Acta Genet Med Gemellol 40: 361-372 (1991)

Received 28 June 1990
Final 3 January 1991

Acid-Base Differences in Preterm and Term Twin Pregnancy

S.A. Ordorica, I.A. Hoskins, B.K. Young

Division of Maternal-Fetal Medicine, Department of Obstetrics and Gynecology, New York University Medical Center, USA

Abstract. A prospective study was undertaken which examined 179 sets of twins, 68 premature (less than 36 weeks of gestation) and 111 term. The purpose of this study was to assess differences in the acid-base status between twins related to gestational age, birth order and the time interval between twin births. Although the twin blood-gas data is within the range considered normal, statistically significant differences favoring the first-born were noted for both preterm and term twins. These differences do not depend on gestational age, route of delivery or presentation, and become evident when the interval between twin births exceeds one minute. We postulate that after delivery of the first twin, the reduced uterine size causes a decrease in the intervillous blood flow and consequently a reduction in the respiratory exchange between the second fetus, still in utero, and its placenta.

Key words: Twins, Preterm, Term, Umbilical blood gas, Apgar score, Birth order

INTRODUCTION

In our previous study [12], twin pairs were shown to have significant biochemical differences at birth favoring the first-born. These results have been corroborated recently by a similar study [6]. However, no study has considered the role of gestational age in producing these differences. This analysis was undertaken to determine the extent by which the differences between twins with regard to birth order apply to preterm twin pregnancies, and to identify specific causes for these differences.

The degree by which gestational age affects twin birth was determined by comparing the differences between twin siblings in weight, Apgar scores, and umbilical venous and arterial blood gas and acid-base status. To identify specific causes for the differences between twin pairs in both term and preterm birth, the following parameters were examined: birth order, gestational age, route of delivery, presentation at delivery, and time interval between twin births.

MATERIALS AND METHODS

The data for this study, part of continuing prospective study of twin births initiated at Bellevue and New York University Hospitals in 1979, consists of 179 sets of twins; 68 sets of preterm twins (mean ± SD: 32.7 ± 2.4 wks), and 111 sets of term twins (mean ± SD: 38.3 ± 1.6 wks). Irrespective of their position in the uterus, the first-born twin was designated Twin A, and the second-born Twin B. Thus, the first-born twin by cesarean section might have been the second-born in the case of a vaginal delivery because of its higher position in the uterus.

The parameters used to determine birth outcome were: weight, Apgar score at 1 and 5 minutes, as determined by a pediatrician not involved in the study, and umbilical venous and arterial blood measurements. These were obtained after cord clamping with delivery of each twin. Blood was drawn with a 21-gauge needle and plastic syringe. The samples were analyzed immediately, or placed in vacuum tubes in an ice bath, and analyzed within twenty minutes of being obtained to prevent significant effects due to delay [9, 10]. Blood samples were analyzed for pH, PO_2, PCO_2, bicarbonate, and base excess with the use of a Corning 165 analyzer, and for lactic acid concentration with an enzymatic electrochemical method previously described by our laboratory [1].

The differences in the twins were determined by means of paired t-tests and chi-square where applicable. A value of $\alpha = 0.05$ was selected as the significance level. The statistical analysis was performed with the SPSS PC+computer program package.

RESULTS

Analysis of twin birth weights as a function of gestational age (Table 1) indicates that there is no statistically significant difference in the mean weights between Twin A and Twin B in both term and preterm twins. These data suggest that, at any gestational age, birth order has no significant influence on the weight differences of twins.

The Apgar score data (Table 1) show no statistically significant differences between term twin siblings in either the 1- or 5-minute mean scores. However, for preterm twins, both the 1- and 5-minute mean scores are lower for twin B and these differences are statistically significant. Analysis of the incidence of low 1- and 5-minute Apgar scores (less than 7) indicates that in term twins there is no statistically significant difference in the incidence of low Agpar scores between Twins A and B. In preterm twins, the incidence of low 1-minute score is significantly greater for Twin B than for Twin A (50.0% and 27.9%, respectively). At 5 minutes, the incidence of low Apgar scores for preterm Twin B is also greater than for Twin A (13.2% and 7.4%, respectively), but this difference is not statistically significant. These data suggest that prematurity is associated with differences in the neonatal condition between twin siblings in favor of the first-born that are not completely overcome by medical intervention during the first five minutes of life.

Table 1 - Term twin (G.A. ≥ 36 wk) and preterm twin (G.A. < 36 wk): Weight and Apgar scores

Parameter	No. of pairs	Mean ± SD		p
		Twin A	Twin B	
Term twins				
Weight (g)	106	2750 ± 411	2720 ± 439	ns
1-min. Apgar score	111	8.0 ± 1.3	7.8 ± 1.5	ns
5-min. Apgar score	111	8.8 ± 1.1	8.9 ± 0.4	ns
Incidence of Apgar scores < 7				
At 1 minute	111	9.9%	10.8%	ns
At 5 minutes	111	1.8%	0%	ns
Preterm twins				
Weight (g)	66	1912 ± 521	1936 ± 544	ns
1-min. Apgar score	68	6.8 ± 2.2	5.8 ± 2.5	< 0.01
5-min. Apgar score	68	8.3 ± 1.1	7.7 ± 1.9	< 0.01
Incidence of Apgar scores < 7				
At 1 minute	68	27.9%	50.0%	< 0.05
At 5 minutes	68	7.4%	13.2%	ns

Term twins gestational age: Mean ± SD = 38.3 ± 1.6 wk.
Preterm twins gestational age: Mean ± SD = 32.7 ± 2.4 wk.

The twin blood gas acid-base data for both term and preterm twins (Table 2), indicate that all the differences in umbilical venous and arterial pH, PO_2, PCO_2, bicarbonate, base excess and lactate concentration, favor Twin A. For both term and preterm twins, the differences in umbilical venous and arterial PO_2 and PCO_2 are statistically significant. In addition, the term twin differences in umbilical venous and arterial bicarbonate and arterial pH, and the preterm twin differences in umbilical venous pH and the umbilical arterial bicarbonate and base excess are also statistically significant. However, the values of these parameters for both term and preterm twin pairs are within the accepted normal range.

To analyze in more detail the effect of gestational age on preterm twin differences, the sample was subdivided into two additional gestational age categories: 33-35 weeks and ≤ 32 weeks. Both of these gestational age groups exhibit similar characteristics favoring Twin A (Table 3). Therefore, gestational age is not the determining factor causing the disadvantaged acid-base status of Twin B.

A number of clinical parameters, including route of delivery, presentation at delivery and time interval between twin births, may have an impact on the twin differences observed. The effect of each of these variables was analyzed.

Route of delivery was considered to determine the effect of obstetric manipulation on the differences noted. In twins delivered vaginally, the blood gas differences in both term and preterm twins favor Twin A (Table 4). Likewise, in twins delivered by cesarean

Table 2 - Term twin (G.A. ≥ 36 wk) and preterm twin (G.A. < 36 wk): Acid-base factors

Parameter	No. of pairs	Mean ± SD		p
		Twin A	Twin B	
Term twins				
Umbilical venous				
pH	109	7.32 ± 0.10	7.31 ± 0.06	ns
PO_2 (mm Hg)	108	30.1 ± 7.1	26.1 ± 7.4	< 0.001
PCO_2 (mm Hg)	108	39.5 ± 7.1	41.6 ± 7.4	< 0.01
Bicarbonate	61	20.6 ± 3.7	21.5 ± 3.4	< 0.05
Base excess	67	–4.8 ± 5.3	–4.3 ± 3.6	ns
Lactate (mmol/l)	66	2.53 ± 1.56	2.57 ± 1.19	ns
Umbilical arterial				
pH	100	7.28 ± 0.06	7.27 ± 0.06	< 0.05
PO_2 (mm Hg)	93	19.4 ± 6.3	16.8 ± 9.2	< 0.05
PCO_2 (mm Hg)	96	44.4 ± 10.4	48.1 ± 10.8	< 0.001
Bicarbonate	57	21.2 ± 5.4	22.6 ± 5.7	< 0.05
Base excess	64	–5.0 ± 4.5	–4.6 ± 4.6	ns
Lactate (mmol/l)	61	2.45 ± 1.20	2.65 ± 1.20	ns
Preterm twins				
Umbilical venous				
pH	66	7.33 ± 0.07	7.30 ± 0.09	< 0.01
PO_2 (mm Hg)	62	28.7 ± 9.0	23.7 ± 8.1	< 0.01
PCO_2 (mm Hg)	62	39.1 ± 10.6	43.1 ± 11.3	< 0.01
Bicarbonate	43	20.4 ± 4.0	20.9 ± 3.8	ns
Base excess	46	–4.9 ± 3.9	–4.8 ± 3.6	ns
Lactate (mmol/l)	35	2.93 ± 1.62	2.94 ± 1.94	ns
Umbilical arterial				
pH	57	7.28 ± 0.08	7.27 ± 0.08	ns
PO_2 (mm Hg)	52	20.5 ± 8.3	15.8 ± 7.3	< 0.01
PCO_2 (mm Hg)	52	41.4 ± 12.3	49.6 ± 13.7	< 0.001
Bicarbonate	37	19.2 ± 6.7	22.3 ± 4.0	< 0.01
Base excess	40	–6.8 ± 6.2	–4.8 ± 3.5	< 0.05
Lactate (mmol/l)	29	2.75 ± 1.09	3.07 ± 1.63	ns

Term twins gestational age: Mean ± SD = 38.3 ± 1.6 wk.
Preterm twins gestational age: Mean ± SD = 32.7 ± 2.4 wk.

section, where theoretically less obstetric manipulation is required to deliver the second-born, the same trend in favor of twin A was observed in both term and preterm twins (Table 5). Therefore, route of delivery is not the determinant of these differences since they favored Twin A in both vaginal and abdominally delivered twins.

Table 3 - Term twin: G.A. 33-35 wk and G.A ≤ 32 wk

Parameter	No. of pairs	Mean ± SD		p
		Twin A	Twin B	
Gestational age 33-35 wk				
Weight (g)	41	2212 ± 334	2236 ± 396	ns
1-min Apgar score	42	7.4 ± 1.8	6.5 ± 2.1	< 0.05
5-min Apgar score	42	8.6 ± 1.0	8.1 ± 1.3	< 0.05
Umbilical venous				
pH	41	7.39 ± 0.08	7.30 ± 0.07	ns
PO_2 (mm Hg)	39	27.5 ± 9.6	23.3 ± 8.4	< 0.01
PCO_2 (mm Hg)	39	40.9 ± 11.8	45.4 ± 10.5	< 0.01
Bicarbonate	25	20.0 ± 4.6	21.9 ± 3.8	< 0.05
Base excess	27	–5.8 ± 4.2	–4.6 ± 3.6	< 0.05
Lactate (mmol/l)	21	3.08 ± 1.95	2.92 ± 1.85	ns
Umbilical arterial				
pH	36	7.26 ± 0.09	7.27 ± 0.08	ns
PO_2 (mm Hg)	33	20.5 ± 9.7	15.3 ± 6.6	< 0.05
PCO_2 (mm Hg)	33	40.8 ± 13.7	50.8 ± 13.6	< 0.001
Bicarbonate	22	17.1 ± 7.8	22.6 ± 4.4	< 0.001
Base excess	25	–8.6 ± 7.0	–4.7 ± 1.4	< 0.05
Lactate (mmol/l)	18	2.67 ± 1.02	3.06 ± 1.91	ns
Gestational age ≤ 32 wk				
Weight (g)	24	1371 ± 293	1414 ± 343	ns
1-min Apgar score	25	5.7 ± 2.4	4.6 ± 2.7	< 0.05
5-min Apgar score	25	7.9 ± 1.3	7.0 ± 2.4	ns
Umbilical venous				
pH	24	7.35 ± 0.05	7.30 ± 0.11	< 0.05
PO_2 (mm Hg)	22	30.8 ± 8.0	23.6 ± 9.5	< 0.05
PCO_2 (mm Hg)	22	35.9 ± 7.8	40.9 ± 12.9	ns
Bicarbonate	17	20.8 ± 3.0	19.9 ± 3.1	ns
Base excess	18	–4.0 ± 2.9	–5.1 ± 3.3	ns
Lactate (mmol/l)	14	2.70 ± 0.94	3.27 ± 1.80	ns
Umbilical arterial				
pH	20	7.31 ± 0.06	7.27 ± 0.08	< 0.01
PO_2 (mm Hg)	18	20.5 ± 5.6	16.8 ± 8.7	ns
PCO_2 (mm Hg)	18	42.2 ± 9.7	47.0 ± 14.2	ns
Bicarbonate	14	22.0 ± 2.7	21.8 ± 3.4	ns
Base excess	14	–4.0 ± 2.6	–5.0 ± 3.0	ns
Lactate (mmol/l)	11	2.88 ± 1.23	3.10 ± 1.10	ns

Gestational age 33-35 wk: Mean ± SD = 34.2 ± 0.8 wk.
Gestational age ≤ 32 wk: Mean ± SD = 30.1 ± 1.8 wk.

Table 4 - Term twin (G.A. ≥ 36 wk) and preterm twin (G.A < 36 wk: Vaginal delivery

Parameter	No. of pairs	Mean ± SD		p
		Twin A	Twin B	
Term twins				
Weight (g)	43	2560 ± 358	2526 ± 353	ns
1-min Apgar score	46	7.9 ± 1.3	7.5 ± 1.9	ns
5-min Apgar score	46	8.8 ± 1.0	9.0 ± 0.4	ns
Umbilical venous				
pH	45	7.34 ± 0.06	7.30 ± 0.05	< 0.001
PO_2 (mm Hg)	45	29.9 ± 6.0	23.1 ± 7.8	< 0.001
PCO_2 (mm Hg)	45	37.4 ± 6.1	42.7 ± 7.6	< 0.001
Bicarbonate	28	20.5 ± 3.0	21.2 ± 3.2	ns
Base excess	29	–4.0 ± 3.0	–4.6 ± 3.1	ns
Lactate (mmol/l)	23	2.95 ± 1.81	3.41 ± 1.44	ns
Umbilical arterial				
pH	43	7.29 ± 0.06	7.25 ± 0.05	< 0.01
PO_2 (mm Hg)	40	20.6 ± 5.1	16.3 ± 6.0	< 0.01
PCO_2 (mm Hg)	43	41.7 ± 10.7	47.9 ± 12.2	< 0.01
Bicarbonate	29	20.3 ± 5.7	22.2 ± 6.1	< 0.05
Base excess	29	–5.8 ± 4.2	–5.7 ± 4.0	ns
Lactate (mmol/l)	22	2.86 ± 1.52	3.38 ± 1.42	< 0.05
Preterm twins				
Weight (g)	17	2000 ± 554	1902 ± 555	ns
1-min Apgar score	17	7.5 ± 1.3	6.0 ± 2.9	< 0.05
5-min Apgar score	17	8.5 ± 0.7	7.8 ± 2.3	ns
Umbilical venous				
pH	16	7.33 ± 0.06	7.32 ± 0.06	ns
PO_2 (mm Hg)	16	31.9 ± 7.3	24.9 ± 9.0	< 0.05
PCO_2 (mm Hg)	16	36.0 ± 8.5	42.8 ± 9.7	ns
Bicarbonate	13	18.9 ± 4.3	21.4 ± 3.6	ns
Base excess	13	–5.6 ± 3.9	–4.7 ± 3.4	ns
Lactate (mmol/l)	9	3.10 ± 1.14	2.79 ± 1.25	ns
Umbilical arterial				
pH	13	7.28 ± 0.07	7.26 ± 0.07	ns
PO_2 (mm Hg)	12	21.9 ± 5.1	16.2 ± 8.4	ns
PCO_2 (mm Hg)	12	40.8 ± 13.5	48.0 ± 15.1	ns
Bicarbonate	10	18.7 ± 5.7	21.4 ± 4.0	ns
Base excess	10	–7.4 ± 5.0	–5.8 ± 2.4	ns
Lactate (mmol/l)	7	3.06 ± 1.46	3.16 ± 1.52	ns

https://doi.org/10.1017/S000156600000355X Published online by Cambridge University Press

Table 5 - Term twin (G.A. ≥ 36 wk) and preterm twin (G.A < 36 wk): Cesarean delivery

Parameter	No. of pairs	Mean ± SD		p
		Twin A	Twin B	
Term twins				
Weight (g)	60	2909 ± 382	2874 ± 442	ns
1-min Apgar score	62	8.1 ± 1.4	8.1 ± 1.0	ns
5-min Apgar score	62	8.9 ± 1.2	8.9 ± 0.4	ns
Umbilical venous				
pH	61	7.31 ± 0.12	7.33 ± 0.05	ns
PO_2 (mm Hg)	60	30.5 ± 7.7	27.9 ± 6.1	< 0.05
PCO_2 (mm Hg)	60	40.9 ± 7.5	40.9 ± 7.4	ns
Bicarbonate	31	20.8 ± 4.4	21.9 ± 3.5	ns
Base excess	36	−5.3 ± 6.6	−3.9 ± 3.8	ns
Lactate (mmol/l)	43	2.30 ± 1.38	2.12 ± 0.71	ns
Umbilical arterial				
pH	55	7.28 ± 0.06	7.28 ± 0.06	ns
PO_2 (mm Hg)	51	18.5 ± 7.1	15.5 ± 4.5	< 0.01
PCO_2 (mm Hg)	51	46.9 ± 9.4	48.6 ± 9.6	ns
Bicarbonate	27	22.4 ± 4.7	23.3 ± 5.4	ns
Base excess	34	−4.1 ± 4.6	−3.5 ± 4.8	ns
Lactate (mmol/l)	39	2.22 ± 0.93	2.23 ± 0.82	ns
Preterm twins				
Weight (g)	41	1911 ± 483	1953 ± 537	ns
1-min Apgar score	43	6.7 ± 2.3	6.0 ± 2.3	< 0.05
5-min Apgar score	43	8.3 ± 1.2	7.6 ± 1.8	< 0.05
Umbilical venous				
pH	42	7.32 ± 0.08	7.31 ± 0.09	ns
PO_2 (mm Hg)	40	27.3 ± 9.3	23.9 ± 8.2	< 0.05
PCO_2 (mm Hg)	40	41.0 ± 10.8	42.8 ± 9.7	ns
Bicarbonate	25	21.4 ± 3.5	21.2 ± 3.1	ns
Base excess	28	−4.4 ± 3.8	−4.2 ± 3.2	ns
Lactate (mmol/l)	21	2.79 ± 1.94	2.94 ± 2.08	ns
Umbilical arterial				
pH	36	7.28 ± 0.08	7.29 ± 0.07	ns
PO_2 (mm Hg)	34	20.4 ± 9.4	16.2 ± 6.5	< 0.05
PCO_2 (mm Hg)	34	42.0 ± 11.5	47.7 ± 11.9	< 0.01
Bicarbonate	22	19.4 ± 7.1	22.4 ± 4.3	< 0.05
Base excess	25	−6.2 ± 6.4	−4.2 ± 3.94	ns
Lactate (mmol/l)	18	2.56 ± 1.05	2.72 ± 1.66	ns

The possibility that the higher incidence of malpresentation of Twin B might be the cause for the disadvantages noted for the second-born twin was considered. Analysis of vertex-vertex pairs, which excludes malpresentation of the second-born, permits evaluation of this possibility (Table 6). Again a trend in blood gas differences favoring Twin A was noted. Malpresentation is therefore excluded as the reason for the disadvantages observed in the second-born twin.

Finally, the interval between twin births was analyzed as a possible etiology for the birth order differences. The results indicate that differences between the twins are observed when the birth interval is > 1 minute (Table 7). At intervals > 1 minute for both term and preterm twins (mean ± SD: 9.3 ± 8.0 and 10.3 ± 13.4 minutes, respectively) statistically significant differences in favor of Twin A are seen in the umbilical venous pH, PO_2, PCO_2 and umbilical arterial PO_2, PCO_2 and bicarbonate. In addition, statistically significant differences favoring the first-born were noted in the 1- and 5-minute Apgar score of the preterm twin group. However, at twin birth intervals ≤ 1 minute for both term and preterm twins (mean ± SD: 1.0 ± 0.0 and 0.90 ± 0.3 minutes, respectively), no statistically significant differences in either Apgar scores or blood gas acid-base data were noted between either the term or preterm twin pairs (Table 8). Although the majority of the infants that were born within one minute of each other were delivered by cesarean section, we have shown that route of delivery (Table 5), is not the determinant for the differences noted. These data strongly suggest that a time interval > 1 minute between twin deliveries is a factor contributing to the less favorable acid-base status of the second-born.

DISCUSSION

A greater neonatal morbidity and mortality for the second-born twin has been reported [3, 11], but more recent studies have shown no differences between twins in these parameters due to birth order [4, 5]. However, biochemical differences favoring the first born have been noted [6, 12]. The results of this study show that, although the blood gas data for both twins is within the range considered normal, there are statistically significant differences in twin umbilical venous and arterial blood gas values favoring the first born, and that these differences are not determined by gestational age, presentation, or route of delivery. However, the differences favoring Twin A in both premature and term twins are influenced by the interval from delivery of Twin A to the delivery of Twin B, and are seen when this time interval is > 1 minute. Although the small blood gas acid-base differences favoring the first born do not appear to be clinically significant, their relationship, if any, to the developmental pattern of twins can only be ascertained by long-term study.

The effect of birth time interval has been considered in other studies. Using birth intervals < 15 and > 15 minutes [2, 8], these studies have concluded that, with appropriate fetal monitoring, the time interval between the delivery of the twins has no detrimental effect on the clinical outcome of the second-born twin. However, using umbilical blood gas measurements, which are sensitive indicators of neonatal condition, we have demonstrated a deterioration of the acid-base status of the second-born twin one minute after delivery of its twin sibling. We have postulated that, after delivery of the first twin,

Table 6 - **Term twin (G.A. ≥ 36 wk) and preterm twin (G.A < 36 wk): Vertex-vertex presentation**

Parameter	No. of pairs	Mean ± SD		p
		Twin A	Twin B	
Term twins				
Weight (g)	46	2727 ± 382	2691 ± 405	ns
1-min Apgar score	50	8.0 ± 1.5	8.2 ± 1.1	ns
5-min Apgar score	50	8.8 ± 1.3	9.0 ± 0.4	ns
Umbilical venous				
pH	50	7.30 ± 0.13	7.30 ± 0.05	ns
PO_2 (mm Hg)	50	29.0 ± 6.7	24.0 ± 6.4	< 0.001
PCO_2 (mm Hg)	50	38.9 ± 7.0	42.1 ± 8.0	< 0.001
Bicarbonate	31	19.6 ± 4.1	20.6 ± 3.9	ns
Base excess	33	−6.2 ± 6.4	−5.5 ± 4.1	ns
Lactate (mmol/l)	29	3.18 ± 2.07	3.08 ± 1.37	ns
Umbilical arterial				
pH	45	7.28 ± 0.06	7.26 ± 0.07	ns
PO_2 (mm Hg)	43	18.8 ±5.4	15.6 ± 4.6	< 0.001
PCO_2 (mm Hg)	45	44.5 ± 11.1	48.6 ± 10.3	< 0.05
Bicarbonate	27	20.4 ± 5.6	21.8 ± 5.4	ns
Base excess	30	−6.0 ± 5.4	−5.7 ± 5.0	ns
Lactate (mmol/l)	27	2.88 ± 1.57	3.12 ± 1.46	ns
Preterm twins				
Weight (g)	22	1911 ± 574	1930 ± 556	ns
1-min Apgar score	23	6.8 ± 2.3	5.5 ± 2.9	< 0.05
5-min Apgar score	23	8.5 ± 0.9	7.2 ± 2.5	< 0.05
Umbilical venous				
pH	22	7.33 ± 0.08	7.30 ± 0.11	ns
PO_2 (mm Hg)	20	29.9 ± 8.8	25.3 ± 9.0	ns
PCO_2 (mm Hg)	20	37.6 ± 11.4	47.2 ± 10.3	ns
Bicarbonate	16	19.3 ± 4.0	20.9 ± 2.0	ns
Base excess	16	−5.8 ± 3.8	−5.1 ± 2.9	ns
Lactate (mmol/l)	13	3.85 ± 2.07	4.01 ± 2.29	ns
Umbilical arterial				
pH	19	7.26 ± 0.09	7.28 ± 0.09	ns
PO_2 (mm Hg)	17	20.2 ± 7.0	18.0 ± 7.0	ns
PCO_2 (mm Hg)	17	40.5 ± 12.5	47.8 ± 12.4	< 0.05
Bicarbonate	14	18.5 ± 6.3	21.5 ± 4.0	< 0.05
Base excess	14	−8.6 ± 6.8	−5.7 ± 4.0	ns
Lactate (mmol/l)	10	3.41 ± 1.39	3.88 ± 1.97	ns

Table 7 - Term twin (G.A. ≥ 36 wk) and preterm twin (G.A < 36 wk): Time interval between births > 1 min

Parameter	No. of pairs	Mean ± SD		p
		Twin A	Twin B	
Term twins				
Weight (g)	69	2689 ± 410	2632 ± 422	ns
1-min Apgar score	72	8.0 ± 1.1	7.7 ± 1.8	ns
5-min Apgar score	72	8.9 ± 1.0	8.9 ± 0.5	ns
Umbilical venous				
pH	70	7.33 ± 0.06	7.31 ± 0.06	< 0.01
PO_2 (mm Hg)	70	29.6 ± 6.8	24.4 ± 7.8	< 0.001
PCO_2 (mm Hg)	70	39.0 ± 7.5	42.2 ± 8.1	< 0.01
Bicarbonate	40	20.7 ± 3.7	21.3 ± 3.8	ns
Base excess	45	–4.4 ± 4.2	–4.5 ± 4.0	ns
Lactate (mmol/l)	36	2.76 ± 1.63	3.00 ± 1.38	ns
Umbilical arterial				
pH	67	7.28 ± 0.06	7.26 ± 0.06	ns
PO_2 (mm Hg)	61	19.9 ± 6.3	16.3 ± 5.7	< 0.01
PCO_2 (mm Hg)	65	43.5 ± 11.6	47.7 ± 11.3	< 0.01
Bicarbonate	40	20.4 ± 6.1	22.3 ± 6.4	< 0.01
Base excess	45	–5.8 ± 5.0	–5.1 ± 5.0	ns
Lactate (mmol/l)	36	2.72 ± 1.45	2.96 ± 1.38	ns
Preterm twins				
Weight (g)	42	1902 ± 496	1897 ± 505	ns
1-min Apgar score	42	7.1 ± 2.0	6.0 ± 2.2	< 0.01
5-min Apgar score	42	8.5 ± 1.0	7.8 ± 1.6	< 0.01
Umbilical venous				
pH	40	7.34 ± 0.06	7.30 ± 0.08	< 0.01
PO_2 (mm Hg)	37	30.9 ± 8.7	23.8 ± 8.6	< 0.001
PCO_2 (mm Hg)	37	37.6 ± 10.2	44.2 ± 12.5	< 0.01
Bicarbonate	27	20.5 ± 4.5	21.3 ± 4.2	ns
Base excess	28	–4.6 ± 3.9	–4.9 ± 3.7	ns
Lactate (mmol/l)	22	2.66 ± 1.11	2.74 ± 1.33	ns
Umbilical arterial				
pH	33	7.29 ± 0.07	7.27 ± 0.08	ns
PO_2 (mm Hg)	30	21.6 ± 9.4	14.5 ± 6.2	< 0.01
PCO_2 (mm Hg)	30	40.1 ± 13.3	51.5 ± 14.6	< 0.001
Bicarbonate	22	19.1 ± 8.1	23.3 ± 4.0	< 0.01
Base excess	23	–5.9 ± 6.8	–4.2 ± 3.6	ns
Lactate (mmol/l)	17	2.60 ± 0.80	3.04 ± 1.42	ns

G.A. ≥36 wk, Birth time interval: Mean ± SD = 9.3 ± 8.0 min.
G.A. <36 wk, Birth time interval: Mean ± SD = 10.3 ± 13.4 min.

https://doi.org/10.1017/S000156600000355X Published online by Cambridge University Press

Table 8 - Term twin (G.A. ≥ 36 wk) and preterm twin (G.A < 36 wk): Time interval between births > 1 min

Parameter	No. of pairs	Mean ± SD		p
		Twin A	Twin B	
Term twins				
Weight (g)	31	2897 ± 338	2877 ± 461	ns
1-min Apgar score	32	8.2 ± 1.0	8.2 ± 0.6	ns
5-min Apgar score	32	9.1 ± 0.2	9.0 ± 0.3	ns
Umbilical venous				
pH	32	7.33 ± 0.05	7.34 ± 0.04	ns
PO_2 (mm Hg)	31	30.4 ± 6.8	29.6 ± 5.1	ns
PCO_2 (mm Hg)	31	40.0 ± 5.0	39.3 ± 5.6	ns
Bicarbonate	17	21.2 ± 1.5	21.6 ± 2.2	ns
Base excess	18	−4.1 ± 2.1	−3.8 ± 2.6	ns
Lactate (mmol/l)	24	1.88 ± 0.58	1.91 ± 0.45	ns
Umbilical arterial				
pH	28	7.30 ± 0.05	7.29 ± 0.04	ns
PO_2 (mm Hg)	26	18.3 ± 6.5	15.9 ± 4.3	ns
PCO_2 (mm Hg)	26	45.8 ± 6.9	46.9 ± 7.8	ns
Bicarbonate	15	23.0 ± 2.7	22.8 ± 3.6	ns
Base excess	17	−3.1 ± 2.7	−3.5 ± 3.1	ns
Lactate (mmol/l)	21	1.98 ± 0.46	2.04 ± 0.36	ns
Preterm twins				
Weight (g)	18	1887 ± 536	1966 ± 550	ns
1-min Apgar score	19	6.0 ± 2.6	5.4 ± 2.9	ns
5-min Apgar score	19	8.1 ± 1.3	7.2 ± 2.5	ns
Umbilical venous				
pH	19	7.32 ± 0.10	7.29 ± 0.12	ns
PO_2 (mm Hg)	18	24.9 ± 8.5	22.0 ± 8.3	ns
PCO_2 (mm Hg)	18	40.7 ± 12.0	43.3 ± 11.0	ns
Bicarbonate	12	20.5 ± 3.1	20.7 ± 2.7	ns
Base excess	13	−5.2 ± 4.3	−4.8 ± 3.4	ns
Lactate (mmol/l)	10	3.40 ± 2.55	3.79 ± 2.68	ns
Umbilical arterial				
pH	17	7.26 ± 0.09	7.27 ± 0.08	ns
PO_2 (mm Hg)	16	17.8 ± 6.4	17.6 ± 8.3	ns
PCO_2 (mm Hg)	16	41.7 ± 8.5	45.9 ± 13.0	ns
Bicarbonate	11	19.5 ± 3.7	20.8 ± 3.9	ns
Base excess	12	−7.4 ± 5.4	−5.7 ± 3.6	ns
Lactate (mmol/l)	9	2.61 ± 1.10	3.00 ± 2.16	ns

G.A. ≥36 wk, Birth time interval: Mean ± SD = 1.0 ± 0.0 min.
G.A. <36 wk, Birth time interval: Mean ± SD = 0.9 ± 0.3 min.

the reduced uterine size might decrease intervillous blood flow, resulting in less respiratory exchange between the second fetus, still in utero, and its placenta [12]. Additionally, placental function or perfusion might be affected by clamping the umbilical cord of the first twin, as has been shown in singleton pregnancies [7]. The data in the present study indicate that one minute after delivery of the first twin, a small but statistically significant decrease in PO_2 and an increase in PCO_2 in the umbilical venous and arterial blood of Twin B is noted, as well as an increase of bicarbonate in the umbilical arterial blood. Thus, there is decreased transport of O_2 and CO_2 between the second fetus and its mother across the placenta after delivery of the first twin. This is consistent with the physicological changes we have previously postulated [12].

In summary, this study demonstrates that, although the umbilical blood acid-base data for the twin siblings in term and preterm pregnancies is within the range considered normal, there are differences which favor the first-born. These differences are the result of a deterioration in the acid-base status of the second twin which occurs one minute after delivery of the first twin, and are not dependent on gestational age, route of delivery, or presentation. Our results suggest a model in which the reduced uterine size after delivery of the first twin causes a decrease in the intervillous blood flow, and consequently less respiratory exchange between the second fetus and its placenta.

REFERENCES

1. Antoine C, Young BK (1982): Fetal lactic acidosis with epidural anesthesia. Am J Obstet Gynecol 142:55.
2. Chervenak FA, Johnson RE, Youcha S, Hobbins JC, Berkowitz RI (1985): Intrapartum management of twin gestations. Obstet Gynecol 65:119-124.
3. Gutmacher AF, Khol SG (1958): The fetus of multiple gestations. Obstet Gynecol 12:528.
4. McCarthy BJ, Sachs BP, Loyde PM, Burton A, Terry JS, Rochat, R (1981): The epidemiology of neonatal death in twins. Am J Obstet Gynecol 141:252.
5. Naeye RL, Tafari N, Judge D, Marboe CC (1978): Twins: Causes of perinatal death in 12 United States cities and one African city. Am J Obstet Gynecol 131:267.
6. Nakano R, Takemura H (1988): Birth order in delivery of twins. Gynecol Obstet Invest 25:217-222.
7. Ogata ES, Kitterman JA, Kleinberg F, et al (1977): Effect of cord clamping and maternal blood pressure on placental transfusion with cesarean section. Am J Obstet Gynecol 128:197.
8. Rayburn WF, Lavin JP, Miodovnik M, Varner MW (1984): Multiple gestation: Time interval between delivery of the first and second twins. Obstet Gynecol 63:502-506.
9. Saling E (1976): Possible errors in fetal blood analysis and their prevention. In Gluck L (ed): Modern Perinatal Medicine. Chicago: Year Book Medical Publishers, pp 149-162.
10. Silverman F, Antoine C, Young BK (1982): Fetal blood analysis. I. Effect of delayed collection. Diagn Gynecol Obstet 4:31.
11. Whyshak G, White C (1963): Birth hazards of the second twin, Jama 186:869.
12. Young BK, Suidan JS, Antoine C (1985): Differences in twins: The importance of birth order. Am J Obstet Gynecol 151:915.

Correspondence: Steven A. Ordorica, M.D., New York University Medical Center, 530 First Avenue, Suite 5 F, New York, NY 10016, USA.