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Trends in Caesarean section rates for twin pregnancies: a 20-year cohort study

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Objective: To evaluate trends in Caesarean section (CS) rates for twin pregnancies over 20 years in a regional obstetric unit in Hong Kong.
Methods: Data on twin deliveries between 1998 and 2017 at United Christian Hospital were collected. CS rates were calculated for each calendar year, and data were stratified into four 5-year intervals to determine trends. Twins delivered vaginally or by CS were compared in terms of maternal epidemiological risk factors, pregnancy characteristics, and pregnancy outcome. A logistic regression model was used to determine significant risk factors associated with CS.
Results: From 1998 to 2017, 1083 (1.24%) of 87 480 deliveries were twin deliveries. The total CS rate for twins progressively increased from 58.9% in 1998-2002 to 84.1% in 2013-2017, particularly the CS rate for cephalic + cephalic twins from 41.7% in 1998-2002 to 74.7% in 2013-2017. The CS rate for non-cephalic first twin was close to 100% for all intervals. Logistic regression analysis showed that CS was positively associated with non-cephalic presentation of the first twin (odds ratio [OR]=13.1), previous CS (OR=4.19), and advanced maternal age (OR=1.7) and negatively associated with preterm delivery (OR=0.34), multiparity (OR=0.29), and induction of labour (OR=0.086). For perinatal outcome, CS was significantly associated with higher mean birthweight, lower incidence of adverse perinatal or neonatal outcome but higher risks of postpartum haemorrhage.
Conclusion: A progressive increase in CS rates for twins was observed over the past 20 years, particularly among cephalic-presenting twins, despite the lack of clear evidence on the preferred mode of delivery for such twin pregnancies.

Keywords: Caesarean section; Delivery, obstetric; Pregnancy, twins

Introduction

Twins account for 1% to 3% of all births[1-3]. There has been contradicting evidence concerning planned Caesarean section (CS) versus planned vaginal delivery (VD) for twin pregnancies. A retrospective cohort study in 2005 reported that CS reduced the risks of adverse perinatal outcome compared with VD[4]. However, the randomised controlled Twin Birth Study in 2013 reported no significant differences between CS and VD in neonatal morbidities or mortalities, particularly with the first twin being cephalic in presentation[5]. Based on such data, the 2014 American College of Obstetricians and Gynecologists guidelines on prevention of primary CS stated that women with cephalic-presenting twins should be counselled to attempt VD[6].

Although there remains no consensus on the optimal mode of twin delivery, the CS rates for twins have increased dramatically in many centres[7]. In an epidemiological study of trends in CS rates in a regional obstetric unit in Hong Kong from 1995 to 2014, the CS rate for multiple pregnancies increased from 48% in early years to 84% in later years, and among different Robson categories, ranked highest in the absolute percentage increase in CS rates[8].

This study aimed to review the trends of CS rates between 1998 and 2017 in a regional obstetric unit in Hong Kong, and to identify any associated risk factors for CS delivery in twin pregnancies.

Methods

This study was approved by the Kowloon Central/ Kowloon East Cluster Research Ethics Committee. Multiple deliveries at United Christian Hospital between 1998 and 2017 were identified from the Clinical Information System. Triplets or higher-order multiples were excluded. The CS and VD groups were compared in terms of maternal epidemiological risk factors (maternal age, parity, and induction of labour), pregnancy characteristics (presentation of the first and second twins, gestation, and mode of delivery), and pregnancy outcome parameters (birthweight, 5-minute Apgar score, and stillbirth or neonatal death). CS rates were calculated for each year to

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Table 1. Presentation of twins and mode of delivery

Presentation	No. (%) of cases		
	Vaginal delivery of both twins (n=227)	Caesarean section of both twins (n=839)	Combined delivery (vaginal delivery of first twin followed by Caesarean section of second twin) [n=17]
Cephalic + Cephalic	177 (31.9)	373 (67.2)	5 (0.9)
Cephalic + Breech	41 (16)	212 (83.1)	2 (0.8)
Cephalic + transverse/oblique	3 (4.5)	54 (80.5)	10 (15)
Breech + cephalic	5 (5.5)	85 (94.5)	0
Breech + transverse/oblique	1 (1)	92 (99)	0
Transverse/oblique + transverse/oblique	0	23 (100)	0

determine trends. The number of twin deliveries in different presentations was stratified into four 5-year intervals (1998-2002, 2003-2007, 2008-2012, and 2013-2017), and the four intervals were compared using a 4 × 2 contingency table using Mantel-Haenszel Chi square tests for linear trends. A logistic regression model was used to determine significant risk factors associated with twin delivery by CS. A p value of <0.05 was considered statistically significant.

Results

Among 87 480 deliveries from 1998 to 2017, 1083 (1.24%) were twin deliveries (2166 babies). Thirteen triplet deliveries were excluded. No maternal death concerning twin deliveries was recorded. Of the 1083 twin deliveries, 227 (21.0%) were by VD for both twins, 839 (77.4%) were by CS for both twins, and 17 (1.6%) were by VD for the first twin followed by CS for the second twin (combined delivery).

The first twin was cephalic presenting in 80.9% of the deliveries (Table 1). CS was performed in 67.2% of cephalic + cephalic twins, 83.1% of cephalic + breech twins, 80.5% of cephalic + transverse/oblique twins, 94.5% of breech + cephalic twins, and 99% of breech + transverse/oblique twins, and 100% (n=23) of transverse/oblique + transverse/oblique twins.

There was a progressive increase in total CS rates for twins, including cephalic + cephalic twins and cephalic + non-vertex twins (Figure). The CS rate for non-vertex first twin was close to 100% for all intervals. The CS rates increased significantly (p<0.001) for all presentations in total, with the greatest increase in cephalic + cephalic twins from 41.7% in 1998-2002 to 78% in 2008-2012 and to 74.7% in 2013-2017 (Table 2).

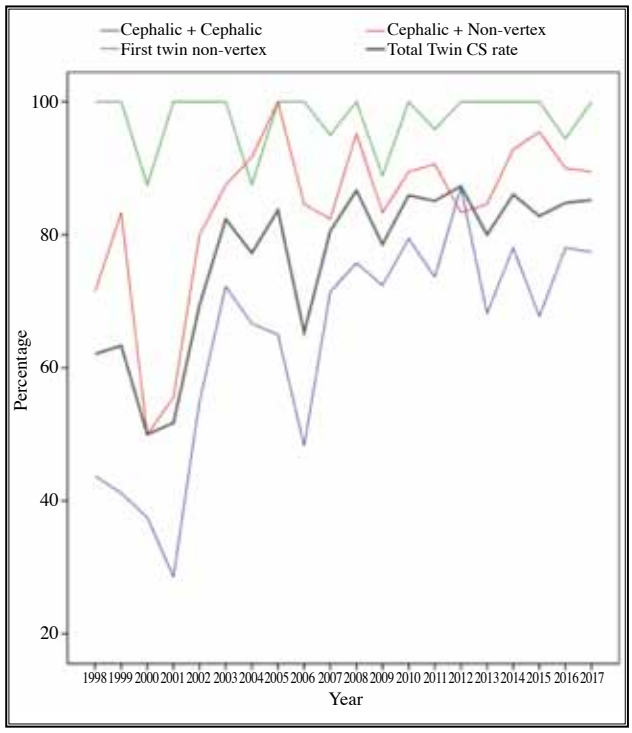

Figure. Total and different Caesarean section (CS) rates for twins with different presentations

Compared with the VD group, the CS group included more women with advanced maternal age (27.7% vs 38%, p=0.004), primiparity (42.3% vs 62.8%, p<0.001), gestational diabetes mellitus (9.25% vs 14.6%, p=0.038), and previous CS (6.6% vs 12.4%, p=0.013) [Table 3]. On the contrary, lower CS rates were associated with multiparity (57.7% vs 37.2%, p<0.001), preterm delivery <37 weeks (55% vs 41.3%, p<0.001), preterm delivery <32 weeks (16.7% vs 6.79%, p<0.001), and induction of labour (17.1% vs 1.8%, p<0.001) [Table 3]. In a logistic regression model, CS was positively associated with non-vertex presentation of first twin (odds ratio [OR]=13.1, p<0.001),

Table 2. Trends in the Caesarean section rate in different presentations

Presentation	Caesarean section rate, no. (%) of cases				p Value
	1998-2002 (n=168)	2003-2007 (n=242)	2008-2012 (n=345)	2013-2017 (n=328)	
Cephalic + cephalic	38/91 (41.7)	81/126 (64.3)	135/173 (78)	124/166 (74.7)	<0.001
Cephalic + non-vertex	29/44 (65.9)	55/62 (88.7)	101/114 (88.6)	93/102 (91.1)	<0.001
First twin non-vertex	32/33 (96.9)	52/54 (96.3)	57/59 (96.6)	59/60 (98.3)	0.91
Total	**99 (58.9)**	**188 (77.7)**	**293 (84.9)**	**276 (84.1)**	**<0.001**

Table 3. Comparison of pregnancy characteristics between vaginal delivery and Caesarean section groups

Characteristic	Vaginal delivery (n=227)*	Caesarean section for one or both twins (n=856)*	p Value
Maternal age, y	30.9±5.55	32.5±5.15	<0.001; mean difference= –1.59 (–2.36 to –0.82)
Advanced maternal age	63 (27.7)	326 (38)	0.004
Parity			<0.001
Primiparous	96 (42.3)	538 (62.8)	
Multiparous	131 (57.7)	318 (37.2)	
Gestation at delivery, weeks	35±4.03	36.1±2.5	<0.001; mean difference= –1.08 (–1.50 to –0.66)
Preterm delivery <37 weeks	125 (55)	354 (41.3)	<0.001
Preterm delivery <32 weeks	38 (16.7)	57 (6.79)	<0.001
Preterm delivery <28 weeks	17 (7.49)	6 (0.7)	<0.001
Gestational diabetes mellitus	21 (9.25)	125 (14.6)	0.038
Gestational hypertension/preeclampsia	19 (8.37)	104 (12.1)	0.13
Previous Caesarean section	15 (6.6)	106 (12.4)	0.013
Induction of labour	39 (17.1)	16 (1.8)	<0.001
Antepartum haemorrhage			0.075
Unknown origin	8 (3.5)	22 (2.57)	
Placenta abruption	0	15 (1.75)	
Placenta praevia	0	7 (0.82)	

* Data are presented as mean ± standard deviation or no. (%) of cases

previous CS (OR=4.19, p<0.001), and advanced maternal age (OR=1.7, p=0.005), whereas CS was negatively associated with preterm delivery (OR=0.34, p=0.001), multiparity (OR=0.29, p=0.001), and induction of labour (OR=0.086, p=0.001) [Table 4]. Gestational diabetes mellitus (OR=1.45, p=0.17) and gestational hypertension (OR=1.72, p=0.07) were not significant risk factors and thus excluded from the final equation.

For pregnancy outcome, compared with VD, CS was associated with higher mean birthweight (2193 g vs 2408 g, p<0.001), but the two groups did not differ significantly in mean birthweight of term babies (≥37 weeks) or the rate of fetal growth restriction in one or both twins (Table 5). CS was associated with lower incidence of adverse perinatal or neonatal outcome, including 5-minute Apgar score of <5 in livebirths (1.6% vs 0.29%, p=0.005), stillbirths (4.6% vs 0.29%, p<0.001), and neonatal deaths (2.2% vs 0.46%, p<0.001). However, CS was associated with higher risk of postpartum haemorrhage (9.69% vs 16.3%, p=0.012).

Discussion

The increasing trend of CS rates for twin pregnancies in our cohort in the past 20 years echoed the findings in

Table 4. Logistic regression analysis of risk factors associated with Caesarean section for twins

Variable	B	Standard error	Wald	Odds ratio (95% confidence interval)	p Value
Non-vertex presentation of first twin	2.57	0.441	33.9	13.1 (5.51-31)	<0.001
Previous Caesarean section	1.43	0.32	19.7	4.19 (2.22-7.87)	<0.001
Advanced maternal age	0.5333	0.1858	8.058	1.7 (1.18-2.46)	0.005
Preterm delivery	-1.066	0.179	35.3	0.34 (0.24-0.48)	0.001
Multiparity	-1.23	0.181	46.4	0.29 (0.20-0.41)	0.001
Induction of labour	-2.45	0.339	52.5	0.086 (0.04-0.17)	0.001
Gestational diabetes	0.37	0.27	1.87	1.45 (0.85-2.46)	0.17
Gestational hypertension	0.544	0.302	3.24	1.72 (0.95-3.12)	0.07

Table 5. Comparison of pregnancy outcome between vaginal delivery and Caesarean section groups

Outcome	Vaginal delivery (n=454)*	Caesarean section for one or both twins (n=1712)*	p Value
Mean birthweight of all babies, g	2193±679	2408±508	<0.001; mean difference (confidence interval)= –214 (–294 to –133)
Mean birthweight of term babies ≥37 weeks, g	2649±366	2663±340	0.71; mean difference (confidence interval)= –14 (–87 to 59)
Fetal growth restriction in one or both twins (birthweight <10th centile according to gestation)	52 (22.9)	203 (23.7)	0.86
5-minute Apgar score <5 in livebirths	7 (1.6)	5 (0.29)	0.005
Stillbirth	21 (4.6)	5 (0.29)	<0.001
Neonatal death	10 (2.2)	8 (0.46)	0.001
Postpartum haemorrhage	22 (9.69)	140 (16.3)	0.012

* Data are presented as mean ± standard deviation or no. (%) of cases

other parts of the world The increase in the overall CS rate for twins was mainly the result of the increase in the CS rate for cephalic-presenting twins. In a cross-sectional study in United States from 1995 to 2008, the CS rate for twins increased from 53.4% to 75%[7], but the increase could not be fully explained by the increase in the CS rate for breech presentation. Despite no data for presentation according to the birth order of twins, it was suspected that the increase was contributed to a significant increase in the CS rate for vertex-vertex twins. This finding is consistent with that of the present study.

In another cross-sectional study in United States from 2006 to 2013, the CS rate for twins peaked at 75.3% in 2009 and remained static and then dropped to 74.8% in 2013[9]. There appeared to be a similar trend in our cohort, as the CS rate for cephalic + cephalic twins fell from 78% in 2008-2012 to 74.7% in 2013-2017. Such a trend could be due to the evidence confirming the safety of VD for twin pregnancies compared with CS[5,6]. Further data in subsequent years should confirm whether there is a genuine decreasing trend.

The CS rate for non-vertex first twins was close to 100% for all intervals, as the Term Breech Trial stated that planned CS was associated with a reduced risk of adverse perinatal outcome in term pregnancy with the fetus in breech presentation[10].

Presentation of the second twin and the mode of delivery

In the present study, the CS rate for cephalic + non-vertex twins increased significantly from 65.9% in

1998-2002 to 91.1% in 2013-2017. However, there is no evidence that CS achieves better neonatal outcomes than VD in delivering non-vertex second twins. In a systematic review in 2012 that included one high-quality clinical trial (60 twin pairs) and 16 moderate/low-quality observational studies (3167 twin pairs), there were no significant differences in neonatal outcome between VD and CS with first twin and/or second twin in non-cephalic presentation[11]. No final conclusion could be drawn because of the small sample size and statistical limitations of the included studies. A retrospective case-control cohort study in 2018 reported that non-cephalic presentation of second twin did not significantly influence the perinatal outcome after VD at or above 32 weeks of gestation[12]. In addition, a French study in 2019 reported that both non-cephalic and cephalic second twins at or above 32 weeks of gestation were associated with low composite neonatal mortalities and morbidities for VD[13]. However, other studies reported that non-vertex second twins had higher odds ratio for combined delivery compared with vertex second twins[14,15]. The odds ratio for combined delivery for breech second twins was 6.2 to 6.9 and that for transverse second twins was up to 177. This was due to a lack of experienced obstetricians in conducting vaginal breech extraction and internal podalic version. A Danish study also suggested that new-generation obstetricians were not sufficiently trained to perform internal podalic version and breech extraction[16], which is also the situation in our unit. Second twins with combined delivery had higher neonatal morbidities than those with successful vaginal delivery[17]. Women with combined delivery are subjected to risks of vaginal delivery and emergency second-stage CS, and therefore are associated with higher morbidities than direct CS of the twins[18]. Such arguments were likely the most important reasons for the increasing trend in CS rate for cephalic + non-vertex twins in our unit. We believe this is also the situation in other obstetric units in Hong Kong, as there is consistently only a very low incidence of vaginal breech deliveries in all training units after the publication of the Term Breech Trial in 2000[10]. There are very few opportunities for obstetricians to have training in internal podalic version and breech extraction. Obstetricians lacking actual experience in these vaginal delivery skills are more likely prefer to perform direct caesarean section on twin pregnancies.

The CS rate for cephalic-cephalic twins was also increasing significantly in our unit. More obstetricians opted for direct CS even for cephalic + cephalic twins, because many are concerned that they do not have enough experience to manage the non-engaged second twin after delivery of the first twin. Non-engaged vertex second twin is common after delivery of the first twin. If the second twin is still not engaged after a prolonged period of maternal pushing, many obstetricians choose to perform CS instead of internal podalic version of the second twin followed by breech extraction. In addition, in approximately 11% to 20% of these vertex second twins, the presentation can change to non-vertex after VD of the first twin[19,20]. Therefore, new-generation obstetricians are tempted to advise patients with twin pregnancies to have direct CS to avoid combined delivery and risks of complications.

Fetal outcomes and mode of delivery

In the present study, CS was associated with fewer adverse perinatal or neonatal outcomes, including 5-minute Apgar score of <5, stillbirth, and neonatal death. However, the poor perinatal outcome of VD twins may be explained by the larger proportion of very preterm twins. Compared with the CS group, the VD group had a significantly higher preterm delivery rate, including very preterm deliveries <32 weeks and <28 weeks, and significantly lower mean birthweight.

The literature showed contradicting evidence in perinatal outcome between CS and VD for twin pregnancies. The retrospective cohort study in 2005 with 8073 twin births reported that CS reduced the risk of perinatal death of twins by approximately 75%[4]. Afterwards, several studies also reported that CS reduced perinatal and neonatal morbidities and mortalities[21-23]. However, the Twin Birth Study in 2013 with 1398 women between 32+0 to 38+6 weeks of gestation and twins in vertex presentation reported no significant differences between planned CS and planned VD in neonatal morbidities and mortalities[5]. In 2017, a nationwide prospective cohort study in France with 5915 twin pregnancies reported that VD with a cephalic first twin at or above 32 weeks was associated with lower composite neonatal mortalities and morbidities, compared with planned CS[24]. Another nationwide cohort study in the Netherlands with 21 107 twin pregnancies reported that CS resulted in more perinatal mortalities before 36+6 weeks and there was no significant difference between CS and VD at or above 37 weeks in morbidities or mortalities[25]. The Cochrane review in 2015 found only two randomised controlled trials comparing planned CS with planned VD for twins[26]. One was the randomised controlled trial of 2013 mentioned above. The second had a small sample size of 60 women and insufficient power to assess neonatal mortalities and morbidities[27]. A prospective cohort study with 354 twins reported that VD was not associated with adverse childhood outcomes in children with an average

age of 5.9 years[28].

The American College of Obstetricians and Gynecologists guidelines in 2014 states that women with cephalic-presenting twins should be counselled to attempt VD[6]. In Hong Kong, there is no guideline or consensus for the mode of delivery in twin pregnancies. As the evidence of CS versus VD for cephalic-presenting twins remains conflicting, our unit provides both options to such cases with uncomplicated pregnancy, and risks of combined delivery were included in the counselling. As there is a general preference for CS even among low-risk patients, it is anticipated that a significant proportion of our twin pregnancy patients will opt for planned CS.

Maternal outcomes and mode of delivery

Our data showed that CS was significantly associated with postpartum haemorrhage. There were studies supporting our finding that mothers in the CS group were significantly more likely to have hemorrhage and surgical complications[23,29], whereas other studies showed that mothers were more likely to suffer from haemorrhage with VD[30]. There were also studies with neutral findings showing no significant differences in postpartum haemorrhage rates between CS and VD[31,32]. Further studies on maternal outcome in twin pregnancies are needed before any conclusion can be drawn.

Risk factors associated with CS

In the present study, compared with the VD group, the CS group were associated with advanced maternal age, primiparity, gestational diabetes mellitus, and previous CS. The logistic regression model identified non-vertex presentation of first twin, advanced maternal age, and previous CS as independent risk factors for CS. The higher CS rate for non-vertex first twins was likely due to the preference of obstetricians to perform CS for all breech-presenting fetuses following the recommendation of the Term Breech Trial[10]. Advanced maternal age was an independent risk factor for CS in both singleton and multiple pregnancies in a systematic review[33]. The increasing number of mothers with advanced maternal age may contribute to a further increase in the CS rates in twin pregnancies in coming years. The increasing rates of CS for those with previous CS have been evident in singletons (from 36.7% to 57% in a local 20-year cohort)[8]; so it came with no surprise that a large proportion of twin pregnancies with previous CS would be delivered by repeat CS.

CS for twin pregnancies was negatively associated with preterm delivery, multiparity, and induction of labour. Particularly for twin pregnancies with very preterm labour before 28 weeks, given the expected poor prognosis, VD would often be the preferred delivery mode. Multiparous women with previous VD likely preferred VD, whereas induction of labour preselected those pregnancies that aimed at planned VD.

Limitations

The limitation of this study is its retrospective design. A prospective cohort may provide better information on the reasons of choice of the mode of delivery from patients and obstetricians, as well as more detailed analysis of neonatal and maternal morbidities. Another limitation of our study is the generalisibility of our data to other centres in Hong Kong, as other service units may not offer the options of planned CS or VD equally to patients with uncomplicated twin pregnancies. On the other hand, theoretically, other centres with more obstetricians experienced in performing vaginal breech deliveries or internal podalic version may also counsel these patients differently, so that their CS rates could differ from our findings.

Conclusion

Despite the lack of consensus on a particular mode of delivery for twin pregnancies, a progressive increase in CS rates for twins was observed over the past 20 years, mainly as a result of an increase in the CS rate for cephalic-presenting twins. Key factors associated with CS for twins were non-vertex presentation of the first twin, advanced maternal age, and previous CS.

Declaration

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