Vaginal delivery of second twins: factors predictive of failure and adverse perinatal outcomes

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ABSTRACT

Introduction: This study was performed to explore factors associated with adverse perinatal outcomes for second twins and to identify predictive factors for successful vaginal delivery of the second twin after vaginal delivery of the first twin.

Methods: This 10-year retrospective study included 231 cases of twin pregnancies in which vaginal delivery of the second twin was attempted after vaginal delivery of the first twin. The relationships of obstetric characteristics with the composite adverse perinatal outcome of the second twin were analysed. Predictive factors for successful vaginal delivery of the second twin were also explored.

Results: Gestational age <32 weeks was the only independent risk factor for the composite adverse perinatal outcome and neonatal intensive care unit admission for the second twin. A longer inter-twin delivery interval was associated with greater risk of caesarean delivery of the second twin, but it did not increase the risk of an adverse perinatal outcome. Non-vertex presentation of the second twin at delivery was independently associated with caesarean delivery (9.0% vs 2.0%, P=0.03). For second twins in breech presentation, caesarean delivery was associated with the presence of less experienced birth attendants.

Conclusion: Among second twins born to mothers who had attempted vaginal delivery, adverse perinatal outcomes were mainly related to prematurity. The presence of more experienced birth attendants may contribute to successful vaginal delivery of the second twin, particularly for twins in non-vertex presentation.

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New knowledge added by this study

- Among second twins born to mothers who had attempted vaginal delivery, adverse perinatal outcomes were mainly related to prematurity, rather than actual mode of delivery.
- An inter-twin delivery interval of >30 minutes alone did not increase the risk of an adverse perinatal outcome, although it increased the risk of caesarean delivery of the second twin.
- For second twins in breech presentation, caesarean delivery was independently associated with a longer inter-twin delivery interval (>30 minutes) and the presence of less experienced birth attendants.

Implications for clinical practice or policy

- Our findings support vaginal delivery of the second twin when the first twin is delivered in cephalic presentation.
- If monitoring of the second twin is possible and the findings are reassuring, obstetricians may consider a conservative approach, even 30 minutes after delivery of the first twin; emergency caesarean delivery should be readily available if necessary.

Introduction

Selection of the mode of delivery in a twin pregnancy is always challenging for obstetricians, although vaginal delivery is theoretically feasible for diamniotic twins if the first twin is in cephalic presentation.[1] In the past 15 years, two cohort studies[2,3] and a multicentre randomised trial[4] concluded that when the first twin was in cephalic presentation, planned caesarean delivery did not significantly decrease or increase the risk of fetal/neonatal death or serious neonatal morbidity, compared with planned vaginal delivery. These findings suggest that vaginal delivery of twins is a safe and reasonable mode of delivery. However, attempts to deliver vaginally are not always successful, and the intrapartum risks of adverse outcomes for second twins should be carefully considered.

In a study of factors that were predictive of successful vaginal delivery, Easter et al[5] found that the vaginal delivery rates of second twins in non-vertex presentation were comparable with the vaginal delivery rates of second twins in vertex presentation.

Successful vaginal delivery was associated with higher parity. In the subgroup of second twins in non-vertex presentation, successful vaginal delivery was associated with the presence of more experienced birth attendants. The rates of neonatal morbidity and mortality were low in both groups, and they did not differ between groups. However, that study only included twins with gestational ages of ≥32 weeks.

In a study that examined caesarean delivery of the second twin after successful vaginal delivery of the first twin, Breathnach et al[6] found that the most common indication for caesarean delivery of the second twin was malpresentation (transverse/shoulder/brow) or compound presentation. Second twins who were delivered by emergency caesarean section after vaginal delivery of the first twin had a perinatal morbidity rate of 29%, but there were only 14 such twins; thus, the sample size was insufficient for robust statistical analysis.

There is a need for additional information concerning factors predictive of successful vaginal delivery of the second twin, which will allow better case selection and avoid combined vaginal-caesarean delivery (ie, failed vaginal delivery of the second twin). To our knowledge, there have been few studies of these factors in Asian populations. Here, we examined the medical records of second twins born to mothers who had attempted vaginal delivery of twins in Hong Kong; we sought to identify factors that could affect the perinatal outcomes and predict failure of vaginal delivery in a predominantly Asian population. We also included deliveries of preterm gestations (23-32 weeks), which were not extensively investigated in previous studies.

雙胞胎第二胎順產：失敗和不良圍產期結局的預測因素

莫秀蘭、盧子健

引言：探討與雙胞胎第二胎圍產期不良結局相關的因素，並確定在第一胎順產後第二胎成功順產的預測因素。

方法：這個為期10年的回顧性研究包括231例雙胞胎妊娠，在第一胎順產後嘗試第二胎順產。分析產科特徵與第二胎的複合不良圍產期結局的關係，還探討第二胎成功順產的預測因素。

結果：胎齡32周以下是雙胞胎第二胎複合圍產期不良結局和新生兒重症監護病房入院的唯一獨立危險因素。更長的雙胞胎分娩間隔與第二胎更高剖腹產風險相關，但不會增加不良圍產期結局的風險。雙胞胎第二胎在分娩時的非頭頂先露與剖腹產相關（9.0% vs 2.0%，P=0.03）。臀位分娩的雙胞胎第二胎中，剖腹產與缺乏經驗的接生員相關。

結論：在嘗試順產所分娩的雙胞胎第二胎中，不良圍產期結局主要與早產相關。有經驗的接生員有助雙胞胎第二胎成功順產，特別是對於非頭頂先露的雙胞胎。

Methods

This retrospective study focused on twin pregnancies that were delivered between 1 January 2006 and 31 December 2015 in Princess Margaret Hospital, a regional public hospital in Kowloon, Hong Kong. Inclusion criteria were vaginal delivery of the first twin at gestational viability or beyond. Exclusion criteria were miscarriage (delivery before gestational viability) or delivery of the first twin by elective or emergency caesarean section. Under Hong Kong law, 24 full weeks of gestation is generally regarded as the threshold of gestational viability. In exceptional cases, the threshold may be reduced to 23 weeks if, after full discussion with the obstetric and neonatal care teams, the parents demonstrate a strong preference for earlier initiation of active neonatal management.

Eligible cases were identified from the Obstetric Clinical Information System (OBSCIS); for each case, the mother's demographic and clinical data were retrieved. The OBSCIS is a territory-wide electronic database that contains the prenatal, intrapartum, and postpartum information of all mothers who receive care in public hospitals in Hong Kong. Clinical information in the system is updated in a timely manner by each patient's midwives and physicians before the patient is discharged from the hospital. Data entry integrity is continuously monitored by a dedicated information technology team within the Hospital Authority, and each obstetrics unit is asked to provide missing data promptly. Each infant's clinical information was retrieved from the Electronic Patient Record, a comprehensive system that contains all health information (except obstetric records) of patients from birth to death and is shared by all public hospitals and out-patient clinics under the Hong Kong Hospital Authority.

The following maternal data were retrieved: age, parity, gestational age at delivery, chorionicity, and mode of delivery of the second twin. The following infant data were retrieved: birth weight, Apgar score, cord blood pH, delivery time, inter-twin delivery interval, presentation at delivery, and neonatal intensive care unit (NICU) admission status.

The primary outcome of the study was a composite adverse perinatal outcome that included any of the following: Apgar score <6 at 5 minutes after birth, cord blood pH <7, NICU admission, birth trauma, and presence of neonatal complications. For infants with a hospital stay of >28 days, complications until hospital discharge were included. The following complications were considered: respiratory morbidity, intracranial haemorrhage, hypoxic ischaemic encephalopathy, sepsis, metabolic disturbance, birth defects, and neonatal death. The secondary outcome was mode

of delivery. Gestational age was established by the patient's last menstrual period and verified by ultrasound in the first or early second trimester. Chorionicity was established by prenatal ultrasound and confirmed by placental histology after delivery. The likelihood of vaginal delivery may be adversely impacted by considerably larger second twin size, compared with the first twin. Breathnach et al[6] found that the rate of caesarean section was higher if the first twin had ≥20% lower weight than the second twin. Therefore, clinically significant weight discordance was regarded as ≥20% in the present study, where weight discordance was defined as the weight difference between the second and first twin divided by the weight of first twin.

TABLE 1. Demographic and obstetric characteristics of 231 cases of twin pregnancies in which vaginal delivery of the second twin was attempted after vaginal delivery of the first twin*

	T2 vaginal delivery	T2 caesarean delivery	P value
Ethnicity			0.21‡
Chinese (n=215)	207 (96.3%)	8 (3.7%)	
Other Asian† (n=15)	13 (86.7%)	2 (13.3%)	
Caucasian (n=1)	1 (100%)	0	
Maternal age, y	37.3 ± 5.4	36.5 ± 6.1	0.65§
Parity			0.20‖
Multiparous (n=134)	126 (94.0%)	8 (6.0%)	
Nulliparous (n=97)	95 (97.9%)	2 (2.1%)	
Chorionicity			0.32‖
MCDA (n=91)	89 (97.8%)	2 (2.2%)	
DCDA (n=140)	132 (94.3%)	8 (5.7%)	
Gestational age at delivery			0.21‖
<32 Weeks (n=20)	18 (90.0%)	2 (10.0%)	
≥32 Weeks (n=211)	203 (96.2%)	8 (3.8%)	
Inter-twin delivery interval			<0.001‖
≤30 Minutes (n=218)	213 (97.7%)	5 (2.3%)	
>30 Minutes (n=13)	8 (61.5%)	5 (38.5%)	
Presentation of T2 at birth			0.03‖
Vertex (n=153)	150 (98.0%)	3 (2.0%)	
Non-vertex (n=78)	71¶ (91.0%)	7** (9.0%)	
Delivery time			0.69‖
06:00-23:59 (n=191)	183 (95.8%)	8 (4.2%)	
00:00-05:59 (n=40)	38 (95.0%)	2 (5.0%)	
Weight discordance			1.00‖
Yes (n=12)	12 (100%)	0	
No (n=219)	209 (95.4%)	10 (4.6%)	
Birth attendant experience (n=227)††			0.53‖
1-5 Years (n=111)	105 (94.6%)	6 (5.4%)	
>5 Years (n=116)	112 (96.6%)	4 (3.4%)	

Abbreviations: DCDA = dichorionic diamniotic; MCDA = monochorionic diamniotic

* Data are shown as No. (%) or mean ± standard deviation

† Other Asian ethnicities included Pakistani, Filipino, Vietnamese, Japanese, Thai, Indian, and Indonesian

‡ Chi squared test

§ Independent samples *t* test

‖ Fisher's exact test

¶ 70 Cases of breech presentation and one case of face presentation

** Six cases of breech presentation and one case of transverse lie presentation

†† Some data on birth attendants were missing

Vaginal deliveries of twins were managed in accordance with our labour ward protocol, which does not regard estimated fetal weight discordance as a contra-indication to vaginal delivery. All deliveries were attended by two physicians (as described below) and assisted by ≥2 midwives. Specialist supervision was recommended. In this context, a specialist is an obstetrician who has completed ≥6 years of postgraduate residency training and received accreditation as a Fellow of the Hong Kong College of Obstetricians and Gynaecologists (FHKCOG). Membership in the Royal College of Obstetricians and Gynaecologists (MRCOG) is a prerequisite for FHKCOG accreditation. When a specialist was unavailable (particularly at night), deliveries were conducted or supervised by an MRCOG-qualified physician. Paediatricians were present for all deliveries of second twins. Prenatal steroids (either betamethasone or dexamethasone depending on pharmacy availability and initial treatment at the referral unit) were administered in cases of delivery before 34 weeks of gestation. If necessary, oral nifedipine was used as a first-line tocolytic. Intravenous salbutamol was used as a second-line tocolytic until 2012; since 2013, atosiban has been used as a second-line tocolytic.

Statistical analysis was carried out using SPSS software (Windows version 17.0; SPSS Inc., Chicago [IL], United States). Categorical data were analysed by the Chi squared test or Fisher's exact test, as appropriate. Among the factors that showed statistical significance in univariate analysis, binary logistic regression was used to identify factors that were independently predictive of vaginal delivery and adverse perinatal outcomes. P values <0.05 were considered statistically significant.

Results

During the 10-year study period, 47 595 deliveries were performed in Princess Margaret Hospital; 718 twin pairs were delivered. Among these twin pairs, 182 and 305 were delivered by elective and emergency caesarean section, respectively; they were excluded from the study. In the remaining 231 cases, the mothers delivered the first twin vaginally and intended to deliver the second twin vaginally. The second twins in this group of patients were included for analysis.

Table 1 shows the demographic and obstetric characteristics of the 231 cases, stratified according

to the mode of delivery of the second twin. Emergency caesarean delivery was required in 10 cases (4.3%). Among the three second twins in vertex presentation, two were delivered by caesarean section because of second twin retention; the remaining twin was delivered by caesarean section because of fetal distress. Among the seven second twins in non-vertex presentation, the indications for caesarean delivery were second twin retention (two cases), fetal distress (four cases), and transverse lie (one case). Of the factors shown in Table 1, only an inter-twin delivery interval of >30 minutes and non-vertex presentation of the second twin at delivery were associated with the mode of delivery of the second twin. Logistic regression analysis showed that an inter-twin delivery interval of >30 minutes (odds ratio [OR]=26.952, 95% confidence interval [CI]=5.924-122.619) and non-vertex presentation of the second twin at delivery (OR=5.003, 95% CI=1.101-22.743) were independently associated with caesarean delivery of the second twin.

In subgroup analyses, we examined the relationships of the demographic and obstetric factors in Table 1 to determine their relationships with the mode of delivery for second twins in breech presentation. Univariate analysis revealed that only an inter-twin delivery interval >30 minutes and the presence of less experienced birth attendants were significantly associated with the mode of delivery. Logistic regression showed that an inter-twin delivery interval >30 minutes (OR=36.492, 95% CI=3.035-438.712) and the presence of less experienced birth attendants (OR=10.252, 95% CI=1.001-104.956) were independently associated with caesarean delivery of second twins in breech presentation.

Perinatal outcomes of second twins are shown in Table 2. Univariate analysis revealed that the composite adverse perinatal outcome was only associated with gestational age <32 weeks (P<0.001; OR=12.1, 95% CI=2.738-53.481) [Table 3]. Similarly, gestational age <32 weeks was the only factor significantly associated with NICU admission (P<0.001; OR=6.420, 95% CI=2.073-19.878) [Table 4].

Among the 47 cases with delivery before 34 weeks of gestation, 27 completed steroid treatment before delivery. In 17 cases, delivery occurred before the completion of steroid treatment because of rapid labour that did not respond to tocolytics. Steroid treatment was not administered in three cases; two of these cases involved delivery before 24 weeks of gestation, which is the threshold for beginning steroid treatment in our hospital. In the third case, the mother was admitted in advanced labour. Completion or non-completion of steroid treatment was not associated with the composite adverse perinatal outcome (25/27 vs 18/20, P=0.753).

TABLE 2. Outcomes of second twins (n=231)

Composite adverse perinatal outcome	
No	123 (53.2%)
Yes	108 (46.8%)
Apgar score <6 at 5 minutes after birth	1
Cord blood pH <7	4
NICU admission	97
Birth trauma	1 (Erb's palsy)
Neonatal complications*, including:	46
Sepsis	11
HIE, IVH	2
RDS	15
Metabolic disturbance†	8
Birth defect‡	8
NND	2

Abbreviations: HIE = hypoxic-ischaemic encephalopathy; IVH = intraventricular haemorrhage; NICU = neonatal intensive care unit; NND = neonatal death; RDS = respiratory distress syndrome

* Some cases had >1 adverse neonatal outcome

† Hypoglycaemia, hypothyroidism, hypocalcaemia, jaundice, and/or hypotonia

‡ Congenital heart problems, patent ductus arteriosus, and/or cleft lip diagnosed before or after birth

Discussion

To our knowledge, this is the first study in Hong Kong concerning the short-term composite adverse perinatal outcomes of second twins in cases where vaginal delivery was attempted. Our approach enabled simultaneous consideration of multiple outcome parameters. The inclusion of additional clinical information until hospital discharge for infants with prolonged hospital stay (>28 days) allowed a more comprehensive assessment of outcomes. Notably, cases of gestation <32 weeks were included; there are minimal published data for this group of infants because they have been excluded from many large trials. Additionally, we examined the effects of birth attendant experience and birth timing.

Perinatal outcomes

Prior to this study, there were two analyses of twin deliveries in a predominantly Asia population, both from Hong Kong. The first analysis mainly focused on patient preference regarding the mode of delivery; it also included few vaginal deliveries (35 cases).[7] The second analysis, reported by Tang et al,[8] was performed in the same obstetric unit as the first analysis; it reviewed neonatal and maternal outcomes after an increase in the rate of

TABLE 3. Factors associated with the composite adverse perinatal outcome of the second twin*

Factor	Short-term composite adverse perinatal outcome of the second twin†		P value
	Yes	No	
Gestational age			
<32 Weeks	18 (90.0%)	2 (10.0%)	<0.001‡
≥32 Weeks	90 (42.7%)	121 (57.3%)	
Weight discordance			
T2 similar to or smaller than T1	104 (47.5%)	115 (52.5%)	0.34‡
T2 ≥20% larger than T1	4 (33.3%)	8 (66.7%)	
Presentation of T2 at birth			
Vertex	68 (44.4%)	85 (55.6%)	0.33‡
Non-vertex§	40 (51.3%)	38 (48.7%)	
Inter-twin delivery interval			
≤30 Minutes	101 (46.3%)	117 (53.7%)	0.60‡
>30 Minutes	7 (53.8%)	6 (46.2%)	
Birth time			
06:00-23:59	86 (45.0%)	105 (55.0%)	0.25‡
00:00-05:59	22 (55.0%)	18 (45.0%)	
Mode of delivery of T2			
Vaginal	102 (46.2%)	119 (53.8%)	0.52‖
Caesarean	6 (60.0%)	4 (40.0%)	
Birth attendant experience (n=227)¶			
1-5 Years (n=111)	50 (45.0%)	61 (55.0%)	0.72‡
>5 Years (n=116)	55 (47.4%)	61 (52.6%)	

Abbreviations: T1 = twin 1; T2 = twin 2

* Data are shown as No. (%), unless otherwise specified

† Short-term composite adverse perinatal outcome of the second twin: Apgar score <6 at 5 minutes after birth, cord blood pH <7, neonatal intensive care unit admission, and/or neonatal complications

‡ Chi squared test

§ 76 Cases of breech presentation, one case of transverse lie presentation, and one case of face presentation

‖ Fisher's exact test

¶ Some data on birth attendants were missing

vaginal delivery of twins. The authors did not find any significant differences in neonatal morbidities between the vaginal delivery group and the elective caesarean delivery group. However, there were fewer successful vaginal deliveries of ≥1 twin (72 cases) and the effect of inter-twin delivery interval was not evaluated.

In this study, the main factor that affected the composite adverse perinatal outcome was gestational age; complications were mainly related to prematurity. Similarly, NICU admission was mainly related to complications of prematurity, rather than complications of vaginal delivery. There were no statistically significant differences in adverse perinatal outcomes, even for twins who were not delivered in cephalic presentation. Thus, non-cephalic presentation alone should not be considered sufficient to recommend caesarean delivery for twin pregnancies.

A study in Hong Kong by Leung et al,[9] published in 2002, showed that all umbilical cord blood gas parameters in the second twin were significantly associated with the inter-twin delivery interval. The risk of severe fetal acidosis was 27% if the second twin was not delivered ≤30 minutes after delivery of the first twin, but the outcomes of second twins were not analysed. In our study, an inter-twin delivery interval of >30 minutes alone did not increase the risk of short-term adverse perinatal outcomes, although it increased the risk of caesarean delivery of the second twin. Schneuber et al[10] also reported similar findings in their series, which suggested that an increased inter-twin delivery interval was not associated with adverse fetal outcomes. If monitoring of the second twin is possible and the findings are reassuring, obstetricians may thus consider a conservative approach, even 30 minutes after delivery of the first twin; however, emergency caesarean delivery should be readily available if necessary.

Our study also showed no increase in adverse perinatal outcomes for infants who were delivered after midnight. In general, delivery of twins in daytime or early evening is preferable because additional staff are present, and those staff are often more experienced. Therefore, when there are no indications for urgent delivery, the usual practice in our unit is to begin labour induction for twin pregnancies in the early morning. Deliveries after midnight usually follow spontaneous labour and are thus unplanned. However, such deliveries are supervised by the most senior on-call obstetrician (MRCOG-qualified or FHKCOG-accredited) during the intrapartum period.

Delivery of non-cephalic second twin

The vaginal delivery of second twins in non-cephalic presentation is challenging. Our findings showed a higher rate of caesarean delivery for second twins in non-cephalic presentation (9.0% vs 2.0%, P=0.03). In a large cohort study using the World Health Organization Global Survey dataset, Vogel et al[11] showed that caesarean rates were 6.2% and 0.9% for second twins in non-cephalic and cephalic presentation, respectively. Another study by Kong et al[12] revealed the caesarean delivery rates of second twins were 4.7% in cephalic presentation, 11.1% in breech presentation, and up to 90% in transverse lie. In both of these studies, analyses were conducted based on the presentation of the second twin at the onset of labour; their findings were consistent with our results. The presence of more

experienced obstetricians who are able to perform artful manoeuvres (ie, internal podalic version and external cephalic version) can increase the likelihood of successful vaginal delivery of the second twin. Regular training and rehearsal of the vaginal delivery of twins is important for obstetricians to maintain their skills.

Caesarean section of second twin

In our study, caesarean delivery of the second twin was necessary in 4.3% of cases, which is similar to or lower than the proportions in other series.[6,8,13,14] Regardless of whether the second twin was delivered by caesarean section, there were no significant increases in short-term adverse perinatal outcomes; however, this mode of delivery is less favourable for mothers. These results are contrary to the findings by Breathnach et al,[6] in which the perinatal morbidity rate was 29% among second twins delivered by emergency caesarean section after vaginal delivery of the first twin. A systematic review by Rossi et al[15] also showed a higher rate of morbidity in second twins after caesarean delivery (19.8% vs 9.5% after vaginal delivery). Thus, combined vaginal-caesarean delivery of twins should be avoided whenever possible.

In the present study, the presence of a larger second twin (≥20% weight discordance) did not significantly increase the risk of caesarean delivery. The second twin was larger in only 12 cases (5.2%). We suspect that many other cases with a larger second twin were scheduled for caesarean delivery without a trial of vaginal delivery. Decisions concerning the mode of delivery are affected by the estimated fetal weight, fetal presentation, and whether the mother has a history of successful vaginal delivery. Various factors must be carefully considered in each case.

Limitations

There were some limitations in this study. First, the retrospective design may have resulted in missing data or incomplete data collection. This is not a large problem because clinical information in the OBSCIS and the Electronic Patient Record is required to be updated when each patient is discharged from the hospital; therefore, these systems are reliable sources of patient data. Nevertheless, some information was not retrievable, such as the presentation of the second twin at the time of first twin delivery and whether birth attendant manoeuvres were necessary to deliver the second twin. Second, the non-randomised analysis might have led to selection bias concerning the mode of delivery, such that low-risk cases were over-represented in the study. The number of second twins delivered by caesarean section was small; a larger trial is needed to more comprehensively evaluate such cases.

TABLE 4. Subgroup analysis of risk factors for neonatal intensive care unit admission*

	NICU (%)	No NICU (%)	P value
Gestational age			
<32 Weeks	16 (80.0%)	4 (20.0%)	<0.001†
≥32 Weeks	81 (38.4%)	130 (61.6%)	
Weight discordance			
T2 similar to or smaller than T1	93 (42.5%)	126 (57.5%)	0.53†
T2 ≥20% larger than T1	4 (33.3%)	8 (66.7%)	
Presentation of T2 at birth			
Vertex	60 (39.2%)	93 (60.8%)	0.23†
Non-vertex	37 (47.4%)	41 (52.6%)	
Inter-twin delivery interval			
≤30 Minutes	91 (41.7%)	127 (58.3%)	0.75†
>30 Minutes	6 (46.2%)	7 (53.8%)	
Birth time			
06:00-23:59	78 (40.8%)	113 (59.2%)	0.44†
00:00-05:59	19 (47.5%)	21 (52.5%)	
Mode of delivery of T2			
Vaginal	92 (41.6%)	129 (58.4%)	0.75‡
Caesarean	5 (50.0%)	5 (50.0%)	
Birth attendant experience (n=227)§			
1-5 Years (n=111)	45 (40.5%)	66 (59.5%)	0.80†
>5 Years (n=116)	49 (42.2%)	67 (57.8%)	

Abbreviations: NICU = neonatal intensive care unit; T1 = twin 1; T2 = twin 2

* Data are shown as No. (%), unless otherwise specified

† Chi squared test

‡ Fisher's exact test

§ Some data on birth attendants were missing

Conclusion

Among second twins born to mothers who had attempted vaginal delivery, we found that adverse perinatal outcomes were mainly related to prematurity, rather than actual mode of delivery. For all second twins, an inter-twin delivery interval <30 minutes was associated with a higher rate of vaginal delivery; for second twins in breech presentation, the presence of more experienced birth attendants was also associated with a higher rate of vaginal delivery. Overall, the risk of caesarean delivery of the second twin was low. Our findings in a predominantly Asian population in Hong Kong support vaginal delivery of the second twin when the first twin is delivered in cephalic presentation.

Author contributions

This study was planned and designed by both authors. Both authors also jointly performed the data analysis. TK Lo provided leadership and supervision, while SL Mok wrote and managed the manuscript. Both authors had full access to

the data, contributed to the study, approved the final version for publication, and take responsibility for its accuracy and integrity.

Conflicts of interest

Both authors have disclosed no conflicts of interest.

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Ethics approval

This study was approved by the Kowloon West Cluster Research Ethics Committee (Ref KW/EX-17-154 (118-02)). The requirement for patient informed consent was waived because this was a retrospective review of medical records that did not involve patient participation.

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