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**Perinatal outcomes of triplet  
pregnancy experiencing vaginal  
birth**

질식분만을 경험한 삼태아 임신에서 주산기  
예후

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서울대학교 대학원

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# Perinatal outcomes of triplet pregnancy experiencing vaginal birth

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Abstract

# Perinatal outcomes of triplet pregnancy experiencing vaginal birth

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**Background:** In clinical practice, most pregnant women with triplet pregnancy deliver via cesarean delivery. However, there are few data regarding the optimal delivery mode in triplet pregnancy, and previous studies were based on observational studies with conflicting results.

**Objective:** This study aimed to determine whether trial of labor (TOL) is an alternative option for triplet pregnancy.

**Study design and population:** This retrospective cohort study included women with triplet pregnancy who were delivered at Seoul National University Hospital since November 1997 to December 2021. The candidates for TOL were defined as the presenting part of the

first fetus was vertex in triplets with absence of any contraindication for vaginal delivery. We compared maternal and neonatal outcomes between women with triplet pregnancy with attempted vaginal delivery and those with planned cesarean delivery. To reduce selection bias in the decision on the mode of delivery, we also used the propensity score matching method to compare the two groups.

**Results:** Of 487 triplet pregnancies, 216 were identified as candidates for TOL. Of these, 84 (39%) women attempted vaginal delivery, and 132 women chose planned cesarean delivery. Among the 84 cases of attempted vaginal delivery, 74 (88%) cases had successful vaginal delivery. Women who attempted vaginal delivery were more likely to be older and multiparous, have spontaneous preterm labor or premature rupture of membranes, or receive antenatal corticosteroids and antibiotics. The rates of maternal and neonatal morbidities did not differ between cases of attempted vaginal delivery and those of planned cesarean delivery. The duration of hospital stay after delivery was shorter in cases of attempted vaginal delivery than in those of planned cesarean delivery. After propensity score matching to reduce these factors, the risks of maternal and neonatal morbidities did not differ between the two matched groups.

**Conclusion:** In triplet pregnancy, attempted vaginal delivery did not increase the risk of maternal and neonatal morbidities, and it resulted in a shorter postpartum hospital stay. Our data suggest that vaginal delivery in triplet pregnancy can be attempted at a hospital with staffs that have experience with breech vaginal delivery of multiple pregnancies.

keywords : Triplet pregnancy, Mode of delivery, Trial of labor,  
TOL, Maternal outcomes, Neonatal outcomes

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# Introduction

Recently, the number of patients with multiple pregnancies, including triplet pregnancies, has been increasing [1]. This is due to the increase of assisted reproductive technology. Most of triplet pregnancies currently undergo planned cesarean deliveries in many countries. [2,3]. However, previous studies on the appropriate mode of delivery for triplet gestation have shown controversial results. Several studies reported that planned cesarean delivery showed better results in terms of perinatal outcome [4-11], whereas other studies reported that attempted vaginal delivery had better results [12-16]. A few studies reported no significant difference in perinatal outcomes between vaginal delivery and planned cesarean delivery [17-21]. To date, the largest research related to the mode of delivery in triplet pregnancy was a population-level study of 7,067 pregnant women beyond 24 weeks of gestational age at delivery [10]. In this study, Vintzileos et al. reported an increase of stillbirths, neonatal deaths, and infant deaths in triplet pregnancies that had attempted vaginal delivery. On the other hand, Peress et al. compared 21 triplet pregnancies who had undergone trial of labor (TOL) to 62 cases with planned cesarean delivery and reported there was no difference in adverse maternal or neonatal outcomes according to mode of delivery [20]. They demonstrated 57% of the cases with TOL succeeded in vaginal delivery.

The results of a large randomized controlled trial (RCT) conducted on women with twin pregnancies were recently published, and there was no difference in perinatal outcome between the attempted vaginal delivery and planned cesarean delivery [29]. However, there is no

RCT in women with triplet pregnancy. Most of the previous studies are retrospective cohort studies [6–8, 10–21]. It is unclear what the criterion for determining the decision of the mode of delivery was, and there is a problem that selection bias may be involved. As a result, it was difficult to derive reliable results as the baseline characteristics of the two groups were inherently different.

In the case of a population-based study using the national registry database, the variables included in the analysis were limited due to the lack of data on important clinical variables (eg, chorionicity, birthweight, birth order, inter-delivery interval, mode of conception, etc.) that could affect the results, and as a result, confounding variables could not be sufficiently adjusted [11, 21]. In addition, due to the characteristics of data that are not specifically recorded for each patient, there is a possibility that the intended mode of delivery and the actual mode of delivery have been misclassified [21]. As a result, there was a problem that the reliability of the results was lowered.

Previous studies were uncontrolled case series with a small cohort size or used historical control, and the proportion of the attempt vaginal delivery group was low. It was difficult to accurately compare the rare maternal and neonatal morbidity between the two groups. Most of the studies published so far had small cohort size between 15 and 105 women [6–8, 11–20]. Although the study conducted by Vintzileos et al. has the largest sample size among studies on the mode of delivery of triplet pregnancies, only 5% of the total number of subjects were in the attempted vaginal delivery group [10]. Although approximately 25% of the total cohort belonged to the

attempted vaginal delivery group in the study by Peress et al., and the proportion of the attempted vaginal delivery group was relatively higher, the absolute number of subjects included in attempted vaginal delivery group was still only 21 [20]. In the study by Mol et al., which analyzed 386 participants, the percentage of the attempted vaginal delivery group was as high as 43%, so far this is the largest cohort of vaginal delivery of triplet pregnancy [21]. However, there is a problem that the birth weight, which can affect the result, is not adjusted even though there is a significant difference between the two groups.

Most of the previous studies were analyzed based on data prior to 2000 [6-8, 10, 12-20], and even studies based on recent data only included data up to 2008 [11, 21], which did not reflect the current obstetric population and practice. In previous studies, perinatal mortality was very high, ranging from 14.8 to 30.0% [6, 16], there are obvious limitations in determining the optimal mode of delivery in women with triplet pregnancy at the present time based on this studies.

The present study aimed to investigate the association between the mode of delivery and maternal/neonatal morbidity in a large cohort of women who had delivered viable triplets at a single tertiary center in South Korea.

# Materials and Methods

## Ethics statements

The Institutional Review Board (IRB) of the Seoul National University Hospital Clinical Research Institute approved this study (IRB number: 1311-045-533). Additionally, informed consent was taken.

## Study design and population

This retrospective cohort study consisted of consecutive women with triplet pregnancy who were delivered at Seoul National University Hospital between November 1997 and December 2021. The inclusion criteria are as follow: 1) women with the vertex presentation of the first fetus and 2) women without any contraindication for vaginal delivery, such as previous cesarean section, uterine surgery, or placenta previa. Cases with births before 24 weeks, major congenital malformations, fetal death in utero (FDIU), twin-to-twin transfusion syndrome (TTTS), delayed interval delivery and attempt of delayed vaginal delivery, follow-up loss due to neonatal transfer to another hospital, severe preeclampsia, non-reassuring fetal heart rate (FHR), and clinical chorioamnionitis were excluded.

## Planned mode of delivery

The study population was divided into two groups according to the final mode of delivery: vaginal delivery versus cesarean delivery. All women were classified as the group with vaginal delivery, regardless of whether labor was spontaneous or induced. Cases of pre-labor cesarean delivery after preterm premature rupture of membrane

(PPROM) were classified as planned cesarean delivery group. Both TOL and planned cesarean delivery were decided to be performed after 34 weeks of gestation due to fetal lung maturation unless there was any indication for emergency preterm delivery. Antenatal corticosteroid for fetal lung maturation was administered in cases with planned induction of labor or cesarean delivery. Induction of labor was initiated by administration of vaginal prostaglandin suppository (either misoprostol or propess) for unfavorable cervix (Bishop score < 6) and intravenous infusion of synthetic oxytocin was followed. Most of the deliveries of triplet pregnancy were operated by one experienced attending physician. Continuous fetal heart rate monitoring was applied during labor.

## **Maternal and neonatal outcomes**

We compared the general characteristics, maternal outcomes, and neonatal outcomes between the two groups. General characteristics of the study population included maternal age, parity, body mass index (BMI) before delivery, method of conception (natural pregnancy, controlled ovarian hyperstimulation (COH) and in-vitro fertilization), and chorionicity. The presence of obstetric complications such as preterm labor (PTL) with regular uterine contractions and the use of tocolytics, PPRM, the use of antenatal corticosteroid, and the administration of antibiotics was reviewed thoroughly. The presentation of fetuses immediately before delivery was checked as well.

Basic obstetric outcomes including gestational age at delivery, neonatal birthweight and gender of newborns were explored. To check maternal morbidities, the use of blood transfusion, uterine

artery embolization, peripartum hysterectomy, wound infection, endometritis, postpartum pulmonary edema, pulmonary embolism, cardiomyopathy, and the duration of hospital stay were reviewed.

Neonatal outcomes to compare according to the delivery mode included small for gestational age (SGA), umbilical artery pH at birth, Apgar scores at 1 and 5 minutes under 7, NICU admission, respiratory distress syndrome (RDS), bronchopulmonary dysplasia (BPD), necrotizing enterocolitis (NEC), intraventricular hemorrhage (IVH), early-onset sepsis and neonatal death. Composite neonatal morbidity was defined as the occurrence of at least one of the following adverse outcomes: RDS, BPD, NEC, IVH and sepsis.

SGA was defined as a weight below the 10<sup>th</sup> percentile for the gestational age [22]. RDS was diagnosed as the presence of respiratory distress, an increased oxygen requirement ( $\text{FiO}_2 > 0.4$ ), and diagnostic radiological and laboratory findings in the absence of evidence of any other causes of respiratory distress [23]. BPD was diagnosed using the criteria of the National Institute of Child Health Workshop definition, i.e., the treatment with oxygen  $> 21\%$  for at least 28 d, and also diagnosed in the presence of typical findings at autopsy [24]. NEC was diagnosed in the presence of abdominal distension and feeding intolerance (vomiting or increased gastric residual) for at least 24 hours with clear evidence of intramural air, perforation, and meconium plug syndrome by radiological examination, or definite surgical or autopsy findings of NEC [25]. Neurosonographic examinations were performed as part of routine clinical care in preterm neonates. Sonographic findings of periventricular-intraventricular hemorrhage were graded into three categories according to McMenamin's classification: 1) grade I:

subependymal hemorrhage with minimal or no IVH; 2) grade II: IVH, but neither lateral ventricle completely filled with blood, with or without mild ventricular dilatation; and 3) grade III: IVH completely filling and distending at least one lateral ventricle. IVH was defined as Grade II or III by McMenamin's classification [26] in usual, but our study also included grade I IVH, because there were too small cases of adverse neonatal outcome to compare. Early-onset sepsis was diagnosed in the presence of a positive blood culture result within 72 hours of delivery [27].

## Statistical analysis

Continuous variables between the groups were analyzed using the t-test, and proportions were analyzed using the chi-square test or Fisher exact test. A generalized estimating equation was used in multivariate analysis to account for the familial correlation between triplet pairs from a single mother. For multivariable analysis, potential confounding covariates selected from the univariate analysis ( $p < 0.05$ ) were included as risk factors for adverse outcomes. Additionally, propensity score (PS) matching analysis was conducted to address selection bias. Multivariable logistic regression was performed to derive the PS with covariates. A greedy 1:1 matching algorithm was applied to match each woman with attempted vaginal delivery to a woman with planned cesarean delivery using a caliper width of 0.01 standard deviation of the log odds of the PS.

Statistical significance was set at  $p < 0.05$ . Statistical analyses were conducted using SPSS Statistics for Windows (version 20.0; IBM Corp., Armonk, NY, USA) and R (version 4.2.0, R Foundation for Statistical Computing, Vienna, Austria (<http://www.R-project.org>)).



## Results

During the study period, 487 cases (1,461 neonates) of triplet pregnancy delivered at Seoul National University Hospital. Figure 1. demonstrates the flow of inclusion for the study population. Patients with contraindications for vaginal delivery (n=168), births before 24 weeks (n=12), major congenital malformations (n= 17), FDIU or TTTS (n=19), follow-up loss due to transfer to another hospital (n=5), non-reassuring FHR pattern before labor and chorioamnionitis (n=7), severe preeclampsia (n=21), and delayed interval delivery or attempted delayed interval delivery (n=22) were excluded. Major congenital malformations included anencephaly (n=1), cleft palate (n=1), complex heart anomalies (n=7) such as pulmonary artery stenosis, and tetralogy of Fallot (n=2), lipomyelomeningocele (n=1), duodenal atresia (n=1), neuroblastoma (n=1), imperforate anus (n=1), cloacal anomaly (n=1) and Down syndrome with multiple anomalies (n=1). The minor congenital malformations included in the study population were clubfoot, inguinal hernia, arachnoid cyst, polydactyly, hydrocele, kidney pyelectasia, and mild ventriculomegaly. A total of 216 cases were included in the final study population. Among them, 39% (84/216) attempted vaginal delivery while 132 cases underwent planned cesarean delivery.

Table 1 shows the baseline characteristics of the study population. Attempted vaginal delivery group had older maternal age (34 vs. 33 years,  $p=0.008$ ) and higher rate of multiparous women (26% vs. 7%,  $p<0.001$ ) than planned cesarean delivery group. The use of assisted reproductive technology and the composition of chorionicity were comparable between two groups. Women with attempted vaginal

delivery were more likely to have PTL or PPROM (54% vs. 28%,  $p<0.001$ ) and to receive antenatal corticosteroids (69% vs. 45%,  $p<0.05$ ) and antibiotics (38% vs. 16%,  $p<0.001$ ) than those with planned cesarean delivery. The presentation of fetuses and gestational age at delivery were not significantly different between two groups, however neonatal birthweight was smaller in attempted vaginal delivery group than cesarean delivery group (1850 vs. 1970 grams,  $p<0.001$ ). In the attempted vaginal delivery group, 88% (74/84) succeeded in vaginal delivery. The causes of failed vaginal delivery were induction failure or failure to progress for 9 cases and maternal request for 1 case. There was no case of combined delivery.

Maternal and neonatal outcomes are presented in Table 2. The rate of maternal morbidity, including blood transfusion, uterine artery embolization, endometritis, postpartum pulmonary edema, and cardiomyopathy, were not significantly different between two groups. There was no peripartum hysterectomy, wound infection, pulmonary embolism, and maternal death in the study population. Two cases with endometritis and one case with cardiomyopathy were found in planned cesarean delivery group while attempted vaginal group had none of them. The rates of maternal morbidity were comparable between two groups even after adjustment for the confounding variables selected in univariate logistic regression analysis (maternal age, nulliparity, PTL/PPROM, antenatal corticosteroid, antibiotics, neonatal birthweight). In women who attempted vaginal delivery, the duration of hospital stay after delivery was shorter than that in those who underwent planned cesarean delivery.

In the analysis of neonatal outcomes, the pH of umbilical artery at

birth, Apgar scores at 1 minute and 5 minutes, the rate of NICU admission, RDS, BPD, NEC, IVH and sepsis were not significantly different between the attempted vaginal delivery group and the planned cesarean delivery group (all  $p>0.05$ ). The rates of composite neonatal morbidity was slightly higher in attempted vaginal delivery group than cesarean delivery group (8% vs. 5%, adjusted  $p=0.637$ ), however the difference did not reach the statistical significance even after adjustment of confounding factors. The result was same when the composite morbidity was compared after the neonates were divided into two groups according to the gestational age at delivery: at or before 34 weeks and over 34 weeks. There was no neonatal death in this study population.

To generate PSs for the probability of attempting vaginal delivery, variables that were different between the groups were used. The final matched group consisted of 36 women who underwent vaginal delivery and 36 who underwent planned cesarean delivery noted on table 3. As a result of matching, the baseline characteristics, including maternal age, parity, PTL/PPROM, use of antenatal corticosteroids and antibiotics, and birth weight, were not different between the two matched groups. Maternal and neonatal morbidities also did not differ between the matched groups even after adjustment of confounding factors.

## Discussion

The principle findings of this study were 1) the success rate of vaginal delivery among the triplet pregnancies with TOL was near 90% (74/84) in this study; 2) vaginal delivery in triplet pregnancy did not increase maternal morbidity; 3) neonatal outcomes were comparable between attempted vaginal delivery group and planned cesarean delivery group. This study consisted of more than 200 cases with triplet pregnancies and among them, about 40% (84/216) underwent TOL. Although this study has a certain limitation from the retrospective design, the number of cases analyzed was absolutely larger than any other previous study from single center. To our best knowledge, the present study is the largest cohort study from a single center among the studies conducted on the delivery mode of triplet pregnancy.

The rate of attempted vaginal delivery in this study was higher than that reported in previous studies. Peress et al. recently conducted a study on women with triplet pregnancy beyond 24 weeks of gestational age at delivery and reported that 21 of 83 women (25.3%) chose TOL [20]. Lappen et al. reported that TOL was performed in 24 patients (30% of 80 patients) in a multicenter study of women with triplet pregnancy beyond 28 weeks gestational age at delivery [11]. In another investigation that included women with late gestational age at delivery, the rate of vaginal delivery was higher than that in our study [21]. The differences in gestational age at delivery may have contributed to the differences in the rate of attempted vaginal delivery from study to study.

In the present study, the success rate of attempted vaginal delivery was 88% (74/84), which was significantly higher than that reported in a previous study as well. Lappen et al. reported that 16.7% of patients had successful attempted vaginal delivery, whereas Peress et al. reported that 57.1% of women with TOL had vaginal delivery of all three triplets [11, 20]. The rate of successful vaginal delivery in triplet pregnancies seems to be very different since the capacity or characteristics of each center facility and the presence of experienced experts determine the management protocols and thus perinatal outcomes. Attempting vaginal delivery in multifetal pregnancies, especially in triplet pregnancies, has to be ready for emergency situations such as the possibility of fetal distress and needs to collaborate many experts in various fields including anesthesiologists and neonatologists.

In this study, attempted vaginal delivery group showed older maternal age (34 vs. 33 years,  $p=0.008$ ) and higher rate of multiparous women (26% vs. 7%,  $p<0.001$ ) than cesarean delivery group. Moreover, women with attempted vaginal delivery had higher rates of risk factors or tendency for preterm births such as PTL/ PPRM (53% vs. 28%,  $p<0.001$ ), the use of antenatal corticosteroids (69% vs. 45%,  $p<0.05$ ) and antibiotics (38% vs. 16%,  $p<0.001$ ) than those with planned cesarean delivery. In fact, neonatal birthweight was significantly smaller in attempted vaginal delivery group than cesarean delivery group (1850 vs. 1970 grams,  $p<0.001$ ). These results could be interpreted as the factors that lead to successful vaginal delivery. In other words, experts can select cases that have high possibility of successful vaginal delivery considering those factors: multiparity, the presence of risk factors for preterm birth including

PTL/PPROM, and smaller estimated fetal weight. When an attending physician without experience of vaginal delivery in multifetal pregnancies wants to attempt TOL, he or she should evaluate the obstetric characteristics thoroughly and then, begin to try the cases with those factors that might increase the possibility of successful vaginal delivery. For example, multiparous women with small fetuses and spontaneous uterine contractions can be good candidates for attempting vaginal delivery.

In addition, there was no combined delivery which is defined as vaginal delivery for presenting fetus and cesarean delivery for the other. This is because the center in which this study was conducted has established clinical management protocols for long time and equipped facilities to enable immediate interventions even if an adverse event occurs while attempting TOL. The medical staffs who participated in delivery of triplet pregnancies have to be proficient in intrapartum fetal monitoring, and these background factors influence the perinatal outcomes of vaginal delivery. The neonatal outcomes of the whole study population are relatively good because this study was conducted at the single tertiary center with extensive experience in vaginal delivery of multiple gestations, and in breech delivery.

The average gestational age at delivery was 35 weeks and there was no significant difference between the groups in this study. The latest gestational ages at delivery were 38+4 weeks in the attempted vaginal delivery group and 36+3 weeks in the planned cesarean delivery group. Since attempting vaginal delivery can be delayed until the development of spontaneous labor, the maximum value of gestational age at delivery was longer in cases with attempted

vaginal delivery than in those with planned cesarean delivery. In this study, delivery was performed at later gestational age than that in previous studies [16, 17, 21]. The gestational age at delivery was approximately 2 weeks later than that in previous studies [11, 15, 21], and it could be explained by the nature of Korean National insurance system that allows frequent visits and hospitalizations for fetal surveillance and the characteristic of the study's institution as a tertiary center for high-risk pregnancy. Remarkably, there was no maternal death in either group as well as neonatal death, and these outcomes are far better than those of previous studies [6, 8, 10, 11, 15, 21].

Through this study, we could suggest that attempting vaginal delivery in triplet pregnancies do not seem to increase adverse neonatal outcomes. Detailed neonatal outcomes such as the pH of umbilical artery at birth, Apgar scores at 1 minute and 5 minutes, the rate of NICU admission, RDS, BPD, NEC, IVH and sepsis were comparable between the attempted vaginal delivery group and the planned cesarean delivery group (all  $p>0.05$ ). Even when analyzed using grouping composite neonatal morbidity, vaginal delivery does not increase the risk significantly. The strong point of this study was the application of PSs to complex analysis of multifetal pregnancies. Through PSs analysis, we could find the neonatal outcomes of attempted vaginal delivery did not show higher risk than those of planned cesarean delivery after adjustment of confounding factors.

Another important strength of this study was that we also reviewed the presentation of each fetus and chorionicity of the study population. The presentation and chorionicity of the second and third

fetuses are known to affect the success rate of TOL and maternal and neonatal outcomes [16, 28]. Ziadeh et al. presented that breech presentation was highly associated with perinatal mortality than vertex presentation [16]. Curado et al. presented that dichorionic triamniotic (DCTA) triplets worsened perinatal mortality and morbidity than trichorionic triamniotic (TCTA) triplets [28]. However, most of population-based cohort studies using nationwide databases do not specify the detailed information on presentations and chorionicity, therefore have limited interpretation in multifetal pregnancy research.

As mentioned above, the present study has certain limitation due to its retrospective nature. Since both groups were not randomly assigned, all women who had labor pain were assigned to the attempted vaginal delivery group. As a result, bias could not be completely avoided, even if confounding variables affecting the outcome were thoroughly controlled through PS matching. In addition, this study's results cannot be generalized and applied to all delivery centers with different practice settings as it was conducted in a single tertiary center with extensive experience in vaginal delivery of multiple gestations. In clinical practice, various factors such as the NICU capacity, differences in the skill level of the NICU staff, and the psychological burden of obstetricians should also be considered. In most delivery centers, it is difficult to provide full coverage for 24 hours, 365 days a year. As the delivery time cannot be controlled with vaginal delivery, it is necessary to consider the lack of professional NICU personnel to support delivery at night. Additionally, the psychological burden of obstetricians is likely to be higher in attempted vaginal delivery than in planned cesarean delivery, as



various events can occur at any time during labor. Lastly, although selection bias was minimized through PS matching, there may be factors other than maternal age, gestational age, nulliparity, PTL/PPROM, antenatal corticosteroid and antibiotics use that could not be considered, and in fact, the sample size was decreased to 36 cases per group during the matching process.

Additional studies with a large number of patients are needed in the future to draw accurate conclusions and establish specific guidelines containing indications for attempted vaginal delivery in triplet pregnancy. By performing vaginal delivery for selected triplet gestations based on evidence-based medicine, it will be possible to reduce the cesarean section rate and duration of hospital stay after delivery, ultimately reducing unnecessary medical expenses.

## Conclusion

In conclusion, attempted vaginal delivery did not increase the risk of maternal and neonatal morbidities, and it resulted in a shorter postpartum hospital stay in triplet pregnancy than planned cesarean section. Our study findings indicate that vaginal delivery of triplet pregnancy can be a good option to attempt in a well-equipped hospital with staffs experienced in breech vaginal birth of multiple pregnancies.

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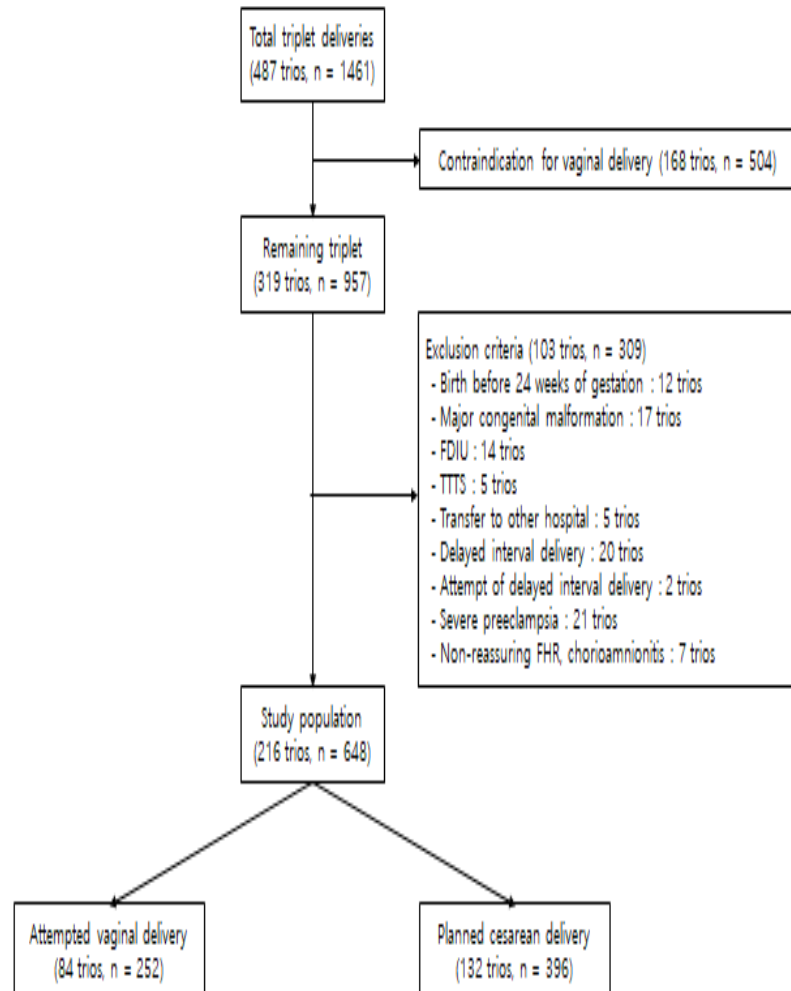
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**Figure 1.** Study population

Birth in Seoul National  
University Hospital  
between Nov. 1997 and  
Dec. 2021



FDIU, fetal death in utero; TTTS, twin-twin transfusion syndrome; FHR, fetal heart rate

**Table 1.** Characteristics of the study population in patients who were candidates for trial of labor

	Attempted vaginal delivery (N= 84 trios)	Planned Cesarean delivery (N=132 trios)	P-value
<b>Maternal characteristics</b>			
Maternal age (year)	34.27 ± 3.25	33.02 ± 3.41	0.008
Nulliparity (% , N)	73.81 (62/84)	93.18 (123/132)	<0.001
BMI before delivery (kg/m2)	27.61 (25.37-30.00)	27.72 (25.53-30.38)	0.795
<b>Pregnancy characteristics</b>			
Method of conception (% , N)			0.381
Spontaneous	7.14 (6/84)	12.12 (16/132)	
COH	27.38 (23/84)	30.30 (40/132)	
In vitro fertilization	65.48 (55/84)	57.58 (76/132)	
Chorionicity (% , N)			0.276
TCTA	58.33 (49/84)	65.15 (86/132)	
DCTA	28.57 (24/84)	28.03 (37/132)	
MCTA	13.10 (11/84)	6.82 (9/132)	
Preterm labor/ Preterm premature rupture of membranes (% , N)	53.57 (45/84)	28.03 (37/132)	<0.001
Antenatal corticosteroid (% , N)	69.05 (58/84)	44.70 (59/132)	0.001
Antibiotics (% , N)	38.10 (32/84)	16.03 (21/131)	<0.001
Presentation of total fetuses			0.208
Cephalic/cephalic/cephalic	26.19 (22/84)	31.82 (42/132)	
Cephalic/cephalic/noncephalic	38.10 (32/84)	25.76 (34/132)	
Cephalic/noncephalic/cephalic	13.10 (11/84)	11.36 (15/132)	
Cephalic/noncephalic/noncephalic	22.62 (19/84)	31.06 (41/132)	
Gestational age at delivery (weeks)	35.0(32.59-35.30)	35.0(34.40-35.30)	0.145
Vaginal delivery (% , N)	88.09 (74/84)	-	
<b>Neonatal</b>			
	(N=252 neonates)	(N=396 neonates)	
Birthweight (kg)	1.85 (1.64-2.08)	1.97 (1.75-2.20)	<0.001
Small for Gestational age (<10th percentile)	18.65 (47/252)	19.95 (79/396)	0.760
Male	51.98 (131/252)	55.05 (218/396)	0.495

BMI, body mass index; COH, controlled ovarian hyperstimulation; TCTA, trichorionic triamniotic; DCTA, dichorionic triamniotic; MCTA, monochorionic triamniotic

Values are given as median (interquartile range) and mean (standard deviation) or % (n/N)

**Table 2.** Maternal and neonatal outcomes of the study population in patients who were candidates for trial of labor

	Attempted vaginal delivery (N= 84 trios)	Planned Cesarean delivery (N=132 trios)	P-value	
			P	Adjust ed PS
<b>Maternal outcomes</b>				
Blood transfusion	25.00% (21/84)	17.42% (23/132)	0.189	0.079
Uterine artery embolization	3.57% (3/84)	2.27% (3/132)	0.589	0.411
Peripartum hysterectomy	0.00% (0/84)	0.00% (0/132)	-	-
Wound infection	0.00% (0/84)	0.00% (0/132)	-	-
Endometritis	0.00% (0/84)	1.52% (2/132)	0.154	0.168
Postpartum pulmonary edema	3.57% (3/84)	3.79% (5/132)	0.934	0.923
Pulmonary embolism	0.00% (0/84)	0.00% (0/132)	-	-
Cardiomyopathy	0.00% (0/84)	0.76% (1/132)	0.315	0.341
Total morbidity	28.57% (24/84)	21.21% (28/132)	0.226	0.097
Death	0.00% (0/84)	0.00% (0/132)	-	-
Duration of hospital stay after delivery	3.00 (3.00-4.00)	5.00 (5.00-6.00)	<.001	<.001
<b>Neonatal outcomes</b>				
	(N=252 neonates)	(N=396 neonates)	P	Adjust ed P+
Umbilical artery pH at birth	7.30 (7.27-7.33)	7.31 (7.29-7.33)	0.710	0.368
1 min Apgar score<7	36.51% (92/252)	28.28% (112/396)	0.091	0.217
5 min Apgar score<7	3.17% (8/252)	4.55% (18/396)	0.495	0.084
NICU admission	54.37% (137/252)	45.71% (181/396)	0.149	0.126
RDS	4.96% (12/242)	3.03% (12/396)	0.333	0.827
BPD	2.47% (6/243)	0.76% (3/396)	0.289	0.471
NEC	0.83% (2/242)	1.01% (4/396)	0.810	0.445
IVH	1.23% (3/243)	1.01% (4/396)	0.822	0.789
Sepsis	0.41% (1/242)	0.25% (1/396)	0.739	0.933
*Composite neonatal morbidity	7.94% (20/252)	5.05% (20/396)	0.293	0.637
≤34 weeks.	21.11% (19/90)	20.00% (15/75)	0.893	0.539
Over 34 weeks.	0.62% (1/162)	1.56% (5/321)	0.304	0.518
Death	0.0% (0/252)	0.0% (0/396)	-	-

NICU, neonatal intensive care unit; RDS, respiratory distress syndrome; BPD, bronchopulmonary dysplasia; NEC, necrotizing enterocolitis; IVH, intraventricular hemorrhage

Values are given as median (interquartile range) and % (n/N)

\* Composite neonatal morbidity was defined as the presence of at least one of the following; RDS, BPD, NEC, IVH, sepsis

§ Adjusted for maternal age, nulliparity, preterm labor (PTL)/preterm premature rupture of membranes (PPROM), antenatal corticosteroid, antibiotics, neonatal birthweight

+ Adjusted for PTL/PPROM, antenatal corticosteroid, antibiotics, gestational age at delivery, fetal presentation by generalized estimating equation



**Table 3.** The comparison of attempted vaginal delivery group and planned cesarean delivery group using propensity score matching analysis matching by maternal age, gestational age, nulliparity, PTL/PPROM, antenatal corticosteroid and antibiotics

	Attempted vaginal delivery (N=36 trios)	Planned Cesarean delivery (N= 36 trios)	P-value
<b>Maternal characteristics</b>			
Maternal age (year)	33.92 ± 2.70	34.47 ± 2.80	0.394
Nulliparity (% , N)	91.67 (33/36)	91.67 (33/36)	>0.999
BMI before delivery (kg/m2)	28.06 ± 4.24	28.50 ± 4.04	0.669
<b>Pregnancy characteristics</b>			
Method of conception (% , N)			0.535
Spontaneous	2.78 (1/36)	8.33 (3/36)	
COH	25.00 (9/36)	19.44 (7/36)	
In vitro fertilization	72.22 (26/36)	72.22 (26/36)	
Chorionicity (% , N)			0.565
TCTA	52.78 (19/36)	58.33 (21/36)	
DCTA	30.56 (11/36)	33.33 (12/36)	
MCTA	16.67 (6/36)	8.33 (3/36)	
Preterm labor/Preterm premature rupture of membranes (% , N)	38.89 (14/36)	33.33 (12/36)	0.806
Antenatal corticosteroid (% , N)	63.89 (23/36)	61.11 (22/36)	>0.999
Antibiotics (% , N)	25.00 (9/36)	25.00 (9/36)	>0.999
Presentation of total fetuses (% , N)			0.108
Cephalic/cephalic/cephalic	22.22 (8/36)	27.78 (10/36)	
Cephalic/cephalic/noncephalic	41.67 (15/36)	16.67 (6/36)	
Cephalic/noncephalic/cephalic	8.33 (3/36)	19.44 (7/36)	
Cephalic/noncephalic/noncephalic	27.78 (10/36)	36.11 (13/36)	
Gestational age at delivery (weeks)	35.10 (34.36 - 35.30)	35.10 (33.85 - 35.30)	0.777
<b>Neonatal</b>			
	(N=108 neonates)	(N=108 neonates)	
Birthweight (kg)	1.93 (1.70–2.10)	1.92 (1.65–2.17)	0.999
Small for Gestational age (<10th percentile)	19.44% (21/108)	24.07% (26/108)	0.509
Male	50.93% (55/108)	59.26% (64/108)	0.274

<b>Maternal outcomes (n=1)</b>			P	Adjusted P
Blood transfusion	30.56% (11/36)	16.67% (6/36)	0.160	0.107
Uterine artery embolization	5.56% (2/36)	2.78% (1/36)	0.554	0.549
Peripartum hysterectomy	0.00% (0/36)	0.00% (0/36)	-	-
Wound infection	0.00% (0/36)	0.00% (0/36)	-	-
Endometritis	0.00% (0/36)	2.78% (1/36)	0.310	0.293
Postpartum pulmonary edema	5.56% (2/36)	5.56% (2/36)	>0.999	0.931
Pulmonary embolism	0.00% (0/108)	0.00% (0/108)	-	-
Cardiomyopathy	0.00% (0/36)	0.00% (0/36)	-	-
Total morbidity				
≤34wks	50.00% (4/8)	30.00% (3/10)	0.382	0.067
Over 34wks	32.14% (9/28)	19.23% (5/26)	0.271	0.395
Death	0.00% (0/36)	0.00% (0/36)	-	-
<b>Neonatal outcomes (n=3)</b>				
Umbilical artery pH at birth	7.30(7.28 - 7.33)	7.31(7.29 - 7.33)	0.265	0.338
1 min Apgar score<7	38.89% (42/108)	31.48%(34/108)	0.349	0.132
5 min Apgar score<7	2.78% (3/108)	5.56% (6/108)	0.337	0.376
NICU admission	46.30% (50/108)	41.67%(45/108)	0.647	0.664
RDS	3.81% (4/105)	3.70% (4/108)	0.973	0.603
BPD	0.00% (0/108)	0.00% (0/108)	-	-
NEC	0.95% (1/105)	1.85% (2/108)	0.569	0.720
IVH	0.95% (1/105)	1.85% (2/108)	0.661	0.764
Sepsis	0.95% (1/105)	0.93% (1/108)	0.984	0.884
*Composite neonatal morbidity				
≤34wks	25.00% (6/24)	23.33% (7/30)	0.913	0.250
Over 34wks	0.00% (0/84)	0.00% (0/78)	-	-
Death	0.00% (0/108)	0.00% (0/108)	-	-

PTL, preterm labor; PPROM, premature rupture of membrane; BMI, body mass index; COH, controlled ovarian hyperstimulation; TCTA, trichorionic triamniotic; DCTA, dichorionic triamniotic; MCTA, monochorionic triamniotic; NICU, neonatal intensive care unit; RDS, respiratory distress syndrome; BPD, bronchopulmonary dysplasia; NEC, necrotizing enterocolitis; IVH, intraventricular hemorrhage  
Values are given as median (interquartile range) and mean (standard deviation) or % (n/N)

\* Composite neonatal morbidity was defined as the presence of at least one of the following; RDS, BPD, NEC, IVH, sepsis

## 국문초록

**배경:** 임상적으로, 대부분의 삼태아 임신은 경험적으로 제왕절개 방법을 통해 분만된다. 그러나 삼태아에서 적절한 분만 방법에 대한 연구가 부족하며, 이전의 대부분의 연구들은 관찰연구이고 그 결과 또한 논쟁의 여지가 있다.

**목적:** 이 연구는 삼태아에서 자연분만의 시도(trial of labor, TOL)를 분만방법으로 선택할 수 있을지 알아보기 위해 시행되었다.

**연구 설계:** 1997년 11월부터 2021년 12월까지 서울대학교병원에서 분만한 삼태아 임신부 및 삼태아를 연구 대상으로 하였다. 분만 시도의 대상자는 첫 번째 태아의 선진부가 두위이고 질식분만의 금기사항이 없는 산모를 대상으로 하였다. 자연분만을 시도한 군과 제왕절개를 계획하여 시행한 군 사이에 산모 및 신생아의 이환율을 비교하였다. 분만 방법을 결정하는 데에 있어서 선택 편의(selection bias)를 줄이기 위해 성향점수 매칭(propensity score matching) 방법을 사용하였다.

**결과:** 487쌍의 삼태아 임신 중에서 216건이 분만시도의 적응증이 되었다. 그 중 84(39%)명의 산모가 자연분만을 시도하였으며, 132명은 제왕절개를 계획하여 시행하였다. 84명의 자연분만을 시도한 경우 중에 자연분만에 성공한 건수는 74건이었다(88%). 자연분만을 시도한 군에서 산모의 나이가 더 많았고, 경산모였으며, 자연조기진통이나 조기양막파수, 스테로이드나 항생제를 미리 투여 받은 경우가 더 많았다. 산모 및 신생아의 예후는 자연분만을 시도한

군과 계획된 제왕절개를 시행한 군에서 의미 있는 차이가 없었다. 재원기간은 자연분만을 시도한 군에서 의미 있게 더 짧았다. 성향 점수 매칭 방법을 사용하여 비교한 경우에도, 두 군 간에 예후의 차이가 없었다.

**결론:** 삼태아 임신에서 자연분만을 시도하는 것은 산모 및 신생아의 이환율을 높이지 않을뿐더러, 병원 재원기간을 줄인다. 그러므로 다태아 임신의 자연분만에 충분한 경험이 있는 병원에서는 삼태아의 자연분만 시도가 가능할 수 있겠다.

**주요어 :** 삼태아 임신, 분만 방법, 자연분만의 시도, 산모의 예후, 신생아의 예후

**학 번 :** 2014-21120