartum	-1.01 (-1.20, -0.83)
Composite maternal morbidity ^b	6.91 (0.79-60.75)
Transfusion	1.76 (0.77-4.01)
EBL	-238.58 (-319.34, -157.82)
EBL \geq 1,000 mL	0.34 (0.20-0.57)
EBL \geq 1,500 mL	1.89 (0.79-4.38)
Endometritis	0.75 (0.14-4.02)
Wound complications	4.98 (0.45-54.79)
Hysterectomy	0.85 (0.05-16.22)
ICU admission	6.05 (0.65-56.49)

Abbreviations: CI, confidence interval; EBL, estimated blood loss; ICU, intensive care unit; OR, odds ratio.

^aAdjusted for intended/not intended labor and differences in baseline characteristics including maternal age, race, in vitro fertilization, nulliparity, fibroids, and gestational age at delivery.

^bComposite maternal morbidity includes thrombosis, hysterectomy, bowel or bladder injury, intensive care unit admission, and maternal death.

Comment

Our data suggest that there are no significant differences in maternal morbidity for women with twin pregnancies between those who intended and did not intend to labor. Serious maternal complications including thrombosis, hysterectomy, bowel or bladder injury, and ICU admission were rare in this cohort, with a total of nine (1.1%) women with one of these outcomes and no difference in incidence between the groups. There were also no significant differences in third/fourth degree laceration, endometritis, and wound complications. We found that though women who did not intend to labor had a significantly higher blood loss, this did not appear to translate into increased rate of blood transfusion. Almost 80% of women who intended to labor had a successful VD. Women who intended to labor had a shorter LOS compared with those who did not intend to labor; this held true when we restricted the analysis to women who had no contraindications to labor in the group of women who did not intend to labor and after adjusting for differences in baseline characteristics.

Previous studies on the association between mode of delivery and maternal morbidity have shown variable results. The Twin Birth Study, a randomized controlled trial of women with twin pregnancies \geq 32 weeks' GA, found no significant differences in maternal outcomes between women who had a planned VD compared with planned CD.³ In this study, however, there was a high rate of CD among the planned VD group with 39.6% of women undergoing unplanned CD and 14% undergoing CD without labor-

Table 4 Maternal morbidity by intended mode of delivery, stratified by parity

Outcome by parity	Labor not intended (n = 384)	Labor intended (n = 404)	p-Value
EBL >1,000			
Nulliparous	121 (39.9%)	44 (18.9%)	<0.001
Parous	40 (49.4%)	13 (7.8%)	<0.001
EBL >1,500			
Nulliparous	17 (5.6%)	16 (6.9%)	0.59
Parous	4 (4.9%)	4 (2.4%)	0.44
Transfusion			
Nulliparous	13 (4.3%)	20 (8.6%)	0.04
Parous	7 (8.6%)	5 (3.0%)	0.05
Composite outcome ^a			
Nulliparous	1 (0.3%)	5 (2.1%)	0.09
Parous	1 (1.2%)	2 (1.2%)	0.99

Abbreviation: EBL, estimated blood loss.

^aComposite maternal morbidity includes thrombosis, hysterectomy, bowel or bladder injury, intensive care unit admission, and maternal death.

ing. This unplanned CD rate may obscure subtle differences in maternal outcomes between groups and, therefore, may be less generalizable to a practice with higher rates of successful VD of twins.^{4,12} In contrast, we found a low rate of CD among women who intended to labor (20.3%) and all women included in our laboring cohort did, in fact, labor prior to delivery.

Recently, a retrospective cohort study by Easter et al found an increased risk of composite maternal morbidity (12.3 vs. 9.1%) and hemorrhage (9.1 vs. 4.9%) among women with a twin pregnancy who underwent a trial of labor compared with elective CD.¹² This study included 1,140 women with 571 (50%) in the CD group and 569 (50%) in the trial of labor group. In this study, the composite maternal outcome included death, postpartum hemorrhage, infection, major procedure, readmission for infection or reoperation, need for dilation and evacuation (D&E), venous thromboembolism, small bowel obstruction or ileus, or ICU admission.¹² In contrast to Easter et al, we did not include postpartum hemorrhage, infection, or D&E in our composite outcome, as we felt that these were less severe complications and should be considered separately from outcomes such as reoperation or ICU admission. This may account for the much lower rates of the composite maternal morbidity seen in our study. We found no significant difference for our composite maternal outcome between women who intended or did not intend to labor. In addition, Easter et al define postpartum hemorrhage as EBL \geq 1,500 mL or need for transfusion.¹² In contrast to this study, we found no significant differences in EBL \geq 1,500 mL or transfusion between women who intended or did not intend to labor, although women who did not intend to labor had a greater mean EBL.

Our low rates of maternal morbidity may be explained, in part, by differences in delivery methods. We found very low rates of VD-CD in both women who intended to labor (0.5%) and those who did not intend to labor (1.0%). The Twin Birth Study had a VD-CD rate of 4.2 and 0.8% among women who had a planned VD and CD, respectively,³ while the study by Easter et al had a VD-CD rate of 9.0 and 0.0%, respectively.¹² Practices that are experienced with internal podalic version quote a VD-CD rate $\leq 1.0\%$, a rate that is consistent with our results.¹³⁻¹⁵ The lower rate of transfusion among women who intended to labor in our study compared with the rate seen in Easter et al may be related to our use of internal podalic version and breech extraction, and consequently, decreased rates of VD-CD delivery. In this way, our findings may not be generalizable to practices that do not perform breech extraction and internal podalic version.

Importantly, neither the Twin Birth Study nor the study by Easter et al examines the outcome maternal LOS. We found that women who intended to labor had a significantly shorter hospital stay, and on average were discharged 1.5 days sooner than women who did not intend to labor. This has important financial implications, as the cost of an elective CD coupled with the cost of a longer hospital stay places added burden on the health care system.¹⁶ Although we did not find significantly different rates of postpartum endometritis or wound infection between the groups, a longer hospitalization also does increase the risk of hospital-acquired infections.¹⁰ Finally, it is important to consider the differences in CD rates between women who intended to labor and those who had an elective CD. As expected, almost all women who did not intend to labor had a CD; however, among women who intended to labor, only 20% had a CD. This indicates that many women with twin pregnancies who attempt VD are able to avoid a major abdominal surgery. Although is not typically included as an outcome measure of maternal morbidity, certainly undergoing CD itself is an outcome worth considering as it impacts recovery, breastfeeding, and future delivery planning.² This should be considered when making decisions concerning mode of delivery for twin pregnancies; women should be counseled that they have a low risk of CD and are more likely to have a shorter hospital recovery if planning for a VD.

Our subanalysis on maternal outcomes by intended mode of delivery stratified by parity showed that nulliparous women who intended to labor had significantly higher rates of transfusion than those who did not intend to labor. In contrast, parous women who intended to labor had lower rates of transfusion than those who did not intend to labor, which approached significance. Since our study excluded women with a history of CD, all parous women in our cohort had a previous successful VD. This suggests that prior VD may be a protective factor for postpartum hemorrhage among women with twins who labor. Providers can consider a woman's parity when making decisions concerning mode of twin delivery; however, more data are needed to verify our results.

Our study is limited by its retrospective design. As with many studies similar to ours, this study was underpowered

to find differences in rarer maternal outcomes. Post hoc power analysis showed that we were powered to detect a twofold decrease in transfusion between those who intended and did not intend to labor, but we were not powered to see a smaller change. Clinically, providers and patients may be interested in knowing whether a smaller difference between the two groups exists which would require a larger study. While a randomized controlled trial to study maternal outcomes in this cohort is possible, such a study would require a very large sample size and is unlikely to be undertaken since the Twin Birth Study has already been completed. In addition, our study may be limited by the homogeneous population. Our study included women from a single maternal-fetal medicine practice, which has both strengths and drawbacks. We believe it increases the reliability of the data, as all maternal outpatient and hospital medical records were available for review. Also, since the deliveries were all by one practice, there is minimal variation in regard to pregnancy and labor management. Conversely, our findings may not be generalizable to other populations, and specifically in practices that do not routinely perform internal podalic version and breech extraction. Finally, we excluded women with a history of prior CD, so we cannot comment on the optimal mode of delivery for these women.

In conclusion, in patients undergoing twin delivery, women who intend to labor have similar maternal morbidity compared with women who do not intend to labor. Women who intend to labor are likely to have a successful VD and have a shorter hospital stay. This supports the current guidelines recommending providers offer VD for twin pregnancies.

Conflict of Interest

None.

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