

Neonatal Outcome of Second Twins Depending on Presentation and Mode of Delivery

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Our objective was to examine the neonatal outcome of second twins depending on presentation and mode of delivery. Using a database we analyzed the short-term neonatal outcome in twin pregnancies offered a trial of labor with special emphasis on the second twin depending on presentation and mode of delivery. Neonatal outcome was evaluated by Apgar scores, umbilical cord blood pH values, and perinatal or neonatal morbidity and mortality. Overall, in 219 (78%) of 281 pregnancies successful vaginal birth (VB) of both twins (VB–VB) was possible, 48 (17%) women had to be delivered by cesarean section (CS) of both twins (CS–CS), and in 14 (5%) women the second twin had to be delivered by CS after VB of the first twin (VB–CS). Successful VB was most common for vertex-vertex (V/V; $n = 171$, 82%) and vertex-nonvertex ($n = 48$, 75%) presentation (V/NV). Twins delivered by VB–CS had the lowest values for pH_{art} ($p = .006$) and pH_{ven} ($p = .010$). pH_{art} less than or equal to 7.00 values occurred only in second twins delivered VB–VB or VB–CS. Lower Apgar scores of the second twin occurred more frequently in the VB–CS and in the VB–VB than in the CS–CS groups ($p_s < .05$). Lower levels of pH_{art} ($p = .002$) and frequency of pH_{art} less than or equal to 7.00 occurred more often in nonvertex second twins than in vertex second twins ($p < .022$). The high CS rate in V/NV presentation and the significantly worse perinatal short-term outcome of NV second twins after VB of the first twin underline that randomized studies are necessary to evaluate the best delivery mode for V/NV twins.

Twin gestations account for about 3.1% of all pregnancies (Martin et al., 2003) but nearly 10% of perinatal mortality (ACOG Practice Bulletin, 2004; MacKay et al., 2000; Martin et al., 2003; Oyelese et al., 2005). Twins, particularly second twins, are at higher risk of obstetric complications, perinatal morbidity, and mortality (MacKay et al., 2000; Wen et al., 2004; Yang et al., 2005). Successful vaginal birth (VB) of the first twin can be followed by abnormal

presentation of the second twin, uterine atony, placental abruption and cord prolapse (Wen et al., 2004; Yang et al., 2005).

Three potential modes of delivery for twin pregnancies are possible: VB of both twins (VB–VB), cesarean section (CS) for both twins (CS–CS), and VB of the first and CS of the second twin (VB–CS). Decisions regarding the mode of delivery are based mainly on gestational age and presentation of the first twin. The American College of Obstetricians and Gynecologists (ACOG) recommends VB for vertex-vertex (V/V) twin gestations, unless specific contraindications exist (ACOG Practice Bulletin, 2004; ACOG Educational Bulletin, 1999). For pregnancies with the first twin in non vertex (NV) presentation, CS is now widely performed (ACOG Practice Bulletin, 2004; Hogle et al., 2003).

The mode of delivery for vertex/nonvertex (V/NV) twins remains controversial. CS has been advocated based on reports of increased perinatal mortality and lower Apgar scores for second twins in breech presentation delivered vaginally (Keith et al., 1995). However, many of these reports date from the 1970s, when fetal heart rate monitoring and ultrasound were not routine. ACOG noted the lack of evidence for advocating a specific route of delivery for NV second twins weighing less than 1500 g, but stated that VB is reasonable for infants weighing more than 1500 g when criteria for VB are met (ACOG Educational Bulletin, 1999). In contrast, recent evidence suggests a protective effect of elective CS for delivery of V/NV twins, regardless of birthweight (Yang et al., 2005).

We describe our experience with a trial of labor in twin pregnancies greater than or equal to 34 weeks of gestation.

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Patient and Methods

A total of 418 twin pregnancies greater than or equal to 34 weeks of gestation delivered at our institution between January 1993 and December 2002 were identified from computerized records. To eliminate cases in which outcome could be related to factors other than delivery mode, cases with the following factors were excluded:

- elective CS
- twin pregnancies with the first twin in nonvertex presentation
- intrauterine death of one twin before the onset of labor
- infants with congenital anomalies incompatible with life
- fetuses with estimated weight less than 1500 g
- discordant twins (> 25%) and twins with intrauterine growth restriction (birthweight < 10th centile), and
- fetuses with abnormal Doppler ultrasound measurements or fetal heart rate tracing.

Demographic and clinical data including maternal age, parity, prepregnancy body mass index (BMI), fetal complications, gestational age at delivery, fetal birthweight, presentation and mode of delivery, birth trauma, Apgar scores, arterial and venous cord blood gas analysis, admission to the neonatal intensive care unit (NICU), neonatal period of hospitalization, neurological complications and perinatal mortality were obtained from an obstetric database.

VB was attempted in 286 uncomplicated twin pregnancies with the first twin in vertex presentation, regardless of the presentation of the second twin.

Continuous electronic fetal heart rate monitoring of each twin was performed throughout labor. All deliveries were supervised by an experienced obstetrician. After delivery of the leading twin, the position of the second twin was controlled with ultrasound. In transverse position, the second twin was stabilized into a longitudinal position by external version. In the present study the position of the second twin was determined at this time point. Neonatal outcome was evaluated on the basis of:

- Apgar scores (at 1 minute [A1] ≤ 4, at 5 minutes [A5] ≤ 7, and at 10 minutes [A10] ≤ 7)
- arterial and venous cord blood pH
- perinatal or neonatal mortality at 28 days of age
- seizures occurring at less than 24 hours of age or requiring two or more drugs
- hypotonia for at least 2 hours, stupor, decreased response to pain, coma
- intubation and ventilation for at least 24 hours
- tube feeding for 4 days or more
- admission to the NICU longer than 4 days.

We analyzed the rate of VB in twin pregnancies according to the presentation of the second twins and the short-term outcome of the second twins. Subgroup analyses were performed to identify a high-risk group for VB regarding presentation of second twins. Additionally, short-term neonatal outcome analyses were performed for second infants with A1 less than or equal to 4, A5 less than or equal to 7, A10 less than or equal to 7, and pH_{art} less than or equal to 7.0.

Statistical analysis was performed with the statistical software packages SPSS 12 (SPSS, Chicago, IL) and StatXact 5.0 (Cytel Boston, MA). Continuous data were compared with *t* test and Wilcoxon-Mann-Whitney-test with respect to normality of the data.

Table 1
Clinical Characteristics of Twin Pregnancies With a Trial of Vaginal Birth

	All cases N = 48	CS–CS N = 219	VB–VB N = 219	VB–CS N = 14	<i>p</i> value
Maternal age (year)	29.2 ± 4.8	29.0 ± 4.4	29.2 ± 4.9	29.4 ± 5.3	<i>ns</i>
Maternal prepregnancy weight (kg)	62.7 ± 10.8	63.7 ± 10.3 ^a	62.2 ± 11.1 ^a	68.0 ± 7.1 ^b	.012
BMI (before pregnancy)	22.4 ± 3.6	22.7 ± 3.1 ^a	22.2 ± 3.7 ^a	23.9 ± 2.3 ^b	.019
Maternal weight at delivery (kg)	76.9 ± 11.6	80.1 ± 10.9 ^b	75.7 ± 11.6 ^a	84.8 ± 8.8 ^b	< .001
Fetal birthweight 1st twin (g)	2513 ± 422	2546 ± 373	2513 ± 438	2414 ± 328	<i>ns</i>
Fetal birthweight 2nd twin (g)	2478 ± 427	2518 ± 443	2477 ± 422	2363 ± 462	<i>ns</i>
Gestational age (week)	N (%)				
≥ 34+0 – ≤ 37+0	140 (50%)	20 (42%)	111 (51%)	9 (64%)	<i>ns</i>
> 37+0	141 (50%)	28 (58%)	108 (49%)	5 (36%)	<i>ns</i>
Parity	N (%)				
Nulliparous	103 (36%)	28 (58%)	69 (32%)	6 (43%)	.002
Multiparous (≥ 1)	178 (64%)	20 (42%)	150 (68%)	8 (57%)	.002

Note: Data are shown as mean ± standard deviation; CS = cesarean section; VB = vaginal birth; different superscripts indicate significant differences between means; *ns* = not significant.

Table 2
Apgar Scores and pH Values of First and Second Twins Regarding Mode of Delivery

	All cases (N = 281)			VB-VB (N = 219)			CS-CS (N = 48)			VB-CS (N = 14)		
	1st twin	2nd twin	p value	1st twin	2nd twin	p value	1st twin	2nd twin	p value	1st twin	2nd twin	p value
A1 ≤ 4 (n)	8	24	.005	4	17	.007	3	3	ns	1	4	ns
A5 ≤ 7 (n)	4	10	ns	1	5	ns	2	3	ns	1	2	ns
A10 ≤ 7 (n)	2	2	ns	0	1	—	2	0	—	0	1	—
pH _{int} *	7.28 ± 0.07	7.22 ± 0.10	<.001	7.29 ± 0.07	7.22 ± 0.11	<.001	7.23 ± 0.06	7.23 ± 0.07	ns	7.26 ± 0.07	7.14 ± 0.08	.002
pH _{ven} *	7.34 ± 0.06	7.28 ± 0.10	<.001	7.35 ± 0.06	7.28 ± 0.10	<.001	7.29 ± 0.05	7.28 ± 0.06	ns	7.32 ± 0.04	7.21 ± 0.08	.003
pH _{int} (n)	252	245	—	202	196	—	38	38	—	12	11	—
> 7.0	0	7	—	0	6	—	0	0	—	0	1	—

Note: *Expressed as mean ± SD.
ns = not significant.

Categorical variables were tested with Pearson's chi-square and Fisher's exact test depending on the expectation values. The Jonckheere-Terpstra-test was used for checking ordered alternatives (pH_{art}). A significance level of .05 was assumed in all hypothesis testing.

Results

A trial of VB was attempted in 305 (73%) of 418 twin pregnancies greater than or equal to 34 weeks of gestation. In five cases, data were missing and in 19 cases the first twin was in NV presentation; therefore the final analysis is based on 281 deliveries. Clinical characteristics of the study patients are shown in Table 1. Of those 281 pregnancies, in 219 (78%) pregnancies both twins were delivered successful vaginally, 48 (17 %) women had to be delivered by CS of both twins and in 14 (5%) women the second twin had to be delivered by CS after successful VB of the first twin (Table 1).

The most common indications for CS-CS (n = 48) following a trial of labor were failure to progress (n = 34) and fetal distress (n = 14). There were no statistical differences between pregnancies delivered vaginally and those delivered operatively in maternal age, fetal birthweight or gestational age. BMI and maternal weight before the pregnancy were significantly higher in women delivered by CS for second twins after VB of the first twins (p < .02). Maternal weight at delivery was significantly higher in women delivered by CS for both twins compared to the other groups (p < .001). Additionally, the number of nulliparous women was higher in the CS-CS group (58%) compared to the group with at least the first twin delivered vaginally (32%; p = .002, Table 1).

Mode of delivery according to presentation was as follows: VB of both twins was most common for V/V (n = 171, 82% of all V/V twins [208]) and V/NV (n = 48, 66% of all V/NV twins [73]) presentations. CS of the second twin after VB of the first twin was performed in 14 women; eight of them were in NV presentation (11% of all NV second twins) and six of them were in vertex presentation (3% of all vertex second twins). The indications for CS of the second twin after VB of the first twin were: fetal distress (n = 10, 72%) and failed progress of labor (n = 4, 28%).

Neonatal Outcome

Overall, cord blood gas values of second twins were significantly lower than those of the first twins, regardless mode of delivery (p < .001, Table 2). None of the first twins had a pH_{art} value less than or equal to 7.0, compared with 7 (2.5%) of the second twins. Similarly, Apgar scores less than or equal to 4 at 1 minute were significantly more common among second twins (p = .005), whereas Apgar scores less than or equal to 7 at 5 minutes, and less than or equal to 7 at 10 minutes, were not statistically different

Table 3
Apgar Scores and pH Values of Second Twins Regarding Mode of Delivery

Variable	Delivery mode 2nd twin			p value
	VB-VB (n = 219)	VB-CS (n = 14)	CS-CS (n = 48)	
A1 ≤ 4 (n)	17 ^a	4 ^b	3 ^a	.023
A5 ≤ 7 (n)	5 ^a	2 ^b	3 ^a	.036
A10 ≤ 7(n)	1 ^a	1 ^b	0 ^a	.006
pH _{art} *	7.22 ± 0.11 ^a	7.14 ± 0.08 ^b	7.23 ± 0.07 ^a	.006
pH _{ven} *	7.28 ± 0.10 ^a	7.21 ± 0.08 ^b	7.28 ± 0.06 ^a	.010
pH _{art} (n)				
> 7.0	203	12	40	<i>ns</i>
≤ 7.0	6	1	0	

Note: *Expressed as mean ± SD; different superscripts indicate significant differences; *ns* = not significant

(Table 2). Arterial and venous blood gas analysis showed significantly lower pH_{art} and pH_{ven} values for second twins compared to first twins in the VB-VB group and in the VB-CS group ($p < .01$, Table 2). We found no differences in any neonatal outcome parameters between first and second twins in the CS-CS group (Table 2).

Table 3 shows the neonatal outcome parameters of the second twins with respect to the mode of delivery: Twins delivered by CS following VB of the first twin had the lowest values for pH_{art} ($p = .006$) and pH_{ven} ($p = .010$). Lower Apgar scores (A1 ≤ 4, A5 ≤ 7, A10 ≤ 7) of the second twin occurred significantly more frequently in the VB-CS group than in the CS-CS and VB-VB groups (Table 3, $p < .05$). pH_{art} less than or equal to 7.00 values were seen only in second twins delivered vaginally or by CS after VB of the first twin (Table 3).

We also analyzed the outcome of second twins according to their presentation in cases of VB of both twin ($n = 219$). pH_{art} values of second twins were significantly lower in NV twins compared to twins in vertex presentation ($p = .002$, Table 4), whereas no statistically significant difference for pH_{ven} was found. In addition, pH_{art} less than or equal to 7.0 occurred significantly more frequently in NV second twins compared to second twins in vertex presentation ($p = .022$, Table 4).

Short-Term Neonatal Outcome

Thirty-eight twins had one or more criteria for neonatal morbidity. Follow-up of up to 28 days was available for 37 twins. 32 twins needed only short-term neonatal care up to one day. There was no perinatal or neonatal death less than 28 days of age. Five infants were transferred to the NICU (Table 5). The longest hospital stay for an infant was 11 days. One second twin with cardiac arrhythmia was transferred to the NICU and found to have intracardiac

rhabdomyomas. Three of these five cases were vaginally delivered nonvertex second twins, and one case was a vertex second twin delivered vaginally, as well (Table 5).

Conclusion

In this series of twins with a trial of labor, 78% of twin pregnancies were delivered vaginally, 17% underwent secondary CS of both twins, and in 5% the second twin had to be delivered by CS following VB of the first twin. As in previous studies, the CS rate was higher in nulliparous women (Blickstein et al., 2000; Grisaru et al., 2000; Rabinovici et al., 1987). Additionally, women, who were delivered by CS (for both or for second twins) had higher values for maternal weight and BMI before the pregnancy and at the delivery. This is in concordance with previous studies, which reported higher incidences of fetal distress and higher CS rates in women with an increased BMI (Shao, 1995; Usha et al., 2005).

How to deliver twin pregnancies continues to be of some controversy. Some authors see a possible protective effect of an elective CS for twins at term (Smith et al., 2002). In a meta-analysis, Hogle et al. (2003) found that planned CS may decrease the risk of low A5 scores, but no evidence for planned CS. A policy of planned CS for all twin pregnancies might increase the risk of neonatal respiratory problems, even at or near term. In a retrospective study of 33,289 term singletons, Morrison et al. (1995) found that respiratory distress syndrome and transient tachypnoea were more common in infants delivered by CS — especially before the onset of labor — compared to those delivered vaginally.

The question about primary CS for pregnancies with the first twin in breech presentation has recently been answered (Abu-Heija et al., 1998; Blickstein et al., 2000; Essel & Opai-Tetteh, 1996; Grisaru et al., 2000). This and the better outcome reported for NV single fetuses delivered by CS (Barrett & Ritchie,

Table 4
Apgar Scores and pH Values of Second Twins Dependent on Their Presentation in Cases of Vaginally Delivered Both Twins (n = 219)

Variable	Presentation second twin		p value
	Vertex N = 171	Nonvertex N = 48	
A1 ≤ 4 (n)	10	7	<i>ns</i>
A5 ≤ 7 (n)	3	2	<i>ns</i>
A10 ≤ 7 (n)	1	0	<i>ns</i>
pH _{art} *	7.23 ± 0.09	7.18 ± 0.13	.002
pH _{ven} *	7.29 ± 0.09	7.25 ± 0.12	<i>ns</i>
pH _{art} (n)			
> 7.00	161	42	.022
≤ 7.00	2	4	

Note: *Expressed as mean ± SD; *ns* = not significant.

Table 5Neonatal Intensive Care (NICU) Therapy for Second Twins ($n = 5$): Clinical Characteristics and Reason for Admission

No., reason for admission and characteristics	ICH	EC	SEI	HYP	INT	TF	NIC
1. Intracardial rhabdomyoma GA 37; V; BW 1990 g; VB–VB A ₁ 6/A ₅ 7/A ₁₀ 9; pH _{art} 7.24; pH _{ven} 7.27				+	+		+
2. Asphyctic shock GA 35; NV; BW 2570 g; VB–VB A ₁ 0/A ₅ 4/A ₁₀ 8; pH _{art} 7.08; pH _{ven} 7.29		+		+	+	+	+
3. Perinatal asphyxia GA 37; V; BW 2345 g; VB–VB; A ₁ 0/A ₅ 3/A ₁₀ 7; pH _{art} 7.06; pH _{ven} 7.11			+		+		
4. Perinatal asphyxia GA 37; NV; BW 2490 g; VB–VB A ₁ 1/A ₅ 7/A ₁₀ 9; pH _{art} 7.13; pH _{ven} 7.26		+		+	+		
5. Perinatal asphyxia, early-onset sepsis GA 36; NV; BW 2000 g; VB–VB A ₁ 6/A ₅ 9/A ₁₀ 9; pH _{art} 6.74; pH _{ven} NA			+		+	+	+

Note: ICH = intracerebral/intraventricular hemorrhage; EC = encephalopathy grade I/II; SEI = seizures (occurring < 24 hours of age or requiring ≥ 2 drugs); HYP = hypotonia ≥ 24 hours; INT = intubation and ventilation ≥ 24 hours; TF = tube feeding ≥ 4 days; GA = gestational age (weeks); V = vertex presentation; NV = nonvertex presentation; VB–VB = vaginal birth–vaginal birth; BW birthweight; NA = not available.

2002; Hannah et al., 2000), and the ACOG analysis (ACOG Practice Bulletin, 2004; ACOG Educational Bulletin, 1999) suggest that planned CS for these pregnancies may reduce the rate of secondary CS and result in better neonatal outcomes (Davison et al., 1992; Hannah et al., 2000; Hogle et al., 2003).

We found statistically significant differences in neonatal outcome parameters between first and second twins after VB ($A_1 \leq 4$, pH_{art}, pH_{ven}), but not after CS. This finding is consistent with other studies and confirms that second twins are more prone to complications during labor and delivery (Keith et al., 1995; Oyelese et al., 2005; Smith et al., 2002; Wen et al., 2004; Yang et al., 2005). With respect to these results, we tried to identify a group with higher risk of problems with VB and analyzed the results with respect to the presentation of second twins:

The 82% rate of VB in cases with V/V presentation in our cohort supports the possibility of a trial of labor for these pregnancies.

The delivery mode for pregnancies with the second twin in NV presentation is another point of controversy (Barrett & Ritchie, 2002; Crowther, 2000; Hogle et al., 2003; Rabinovici et al., 1987; Yang et al., 2005). The successful VB rate of V/NV twins in our study was 66%. From all NV second twins, 8 cases (11%) had to be delivered by CS after VB of the first twin, which is significantly more frequently than for second twins in vertex presentation (3%; $n = 6$). Some data indicate that planned CS is associated with reduced neonatal morbidity compared with VB for the NV second twin (Crowther, 2000; Yang et al., 2005). In contrast, a systematic review and meta-analysis found no benefit of planned CS for V/NV (Hogle et al., 2003). Additionally, infants delivered by elective CS had significantly longer hospital stays (Hogle et al.,

2003). Most previous studies reported that VB of NV second twins is safe, with no significant differences in neonatal morbidity in comparison with the delivery by primary CS (Adam et al., 1991; Adams & Chervenak, 1990; Caukwell & Murphy, 2002; Crowther, 2000; Davison et al., 1992; Rabinovici et al., 1987; Wolff, 2000). The discrepancies amongst these reports may be due to differences in the study designs, because some studies did not exclude emergency CS, and some compared all vaginally born second twins, regardless of their presentation, with their first-born twin, whereas others restricted their comparisons of NV second twins to their first-born siblings.

Looking at the influence of presentation on neonatal outcome in second twins born after VB of the first twin, we found a worse short-term neonatal outcome in NV second twins compared to vertex second twins (pH_{art}, pH_{ven} ≤ 7.0). The worst short-term neonatal outcome was seen in second twins delivered by CS after VB of the first twin, a finding that has also been reported by others (Cetrulo, 1986; Keith et al., 1995). Cetrulo advocated a liberal CS policy in cases with second twins in NV presentation and reported an 84% CS rate with similar mortality and morbidity for each twin (Cetrulo, 1986). Additionally Yang et al. (2005) reported a higher risk of neonatal death and morbidity of second born twins in NV presentation delivered vaginally compared with those cases in which both twins were delivered by CS. Our results are similar, but Yang et al. (2005) included cases with elective CS and also weight discordances greater than 25%, which may have had a favourable effect on neonatal outcome for the CS–CS group, and therefore biased the results. Because we excluded elective CS and discordant twins (> 25%), we are confident

that our results are more likely to reflect an unbiased outcome of the second twin.

In the literature, CS rates for the second twin after VB of the first twin range from 0.33 to 26.8% (Constantine & Redman, 1987; Pons et al., 2002; Roonnarinesinhg, 2002). In the present study the CS rate for all presentations of the second twin was 5%, less than the 9.5% in the same study population reported in the literature (Wen et al., 2004), but is significantly more frequent in NV second twins (11% of all NV twins) than for second twins in vertex presentation (3%, $n = 6$).

Similar to our results Persad et al. (2001) found that VB–CS rates were higher among NV second twins. Wen et al. (2004) reported that second twins with emergency CS had less favorable neonatal outcomes than those delivered vaginally or by primary CS.

Due to the literature and our results, we propose that women with V/NV twins should be counselled about the higher risk for secondary CS (for both or only the second twin) and the possibility of an elective CS.

Because of the small number of second twins who were admitted to the NICU, any conclusion about possible higher neonatal morbidity for second twins can not be drawn.

Our study has a number of limitations. It was retrospective and has a risk of selection bias. We had no information on chorionicity and missing data for five pregnancies. In cases of emergency CS we were unable to discuss whether the CS was performed for a distress of the first or the second twin. The study covered a 10-year period during which obstetrics, anesthesiology and neonatal management are likely to have changed.

Despite the limitations of the present study the following recommendations are justified: In twin pregnancies with both fetuses in vertex presentation, a trial of VB is appropriate, and planned CS would not appear to provide a significant benefit. Finally, high rates of CS in V/NV presentation, and the significantly worse neonatal short term outcome of the NV second twin after VB of the first twin, underline the need for randomized studies to evaluate the best delivery mode for V/NV twins. At present one randomized controlled trial for twin delivery is being carried out by the Collaborative Group for the Twin Birth Study (Barrett, 2003).

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