Influence of mode of delivery on neonatal mortality in second twins at and before term

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Running title: Lower mortality after caesarean in preterm twins

ABSTRACT

Objective: To study the association between mode of delivery and neonatal mortality in second twins. To study the association between caesarean delivery and mortality with minimum bias of the indication for the operation, we wanted to compare the outcome of second twins delivered by caesarean due to breech presentation of the sibling with vaginally delivered second twins in uncomplicated pregnancies.

Methods: Twins born 1980-2004 were identified from the Swedish Medical Birth Registry. Twin pairs delivered by caesarean due to breech presentation of the first twin, and vaginally delivered twins with the first twin in cephalic presentation were included. Pregnancies with antepartum complications were excluded. Odds ratios (OR) and 95 % confidence intervals (CI) were calculated using multiple logistic regression analyses, adjusting for year of birth, maternal age, parity and gestational age.

Results: Compared to second born twins delivered vaginally, second born twins delivered by caesarean (for breech presentation of the sibling) had a lower risk of neonatal death (adjusted OR 0.40; 95% CI 0.19 - 0.83). The decreased risk after caesarean delivery was significant for births before 34 weeks (2.1% *versus* 9.0%; adjusted OR 0.40; 95% CI 0.17 - 0.95). After 34 weeks, neonatal mortality was low in both groups (0.1% and 0.2%, respectively), and the difference was not statistically significant (adjusted OR 0.42; 95% CI 0.10 - 1.79).

Conclusion: Neonatal mortality is lower for the second twin after caesarean delivery at birth before 34 weeks. At term, mortality is low irrespective of delivery mode.

Key-words: twin, mode of delivery, caesarean, neonatal mortality

INTRODUCTION

The question of whether all twin pregnancies should be delivered by caesarean section was raised in a recent editorial,[1] prompted by a study of intrapartum and neonatal deaths of twins in Britain 1994-2003.[2] In that study by Smith and co-workers, the risk of death due to intrapartum anoxia or trauma for the term second twin compared with the first was fourfold at vaginal delivery and twofold at caesarean delivery.[2] In a previous report from Scotland 1985-2001, the risk of intrapartum or neonatal death was fivefold for the second twin compared with the first at vaginal birth, whereas no association was found between birth order and mortality after planned caesarean section.[3] A higher risk of intrapartum complications for the second twin may be anticipated, since malpresentation, cord prolapse, abruption, and hypoxia is more likely to occur at delivery of the second twin, and since monitoring of the second twin may be more difficult. Thus, fetal distress and low Apgar scores are more frequent in second twins.[4,5] However, another large registry study of twin births in the United States 1995-97 showed no difference in neonatal mortality between first and second twins.[6] The authors suggested that the reported higher mortality in second twins is an artefact, since a dead twin fetus is more likely to be delivered last.

An international randomised trial is ongoing, in an attempt to determine the ideal mode of delivery for term twins. Since the publication of the "Term breech trial", [7] the debate about the ideal mode of delivery for breech pregnancies has continued for years,[8] and in our country a national retrospective study was called for, to address whether the result was applicable to our conditions.[9] A similar debate about the ideal mode of delivery for twins may be expected, and we considered that a retrospective analysis of our national data of neonatal mortality in twin deliveries according to mode of delivery might inform this debate. In addition, we were

interested in the outcome of preterm twin deliveries, for which a randomised controlled trial is unlikely ever to be performed.

The purpose of this study was to examine the association between mode of delivery and neonatal mortality in term and preterm twin pregnancies, particularly for second born twins. In Sweden today, about half of twin pregnancies are delivered by caesarean section. If the first twin is in cephalic presentation, caesarean delivery is usually restricted to complicated or high risk pregnancies. When the first twin presents by the breech, caesarean delivery is generally recommended. This difference in policy according to presentation of the first twin provided the opportunity to evaluate the outcome of the second twin in pregnancies without significant ante-partum complications delivered by caesarean section (for breech presentation of the first twin) compared with those delivered vaginally (first twin cephalic in otherwise uncomplicated pregnancy).

MATERIAL AND METHODS

Twins born in 1980-2004 were identified from the National Board of Health Medical Birth Registry (MBR).[9] The MBR contains medical information on nearly all deliveries in Sweden (coverage about 99%).[10] Standardised record forms are used at all antenatal clinics, all delivery units, and at all paediatric examinations of new-born infants in the maternity ward. Copies of these forms are sent to the National Board of Health and Welfare where they are computerised. Diagnoses are recorded as ICD-codes (before 1987: ICD8, 1987-1996: ICD9, and 1997 and onwards: ICD10).

Two groups of twin pairs were selected and included in the study. Group A: Twin pairs with the first twin in breech presentation, delivered by caesarean section. Group B: Vaginally delivered

twin pairs with the first twin in cephalic presentation. Twin pairs were excluded if the mother or any of the twins was assigned a diagnosis suggesting any ante-partum pathology (ICD diagnoses according to ICD-8; ICD 9; and ICD 10): congenital malformations (655, 740-59; 655, 740-59; O35, Q), immunization or hydrops (634.1-3,9; 656.0-2; O36.0-2), intrauterine growth retardation (- ; 656F; O36.5), chorioamnionitis, maternal infection or fever (- ; 658.4, 659.2,3; O41), antepartum bleeding or placenta praevia (632; 641.0-9; O44, O46), preeclampsia or eclampsia (637; 642.4-7; O14-15), diabetes (250; 648.0; O24), twin-to-twin transfusion syndrome (- ; - ; O43.0), or intrauterine fetal death.

Odds ratios (OR) and 95 % confidence intervals (CI) for Apgar score at 5 minutes <7 or neonatal death, respectively, were calculated using multiple logistic regression analyses (Gauss^{TM}, Aptech Systems Inc., Maple Valley, WA, USA, http://www.aptech.com). If not stated otherwise it was adjusted for year of birth (continuous variable), maternal age (five-year-steps), primiparity (yes/no), and gestational week (continuous variable). When numbers were small, the number of variables entered in the multivariate analyses was restricted, or a Fisher exact test was performed, as specified.

Sub-analyses of outcome were made for twin deliveries before and after 34 completed gestational weeks, since from a clinical view, intrapartum problems due to preterm delivery were mainly considered to be of importance before 34 completed weeks. Elective caesarean deliveries are not performed before 34 weeks. Therefore, the group of caesarean deliveries due to breech presentation of the first twin (Group A) in this period consisted of pregnancies with preterm labour or rupture of the membranes. Likewise, before 34 weeks, Group B only included women with spontaneous preterm labour.

RESULTS

Table 1 shows the number of twin pairs by presentation of the first twin and mode of delivery, and occurrence of reported ante-partum pathology. Ante-partum pathology was reported in 24% of all twin pregnancies. In 14% of the remaining eligible twin pairs, the first twin was in breech presentation, and among these, 82% were delivered by caesarean section (study group A). In 86% of eligible twin pairs, the first twin was in cephalic presentation, of which 68% were vaginally delivered (study group B). The demographic characteristics for the two study groups and for non-included twin pairs without ante-partum pathology are shown in Table 2. Compared to twin pairs in study Group B, twin pairs in study Group A were more often born towards the end of the study period, were more often born to primiparous and slightly older women, and had slightly lower gestational age at birth. Thus, year of birth, maternal age, primiparity, and gestational age were considered as possible confounders and were controlled for in the multivariate analyses.

The neonatal outcome in the two study groups is shown in Table 3. Second born twins in Group A (first twin in breech presentation, caesarean section) was at significantly lower risk of having an Apgar score below 7 at five minutes ($p<0.001$) or neonatal death ($p=0.014$) compared to second born twins in group B (first twin in cephalic presentation, vaginal delivery). The risk reductions were of the same magnitude among infants born before and after 34 completed gestational weeks, but since the absolute mortality was low after 34 weeks (0.1% and 0.2%, in Group A and B, respectively), the difference in mortality was only significant before 34 weeks.

For first born twins, there were no significant differences in mortality or low Apgar scores between the two study groups.

Table 4 shows neonatal outcome data for non-included twin pairs, after the exclusion of those with antepartum pathology. The left column ("exclusion I") includes twin pairs delivered by elective or emergency caesarean section for all other indications than breech presentation of the first twin. It should be noted that these deliveries include emergency caesarean sections due to intrapartum complications. The right column ("exclusion II") includes vaginally delivered twin pairs with the first twin in breech presentation.

DISCUSSION

This study showed a difference in neonatal mortality in second twins born after caesarean delivery where the indication was breech presentation of the first twin compared with second twins from uncomplicated pregnancies born vaginally where their co-twin was a cephalic presentation. The difference, a reduction, was statistically significant only for deliveries before 34 completed weeks. The similar reduction in the rate of low Apgar scores was significant for deliveries before as well as after 34 completed weeks.

We cannot definitively conclude that the lower mortality after caesarean delivery is a causal relationship. The analyses of outcome were adjusted for gestational age, maternal age and parity, and year of birth. In order to minimize bias, we excluded pregnancies in which the mother or any of the twins had been given a diagnosis suggesting ante-partum pathology: Fetal malformations, immunization, hydrops, intrauterine growth retardation, chorioamnionitis, maternal infection or fever, antepartum bleeding, placenta praevia, preeclampsia, diabetes, or twin-to-twin transfusion syndrome. However, there may have been complications during pregnancy not clearly identified or coded. In the presence of such complications it would have been more likely that birth would be by caesarean section. If so, and twin number one was in

cephalic presentation, the twin-pair would not have been included in either of the study groups, but may be in exclusion group 1. If, on the other hand, the first twin was a breech presentation, the complicated case would have been included in the caesarean group (study group A). Therefore, unknown or uncoded complications would tend to underestimate risk differences.

There were more registered twin pairs where the first twin was a breech presentation during the latter part of the study period (1990-2004). This was due to incomplete information about breech presentation during 1980-89, since until then breech presentation was only registered as an ICD-diagnosis. From 1990 and onwards, the presentation was also registered in a compulsory check-box. Therefore, the information about cephalic presentation was more reliable from 1990 and onwards, as before then, non-registered breech presentations may have been recorded as cephalic presentations. Such an error would also lead to an underestimate of risk differences between the study groups.

Other potential sources of under-estimation of the mortality at (planned) vaginal delivery may be that planned vaginal deliveries ending in emergency caesarean section were not included in the vaginal delivery group. We only studied neonatal mortality and not intrapartum deaths. We did not include intrauterine deaths because registry data on the timing of intrauterine death was not reliable.

The results are in agreement with a report of twin deliveries in the United States 1995-97.[12] In that cohort, the neonatal mortality for the second twin at preterm birth was significantly higher after vaginal than after caesarean delivery (OR 1.8; 1.6-2.1), and at term birth no significant difference was found, when complications were adjusted for and congenital malformations excluded.[12] A higher rate of morbidity and mortality for preterm twins delivered vaginally (significant for those below 750 g) was also reported by Zhang et al., who studied 4428 live-born twin pairs in North Carolina.[13] In a recent Canadian study, no perinatal death occurred in

876 term twin births (prelabour deaths excluded) of which 79% were planned as vaginal deliveries.[14] Although the present study was considerably larger, no significant difference in mortality for term (or near-term) twins was found despite a risk reduction similar to preterm pregnancies, since the absolute mortality was low.

Although it was not the aim of this study to compare the outcome of the first and second twins, an interesting finding was that neonatal mortality was very similar for the first (0.9%) and second twin (1.1%) in the group with vaginal deliveries; before 34 weeks (8.0% and 9.0%, respectively), as well as after 34 weeks (0.2% for both twins). This finding is at partly odds with British studies, reporting four to fivefold risks of intrapartum or neonatal death due to intrapartum anoxia or trauma for the vaginally delivered term second twin compared with the first twin.[2,3] However, our material mainly included low risk labours, since pregnancies with diagnoses of complications (or risk factors such as IUGR) were excluded, and the results are therefore not necessarily at odds.. It may be that although the second twin is at increased risk, mortality is minimal in selected low risk pregnancies, even at vaginal delivery. However, the rate of low Apgar scores at 5 minutes was significantly higher for second twins (3.5%) than for first twins (1.9%) at vaginal birth even in these low risk pregnancies.

In conclusion, the present results support that before 34 weeks, caesarean delivery may be associated with a better chance of neonatal survival in otherwise uncomplicated twin pregnancies. However, as for preterm singleton breech delivery, it must be emphasised that a caesarean section performed merely due to preterm labour in a twin pregnancy may do more harm than good if the diagnosis of inevitable delivery is incorrect.[15]

Based on the present results, we cannot rule out that mortality may be lower after caesarean delivery also after 34 weeks. A similar association at term might even be likely, considering the similar OR as before 34 weeks, and the significantly lower risk of low Apgar scores after

caesarean, also after 34 weeks. However, since the absolute mortality was low at this gestational age, the difference in odds ratios was not statistically significant. As the study included 14,352 twin deliveries after 34 weeks, a conclusion may be that there is no clinically relevant difference in neonatal mortality due to mode of delivery after 34 weeks.

CONCLUSION

Neonatal mortality was lower after caesarean delivery of twins before 34 completed gestational weeks, whereas mortality was low in uncomplicated term twin pregnancies irrespective mode of delivery.

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CONTRIBUTION TO AUTHORSHIP

Andreas Herbst and Karin Källén designed the study. Karin Källén analysed the data. Both authors wrote different parts of the manuscript.

DETAILS OF ETHICS APPROVAL

The study was approved by the Regional Ethical Board at Lund University.

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Table 1. Numbers of twin-pairs by mode of delivery and presentation of the first twin, and presence of ante-partum pathology.

Presentation of the first twin and mode of delivery (n=total pairs)	No ante-partum pathology reported for any twin	
	n	(%)
Vertex, vaginal delivery (16,528)	13,353	(80.8)
Vertex, cesarean section (9,215)	6,349	(68.9)
Breech, vaginal delivery (729)	598	(82.0)
Breech, cesarean section (3,575)	2,638	(73.8)
Total twin pairs (30,047)	22,938	(76.3)

Table 2. Demographic characteristics for the two study groups and the two groups of twins not included in the study. Group A consists of twin pairs with the first twin in breech presentation, delivered by caesarean section. Group B consists of vaginally delivered twin pairs with the first twin in cephalic presentation. Exclusion group I consists of twin pairs with the first twin in vertex presentation delivered by caesarean section, i.e. elective and emergency caesarean deliveries for any other indication than breech presentation of the first twin. Exclusion group II is vaginally delivered twin pairs with the first twin in breech presentation. Pregnancies with reported ante-partum pathology for any twin were excluded.

	Group A Breech presentation, Caesarean section N=2638		**Group B** Vertex presentation, vaginal birth N=13 353		**Exclusion I** Vertex presentation Caesarean section* N=6349		**Exclusion II** Breech presentation vaginal birth N=598	
	n	(%)	n	(%)	n	(%)	n	(%)
Year of birth								
1980-84	43	(1.6)	2036	(15.2)	1285	(20.2)	52	(8.7)
1985-89	108	(4.1)	2525	(18.9)	1474	(23.2)	56	(9.4)
1990-94	761	(28.8)	3460	(25.9)	1139	(17.9)	233	(39.0)
1995-99	806	(30.6)	2855	(21.4)	1120	(17.6)	190	(31.8)
2000-04	920	(34.9)	2477	(18.6)	1331	(21.0)	67	(11.2)
Maternal age								
<20	23	(0.9)	169	(1.3)	82	(1.3)	5	(0.8)
20-24	266	(10.1)	1841	(13.8)	804	(12.7)	81	(13.5)
25-29	849	(32.2)	4564	(34.2)	1954	(30.8)	214	(35.8)
30-34	947	(35.9)	4458	(33.4)	2211	(34.8)	193	(32.3)
35-39	484	(18.3)	2078	(15.6)	1125	(17.7)	95	(15.9)
40+	69	(2.6)	243	(1.8)	173	(2.7)	10	(1.7)
Parity								
1	1231	(46.7)	4864	(36.4)	3071	(48.4)	199	(33.3)
2	919	(34.8)	5198	(38.9)	2074	(32.7)	212	(35.5)
3	322	(12.2)	2306	(17.3)	876	(13.8)	109	(18.2)
4+	166	(6.3)	985	(7.4)	328	(5.2)	78	(13.0)
Gestational age								
<28v	32	(1.2)	193	(1.4)	90	(1.4)	25	(4.2)
28-31v	121	(4.6)	362	(2.7)	410	(6.5)	16	(2.7)
32-33v	182	(6.9)	749	(5.6)	492	(7.7)	34	(5.7)
34-36v	724	(27.4)	3677	(27.5)	1658	(26.1)	172	(28.8)
37v	731	(27.7)	2347	(17.6)	1404	(22.1)	99	(16.6)
38v	618	(23.4)	2680	(20.1)	1257	(19.8)	110	(18.4)
39v	154	(5.8)	2040	(15.3)	594	(9.4)	92	(15.4)
40v+	76	(2.9)	1305	(9.8)	444	(7.0)	50	(8.4)

* Planned or emergency caesarean sections for any other indication than breech presentation of the first twin

Table 3. Neonatal outcome for first and second born twins, by presentation of the first twin and delivery mode. Pregnancies for which any ante-partum pathology was reported for any twin were excluded. If not stated otherwise, OR with 95% CI were obtained after multiple logistic regression analyses, adjusting for year of birth, maternal age, primiparity, and gestational age.

Deleted: of the first twin

	Presentation of the first twin and mode of delivery				
	Group A Breech presentation, caesarean section		**Group B** Vertex presentation, vaginal birth		
	n	(%)	n	(%)	OR (95%CI)
Total twin pairs, n	**2638**	**(100)**	**13353**	**(100)**	
First twin					
Apgar score 5´ <7	46	(1.7)	250	(1.9)	0.91 (0.65 - 1.27)
Neonatal death	12	(0.5)	125	(0.9)	0.65 (0.34 - 1.26)
Second twin					
Apgar score 5´ <7	49	(1.9)	470	(3.5)	0.48 (0.35 - 0.65)
Neonatal death	9	(0.3)	142	(1.1)	0.40 (0.19 - 0.83)
<34 weeks, n	**335**	**(100)**	**1304**	**(100)**	
First twin					
Apgar score 5´ <7	20	(6.0)	112	(8.6)	0.86 (0.50 - 1.48)
Neonatal death	12	(3.6)	105	(8.0)	0.91 (0.45 - 1.84)
Second twin					
Apgar score 5´ <7	18	(5.4)	159	(2.2)	0.46 (0.27 - 0.79)
Neonatal death	7	(2.1)	117	(9.0)	0.40 (0.17 - 0.95)
≥34 weeks, n	**2303**	**(100)**	**12049**	**(100)**	
First twin					
Apgar score 5´ <7	26	(1.1)	138	(1.2)	0.99 (0.64 - 1.53)
Neonatal death	0	(-)	20	(0.2)	(p-value: 0.06)[a]
Second twin					
Apgar score 5´ <7	31	(1.4)	311	(2.6)	0.50 (0.34 - 0.73)
Neonatal death	2	(0.1)	25	(0.2)	0.42 (0.10 - 1.79)[b]

[a] Fisher exact test

[b] Due to small numbers, OR obtained from multiple logistic regression analysis controlling only for gestational age.

Table 4

Perinatal outcome among twin pairs not included in the study. Incidence of low Apgar score and mortality for twin one and two, respectively, by presentation and delivery mode of twin number one. Pregnancies for which any ante-partum pathology was reported for any twin were excluded.

Presentation of the first twin and mode of delivery				
	Exclusion I Vertex presentation, caesarean section*		**Exclusion II** Breech presentation, vaginal birth	
	n	(%)	n	(%)
Total, n	**6 349**	**(100)**	**598**	**(100)**
First twin				
Apgar score 5´ <7	229	(3.6)	28	(4.7)
Neonatal death	71	(1.1)	19	(3.2)
Second twin				
Apgar score 5´ <7	252	(4.0)	27	(4.5)
Neonatal death	85	(1.3)	18	(3.0)
<34 weeks, n	**992**	**(100)**	**75**	**(100)**
First twin				
Apgar score 5´ <7	119	(12.0)	16	(21.3)
Neonatal death	61	(6.2)	19	(25.3)
Second twin				
Apgar score 5´ <7	126	(12.7)	12	(16.0)
Neonatal death	72	(7.3)	16	(21.3)
≥34 weeks, n	**5357**	**(100)**	**523**	**(100)**
First twin				
Apgar score 5´ <7	110	(2.0)	12	(2.3)
Neonatal death	10	(0.2)	0	(-)
Second twin				
Apgar score 5´ <7	126	(2.4)	15	(2.9)
Neonatal death	13	(0.2)	2	(0.4)

* Planned or emergency caesarean sections for any other indication than breech presentation of the first twin