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The Northwestern University Twin Study V: Twin Deliveries at Prentice Women's Hospital and Maternity Center, 1978-83

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Abstract. Two hundred fifty-one twin deliveries between January 1, 1978 and June 30, 1983 at Prentice Women's Hospital and Maternity Center were reviewed. Cases were excluded if birth weight was less than 500 g, if gestational age was less than 26 weeks or if an antenatal fetal demise had occurred. Maternal demographic characteristics, delivery data and infant characteristics are described. The effect of providing care to a high-risk population of mothers in whom approximately 60% either deliver thair infants preterm or with a birth weight of less than 2,500 g is discussed in terms of costs of care.

Key words: Multiple gestation, Cost of care, Preterm labor, Premature rupture of membranes

Interest in twin studies at Northwestern University began in 1975 with the establishement of a state-supported perinatal center at the Prentice Women's Hospital and Maternity Center (PWHMC). A data base was initially developed from deliveries of 588 women and their 1,176 twin concepti at the Northwestern University Medical Center and 11 of its

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referring institutions between the years 1970 and 1975. The first report characterized the study population of mothers and twins [5]. Subsequent analyses described the causes of mortality in first and second twins [2], maternal obstetric characteristics as they related to pregnancy outcome [1], and finally investigated the possibility that the duration of gestation was related to fetal sex [6].

Because the numbers of twin deliveries at PWHMC were substantial in the decade after the hospital came into existence, a decision was made to focus future twin studies on data obtained solely from that institution. However, since delivery records from 1975 to 1977 had already been placed on microfilm, we elected to review twin deliveries from January 1, 1978 to June 30, 1983 as the initial effort in our "second generation" of twin studies.

MATERIALS AND METHODS

All deliveries were conducted by physicians at PWHMC. The patients of this hospital are of mixed ethnic and socioeconomic backgrounds and represent the numerous social groups who reside in the city. Because PWHMC is a regional perinatal center and is equipped to accept maternal transports by ambulance and helicopter, the patient population includes a large number of women who were referred for treatment of complications of multiple gestation such as toxemia, preterm labor and premature rupture of membranes. These patients contributed significantly to the high numbers of preterm deliveries, and their care was generally directed by the same group of specialists.

Data Collection and Processing

A list of all twin deliveries during the years under study was obtained from the medical record library of the Northwestern Memorial Hospital, the parent institution of PWHMC. A data collection instrument was prepared to capture maternal sociodemographic as well as antenatal, intrapartum and postpartum information. All maternal records were reviewed by two of the authors (RW and JLZ). Additionally, neonatal charts were reviewed if one of the following conditions was present: 1) birth weight discrepancy greater than or equal to 15% ([large − small]/small = % discrepancy); 2) antenatal and/or postnatal fetal demise; 3) cases in which the maternal record failed to provide information to explain the poor neonatal outcome. Problem maternal and neonatal cases were reviewed with the Head of the Section of Maternal-Fetal Medicine (RD).

In order to consider those pregnancies in which favorable outcome was possible or likely, cases were arbitrarily excluded from consideration if one of the following conditions was determined to be present: 1) antenatal fetal demise; 2) birth weight less than 500 g; and 3) gestational age determined to be less than 26 weeks. Completed data forms were given to the Perinatal Center staff for entering into the computer data bank. In some instances, records were incomplete and did not permit the coders to capture data for every requested question. As the patients had already been discharged from the hospital, on-site verification of missing data from the patient or her physician was not possible.

RESULTS

During the 5 1/2-year study period, a total of 21,423 deliveries were recorded. Two-hundred seventy-two women were delivered of twins for a rate of 12.8/1,000 deliveries or one woman delivered of twins for every 78 puerperal women. Twenty-one records with incomplete data were excluded from further analysis, leaving a study population of 251 mothers.

Mothers of Twins

Selected maternal demographic data are summarized in Table 1 (upper panel). Black and Hispanic mothers were significantly more likely to deliver their twins below the age of 25 (42.6% and 47.0%, respectively) than were their white counterparts (13.6%) ($P \leq 0.05$) (lower panel, Table 1). More than half (52.3%) of white women delivered after the age 30, compared to 22.7% of the black women and 35.1% of the Hispanic women, respectively ($P \leq 0.05$). These data may not reflect the relative racial frequency of multiple gestation because we have observed over the years that ovulation induction has been more common in our white population.

Table 1 - Maternal demographic characteristics

Characteristics	N	%
Age (yr)		
< 20	16	6.4
20–24	54	21.5
25–29	82	32.7
30–34	72	28.7
35–39	24	9.6
40+	3	1.2
Total	251	100.0
Race		
White	131	52.2
Black	74	29.5
Hispanic	36	14.3
Other	10	4.0
Total	251	100.0

Race by Age

Age (yr)	White		Black		Hispanic		Other	
	N	%	N	%	N	%	N	%
< 20	4	3.0	7	9.6	5	13.9	0	30.0
20–24	14	10.7	25	33.8	12	33.3	3	30.0
25–29	44	33.6	25	33.8	10	27.8	3	30.0
30–34	50	38.2	14	18.9	6	16.7	2	20.0
35–39	18	13.7	3	4.0	2	5.6	1	10.0
40+	1	0.8	0	0	1	2.8	1	10.0
Total	131		74		36		10	

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Maternal obstetric characteristics are summarized in Table 2. Ninety-two percent of the gravida had no prior deliveries. Almost three-quarters of deliveries occurred after 32 weeks of gestation, but only 40% were at term (at least 37 completed weeks from the last menstrual period). The large number of nulliparous women precluded observing any effect of parity on the length of gestation.

Table 2 – Maternal obstetric characteristics

Characteristic	N	%
Parity		
0	230	91.6
1–2	18	7.1
3–4	3	1.1
5+	0	0.0
Total	251	100.0
Weeks from LMP at Delivery		
< 24	6	2.6
24–28	22	8.7
29–32	39	15.1
33–36	82	32.6
37+	102	40.6
Total	251	100.0

Twin Infants

For each member of the twin pair, the sex and birth weights are shown in Table 3. Overall there were 256 males, 244 females and 2 infants whose sex was deemed ambiguous. The predominance of male over female births was apparent in the second twin. Sex ratios for twin 1 and for twin 2 are not significantly different. It was not possible to assess zygosity in this study because the individual practitioners who delivered these infants did not uniformly test the infants by acceptable methods.

The distribution of all birth weights in 500 g categories is shown in the middle panel of Table 3 for the first and second twins. A birth weight of less than 2,500 g was recorded for 62% of the firstborn and 61% of secondborn twins, respectively. The mean birth weight for the first twin (2,224 ± 700 g) is not significantly different from the mean for the second twin (2,230 ± 707 g).

In general, twin 2 had lower 1-minute Apgar scores (lower panel, Table 3) compared to twin 1, but these differences tended to minimize themselves by 5 minutes, at which time almost 90% of the twin 1 and twin 2 infants had an Apgar score of 7-10.

Table 4 is an analysis of Apgar scores by weight for twins 1 and 2, respectively. For both twins, low Apgar scores were more common in infants weighing less than 2,500 g.

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Table 3 – Infant characteristics by birth order

Characteristics	Twin 1		Twin 2	
	N	%	N	%
Sex				
Male	124	49.4	132	52.5
Female	126	50.1	118	47.5
Ambiguous	1	0.4	1	0.4
All	251	100.0	251	100.0
Weight (g)				
500–999	19	7.51	17	6.77
1000–1499	26	10.35	27	10.75
1500–1999	36	14.3	46	18.32
2000–2499	73	29.0	63	25.09
2500–2999	65	25.8	66	26.29
3000–3499	29	11.5	29	11.55
3500+	3	1.19	3	1.19
All	251	100.00	251	100.00
Apgar score				
1 minute				
0–3	29	11.5	53	21.1
4–6	39	15.5	61	24.3
7–10	183	72.9	137	54.5
All	251	100.0	251	100.0
5 minutes				
0–3	11	4.3	7	2.8
4–6	16	6.3	26	10.4
7–10	224	89.2	218	86.8
All	251	100.0	251	100.0

Low Apgar scores also were less common for twin 1 than twin 2. The frequency of low Apgar scores was reduced substantially in twin 1 and 2 by 5 minutes. This improvement was most marked in twin 2.

Delivery Parameters

Table 5 (upper panel) shows the method of delivery and the anesthesia for both twins. Spontaneous vaginal vertex delivery was twice as frequent for twin 1 compared to twin 2 (34.4% vs 17.1%) as was the use of low forceps (24.7% vs 11.5%). Vaginal breech deliveries were four times as frequent for twin 2 compared to twin 1 (26.2% vs 5.1%). General inhalation anesthesia was used almost twice as frequently for twin 2 compared to twin 1 (25.7% vs 14.6%). Placental weights and the outcomes of the use of oxytocin are listed in Table 6.

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Table 4 – Apgar scores by weight

Weight (g)	Twin 1			Twin 2		
	0–3	4–6	7–10	0–3	4–6	7–10
	1–minute Apgar score					
500–999	11	4	4	9	7	1
1000–1499	8	7	11	15	8	4
1500–1999	3	8	25	12	12	22
2000–2499	4	12	57	7	15	40
2500–2999	2	3	60	6	14	46
3000–3499	1	4	24	4	4	21
3500+	0	1	2	0	1	2
All	29	39	183	53	61	137
	5–minute Apgar score					
500–999	4	7	8	2	5	10
1000–1499	3	3	20	1	9	17
1500–1999	1	3	32	2	5	39
2000–2499	0	3	70	0	3	59
2500–2999	2	0	63	0	1	65
3000–3499	1	0	28	1	4	24
3500+	0	0	3	0	0	3
All	11	16	224	6	27	218

Table 5 – Delivery parameters

Characteristics	Twin 1		Twin 2	
	N	%	N	%
Method of delivery				
Spontaneous vaginal	87	34.6	43	17.1
Low forceps	62	24.7	29	11.5
Mid-forceps	10	3.9	16	6.3
Breech (vaginal)	13	5.1	66	26.2
C-section	63	25.0	73	29.0
Version	0	0	6	2.4
Not stated	16	6.3	18	7.1
All	251	100.0	251	100.0
Anesthesia				
None	11	4.3	6	2.4
Epidural	97	38.6	71	28.3
General	37	14.7	65	25.9
Local/pudental	101	40.2	101	40.2
Paracervical	0	0	1	0.4
Spinal	3	1.2	4	1.6
Other	2	0.8	3	1.2
All	251	100.0	251	100.0

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Table 6 – Selected intrapartum/postpartum characteristics

Oxytocin		
None	154	61.4
Augmentation	83	33.1
Induction success	9	3.6
Induction, failed	2	0.8
Not stated	3	1.2
All	251	100.00
Placental weight (g)		
< 500	64	25.5
500–749	55	21.9
750–999	74	29.5
1000–1249	37	14.7
1250–1499	11	4.4
1500+	10	4.0
All	251	100.0

Risk Factors in Pregnancy Loss

The relationship between selected demographic and obstetric factors for women who suffered neonatal death (death of one or both twins after birth) is shown in Table 7. The

Table 7 – Risk of neonatal death by selected maternal characteristics

		Women with pregnancy loss	
	Total women	N	Rate/1000
Age (gr)			
10–19	16	0	0
20–24	54	3	55.6
25–29	84	6	71.4
30–34	72	8	111.1
35–39	24	1	41.6
40+	3	0	0
Parity			
0	232	17	73.2
1–2	18	1	55.5
3–4	3	0	0
5+	0	0	0
Week from LMP			
< 24	7	1	142.8
24–28	23	8	347.8
29–32	39	2	51.2
33–36	82	3	36.5
37+	102	4	39.2

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uncorrected neonatal death rate in the right-hand column is calculated as: neonatal deaths/number of live births × 100. The neonatal death rate increased progressively with maternal age until the middle of the fourth decade when it declined to a level below that seen in women in the first half of the third decade. The pregnancy loss rate was highest among nulliparous twin mothers and declined for primi- and secundiparas.

The relationship of neonatal deaths to gestational age is documented in the third panel of Table 7. The loss rate per 100 women decreased progressively with increasing gestational age. In fact, after the 29th week of gestation one or both infants survived the birth and neonatal period in more than 95% of cases.

Since birth-weight related mortality is less subjective than mortality related to gestational age, twin-specific mortality rates by weight have been calculed and are shown in Table 8. For the weight categories below 1,500 g, 250 g increments were chosen in order to more clearly study the earliest potentially viable gestations. Clear differences between twin 1 and 2 are not seen. In contrast to prior studies from this and other institutions, twin 2 did not have a less favorable outcome.

Table 8 – Twin specific mortality by birth weight

	Twin 1			Twin 2		
		Deaths			Deaths	
Weight (g)	Total infants	N	Rate/1000	Total infants	N	Rate/1000
500–749	3	3	100.00	3	0	0
750–999	16	1	6.25	14	1	7.1
1000–1249	12	3	25.00	8	0	0
1250–1499	14	1	7.14	19	1	5.2
1500–1999	36	1	2.7	46	1	2.2
2000–2499	73	0	0	62	0	0
2500–2999	65	2	3.1	66	0	0
3000–3499	29	1	3.5	29	1	3.5
3500+	3	0	0	4	0	0
All	251	12		251	4	

DISCUSSION

The patient population described in this paper comprises two groups: those of the staff physicians and those referred for care. This latter group can be further subdivided into women who received part or all of their prenatal care at PWHMC and those brought in by helicopter or ambulance in the third trimester of pregnancy for treatment of specific complications of multiple gestation. Thus, the rate of twin deliveries of 12.8/1,000 or one woman delivered of twins for every 78 puerpera is artificial. Although precisely comparable data from an earlier time period does not exist, this figure represents a 70% increase in rate of twin deliveries described in hospitals which referred to PWHMC during the period immediately preceding this study [5].

There are at least two major effects of serving a substantial population of referred patients. The first is that outcome results are biased by the addition of substantial numbers of patients with preterm labor who subsequently deliver preterm infants. In this study, 60% of patients fell into this category, whereas in prior years [5] more than 60% of mothers delivered at 37 or more weeks of gestation and only approximately 50% of the infants weighed less than 2,500 g. Perhaps more importantly, the percentage of infants weighing less than 1,500 g almost doubled from ~ 10% in our earlier study [5] to almost 18% at present.

The second effect relates to the cost of providing care to large numbers of preterm infants. Although our mortality rate was laudable in infants weighing > 1,500 g at birth and acceptable in the weight categories below this, survival was not without the expenditure of vast amounts of health-care dollars. During the years under study the average cost per day in the neonatal intensive care unit for hospital care, medications and medical staff ranged from $ 900 to $ 1,000. The average length of stay in all weight categories is 21 days and the range of stay for infants below 1,500 g is 45-60 days. In many instances, the infants requiring these extended stays were born to young, unmarried mothers who did not have insurance to fund their care. In other instances, insurance coverage was insufficient to reimburse the hospital for the true extent of the incurred costs and the hospital and the state of Illinois had to bear this burden.

Reasonably, there are two conclusions that can be drawn from these limited data. The first is to support the contention of Papiernick and coworkers [7,8] that programs that reduce the incidence of preterm delivery are worthwhile and cost-effective. The second is to inform hospital planners, budget directors and administrators of the potentially staggering outlays required to support referral perinatal centers which care for multiple pregnancies. Although the present study was not designed or executed as a cost analysis comparing singleton and multiple birth costs, the experience at our hospital is instructive, to say the least.

One of the major findings of this study relates to gestational age. Unfortunately, this assessment frequently is associated with subjectivity and bias. In this study, several parameters were used to assess gestational age: 1) LMP, 2) weeks of gestation from LMP, and 3) ultrasound. Although independent pediatric examination frequently was performed using the Dubowitz assessment scale, results of these examinations were not consistently available at the time of our record analysis. Even when used regularly, however, the Dubowitz scale may insert its own bias by suggesting that the heavier twin has a greater gestational age than the lighter twin [3].

Although a substantial portion of the maternities in our study were conducted according to protocol previously published from our institution [4], the large number of referred patients did not permit us to study aspects such as the frequency and type of bed rest or smoking and drug use, both of which have a negative impact on pregnancy duration and birth weight.

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