*Original Research*

# Mode of Delivery in Monochorionic Compared With Dichorionic Twin Pregnancies

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**OBJECTIVE:** To compare mode of delivery between monochorionic and dichorionic twin pregnancies.

**METHODS:** This was a retrospective cohort study of women undergoing delivery of diamniotic twins in a single maternal–fetal medicine practice in New York City between 2005 and 2021. We compared baseline characteristics and delivery outcomes between monochorionic and dichorionic gestations. The primary outcome was mode of delivery. For monochorionic–diamniotic twin pregnancies at or after 34 weeks of gestation, we also compared neonatal outcomes between women who did and did not attempt vaginal delivery. Data were analyzed using the $\chi^2$ test, Fisher exact test, and *t* test when appropriate.

**RESULTS:** A total of 1,121 diamniotic twin pregnancies were identified, of which 202 (18%) were monochorionic and 919 (82%) were dichorionic. Mode of delivery did not differ between monochorionic and dichorionic pregnancies, both in the overall cohort (cesarean delivery rate 61% vs 63%, *P*=.54) and in the subgroup of women who attempted vaginal delivery (cesarean delivery rate 22% vs 21%, *P*=.80). For patients with a vaginal delivery of twin A, the mode of delivery for twin B did not differ between the groups. Among the patients with monochorionic pregnancies at or after 34 weeks of gestation, neonatal outcomes did not differ between women who did and did not attempt vaginal delivery.

**CONCLUSION:** Monochorionic–diamniotic pregnancies are not at an increased risk of cesarean delivery when compared with their dichorionic–diamniotic counterparts.

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After more than three decades of increases, the twin birth rate declined 4% during 2014–2018, to the lowest rate in more than a decade. Although the 2018 twin birth rate of 32.6 per 1,000 births was the lowest rate in more than a decade, it remained higher than those for all years before 2008.[1] Twin gestations are associated with a significantly higher risk of adverse maternal and perinatal outcomes. This is especially true for twin B, which has long been shown to be at a higher risk of complications at the time of delivery; however, chorionicity has not been shown to directly affect the outcomes for twin B at the time of delivery.[2,3]

Monochorionic–diamniotic gestations are associated with more adverse obstetric outcomes and, therefore, may be more likely to undergo cesarean delivery than their dichorionic–diamniotic counterparts.[4–6] With that being said, based on current evidence, independent of chorionicity, vaginal birth is still preferred in the absence of any contraindications and when a capable physician is available.[7–10]

Planned cesarean delivery does not reduce the risk of neonatal death or morbidity when compared with planned vaginal delivery.[8] The current literature regarding the recommended mode of delivery of monochorionic–diamniotic twins is limited to small numbers, limited U.S. data, and retrospective studies with variable controlled settings and physician skill levels.[5] We sought to compare the outcomes of monochorionic–diamniotic twin pregnancies with those of dichorionic–diamniotic twin pregnancies, as

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well as outcomes of attempted vaginal delivery compared with planned cesarean delivery of monochorionic–diamniotic twins in a single center with a standardized protocol for delivery in an exclusively U.S. cohort.

## METHODS

This was a retrospective cohort study of women undergoing delivery of twins in a single maternal–fetal medicine practice in New York City between 2005 (the inception of the practice) and 2021. After Biomedical Research Alliance of New York institutional review board approval was obtained, we reviewed the medical records of all twins delivered at or after 24 weeks of gestation in this practice. We excluded monoamniotic and higher-order multifetal gestations, as well as twins with an intrauterine fetal demise of either twin before labor or planned cesarean delivery.

Gestational age and chorionicity were confirmed by first-trimester ultrasonography in all cases. Contraindications to vaginal twin delivery in our practice are based on standard obstetric recommendations.[10,11] Patients eligible for a planned vaginal delivery may choose to have a cesarean delivery instead.

We defined the planned vaginal delivery group as all patients for whom a vaginal twin delivery was intended. The planned cesarean delivery group included patients with a contraindication to vaginal twin delivery, as well as those patients who elected to have a cesarean delivery. In our practice, induction of labor occurs at 37 weeks of gestation for monochorionic twins and at 38 weeks for dichorionic twins unless otherwise medically indicated. Planned vaginal twin births are managed according to a protocol described previously.[12,13] After delivery of twin A, the cord is clamped and cut and the presentation of twin B is ascertained by physical examination, sometimes with the assistance of ultrasonography. If twin B is vertex and engaged, the patient is instructed to push and amniotomy is performed. If twin B is breech or transverse, complete breech extraction is performed. If twin B is cephalic and unengaged, an internal version is performed, followed by breech extraction.

We compared baseline characteristics and delivery outcomes in monochorionic and dichorionic twins, first in all patients, and then in women who attempted a vaginal birth. We also compared outcomes in the subgroup of nulliparous women with a planned vaginal delivery. Nulliparity was defined as

**Table 1. Baseline Characteristics of Twin Pregnancies, Based on Chorionicity**

| Characteristic | Monochorionic–Diamniotic | Dichorionic–Diamniotic | *P* |
|---|---|---|---|
| All patients | n=202 | n=919 | |
| Maternal age (y) | 33.3±6.5 | 34.4±6.2 | .02 |
| Advanced maternal age* | 82 (41) | 415 (45) | .24 |
| Prepregnancy BMI (kg/m$^2$) | 23.0±4.0 | 23.8±4.9 | .05 |
| Prepregnancy obesity | 14 (7) | 97 (11) | .12 |
| Preeclampsia | 30 (15) | 150 (17) | .62 |
| Gestational diabetes | 22 (11) | 82 (9) | .38 |
| Prior vaginal delivery after 20 wk | 79 (39) | 275 (30) | .01 |
| Prior cesarean delivery | 24 (12) | 108 (12) | .96 |
| In vitro fertilization | 65 (32) | 545 (59) | <.001 |
| Gestational age at delivery (wk) | 35.2±2.5 | 36.0±2.4 | <.001 |
| Patients with planned vaginal delivery | n=101 | n=422 | |
| Maternal age (y) | 31.8±6.3 | 33.0±5.7 | .05 |
| Advanced maternal age | 35 (35) | 153 (36) | .76 |
| Nulliparity† | 48 (47.5) | 257 (60.9) | .01 |
| Prepregnancy BMI (kg/m$^2$) | 23.1±4.0 | 23.4±4.6 | .58 |
| Prepregnancy obesity | 8 (8) | 37 (9) | .80 |
| Preeclampsia | 15 (15) | 49 (12) | .37 |
| Gestational diabetes | 9 (9) | 35 (8) | .82 |
| Prior vaginal delivery after 20 wk | 53 (53) | 165 (39) | .01 |
| Prior cesarean delivery | 4 (4) | 25 (6) | .44 |
| In vitro fertilization | 20 (20) | 227 (54) | <.001 |
| Gestational age at delivery (wk) | 36.0±1.9 | 36.7±1.8 | .001 |

BMI, body mass index.
Data are mean±SD or n (%) unless otherwise specified.
* Maternal age 35 years or older.
† No prior vaginal deliveries at or after 20 weeks of gestation.

**Table 2. Delivery Outcomes of Twin Pregnancies, Based on Chorionicity**

| Outcome | Monochorionic–Diamniotic | Dichorionic–Diamniotic | *P* |
|---|---|---|---|
| All patients | n=202 | n=919 | |
| Mode of delivery | | | .44 |
| Vaginal–vaginal | 79 (39) | 338 (37) | |
| Cesarean–cesarean | 123 (61) | 575 (63) | |
| Vaginal–cesarean | 0 (0) | 6 (0.7) | |
| Any cesarean delivery | 123, (61, 54–68) | 581, (63, 60–66) | .54 |
| Patients with planned vaginal delivery | n=101 | n=422 | |
| Mode of delivery | | | .74 |
| Vaginal–vaginal | 79 (78) | 335 (79) | |
| Cesarean–cesarean | 22 (22) | 85 (20) | |
| Vaginal–cesarean | 0 (0) | 2 (0.5) | |
| Any cesarean delivery | 22 (22, 14–31) | 87 (21, 17–25) | .80 |
| Nulliparous patients with planned vaginal delivery | n=48 | n=257 | |
| Mode of delivery | | | .67 |
| Vaginal–vaginal | 31 (65) | 177 (69) | |
| Cesarean–cesarean | 17 (35) | 78 (30) | |
| Vaginal–cesarean | 0 (0) | 2 (0.8) | |
| Any cesarean delivery | 17 (35, 22–51) | 80 (31, 26–37) | .56 |

Data are n (%) or n (%, 95% CI) unless otherwise specified.

no prior vaginal deliveries at or after 20 weeks of gestation. The primary outcome was mode of delivery. We also examined all women who had a vaginal delivery of twin A and then compared mode of delivery for twin B, based on chorionicity.

Finally, for all women with monochorionic pregnancies, we compared baseline characteristics and neonatal outcomes, based on intended mode of delivery. Neonatal outcomes included 1- and 5-minute Apgar scores, arterial cord pH less than 7.20, NICU admission, length of stay, neonatal death, intraventricular hemorrhage, mechanical ventilation, sepsis, and necrotizing enterocolitis. Data were analyzed using the $\chi^2$ test, Fisher exact test, and *t* test when appropriate (SPSS 16.0).

## RESULTS

From 2005 to 2021, a total of 1,121 twin pregnancies met the inclusion criteria, of which 202 (18%) were monochorionic and 919 (82%) dichorionic. The two groups were generally similar with the exception that the mothers carrying monochorionic twins were younger, weighed less, were less likely to have undergone in vitro fertilization, more likely to have experienced a previous vaginal birth, and were delivered at an earlier gestational age (Table 1).

Mode of delivery did not differ between monochorionic and dichorionic pregnancies in both the overall cohort and the subgroup of women who attempted vaginal birth (Table 2).

For all women with a vaginal delivery of twin A, mode of delivery for twin B did not differ based on chorionicity (Table 3). There was a less than 1% rate of combined vaginal–cesarean births and a high rate of breech extraction of twin B (76% of monochorionic and 74% of dichorionic pregnancies).

We compared baseline maternal demographics and neonatal outcomes in monochorionic–diamniotic twins based on intended mode of delivery (Tables 4 and 5). For this analysis, we included only women at 34 weeks of gestation or more because our cohort was not large enough to adequately control for gestational age for outcomes that were expected to be rare. In this cohort, attempted vaginal delivery was not associated with any adverse neonatal outcomes, compared with planned cesarean delivery. Additionally, attempted vaginal

**Table 3. Mode of Delivery for Twin B After Vaginal Delivery of Twin A, Based on Chorionicity**

| Mode of Delivery for Twin B | Monochorionic–Diamniotic (n=79) | Dichorionic–Diamniotic (n=337) | *P* |
|---|---|---|---|
| Vaginal (vertex) | 19 (24) | 86 (26) | .76 |
| Breech extraction | 60 (76) | 249 (74) | |
| Cesarean | 0 (0) | 2 (0.6) | |

Data are n (%) unless otherwise specified.

**Table 4. Baseline Characteristics of Monochorionic–Diamniotic Twin Pregnancies at or After 34 Weeks of Gestation, Based on Intended Mode of Delivery**

| Characteristic | Planned Vaginal Delivery (n=95) | Planned Cesarean Delivery (n=68) | *P* |
|---|---|---|---|
| Maternal age (y) | 31.6±6.2 | 35.4±6.4 | <.001 |
| Advanced maternal age* | 32 (34) | 34 (50) | .04 |
| Prepregnancy BMI (kg/m$^2$) | 23.0±4.0 | 22.8±3.8 | .72 |
| Prepregnancy obesity | 8 (9) | 3 (4) | .31 |
| Prior vaginal delivery after 20 wk | 49 (52) | 11 (16) | <.001 |
| Prior cesarean delivery | 4 (4) | 14 (21) | .001 |
| In vitro fertilization | 19 (20) | 33 (49) | <.001 |
| Gestational age at delivery (wk) | 36.3±1.1 | 35.9±1.3 | .04 |

BMI, body mass index.
Data are mean±SD or n (%) unless otherwise specified.
* Maternal age 35 years or older.

delivery was associated with a decreased incidence of mechanical ventilation (7% vs 21%, *P*=.03).

## DISCUSSION

Our data affirm that an attempt at a vaginal birth for twin pregnancies, without contraindications to vaginal delivery and regardless of chorionicity, is reasonable and achievable. We have shown this by demonstrating that mode of delivery does not differ between monochorionic–diamniotic and dichorionic–diamniotic twin cohorts. This was true in both the overall cohort and the subgroup of women who attempted vaginal birth.

The Twin Birth Study, a prospective multicenter randomized controlled trial from 2013, demonstrated that planned cesarean delivery did not significantly affect the risk of fetal or neonatal death or morbidity, as compared with planned vaginal delivery.[8] These findings contradicted prior studies that suggested twin

**Table 5. Delivery and Neonatal Outcomes of Monochorionic–Diamniotic Twin Pregnancies at or After 34 Weeks of Gestation, Based on Intended Mode of Delivery**

| Outcome | Planned Vaginal Delivery (n=95) | Planned Cesarean Delivery (n=68) | *P* |
|---|---|---|---|
| Mode of delivery | | | <.001 |
| Vaginal–vaginal | 73 (77) | 0 (0) | |
| Cesarean–cesarean | 22 (23) | 68 (100) | |
| Vaginal–cesarean | 0 (0) | 0 (0) | |
| Apgar score less than 7 | | | |
| 1-min | | | |
| Twin A | 2 (2) | 4 (6) | .21 |
| Twin B | 8 (8) | 3 (4) | .31 |
| 5-min | | | |
| Twin A | 0 (0) | 0 (0) | NA |
| Twin B | 0 (0) | 0 (0) | NA |
| Arterial cord pH less than 7.2 | | | |
| Twin A | 1 (1) | 1 (2) | .81 |
| Twin B | 1 (1) | 0 (0) | .39 |
| NICU admission | | | |
| Twin A | 31 (33) | 22 (32) | .97 |
| Twin B | 30 (32) | 23 (34) | .76 |
| Greatest LOS (d) | 4 (2, 8) | 4 (3, 9) | .14 |
| Either twin with | | | |
| LOS longer than maternal LOS | 26 (38) | 20 (38) | .96 |
| Neonatal death | 0 (0) | 0 (0) | NA |
| Intraventricular hemorrhage | 0 (0) | 0 (0) | NA |
| Mechanical ventilation | 5 (7) | 11 (21) | .03 |
| Sepsis | 0 (0) | 0 (0) | NA |
| Necrotizing enterocolitis | 0 (0) | 0 (0) | NA |

NA, not applicable; NICU, neonatal intensive care unit; LOS, length of stay.
Data are n (%) or median (25$^{th}$ percentile, 75$^{th}$ percentile) unless otherwise specified.

B is at substantial risk when vaginal delivery is planned.[2,3]

Combined vaginal–cesarean delivery occurs in approximately 5–10% of twin pregnancies.[14–18] Interestingly, we observed a significantly lower number of vaginal–cesarean deliveries at a frequency of less than 1%. This is consistent with the recent publication by Schmitz T, et al.[19] Our practice uses active second stage management for twin B that involves breech extraction and internal version of a nonengaged vertex and previously we demonstrated that this approach is associated with a low rate of combined vaginal–cesarean delivery.[12,13] Further, senior personnel experienced in intrauterine twin manipulation are always present at delivery. In comparison with other studies, our study had similar rates of vaginal–vaginal and cesarean–cesarean deliveries but had a significantly lower rate of combined deliveries.[14,15] Additionally, it appears that monochorionic–diamniotic pregnancies are not at an increased risk of adverse neonatal outcomes when compared with their dichorionic–diamniotic counterparts.

Our study has several strengths. Our cohort is relatively large and was accrued over a long time span. Additionally, all deliveries were performed by the same senior group of physicians under similar circumstances, which controls for practice differences. Our study is limited by its retrospective design, which inherently increases the possibility for selection bias. Regarding neonatal outcomes in monochorionic pregnancies, we are underpowered to find small differences between the groups due to sample size. Also, our study may be limited by using data from one obstetric practice, as opposed to a more heterogeneous population of patients and physicians, thereby decreasing the external validity and overall generalizability.

The clinical implication of our study is that mode of delivery in a twin gestation without any contraindications to vaginal birth should not be affected by chorionicity.

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