

# Maternal postpartum complications according to delivery mode in twin pregnancies

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**OBJECTIVE:** We aimed to examine maternal postpartum complications of twin deliveries according to mode of delivery and investigate the associated risk factors.

**METHODS:** This was a retrospective cohort review of twin pregnancies with delivery after 26 weeks at a tertiary teaching hospital (1993-2008). The rates of maternal postpartum complications were compared among vaginal, elective cesarean and emergency cesarean deliveries. Significant predictors of complications were investigated with stepwise regression analysis and relative risks were calculated.

**RESULTS:** A total of 90 complications were observed in 56/817 (6.9%) deliveries: 7/131 (5.3%) vaginal, 10/251 (4.0%) elective cesarean and 39/435 (9.0%) emergency cesarean deliveries. Significant predictors included high-risk pregnancy, gestational age at birth and delivery mode. The occurrence of complications was significantly increased in emergency compared to elective cesarean deliveries (RR = 2.34).

**CONCLUSIONS:** Maternal postpartum complications in twin pregnancies are higher in emergency compared to elective cesarean deliveries and are also related to preexisting complications and earlier gestational age at delivery.

**KEYWORDS:** Twin Pregnancy; Delivery; Vaginal Birth; Cesarean; Maternal Morbidity.

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## ■ INTRODUCTION

Twin pregnancy is associated with an increased incidence of complications (1). A recent secondary analysis of the WHO Global Survey dataset from low- and middle-income countries showed that the odds of adverse maternal outcomes (death, need for blood transfusion, intensive care unit admission and hysterectomy) are significantly increased in twin compared to singleton deliveries (2).

In recent decades, an increase in the incidence of cesarean deliveries has been observed worldwide, for both singleton and twin pregnancies (3-5). In singleton deliveries, planned cesarean section is associated with a significant increase in maternal postpartum morbidity compared to planned vaginal birth (6). Furthermore, both morbidity and mortality are even greater when cesarean sections are performed under emergency conditions (7).

Nevertheless, the impact of delivery mode on both maternal and neonatal outcome remains a debatable issue in twin pregnancies (8). Only a few underpowered studies have examined maternal complications and predictive factors according to delivery mode in twin pregnancies (9-11).

To contribute to this body of knowledge, we have reviewed our data on maternal postpartum complications in twin pregnancies according to delivery mode at a tertiary teaching hospital over a period of fifteen years.

## ■ MATERIALS AND METHODS

This was a retrospective (1993-2008) cohort review of twin pregnancies according to delivery mode (vaginal (VD), elective cesarean (ELC), and emergency cesarean (EMC)) conducted at Hospital das Clínicas, São Paulo University Medical School, Brazil.

At our institution, the indications for cesarean delivery in twin pregnancies include first twin non-vertex, 2<sup>nd</sup> twin with an estimated weight that is 500 g greater than that of the presenting twin, both fetuses estimated to weigh <1500 g, a history of previous cesarean delivery and monoamniotic twins, in addition to the usual obstetric indications for singleton pregnancies. For the remaining cases, deliveries were managed according to the judgement

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of the staff on duty. Cesarean deliveries are usually performed under spinal anesthesia, with Pfannenstiel and low transverse uterine incisions. Intravenous cefazolin (2 g) is administered after cord clamping in cesarean deliveries but not in vaginal deliveries. Dilute oxytocin infusion (10 IU) is administered routinely regardless of delivery type. All deliveries are performed by residents under direct senior staff supervision and clinical data are prospectively entered into a computer database in addition to being recorded on paper hospital records.

The labor ward registry books were manually searched by the principal investigator (SLS) and a computer database search was performed by another investigator (AWL) to identify all twin deliveries that occurred during the study period. Both lists were cross-checked to ensure accurate case identification. Pregnancies with a gestational age  $\geq 26$  weeks and both fetuses alive at admission to the labor ward were included. Cases with incomplete outcome information, missing hospital notes, combined deliveries (first twin delivered vaginally and second twin by cesarean) and conjoined twins were excluded.

The following maternal demographic and clinical data were retrieved from both the computer database and the hospital notes: maternal age, ethnicity, parity, previous obstetric history, chorionicity, preexisting medical conditions, additional complications during pregnancy, gestational age, mode of delivery, maternal postpartum complications and length of hospital stay. Pregnancies were classified as high-risk according to the presence of preexisting medical conditions or pregnancy complications including severe preeclampsia, placenta previa, placental abruption, chorioamnionitis and sepsis.

Emergency cesarean was defined as a cesarean performed during labor or one of the following situations: premature rupture of membranes, fetal distress, placenta previa with bleeding, umbilical cord prolapse, placental abruption, severe preeclampsia, maternal sepsis, or surgery under general anesthesia.

The primary outcome was considered to be the occurrence of at least one of the following maternal complications: excessive bleeding with a need for blood transfusion, uterine inversion, non-elective hysterectomy, endometritis, episiotomy breakdown, surgical wound infection requiring intravenous antibiotics, other maternal infection (e.g., pneumonia), *Clostridium difficile*-associated diarrhea, subaponeurotic or intraabdominal hematoma requiring surgical drainage, abscess, third or fourth degree perineal lacerations, surgical damage to secondary urinary or gastrointestinal structures and other clinical complications including pulmonary edema, cardiorespiratory insufficiency, renal failure, thromboembolic events, admission to intensive care unit and maternal death.

The data were entered in an Excel spreadsheet (Microsoft Corporation, USA) and statistical analysis was performed with Statsdirect (Statsdirect, UK). The results are presented as the mean, standard deviation and relative frequencies. Stepwise regression analysis was used to investigate significant predictors of maternal postpartum complications. Multivariate analysis included maternal age, ethnic group, parity, previous cesarean delivery, high-risk pregnancy as defined in the present study, chorionicity, gestational age, mode of delivery and whether cesarean was performed during labor. Relative risks were calculated for categorical variables found to be significant in the stepwise regression analysis. The significance level for entry

into the multivariate model was  $<0.2$ . For the remaining statistical tests, the significance level was set at 5%.

## ■ ETHICS

The study was approved by the Hospital Ethics Committee (CAPPESQ 0849/08). Due to the retrospective nature of the study, informed consent was not required.

## ■ RESULTS

A total of 880 twin deliveries occurred during the study period. Pregnancies involving combined delivery ( $n=8$ ; 0.9%), conjoined twins ( $n=14$ ; 1.6%), and those for which hospital records could not be retrieved (10 vaginal and 31 cesarean deliveries; 4.7%) were excluded. The final data analysis was based on 817 deliveries: 131 (16.1%) VD, 251 (30.7%) ELC and 435 (53.2%) EMC (Figure 1). The maternal demographics and pregnancy information are summarized in Table 1.

Overall, there were 90 maternal postpartum complications in 56/817 (6.9%) pregnancies. The occurrence of at least one maternal complication was significantly associated with high-risk pregnancy ( $r=0.16$ ,  $p<0.001$ ), gestational age at birth ( $r=-0.09$ ,  $p=0.01$ ), and mode of delivery ( $r=0.05$ ,  $p=0.13$ ) (Table 2).

In high-risk pregnancies, 23/143 (16.1%) women presented at least one postpartum complication, whereas only 33/674 (4.9%) in the remaining group experienced complications. Table 3 summarizes maternal postpartum complications according to the mode of delivery. A comparison between subgroups demonstrated that the frequency of at least one complication was significantly greater in EMC compared to ELC (RR = 2.34, 95% CI = 1.21-4.57); similarly, the occurrence of any infectious complication was significantly greater in EMC compared to ELC (EMC = 3.7% (16/434) versus ELC = 0.8% (2/252); RR = 4.65, 95% CI = 1.21-18.1).

## ■ DISCUSSION

The present study demonstrates that maternal postpartum complications occur in approximately 7% of twin deliveries. Our data also show that these complications are associated with pregnancies with concomitant clinical or obstetrical complications, earlier gestational age at delivery and emergency cesarean deliveries.

In a multicenter Finnish prospective study involving 2496 deliveries, Pallasmaa et al. showed that the odds ratio for maternal cesarean complications was 1.8 times higher in emergency deliveries compared to elective deliveries and delivery earlier than 37 weeks was also found to be a marginally significant independent risk factor. However, the incidence of complications in that study was 29%. The difference between this result and our findings may be due to the possible loss of information in retrospective studies (12).

Previous studies have revealed an increased risk of maternal postpartum complications, such as hemorrhage and endometritis, in twin pregnancies compared to singleton pregnancies (13,14). In our study, women undergoing emergency cesarean deliveries were more likely to present infectious complications of any type (clinical, surgical wound and endometritis). One randomized trial including 60 vertex/non-vertex twin pregnancies demonstrated that maternal febrile morbidity was significantly greater in the



**Figure 1** - Historical cohort of twin pregnancies delivered at the Hospital das Clínicas, São Paulo University Medical School, Brazil between 1993 and 2008.

cesarean group compared to the vaginal group (41% versus 11%,  $p < 0.05$ ). Moreover, the hospital stay was also longer in the cesarean group (9). In a retrospective cohort of twin deliveries, Alexander et al. showed that postpartum infectious complications, such as endometritis and wound

infection, were significantly more common after cesarean delivery compared to vaginal delivery (18% versus 6%,  $p < 0.001$ ) (15).

Although the mode of delivery was a significant determinant of maternal morbidity in the present study,

**Table 1** - Maternal characteristics and pregnancy information for twin pregnancies according to mode of delivery.

	All	Vaginal delivery (VD)	Elective cesarean section (ELC)	Emergency cesarean section (EMC)	$p^*$
<i>n</i>	817	131	251	435	
Maternal age, years	28.5 ± 6.4	28.4 ± 6.9	29.3 ± 6.4	28.0 ± 6.3	0.03 ELC>EMC
White (%)	426 (52.1)	75 (57.3)	115 (45.8)	236 (54.3)	0.05
Nulliparous (%)	314 (38.4)	46 (35.1)	96 (38.2)	172 (39.5)	0.66
Previous cesarean (%)	215 (26.3)	7 (5.3)	84 (33.5)	124 (28.5)	<0.001 VD<ELC; VD<EMC
Dichorionic pregnancy (%)	549 (67.2)	81 (61.8)	173 (68.9)	295 (67.8)	0.35
Maternal disease (%)	232 (28.4)	33 (25.2)	77 (30.7)	122 (28.0)	0.51
High-risk pregnancy (%) <sup>a</sup>	143 (17.5)	13 (9.9)	47 (18.7)	83 (19.1)	0.05
Time to hospital discharge, days	3.1 ± 2.5	2.7 ± 1.6	2.9 ± 1.7	3.4 ± 3.1	<0.001 EMC>VD; EMC>ELC
Hospital readmission (%)	11 (1.3)	1 (0.8)	1 (0.4)	9 (2.1)	0.15
Gestational age at delivery, weeks	35.6 ± 2.8	35.1 ± 3.3	36.7 ± 2.3	35.1 ± 2.8	<0.001 ELC>VD; ELC>EMC
Birth weight, grams	2214 ± 593	2154 ± 571	2359 ± 567	2148 ± 600	<0.001 ELC>VD; ELC>EMC
Twin 1	2239 ± 579	2172 ± 563	2397 ± 549	2168 ± 585	
Twin 2	2188 ± 605	2136 ± 580	2320 ± 583	2127 ± 614	

The results are presented as the mean ± standard deviation or as absolute and relative frequencies. \*: Kruskal-Wallis or chi-square test; <sup>a</sup>: pregnancies complicated by maternal anemia requiring blood transfusion, thrombocytopenia, cardiomyopathy, pulmonary edema, liver disease, pancreatitis, renal failure, thromboembolic disease, severe preeclampsia, placenta previa, placental abruption, chorioamnionitis, or sepsis.



**Table 2 - Significant predictors of maternal postpartum complications in twin deliveries.** High-risk pregnancy (0 = no, 1 = yes), gestational age at birth in weeks, mode of delivery (1 = vaginal, 2 = elective cesarean section, 3 = emergency cesarean section). The significance level was set at 0.20. OR: odds ratio, CI: confidence interval.

	Coefficient	p	OR (95% CI)
Constant	0.286	0.01	
High-risk pregnancy	0.104	<0.001	2.11 (1.21-3.68)
Gestational age at birth	0.008	0.01	0.89 (0.81-0.97)
Mode of delivery	0.018	0.13	1.42 (0.95-2.12)

multiple regression analysis showed that pregnancies considered as high-risk due to concomitant clinical or obstetrical complications presented the strongest association with maternal postpartum complications. In fact, in a retrospective population-based cohort study, Lydon-Rochelle et al. showed that maternal mortality was not related to the mode of delivery itself. Rather, emergency cesarean deliveries likely represent a marker of preexisting serious morbidity, which itself increases the risk of maternal death (16).

In Brazil, the most recent official figures report that cesarean deliveries account for approximately half of the births in the country (17). Although learning to perform vaginal deliveries is a fundamental part of our residency training program, our results show that even in our teaching facility, where all deliveries are supervised by senior staff, the rates of cesarean deliveries in twin pregnancies are exceedingly high (91% in the high-risk group and 82% in the remaining population). These high rates may be partially related to the fact that twin pregnancies that undergo therapeutic delivery in our clinic are all scheduled for elective cesarean section. In fact, it is important to highlight that the conclusions of the present study are intimately related to our setting (a tertiary referral teaching center) and should not be unduly generalized.

A retrospective population survey in Scotland showed that 41% of twin pregnancies were delivered by cesarean during the study period (18). However, a high rate of cesarean delivery of twins (82%) was also reported in a public hospital in Hong Kong (19). This finding was attributed to maternal choice, despite the lack of evidence for a protective effect on neonatal outcome. In our unit, the

mode of delivery is not influenced by maternal request. We believe that our high cesarean rates can be partially explained by our policy not to deliver twins vaginally in women with previous cesarean delivery. In addition, the referral of high-risk pregnancies to our unit results in a high prevalence of women with preexisting medical conditions, introducing a population selection bias.

Moreover, this historical series could be biased by differences in terms of management of labor and delivery of twin pregnancies amongst attending physicians, changes in scientific knowledge about this topic over time, and the fact that clinical records were not retrieved in almost 5% of the cases. Additionally, it is worth highlighting that the proportion of women with a previous cesarean delivery was significantly smaller in the vaginal delivery group. Although the mean maternal age was higher in the elective cesarean group, the difference in means was less than 1.5 years.

Although combined deliveries have been excluded from the analysis, our data show that this occurs in approximately 5% of the cases in which a vaginal delivery is attempted. Maternal complications were observed in almost half of these cases (3/8; results not presented). The inclusion of these cases would certainly have worsened maternal outcome in the vaginal delivery group. However, because vaginal deliveries are underrepresented in our population, the present study lacks the power to demonstrate differences in maternal morbidity between vaginal and cesarean births or to establish risks for specific and rare complications.

Sample size limitations are also evident in previous publications. Simões et al. compared data from 299 elective and 80 emergency cesarean deliveries (10) and Haest et al. included 29 women undergoing elective cesarean deliveries, 26 urgent cesarean deliveries and 109 vaginal births (11). Both publications failed to demonstrate clear advantages of planned elective abdominal delivery in twin pregnancies. Nevertheless, our data show that the circumstances that lead to an emergency C-section contribute significantly to maternal postpartum morbidity.

A significant inverse correlation was also observed between gestational age at delivery and maternal complications. It might be postulated that this reflects the association between early deliveries and underlying critical maternal conditions. Furthermore, fetal extraction can be difficult if the lower segment of the uterus is small and poorly developed, and it

**Table 3 - Maternal postpartum complications in twin pregnancies according to mode of delivery.**

	All (n = 817)	Vaginal delivery (n = 131)	Elective cesarean (n = 251)	Emergency cesarean (n = 435)
At least one complication	56 (6.9)	7 (5.3)	10 (4.0)	39 (9.0)
Hemorrhage requiring blood transfusion	24 (2.9)	2 (1.5)	6 (2.4)	16 (3.7)
Infectious complication	20 (2.4)	2 (1.5)	2 (0.8)	16 (3.7)
Endometritis	11 (1.3)	-	2 (0.8)	9 (2.1)
Surgical wound infection	8 (1.0)	1 (0.8)	-	7 (1.6)
Clinical infection	4 (0.5)	1 (0.8)	-	3 (0.7)
Need for reoperation	13 (1.6)	2 (1.5)	1 (0.4)	10 (2.3)
Admission to intensive care unit	9 (1.1)	-	3 (1.2)	6 (1.4)
Surgical injury	6 (0.7)	2 (1.5)	1 (0.4)	3 (0.7)
Clinical complication	6 (0.7)	-	-	6 (1.4)
Non-elective hysterectomy	4 (0.5)	-	1 (0.4)	3 (0.7)
Thromboembolic event	4 (0.5)	-	-	4 (0.9)
Maternal death	1 (0.1)	-	-	1 (0.2)

Values in parenthesis are expressed as percentages.



often requires additional intrapartum maneuvers, consequently increasing maternal morbidity (20).

The results from a recent randomized trial including twin pregnancies delivering between 32 weeks 0 days and 38 weeks 6 days of gestation, with the first twin in the cephalic presentation, did not show significant differences in the risk of perinatal death or serious neonatal morbidity between planned cesarean and vaginal deliveries. Moreover, there were also no differences in maternal death or serious morbidity. However, more than 40% of women in the planned vaginal delivery group had a cesarean delivery (21).

Therefore, in daily clinical practice, decisions regarding the mode of delivery of a twin pregnancy rely on several factors including gestational age, fetal presentation, underlying severe maternal and fetal complications, past obstetric history, parental wishes and beliefs, and the obstetrician's skill, confidence, and ability to deliver a non-vertex second twin.

## ■ AUTHOR CONTRIBUTIONS

Stach SL and Liao AW collected the data, performed the statistical analysis and drafted the manuscript. Brizot ML performed data analysis and drafted the manuscript. Francisco RP and Zugaib M revised the manuscript.

## ■ REFERENCES

1. Conde-Agudelo A, Belizán JM, Lindmark G. Maternal morbidity and mortality associated with multiple gestations. *Obstet Gynecol.* 2000;95 (6 Pt 1):899-904, [http://dx.doi.org/10.1016/S0029-7844\(99\)00640-7](http://dx.doi.org/10.1016/S0029-7844(99)00640-7).
2. Vogel JP, Torloni MR, Seuc A, Betrán AP, Widmer M, Souza JP, Merialdi M. Maternal and perinatal outcomes of twin pregnancy in 23 low- and middle-income countries. *PLoS One.* 2013;8(8):e70549, <http://dx.doi.org/10.1371/journal.pone.0070549>.
3. Menacker F, Hamilton BE. Recent trends in cesarean delivery in the United States. *NCHS Data Brief.* 2010;(35):1-8.
4. Lee HC, Gould JB, Boscardin WJ, El-Sayed YY, Blumenfeld YJ. Trends in cesarean delivery for twin births in the United States: 1995-2008. *Obstet Gynecol.* 2011;118(5):1095-101, <http://dx.doi.org/10.1097/AOG.0b013e3182318651>.
5. Smulian JC, Ananth CV, Kinzler WL, Kontopoulos E, Vintzileos AM. Twin deliveries in the United States over three decades: an age-period-cohort analysis. *Obstet Gynecol.* 2004;104(2):278-85, <http://dx.doi.org/10.1097/01.AOG.0000134524.58795.bd>.
6. Burrows LJ, Meyn LA, Weber AM. Maternal morbidity associated with vaginal versus cesarean delivery. *Obstet Gynecol.* 2004;103(5 Pt 1):907-12, <http://dx.doi.org/10.1097/01.AOG.0000124568.71597.ce>.
7. Hall MH, Bewley S. Maternal mortality and mode of delivery. *Lancet.* 1999;354(9180):776, [http://dx.doi.org/10.1016/S0140-6736\(05\)76016-5](http://dx.doi.org/10.1016/S0140-6736(05)76016-5).
8. Hogle KL, Hutton EK, McBrien KA, Barrett JF, Hannah ME. Cesarean delivery for twins: a systematic review and meta-analysis. *Am J Obstet Gynecol.* 2003;188(1):220-7, <http://dx.doi.org/10.1067/mob.2003.64>.
9. Rabinovici J, Barkai G, Reichman B, Serr DM, Mashiach S. Randomized management of the second nonvertex twin: vaginal delivery or cesarean section. *Am J Obstet Gynecol.* 1987;156(1):52-6, [http://dx.doi.org/10.1016/0002-9378\(87\)90201-8](http://dx.doi.org/10.1016/0002-9378(87)90201-8).
10. Simões T, Aboim L, Costa A, Ambrosio A, Alves S, Blickstein I. Puerperal complications following elective Cesarean sections for twin pregnancies. *J Perinat Med.* 2007;35(2):104-7.
11. Haest KM, Roumen FJ, Nijhuis JG. Neonatal and maternal outcomes in twin gestations > or =32 weeks according to the planned mode of delivery. *Eur J Obstet Gynecol Reprod Biol.* 2005;123(1):17-21, <http://dx.doi.org/10.1016/j.ejogrb.2005.02.007>.
12. Pallasmaa N, Ekblad U, Aitokallio-Tallberg A, Uotila J, Raudaskoski T, Ulander VM, et al. Cesarean delivery in Finland: maternal complications and obstetric risk factors. *Acta Obstet Gynecol Scand.* 2010;89(7):896-902, <http://dx.doi.org/10.3109/00016349.2010.487893>.
13. Suonio S, Huttunen M. Puerperal endometritis after abdominal twin delivery. *Acta Obstet Gynecol Scand.* 1994;73(4):313-5, <http://dx.doi.org/10.3109/00016349409015769>.
14. Suzuki S, Hiraizumi Y, Miyake H. Risk factors for postpartum hemorrhage requiring transfusion in cesarean deliveries for Japanese twins: comparison with those for singletons. *Arch Gynecol Obstet.* 2012;286(6):1363-7, <http://dx.doi.org/10.1007/s00404-012-2461-9>.
15. Alexander JM, Gilstrap LC, Cox SM, Ramin SM. The relationship of infection to method of delivery in twin pregnancy. *Am J Obstet Gynecol.* 1997;177(5):1063-6, [http://dx.doi.org/10.1016/S0002-9378\(97\)70015-2](http://dx.doi.org/10.1016/S0002-9378(97)70015-2).
16. Lydon-Rochelle M, Holt VL, Easterling TR, Martin DP. Cesarean delivery and postpartum mortality among primiparas in Washington State, 1987-1996(1). *Obstet Gynecol.* 2001;97(2):169-74, [http://dx.doi.org/10.1016/S0029-7844\(00\)01119-4](http://dx.doi.org/10.1016/S0029-7844(00)01119-4).
17. Rebelo F, da Rocha CM, Cortes TR, Dutra CL, Kac G. High cesarean prevalence in a national population-based study in Brazil: the role of private practice. *Acta Obstet Gynecol Scand.* 2010;89(7):903-8, <http://dx.doi.org/10.3109/00016349.2010.484044>.
18. Smith GC, Shah I, White IR, Pell JP, Dobbie R. Mode of delivery and the risk of delivery-related perinatal death among twins at term: a retrospective cohort study of 8073 births. *BJOG.* 2005;112(8):1139-44, <http://dx.doi.org/10.1111/j.1471-0528.2005.00631.x>.
19. Liu AL, Yung WK, Yeung HN, Lai SF, Lam MT, Lai FK, et al. Factors influencing the mode of delivery and associated pregnancy outcomes for twins: a retrospective cohort study in a public hospital. *Hong Kong Med J.* 2012;18(2):99-107.
20. Häger RM, Daltveit AK, Hofoss D, Nilsen ST, Kolaas T, Øian P, et al. Complications of cesarean deliveries: rates and risk factors. *Am J Obstet Gynecol.* 2004;190(2):428-34, <http://dx.doi.org/10.1016/j.ajog.2003.08.037>.
21. Barrett JF, Hannah ME, Hutton EK, Willan AR, Allen AC, Armson BA, et al. Twin Birth Study Collaborative Group. A randomized trial of planned cesarean or vaginal delivery for twin pregnancy. *N Engl J Med.* 2013;369(14):1295-305.