

Success rate of induction of labour in twin pregnancies relative to singleton pregnancies in a predominantly Chinese population

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ABSTRACT

Introduction: This study assessed the efficacy of induction of labour in twin pregnancies relative to singleton pregnancies within a predominantly Chinese patient population.

Methods: This retrospective case-matched cohort study included patients with twin pregnancies who underwent induction of labour at our institution in Hong Kong between 2012 and 2020. Patients with twin pregnancies were matched one-to-one with singleton pregnancies based on parity, maternal age, and the indication for induction of labour. The primary outcome was the mode of delivery. Secondary outcomes included the time from oxytocin infusion to delivery, indications for caesarean or instrumental delivery, and maternal and neonatal outcomes.

Results: In total, 160 women with twin pregnancies met the inclusion criteria and were matched with 160 singleton pregnancies. Caesarean section was performed in 42 patients (26.3%) with twin pregnancies and 27 patients (16.9%) with singleton pregnancies undergoing induction of labour. Patients with twin pregnancies had a significantly higher risk of caesarean section relative to those with singleton pregnancies (odds ratio=2.14, 95% confidence interval=1.14-4.04; $P=0.024$). Internal

podalic version was required in 13.6% of cases for the vaginal delivery of the second twin. There was no significant difference between the groups in the time from oxytocin administration to vaginal delivery ($P=0.143$).

Conclusion: Despite a higher induction failure rate, about three quarters of twin pregnancy patients achieved successful vaginal deliveries. Our findings inform decision making for patients and obstetricians, emphasising the importance of training for internal podalic version to aid second twin delivery and reduce caesarean rates in twin pregnancies.

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New knowledge added by this study

- Approximately three-quarters of patients with twin pregnancies who underwent induction of labour achieved successful vaginal deliveries.
- The failure rate of induction of labour was higher in twin pregnancies than in singleton pregnancies.
- The probability of requiring a caesarean section for the second twin when the first twin is delivered vaginally is only 0.8% if experts in twin vaginal delivery are available. Internal podalic version was necessary in 13.6% of cases for the vaginal delivery of the second twin.

Implications for clinical practice or policy

- Patients with twin pregnancies undergoing induction of labour should be counselled regarding the increased risk of unsuccessful labour induction relative to singleton pregnancies.
- Proficient obstetricians skilled in internal podalic version should be readily available during the delivery of the second twin to improve the success rate of vaginal delivery for the second twin.
- Greater emphasis should be placed on implementing training opportunities, simulation models, and practices for junior obstetricians to enhance proficiency in internal podalic version. These measures can facilitate second twin delivery and reduce the need for caesarean sections in second twin births.

Introduction

The global twin birth rate has increased by one-third since the 1980s, rising from 9.1 to 12 per 1000 deliveries, resulting in approximately 1.6 million twin pairs born annually.¹ One major

factor contributing to this trend is the growing use of assisted reproductive techniques in recent decades.¹ Relative to singleton pregnancies, twin pregnancies are associated with higher incidences of maternal and fetal complications, which may

require earlier delivery.^{2,3} Even in uncomplicated cases, the National Institute for Health and Care Excellence (NICE) guidelines recommend delivery at 37 weeks for dichorionic twin pregnancies and 36 weeks for monochorionic twin pregnancies.⁴ Consequently, earlier delivery is frequently required in twin pregnancies. The Twin Birth Study,⁵ a large multicentre randomised controlled trial published in 2013, demonstrated the safety of both vaginal and caesarean birth in twin pregnancies where the first twin presented in cephalic position at 32 weeks of gestation or later. These findings have supported an increase in vaginal deliveries for twin pregnancies through induction of labour.

The success rate, benefits, and complications associated with induction of labour in singleton pregnancies have been extensively studied.^{6,7} However, only a limited number of studies have compared the success rate of induction of labour in twin pregnancies relative to singleton pregnancies.⁸⁻¹¹ According to Loscul et al⁸ and Okby et al,⁹ induction of labour in twin pregnancies increases the likelihood of caesarean section. In contrast, Fauset et al¹⁰ and Taylor et al¹¹ reported that the risk of caesarean delivery in twin pregnancies is comparable to the risk in singleton pregnancies undergoing induction of labour. These conflicting findings may arise from variations in induction methods, ethnicity-related factors, selection biases, and differences in study designs.

To provide appropriate counselling to patients, obstetricians must understand the likelihood of vaginal delivery after induction of labour. Reliance on data from singleton deliveries to estimate this likelihood for twin pregnancies may be inappropriate due to inherent differences between twin and singleton pregnancies.¹² Considering the current lack of robust evidence regarding induction of labour in twin pregnancies, this study aimed to evaluate the rate of caesarean section (including classical or lower segment caesarean sections) and associated outcomes in twin pregnancies undergoing induction of labour, compared with singleton pregnancies.

Methods

Study design

Our institution, a regional public hospital in Hong Kong, provides obstetric services for 3000 to 5000 deliveries annually. All cases of twin pregnancies are recorded in a specialised twin pregnancy clinic registry and managed by a dedicated team of obstetricians and midwives in the Twin Pregnancy Clinic. The medical professionals overseeing this clinic have specialised expertise in maternal fetal medicine.¹³ In accordance with departmental protocol, patients attend regular follow-up appointments and undergo ultrasound examinations. When a patient approaches term or requires earlier delivery, the

華人為主的口中雙胎妊娠與單胎妊娠引產成功率比較

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引言：本研究在以華人患者為主的群體中，比較雙胎妊娠與單胎妊娠的引產成功率。

方法：本研究為一項回顧性病例配對隊列研究，包括了2012至2020年間在香港本醫院接受引產的雙胎妊娠孕婦。雙胎妊娠孕婦根據分娩次數、年齡及引產原因與單胎妊娠孕婦進行一對一匹配。主要結果指標為分娩方式，次要結果指標包括從催產素輸注至分娩的時間、剖腹產或器械助產率及母嬰出生結果。

結果：共有160名符合納入標準的雙胎妊娠孕婦與160名單胎妊娠孕婦進行匹配。其中，42名（26.3%）雙胎妊娠孕婦接受剖腹產，而單胎妊娠孕婦中為27名（16.9%）。雙胎妊娠需要剖腹產的風險顯著高於單胎妊娠（比值比=2.14，95%置信區間=1.14–4.04；P=0.024）。在進行第二位胎兒的陰道分娩時，13.6%孕婦須進行內腎位倒轉術。單胎及雙胎妊娠孕婦在使用催產素到陰道分娩的時間沒有顯著差異（P=0.143）。

結論：雖然雙胎妊娠的引產失敗率較高，但本研究發現約有四分之三雙胎妊娠孕婦成功進行陰道分娩。研究結果為孕婦和產科醫生的決策提供信息，強調了內腎位倒轉術訓練的重要性，有助進行第二位胎兒分娩並減低雙胞胎的剖腹產率。

attending obstetrician discusses the mode of delivery with the patient. For uncomplicated dichorionic-diamniotic and monochorionic-diamniotic twin pregnancies, vaginal delivery is encouraged if the first twin presents in cephalic position.

The same induction of labour protocol is applied to both twin and singleton pregnancies. Patients are admitted to the hospital and a cervical examination is conducted to assess the modified Bishop score. If the cervix is unfavourable with a modified Bishop score (Calder score) <6, cervical priming is performed using either dinoprostone tablets or a cervical ripening balloon (Cook Medical, Bloomington [IN], United States). If the cervix is favourable with a modified Bishop score \geq 6, the patient is transferred to the labour ward for artificial rupture of membranes and administration of synthetic oxytocin. The induction of labour protocol used in this study aligns with NICE recommendations, except that the modified Bishop score was used instead of the Bishop score to assess cervical readiness for induction.^{14,15}

Medical records of patients with twin pregnancies who underwent induction of labour and delivered at our institution between January 2012 and December 2020 were retrospectively identified using the International Classification of Diseases codes through the Clinical Data Analysis and Reporting System of Hospital Authority. The identified medical records were individually reviewed. Study participants were required to meet

all of the following inclusion criteria: gestational age ≥ 24 weeks, intact membranes, and planned induction of labour. Exclusion criteria included premature rupture of membranes, labour in the latent or active phase, threatened preterm labour resulting in spontaneous labour, and intrauterine fetal death.

Each twin pregnancy patient who underwent induction of labour was matched with a singleton pregnancy patient at a 1:1 ratio in the same hospital during the same study period. Matching was based on specific criteria, including parity (nulliparous or multiparous),¹⁶ maternal age (advanced maternal age of ≥ 35 years, or not),^{16,17} and the indication for induction of labour.¹⁸ These criteria were selected to minimise confounding factors that could affect the success rate of induction of labour. To further reduce the impact of variations in medical practice during the study period, the singleton pregnancy patient with the delivery date closest to that of the twin pregnancy patient was selected.

For both twin and singleton pregnancies, demographic data, past obstetric history, parity, modified Bishop score, method of cervical priming, indication for induction of labour, and use of epidural analgesia were recorded. The primary outcome was the mode of delivery. Secondary outcomes included the time from oxytocin infusion to vaginal delivery or caesarean section, indications for caesarean section or instrumental delivery, and maternal and neonatal outcomes. Postpartum haemorrhage was defined as blood loss of ≥ 500 mL, regardless of the mode of delivery. Patients who underwent caesarean section for the second twin after vaginal delivery of the first twin were considered to have undergone caesarean section.

Statistical analyses

To calculate the required sample size, it was assumed that the incidences of caesarean section were 25% in the control group and 40% in the study group. The proportion of discordant pairs was assumed to be 0.45. A two-sided significance level of 0.05 was selected, and the study aimed to achieve a 1:1 comparison between the groups. Calculations in G*Power software (version 3.1.9.6; Erdfelder, Faul, & Buchner, Germany) indicated that a total sample size of 160 pairs would provide 80% power for the analysis.

Categorical variables are reported as numerator and denominator values (%), whereas continuous variables are presented as mean \pm standard deviation. McNemar's test was used to analyse the primary outcome for twin pregnancies and their matched controls. Data for the matched pairs are presented in a 2x2 table, showing concordant and discordant study pairs. Odds ratios (ORs) were calculated as the ratio of discordant pairs, and the test statistic was

derived from McNemar's test. For the remaining outcomes, paired *t* tests, Wilcoxon signed rank test and analyses of variance were used to analyse continuous variables, whereas McNemar's tests or Fisher's exact tests were utilised for categorical variables when comparing the case and control groups. For non-matched data, the Chi squared test was applied for categorical data, and unpaired *t* tests were used for normally distributed continuous data.

Statistical analyses of data using McNemar's test were performed with Epi Info (version 7.2.5.0; Centers for Disease Control and Prevention, Atlanta [GA], US). All other analyses were conducted with SPSS (Windows version 27.0; IBM Corp, Armonk [NY], US). Two-sided P values < 0.05 were considered statistically significant.

Results

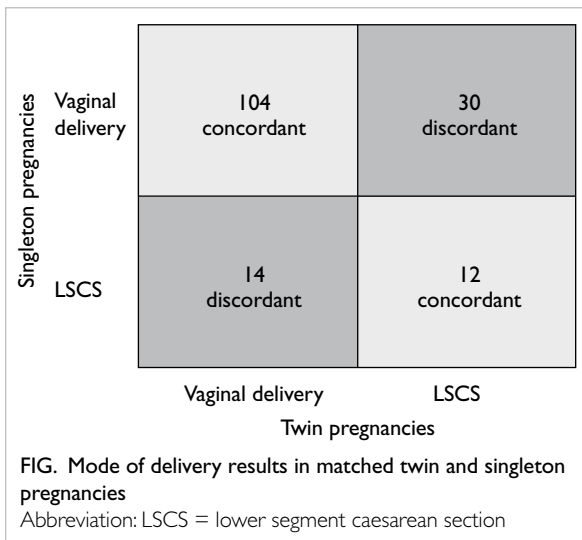
During the study period, 760 women with twin pregnancies were recorded out of 42 280 maternity cases. Of these, 160 women met the inclusion criteria for this study. The incidence of twin pregnancies was 1.8% and the rate of induction of labour in twin pregnancies was 21.1%.

The study group consisted of women with twin pregnancies who underwent induction of labour, whereas the control group comprised women with singleton pregnancies who delivered at the same hospital during the same period. The two groups were matched in terms of age, parity and indication for induction of labour, and were well balanced with respect to these matching factors. Patients with twin pregnancies had a significantly lower body mass index (21.1 kg/m² vs 22.2 kg/m²; $P=0.008$) and a significantly higher modified Bishop score (6.2 vs 5.4; $P<0.001$) relative to the control group. The mean gestational age at delivery was significantly earlier in twin pregnancies than in the control group (37.1 weeks vs 40.2 weeks; $P<0.001$). Other baseline characteristics, including ethnicity, prior caesarean section, and use of epidural anaesthesia, did not significantly differ between the two groups (Table 1).

Success rate of induction of labour

Out of 160 pairs, 44 were discordant (ie, one member of the pair had a caesarean section and the other had a vaginal delivery), and 116 were concordant (ie, both members of the pair had either a caesarean section or a vaginal delivery) [Fig]. Patients with twin pregnancies who underwent induction of labour had a significantly higher risk of caesarean section relative to those with singleton pregnancies (OR=2.14, 95% confidence interval [CI]=1.14-4.04; $P=0.024$).

Among the patients with twin pregnancies, there were 118 vaginal deliveries, 41 caesarean sections, and one case in which the first twin was delivered vaginally and the second twin was



delivered by caesarean section. Among the patients with singleton pregnancies, there were 133 vaginal deliveries and 27 caesarean sections. Instrumental deliveries were performed in 32 patients with twin pregnancies and eight patients with singleton pregnancies (Table 2).

There was no significant difference between the groups in the time from oxytocin administration to vaginal delivery (P=0.143) or the time from oxytocin administration to caesarean section (P=0.054). In total, eight patients with twin pregnancies and three patients with singleton pregnancies delivered after dinoprostone insertion without requiring artificial rupture of membranes or oxytocin infusion. Three patients with twin pregnancies and one patient with a singleton pregnancy had an unfavourable cervix after repeated doses of dinoprostone; thus, caesarean section was performed (Table 2).

Obstetric outcomes

Twin pregnancies were associated with significantly greater blood loss relative to singleton pregnancies (median: 400 mL vs 250 mL; P<0.001) and a higher incidence of postpartum haemorrhage (35.0% vs 10.6%; P<0.001). However, there was no significant difference between the groups in blood transfusion rates (8.1% vs 3.8%; P=0.115). The aetiology of postpartum haemorrhage and need for second-line treatments were also comparable between the two groups (Table 2).

Mode of delivery in twin pregnancies

Among those 118 vaginal deliveries, 45 had vaginal cephalic deliveries of both twins, whereas 42 had a vaginal cephalic delivery of the first twin followed by a vaginal breech delivery of the second twin. Additionally, 32 patients required instrumental

TABLE 1. Baseline maternal characteristics*

	Twin (n=160)	Singleton (n=160)	P value
Age, y	32.0±4.1	31.8±4.8	0.44
Ethnicity			
Chinese	157 (98.1%)	153 (95.6%)	0.29
South Asian	3 (1.9%)	7 (4.4%)	
Parity			
Nulliparous	89 (55.6%)	89 (55.6%)	1
Multiparous	71 (44.4%)	71 (44.4%)	
Body mass index, kg/m ²	21.1±2.9	22.2±3.9	0.008
Prior vaginal delivery	71 (44.4%)	71 (44.4%)	1
Prior caesarean section	0	1 (0.6%)	0.5
Gestation at delivery, wk	37.1±0.7	40.2±1.8	<0.001
Chorionicity			
MCDA	58 (36.3%)	N/A	
DCDA	102 (63.8%)	N/A	
Indication for induction of labour			
Post-date	100 (62.5%)	100 (62.5%)	
Labile blood pressure	5 (3.1%)	5 (3.1%)	
Pregnancy-induced hypertension	2 (1.3%)	2 (1.3%)	
Pre-eclampsia	3 (1.9%)	3 (1.9%)	
Preexisting diabetes/gestational diabetes	30 (18.8%)	30 (18.8%)	
Intrauterine growth restriction	17 (10.6%)	17 (10.6%)	
Obstetric cholestasis	2 (1.3%)	2 (1.3%)	
Suboptimal cardiotocography	1 (0.6%)	1 (0.6%)	
Modified Bishop score (initial)	6.2±1.3	5.4±1.2	<0.001
Cervical priming required	33 (20.6%)	68 (42.5%)	<0.001
Dinoprostone	32 (97.0%)	67 (98.5%)	
Cervical ripening balloon	1 (3.0%)	1 (1.5%)	
Epidural anaesthesia	6 (3.8%)	2 (1.3%)	0.22

Abbreviations: DCDA = dichorionic diamniotic; MCDA = monochorionic diamniotic; N/A = not applicable

* Data are shown as No. (%) or mean±standard deviation, unless otherwise specified

delivery with vacuum or forceps for at least one twin (Table 3).

In cases where vaginal breech delivery was required for the second twin, most babies were in breech presentation. Internal podalic version was performed in 16 patients (13.6%) to facilitate delivery of the second twin (Tables 3 and 4). Notably, even in five cases where the second twin was in cephalic presentation, internal podalic version was performed by manual upward displacement of the fetal head to expedite delivery due to fetal bradycardia or cord presentation.

Neonatal outcomes

When neonatal outcomes were compared between

TABLE 2. Maternal outcomes*

	Twin (n=160)	Singleton (n=160)	P value
Mode of delivery			0.024
Vaginal	118 (73.8%)	133 (83.1%)	
Normal	87 (73.7%)	125 (94.0%)	
Forceps	2 (1.7%)	1 (0.8%)	
Vacuum	28 (23.7%)	7 (5.3%)	
Vacuum + forceps	1 (0.8%)	N/A	
Vacuum + LSCS	1 (0.6%)	N/A	
LSCS	41 (25.6%)	27 (16.9%)	
Delivery after dinoprostone	8 (5.0%)	3 (1.9%)	0.15
Blood loss, mL	400 (200)	250 (150)	<0.001
No. of PPH cases	56 (35.0%)	17 (10.6%)	<0.001
Reason for PPH			
Uterine atony	44 (78.6%)	11 (64.7%)	0.34
Vaginal haematoma	1 (1.8%)	1 (5.9%)	0.41
Perineal wound bleeding	7 (12.5%)	2 (11.8%)	1
Uterine atony + wound bleeding	2 (3.6%)	1 (5.9%)	0.55
Placenta accreta	1 (1.8%)	0	1
Retained placenta	1 (1.8%)	0	1
Uterine tear	0	2 (11.8%)	0.05
Blood transfusion	13 (8.1%)	6 (3.8%)	0.115
Second-line treatments for PPH due to atony (alone or with wound bleeding)			
Balloon tamponade	6/46 (13.0%)	2/12 (16.7%)	0.67
Compression suture	1/46 (2.2%)	0	1
Time from oxytocin to vaginal delivery, min	403.8±183.8	366.9±196.8	0.143
Delivered with oxytocin	107 (66.9%)	126 (78.8%)	
Delivered without oxytocin	4 (2.5%)	4 (2.5%)	
Delivered after dinoprostone alone	8 (5.0%)	3 (1.9%)	
Time from oxytocin to caesarean section, min	498.4±141.8	581.6±188.1	0.054
Oxytocin usage	36 (22.5%)	25 (15.6%)	
Unfavourable cervix after dinoprostone and proceeded to LSCS	3 (1.9%)	1 (0.6%)	
Proceeded to LSCS without oxytocin	2 (1.3%)	1 (0.6%)	
Indication for caesarean section			
LSCS	41†	27	
Failed IOL	30	12	0.02
Slow progress	1	3	0.29
No progress	5	6	0.32
NRFS	2	4	0.21
Unfavourable cervix after dinoprostone	3	1	1
CPD	0	1	0.40
Vaginal delivery + LSCS	1‡	N/A	
Indication for instrumental delivery			
NRFS	20	4	0.69
Prolonged second stage	4	3	0.13
Poor maternal effort	8	0	0.17
Eclampsia	0	1	0.2

Abbreviations: CPD = cephalopelvic disproportion; IOL = induction of labour; LSCS = lower segment caesarean section; N/A = not applicable; NRFS = non-reassuring fetal status; PPH = postpartum haemorrhage

* Data are shown as No., No. (%), mean±standard deviation or median (interquartile range), unless otherwise specified

† For both twins

‡ NRFS in the second twin

the two groups, no significant differences were observed in Apgar scores at 1 and 5 minutes or in rates of admission to neonatal intensive care units. However, both the first and second twins were significantly lighter in weight relative to neonates in singleton pregnancies (Table 5).

Discussion

Primary outcomes

This case-control study, utilising matched controls, demonstrated that the rate of failed induction of labour was significantly higher in twin pregnancies than in singleton pregnancies. Nevertheless, 73.8% of patients with twin pregnancies achieved successful vaginal deliveries. This study represents the largest cohort investigation of its kind in a predominantly Chinese population and differs from previous studies conducted in Western countries.⁸⁻¹¹ A previous study¹⁹ revealed that ethnic variation can influence the success of induction of labour; thus, our findings provide valuable insights for counselling and managing Chinese patients with twin pregnancies.

Comparison with previous studies

The literature on induction of labour in twin pregnancies compared with singleton pregnancies remains limited. The present findings are consistent with those reported by Loscul et al⁸ and Okby et al,⁹ both of which identified an increased risk of caesarean delivery after induction of labour in twin pregnancies. Loscul et al⁸ reported an adjusted OR of 1.8 (95% CI=1.4-2.2), whereas Okby et al⁹ reported an adjusted OR of 2.2 (95% CI=1.7-2.7). Similarly, the current study demonstrated an OR of 2.14, reinforcing the notion that induction of labour in twin pregnancies is associated with a higher rate of caesarean section relative to singleton pregnancies. However, limitations existed in these studies. For instance, the large cohort study by Loscul et al,⁸ which included 1995 twin deliveries and 2771 singleton deliveries, did not consider chorionicity, and the methods of induction were not described; considering the multicentre retrospective design of that study, interhospital variations may have existed in terms of induction methods, intrapartum assessment, and decisions regarding caesarean section. Furthermore, Okby et al⁹ included 191 twin deliveries and 25 913 singleton deliveries, but did not provide details regarding induction methods, cervical status prior to induction, Bishop score, or the chorionicity of twin pregnancies. Conversely, Fausett et al¹⁰ and Taylor et al¹¹ included smaller cohorts of twin pregnancies (62 and 100 patients, respectively), and their findings may have been influenced by the small sample sizes. The method of random patient selection used in the control group of the study by Taylor et al¹¹ may have introduced potential bias. Another factor potentially

TABLE 3. Mode of delivery in twin pregnancies (n=160)

	No. (%)
Vaginal	
Vaginal cephalic + vaginal cephalic	45 (28.1%)
Vaginal cephalic + vaginal breech	42 (26.3%)
Vaginal cephalic + vacuum delivery	15 (9.4%)
Vacuum delivery + vaginal cephalic	4 (2.5%)
Vacuum delivery + vaginal breech	7 (4.4%)
Vacuum delivery + vacuum delivery	1 (0.6%)
Forceps delivery + vaginal cephalic	1 (0.6%)
Vaginal delivery + forceps delivery	2 (1.3%)
Vacuum delivery + failed vacuum with forceps	1 (0.6%)
LSCS + LSCS	41 (25.6%)
Vacuum delivery + LSCS	1 (0.6%)

Abbreviation: LSCS = lower segment caesarean section

TABLE 4. Vaginal delivery of the second twin (n=118)

	No. (%)
Vaginal breech delivery	49 (41.5%)
Presentation after delivery of the first twin	
Breech	33 (28.0%)
Cephalic	5 (4.2%)
Transverse lie	9 (7.6%)
Oblique lie	2 (1.7%)
Mode of delivery	
Vaginal breech delivery (spontaneous or assisted)	33 (28.0%)
Internal podalic version (then breech extraction)	16 (13.6%)

contributing to differences in findings among these studies is ethnic variation.

Physiological explanations

Physiological differences in the myometrium between twin and singleton pregnancies may explain the higher incidence of failed labour induction in twin pregnancies. Research has shown that myometrial activity in twin pregnancies is characterised by shorter and more frequent contractions compared with singleton pregnancies, particularly at term.²⁰ Shortened contraction duration may result in ineffective and dysfunctional contractions, increasing the likelihood of failed labour induction. Additionally, the uterus undergoes greater distension and stretching in twin pregnancies. Physiological studies have indicated that increased myometrial stretching is associated with reduced uterine contraction in response to oxytocin stimulation.²¹

TABLE 5. Neonatal outcomes*

	Twin 1 (n=160)	Twin 2 (n=160)	Singleton (n=160)	P value
Birth weight, g	2489.5±24	2472.8±24.2	3243.6±32.5	<0.01
Apgar score at 1 min ≤4	1 (0.6%)	0	0	1
Apgar score at 5 min ≤7	1 (0.6%)	1 (0.6%)	0	0.56
Admission to NICU	2 (1.3%)	3 (1.9%)	1 (0.6%)	0.875

Abbreviation: NICU = neonatal intensive care unit

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

One potential mechanism for this phenomenon is that prolonged stretching enhances the expression or activity of TWIK-related K⁺ channels, which subsequently diminish myometrial contraction in response to oxytocin.²¹ Further physiological and molecular investigations are warranted to explore the differences between singleton and twin pregnancies in greater detail.

Clinical implications of secondary outcomes

In conjunction with the primary outcomes, the secondary outcomes of this study provide important clinical insights and have substantial implications. Notably, 26.3% of twin pregnancies delivering vaginally required a vaginal breech delivery for the second twin (Tables 3 and 4). Therefore, we recommend that senior obstetricians with expertise in internal podalic version and breech extraction be present during such deliveries.

This study identified one patient who required a caesarean section for the second twin after the first twin had been delivered vaginally. When the first twin was delivered vaginally in our cohort, the probability of caesarean section for the second twin was 0.8%. Patients should be informed of this potential risk prior to induction of labour. Previous studies have shown that the risk of caesarean section for the second twin after vaginal delivery of the first twin ranges from 4.3% to 10.7%.^{5,22-24} In our cohort, the percentage of caesarean deliveries for second twins was much lower than that in other series, including another retrospective study conducted in Hong Kong with the same ethnic population.²²⁻²⁴ This discrepancy may be attributed to selection bias because the present study included only patients undergoing induction of labour, whereas other studies included patients with both induction of labour and spontaneous onset of labour. Furthermore, elective induction of labour for twin pregnancies in our unit is typically scheduled during daytime hours. This practice ensures the availability of experienced staff proficient in internal podalic version, potentially improving the likelihood of successful vaginal delivery for the second twin. Our findings showed that 13.6% of cases involving

second twin deliveries required internal podalic version, primarily due to transverse or oblique lie (Table 4). Even when the second twin presented in cephalic position (as observed in five cases), internal podalic version was required to expedite delivery because of complications such as cord presentation or fetal bradycardia. The presence of experienced staff skilled in performing internal podalic version can significantly increase the likelihood of achieving successful vaginal delivery for the second twin. At our hospital, vaginal twin deliveries during daytime hours are typically supervised by experienced obstetric consultants or associate consultants.

Strengths and limitations

To minimise the impact of variations in medical practice during the study period, we utilised a rigorous matching approach in which the singleton pregnancy patient with the delivery date closest to that of the twin pregnancy patient was selected. This approach effectively reduced the potential for confounding factors, including variations in medical practices, and ensured that the same induction of labour protocol was applied to both patient groups. Also, we recorded detailed information concerning chorionicity, indications for induction of labour, and the modified Bishop score. Finally, the induction of labour protocol used in this study aligns with NICE recommendations; thus, the results are applicable to other centres that use a similar protocol.

However, this study had some limitations. The earlier gestational age at delivery in the twin pregnancy group, as recommended by international guidelines⁴ even for uncomplicated twin pregnancies, may have affected the efficacy of induction of labour and influenced the overall outcomes. Additionally, patients with twin pregnancies had a higher initial modified Bishop score relative to those with singleton pregnancies. This difference may be due to selection bias because obstetricians often discourage vaginal delivery in patients with low initial modified Bishop scores; instead, they recommend caesarean section. Despite the higher initial modified Bishop score in twin pregnancies, the success rate of vaginal delivery remained lower in this group than in singleton pregnancies, suggesting that this factor did not significantly influence the study's results.

Although the induction of labour protocol was consistent for both twin and singleton pregnancies, variations in obstetricians' assessments of cervical dilatation, labour progression, and confidence in managing vaginal twin deliveries may have influenced study outcomes. Obstetricians with less experience or confidence in vaginal twin delivery may have been more likely to diagnose failed induction of labour and proceed with caesarean section. However, no statistically significant difference was observed in the time from initiation of oxytocin to selection

of caesarean section between the two groups. The retrospective nature of the study introduced potential biases, and the limited incidence of twin pregnancies in a single regional hospital restricted the sample size. A larger sample size and multicentre design would enhance the generalisability of the findings. Furthermore, because the study primarily included Chinese patients, the applicability of these conclusions to other ethnic groups is limited; there is a need for further research in this area.

Conclusion

The failure rate of induction of labour was higher in twin pregnancies than in singleton pregnancies. Nevertheless, 73.8% of patients with twin pregnancies achieved successful vaginal deliveries; approximately 20% required instrumental delivery for at least one twin. Furthermore, twin pregnancies were associated with a higher incidence of postpartum haemorrhage. These findings can help facilitate informed decision making for patients and obstetricians when considering induction of labour and selecting the most appropriate mode of delivery for patients with twin pregnancies.

Author contributions

Concept or design: CK Wong, WL Lau.

Acquisition of data: CK Wong.

Analysis or interpretation of data: CK Wong.

Drafting of the manuscript: CK Wong, CMW Hung.

Critical revision of the manuscript for important intellectual content: All authors.

All 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

All authors have disclosed no conflicts of interest.

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Declaration

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Ethics approval

This research was approved by the Kowloon Central Cluster/ Kowloon East Cluster Research Ethics Committee of Hospital Authority, Hong Kong (Ref No.: KC/KE-22-0113/ER-3). The

requirement for informed patient consent was waived by the Committee due to the retrospective nature of the research and the use of anonymised data in the research.

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