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Temperament and Neonatal Risk in Full-Term and Preterm Combined Vaginal/Cesarean Section Twin Pairs

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Abstract. Ten pairs of full-term and 8 pairs of preterm twins from combined vaginal and Cesarean section deliveries were evaluated on measures of neonatal temperament, developmental status, and integrity to determine if the Cesarean-delivered infant was compromised relative to its vaginally-delivered twin. There were no significant differences, within groups, between the vaginal and Cesarean section infants on measures of risk and developmental status. Analyses of variance of paired comparisons performed on the temperament measures indicated that, for the full-term group, there were no significant differences in ratings between vaginally and Cesarean-delivered infants. In contrast, preterm infants delivered by Cesarean section were more active during sleep than their vaginally-delivered cotwins. This finding, together with previous findings demonstrating a relation between this measure and temperament at 9, 18, and 24 months of age, suggested that the preterm Cesarean-delivered infant may be at risk in this area when compared with its twin. In the main, however, the results demonstrated that infants born by Cesarean section following vaginal delivery of their twins were not more compromised than their twin siblings.

Key words: Twins, Cesarean section, Preterm infant, Neonatal risk, Temperament

Cesarean section delivery of a second twin, when the first twin is delivered vaginally, is a rare occurrence [4,5,9]. Nevertheless, unexpected fetal indications or delivery complications occasionally dictate an emergency Cesarean delivery for the well-being of the second twin. Since the second twin was at risk during the delivery, it

is in the infant's interest to determine if risk still exists relative to its twin following delivery, or if the surgical delivery served to obviate the need for concern. Neonatal assessment of the twins could ascertain if there were any postnatal behavioral complications related to method of delivery, or if the Cesarean delivered infant was at higher risk for postnatal complications than its vaginally delivered twin.

There has been some interest recently in comparing twins who are delivered by Cesarean section with their cotwins who have been delivered vaginally. In one study of four such pairs, 1- and 5-minute Apgar [1] scores were found to be lower in the second twin for all cases [4]. A later study of 21 such pairs found no differences between the groups in perinatal morbidity and mortality, including Apgar scores [9]. Neither of these studies, however, evaluated the infant's behavior in the neonatal period. Therefore, the present study was designed to determine if twins delivered by emergency Cesarean section differed on measures of neonatal temperament, developmental status, and neonatal morbidity from their cotwins who had been delivered vaginally.

It has been demonstrated that some aspects of temperament are apparent during the neonatal period and are related to behavior in later infancy [2,7,8,12]. Comparison of vaginally-delivered and Cesarean-delivered twins on ratings of neonatal temperament would determine if this is a risk area for the second twin. For this purpose this study used a neonatal assessment designed to measure individual differences across a broad range of situations [11] with the procedures tailored to the individual neonate's metabolic cycle. Several ratings of each behavioral attribute were aggregated into composite scores to provide a more reliable measure of behavior than single-item scores [3]. After the behavioral assessments were completed, the medical charts were reviewed to obtain information related to demographic and medical variables. The performance of full-term and preterm twin pairs was evaluated separately to determine if prematurity might affect the risk within the measured variables.

Table 1 - Means and standard deviations of background factors for full-term and preterm infants

	Full-term				Preterm			
	Vaginal		Cesarean		Vaginal		Cesarean	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Birth weight (grams)	2538	502	2444	498	1824	556	1781	533
1 min Apgar scores	7.7	1.4	6.8	1.7	7.3	2.3	5.1	2.7
5 min Apgar scores	8.8	0.63	8.4	0.70	8.1	2.6	7.1	2.0
Test weight (grams)	2462	456	2428	474	2083	195	2013	236
Test chronological age (days)	3.8	1.2	4.9	2.1	23.5	31.5	25.3	30.4
Days in hospital	7.5	2.4	8.3	3.1	34.6	43.4	35.9	44.0
Postnatal Complications Score	9.8	0.42	9.7	0.48	8.3	2.7	7.0	2.6

METHOD

Subjects

The sample consisted of 10 pairs of full-term twins born between 38 and 41 weeks gestational age, and 8 pairs of preterm twins born between 25 and 37 weeks gestational age (mean = 33 weeks) from a sample of 345 pairs evaluated as part of a larger study. Full-term pairs included 3 female-female pairs, 3 male-male pairs, 2 female-male pairs, and 2 male-female pairs. Preterm pairs included 6 female-female pairs and 2 male-male pairs. Mean birth weight and test weight are presented in Table 1. Zygosity determination of same-sex twins was not available because the twins have not been bloodtyped.

Procedure

Test chronological age for the full-term and preterm infants is listed in Table 1 by group. Preterm infants were examined when they were medically stable, just before discharge from the hospital. There were no significant differences in test chronological age between first- and second-born twins for either the full-term or preterm groups.

Assessment items were selected so that six categories of behavior could be described: Irritability, resistance to soothing, reactivity, reinforcement value, activity, and developmental status. The assessment was organized to elicit a variety of behaviors relative to each category. The procedures have been presented in detail elsewhere [10,11]. In brief, neonates were examined during a period that extended from one feeding to the next (3 to 4 hr) according to the following protocol:

1. Each neonate was fed at its regularly scheduled feeding time. Behavioral state and irritability were rated by the examiner before, during, and immediately after the feeding. Ratings were also made of the infant's feeding adequacy (ie, rooting, sucking, spitting, etc).

2. For a 10 min period during the first active sleep state, 15 sec time sampling recordings were made of spontaneous activity, consisting of the number and vigor of limb movements, to obtain an index of activity during sleep. For each subject, a mean score was determined for activity during this observation period, then transformed to a normalized 5-point scale.

3. Midway between feedings the infant was awakened so that maturational level, sensorimotor status, and orienting behaviors could be assessed. Measures included visual or auditory orienting responses toward a bulls-eye, rattle, bell, voice, and face and voice combined; reflexive responses such as foot withdrawal, Moro, and sucking; summary measures of alertness, cuddliness, activity level, and reinforcement value of the infant's behavior; and patterns of irritability and soothability in response to specific items such as the orienting items and reflex testing.

4. Ratings were then made of the infant's response to a potentially stressful stimulus. For this procedure, a metal disc was chilled in ice water for 3 min, then placed against the neonate's left thigh and held there for 5 sec. The procedure was

repeated five times, and after each presentation the infant's behavioral responsivity, irritability, and soothability were rated.

5. Finally, ratings were made of episodic irritability and resistance to soothing throughout the course of the assessment sequence, but especially before a feeding. A standard series of soothing procedures was applied, including responsivity to a pacifier, vocal stimulation, manual stimulation, placement in the prone position, lifting to shoulder, cradling in arm, and swaddling in blanket. Individual responsivity to the various types of soothing and degree of intervention necessary for soothing were assessed.

The behaviors were rated on 5-point scales, with a higher score indicating a higher level of the measured attribute. The assessment items were then combined, and the scaled scores were averaged to form five composite scales: irritability, resistance to soothing, reactivity, reinforcement value, and developmental status. The specific items drawn from these assessments to form the composite scales were defined as follows:

1. *Irritability*. Refers to irritability during the various situations in the assessment (ie, irritability before feeding, and irritability in response to visual stimuli, auditory stimuli, manipulation, and aversive stimuli).

2. *Resistance to soothing*. Refers to the neonate's response to soothing procedures during various parts of the assessment (ie, console latency after withdrawal reflex to prick on sole of foot, soothability after reflex testing and after application of the cold disc, soothability by pacifier and by the various handling procedures described previously).

3. *Reactivity*. Refers to the neonate's responsivity and degree of orienting to visual and auditory stimuli (ie, visual following of bulls-eye; auditory orienting to a rattle, bell, voice, and face plus voice; alertness during presentation of orienting items).

4. *Reinforcement value*. Refers to the effect of the infant's behavior on the attitude of the examiner toward the infant (ie, cuddliness; reinforcement value of infant's behavior during all assessments, but especially for maturational level, sensorimotor status, and orienting behaviors; response to handling).

5. *Developmental status*. Refers to responsivity to measures of early integrity (ie, feeding ability, sucking reflex, tremor, tonus, spontaneous supine position, predominant behavioral state during neurobehavioral examination, quality of cry, cuddliness, and sum of scores on orienting items).

In addition, two measures of activity were included: one during sleep, and one while awake. Interrater reliabilities, determined by intraclass correlations for exact agreement on raw scores, ranged from $r = 0.79$ to $r = 0.99$.

RESULTS

For descriptive purpose Table 2 lists, by twin pair, the presentation of each infant at delivery, type of delivery for twin A and indication for Cesarean section for delivery of twin B, time between the delivery of twins A and B, 1- and 5-minute Apgar scores, and neonatal complications.

Table 2 Perinatal variables for vaginally- and Cesarean-delivered twins

Twin pair	Presentation	Delivery/Indication for Cesarean section	Time between deliveries	Apgar 1 min	Apgar 5 min	Neonatal complications
			FULL-TERM			
1 A	breech	low forceps		4	7	slight retractions at birth; resuscitation: mask
B	transverse lie	transverse lie; fetal distress	39 min	7	9	none
2 A	vertex	spontaneous		8	9	slight retractions at birth; transient initial hypoglycemia
B	vertex	cervix closed after A delivered	33 min	8	9	none
3 A	vertex	spontaneous		8	9	none
B	vertex	prolapsed cord in front of head and tight nuchal cord; fetal distress	25 min	8	9	whiffs of O_2 at birth
4 A	vertex	low forceps		9	9	transient vomiting: moderate gastro-esophageal reflux
B	left arm and chin	could not convert position; heart rate dropping; fetal distress	20 min	4	8	none
5 A	vertex	outlet mid forceps		7	9	none
B	vertex	mild fetal distress; failure to progress	24 min	7	8	slight retractions, moderate rales at birth
6 A	vertex	low outlet forceps		8	9	none
B	head & arms	fetal distress	13 min	9	9	none
7 A	vertex	induced		7	8	whiffs O_2 at birth
B	breech	cervix closed after A delivered	21 min	8	9	whiffs O_2 at birth
8 A	vertex	induced		8	9	none
B	transverse lie	transverse lie; fetal distress; decelerations of fetal heart tone	24 min	4	8	intubated and bagged for 5 min; 100% O_2

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Table 2 - *Continued*

Twin pair	Presentation	Delivery/Indication for Cesarean section	Time between deliveries	Apgar 1 min	Apgar 5 min	Neonatal complications
9 A	vertex	spontaneous		9	9	none
B	face	for facial presentation	46 min	8	9	none
10 A	vertex	spontaneous		8	9	none
B	transverse lie	transverse lie	22 min	6	7	O_2 to face; very mild substernal retractions at birth; transient thrombocytopenia
			PRETERM			
11 A	vertex	induced; low forceps		8	9	heart rate and apnea monitor; sepsis work up
B	transverse lie	transverse lie	36 min	7	8	bagged and suctioned; 40% O_2 for 3 min
12 A	vertex	low forceps		9	10	slight nasal flaring and suprasternal retractions at birth
B	vertex	prolapsed cord	20 min	7	8	mild RDS at birth; assisted ventilation less than 24 hr; apnea and bradycardia; sepsis work up; possible seizure day 7
13 A	vertex	spontaneous		7	8	staphylococcal impetigo
B	vertex	decelerations after A delivered	19 min	7	8	grunting at birth; perinatal hypovolemia; anemia; neutropenia-day 1
14 A	vertex	spontaneous		8	9	O_2 at birth; some nasal flaring and retractions
B	shoulder and back	shoulder and back presenting	45 min	8	9	none
15 A	vertex	spontaneous		8	9	none
B	transverse-arm	prolapse of arm and cord; loss of fetal heart tones after A delivered	16 min	2	4	asphyxia; 100% O_2; assisted ventilation; seizures

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Table 2 - *Continued*

Twin pair	Presentation	Delivery/Indication for Cesarean section	Time between deliveries	Apgar 1 min	Apgar 5 min	Neonatal complications
16 A	vertex	spontaneous		2	2	asphyxia; 100% O_2; severe RDS; assisted ventilation; hypoglycemia; apnea; bradycardias grade III IVH; low hemoglobin, required frequent transfusions; bronchopulmonary dysplasia; ricketts; PDA; stage 2 retinopathy; hyponatremia
B	transverse lie	transverse lie; heart rate fell below 100	15 min	1	4	asphyxia; 100% O_2; severe RDS; assisted ventilation; apnea; bradycardia; grade III IVH; low hemoglobin, required frequent transfusions; PDA; small bowel perforation; NEC; bronchopulmonary dysplasia, ricketts; necrotizing fingers
17 A	vertex	low forceps		9	10	none
B	transverse lie	failure to descend after birth of first twin	15 min	6	8	mild asphyxia; resuscitation: O_2
18 A	vertex	spontaneous		7	8	intermittent nasal flaring and mild substernal retractions at birth; O_2 to face
B	breech: foot, hand and cord presentation	appeared to be a ring developing in lower uterus; not adequate space to rotate infant	31 min	3	8	mild asphyxia; 100% O_2 - bagged and intubated; mild RDS; mild tachypnia

As an initial examination of the data, comparisons were made between the vaginally- and Cesarean-delivered twins on the mean scores of the following variables: birth weight, 1- and 5-minute Apgar scores, test weight, test chronological age, number of days in the hospital, and Postnatal Complications Scores [6]. The means and standard deviations for these variables are presented in Table 1. The results of t tests performed separately for full-term and preterm infants demonstrated that there were no significant differences between the vaginal and Cesarean section groups on any of these measures. These results indicated that the twins

delivered by Cesarean section were not at higher risk than the twins delivered by the vaginal route as assessed by two measures of postnatal risk, Apgar scores and Postnatal Complications Scores. Similarly, there was no difference between the groups in the time in which they became medically stable and were able to be tested, as measured by test weight, test gestational age, and length of stay in the hospital. It should be noted, however, that the standard deviations for the preterm infants' scores on test chronological age and days in hospital are very large relative to the means, indicating the high variability on these items within the group. Also, days in hospital, particularly for full-term infants, frequently is influenced by the length of stay required for the mother following her surgery.

To determine if there were any temperament or behavioral differences between the vaginally-delivered and Cesarean section-delivered twins, an analysis of variance of a paired comparison was performed for each behavioral category (irritability, resistance to soothing, activity-awake, activity-asleep, reactivity, reinforcement value, and developmental status). This test takes into account the relation between the twins of each pair. Separate tests were performed for the full-term and preterm infants. The results indicated that, for the full-term infants, there were no significant differences between Twins A and B in any of the behavioral areas, or in the measure of developmental status. For the preterm infants, there was a significant difference between the groups in the measure of activity level during sleep. Preterm infants delivered by Cesarean section were more active during sleep than their twins delivered by the vaginal route, $F(1) = 7.00$, $P < 0.04$. There were no other significant differences within the preterm group. Thus, of the several comparisons made between the vaginally- and Cesarean-delivered twins, there was only one significant difference between the groups to suggest that the Cesarean-delivered preterm twin may be at risk when compared with its vaginally-delivered cotwin.

DISCUSSION

These findings have demonstrated that, in the main, infants born by Cesarean section following vaginal delivery of their cotwins are not more compromised than their twin siblings as assessed on these measures during the neonatal period. Thus, the surgical delivery has not placed the infant at higher risk than its cotwin, and actually may have reduced any risk that might have occurred if the second twin had been delivered vaginally. The neonatal complications listed in Table 2 demonstrate that, although in some cases twin B had more such complications than twin A, in other cases twin A had more complications than twin B. In any event, there were no significant differences between twins A and B on the Postnatal Complications Scores which include these neonatal complications in its scale.

Similarly, there were no significant differences between twins A and B on their 1- and 5-minute Apgar scores. The present findings of no differences on the measures of postnatal risk were similar to those of Rattan et al [9] in a study of

21 twin pairs, but did not concur with those of Evrard and Gold [4] in a study of 4 twin pairs. These differences may be accounted for by differences in sampling distribution or in sample size.

For the behavioral measures, full-term infants delivered by Cesarean section were not more compromised on these measures of neonatal temperament and developmental status than their twins who were delivered vaginally. In contrast, preterm infants delivered by Cesarean section were more active during sleep than their vaginally-delivered twins, suggesting that the Cesarean-delivered preterm twin may be compromised in this behavioral area. These measures of activity level during sleep in preterm infants previously had been found to be related to a laboratory assessment of temperament at 9, 18, and 24 months of age [13]. Thus, differences on this measure between these two groups of preterm infants may have implications for later temperament development. In any event, in contrast with full-term infants, the preterm Cesarean-delivered second twin may be more compromised than its vaginally delivered cotwin, at least in one area of behavior. Longitudinal studies can determine if these differences are meaningful for development.

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