Can Fetal Weight Discordancy Measured by Ultrasound During Pregnancy Predict Maternal Complications and Neonatal Outcomes in Dichorionic Diamniotic Twins?

Hyun Mi Kim
Kyungpook National University Hospital, Kyungpook National University School of Medicine

Hyun-Hwa Cha
Kyungpook National University Hospital, Kyungpook National University School of Medicine
https://orcid.org/0000-0002-4399-7627

Won Joon Seong
Kyungpook National University Hospital, Kyungpook National University School of Medicine
https://orcid.org/0000-0002-8088-2554

Mi Ju Kim (ties1004@naver.com)
Kyungpook National University Hospital, Kyungpook National University School of Medicine
https://orcid.org/0000-0001-9770-1580

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Abstract

Purpose: The aim of this study was to determine the relationships between the estimated fetal weight discordancy, which was measured by ultrasound during pregnancy, and maternal pregnancy complications and neonatal outcomes in dichorionic diamniotic twin pregnancies.

Methods: We conducted a retrospective review of the medical records of 320 twin pregnancies delivered at Chilgok Kyungpook National University Hospital between January 2011 and February 2020. This study included dichorionic diamniotic twin mothers who delivered between 32+1 and 38+0 weeks of gestation. Mothers who had one fetal demise, a major anomaly, or twin-specific complications were excluded. At 20–24 weeks and 28–32 weeks of gestation, participants were divided into 2 groups: discordant twins with an estimated fetal weight difference of more than 20% and concordant twins with a weight difference of less than 20%. The maternal complications and neonatal outcomes were compared between the two groups.

Results: The incidences of preeclampsia and placenta previa were significantly higher in discordant twins measured between 20 and 24 weeks compared with concordant twins, but no statistical significance was found in the neonatal outcomes between the two groups. Delivery times were earlier and neonatal weights were lower in discordant twins measured between 28 and 32 weeks. Neonatal outcomes such as ventilator use and neurodevelopment were also significantly different.

Conclusion: Discordance in estimated fetal weight measured by ultrasound between 20 and 24 weeks is a risk factor for maternal preeclampsia and placenta previa, whereas discordancy at 28–32 weeks can predict poor neonatal outcomes.

Introduction

The incidence of multifetal pregnancies, including twins and triplets, is increasing worldwide. In the United States, approximately 33.3 births per 1000 pregnancies were twin pregnancies in 2009, a 76% increase since 1980 [1]. Increasing maternal age and pregnancy by assisted reproductive techniques (ART) contribute to increased twin births [2, 3]. The incidences of maternal pregnancy-related complications and neonatal morbidities and mortalities are higher in twin pregnancies compared to singleton pregnancies. Preeclampsia occurs 2.6 times more frequently in twin pregnancies, which increases the risk of placental abruption and preterm delivery [4]. Twin pregnancies also increase maternal morbidities, such as gestational diabetes, postpartum bleeding, and operative delivery [5–8]. In neonates, twin pregnancies increase the risk of stillbirth by approximately 5 times [9]. In addition, neonatal morbidity, and mortality increase, including a 6-fold increase in preterm birth before 34 weeks [10]. Moreover, risks, such as preterm birth and stillbirth, congenital fetal anomaly, intrauterine growth restriction (IUGR), umbilical artery acidosis, neonatal intensive care unit (NICU) admission, and respiratory distress, are increased in discordant twins whose birth weights differ by more than 20% [11, 12]. Neonatal morbidity increases by approximately 7.7 times in discordant twins and small for gestational age (SGA)

babies [12]. Fetal weight discordancy after birth has been used to predict the prognosis. The purpose of this study was to determine if discordancy of the estimated fetal weight could predict neonatal outcomes of twin babies based on the ultrasound findings of the fetus performed during the prenatal examination. In addition, the relationship between weight discordancy and maternal pregnancy complications was investigated. This study used the estimated fetal weights between 20 and 24 weeks and 28 and 32 weeks of gestation of twin pregnancies and compared maternal and neonatal outcomes between discordant and concordant fetal weight groups.

Materials And Methods

The medical records of 320 patients with twin pregnancies who delivered at Chilgok Kyungpook National University Hospital in Daegu, South Korea, between January 2011 and February 2020 were retrospectively reviewed. Of these, 48 pregnancies delivered before 32 + 0 weeks of gestation were excluded from the study, and an additional 29 women were excluded because of major fetal anomalies, chromosomal abnormalities, and fetal death in utero. Four women with unclear chorionicity, 3 women with monochorionic-monoamniotic twins, and 23 women with monochorionic-diamniotic twins were also excluded. When the chorionicity in the medical records and placental pathologic findings after delivery were different, the pathologic result was followed. 10 cases of twin-to-twin transfusion syndromes were excluded. Thus, 117 pregnancies were excluded, and 203 twin pregnancies were reviewed. The fetal ultrasonography (Samsung Medison WS 80a, Korea) reports between 20 and 24 weeks of gestation of pregnancy, 28 and 32 weeks of gestation were reviewed. The weight was measured three times per fetus, and the average values were taken as the estimated fetal weight. Ninety-seven pregnancies were delivered but did not have ultrasonographic measurements between 20 and 24 weeks of gestation or 28 and 32 weeks of gestation and were excluded from the study. Thus, the final number of pregnancies included in the analyses was 106.

Weight discordancy was measured using the estimated fetal weight of the two fetuses, which was multiplied by 100 after dividing the difference between the weights of two fetuses by the expected weight of the large fetus, as defined in previous studies [3]. If the value was more than 20%, the fetuses were classified as discordant twins, and if the value was less than 20%, the fetuses were classified as concordant twins according to the consensus of The American College of Obstetricians and Gynecologists (ACOG) and the International Society of Obstetrics and Gynecology (ISUOG) [13]. Maternal characteristics, such as age at delivery, parity, pre-pregnancy body mass index (BMI), use of ARTs, and pregnancy-related complications, such as preeclampsia, placenta previa, gestational diabetes (GDM), threatened preterm labor, and postpartum bleeding, were compared. Preeclampsia was characterized by a blood pressure of 140/90 mmHg or more and proteinuria of 300 mg or more for 24 hours after 20 weeks of gestation in accordance with the criteria of the International Society for the Study of Hypertension in Pregnancy. For GDM, a 50-gm glucose tolerance test was performed as a screening test between 24 and 28 weeks of gestation, and a 100-gm glucose tolerance test was performed when the value was over 140 mg/dL. GDM was diagnosed in accordance with the Carpenter–Coustan criteria. Placenta previa was defined by evaluating the location of the placenta through ultrasound immediately before delivery,

including placenta previa totalis, placenta previa partialis, placenta previa marginalis, and low-lying placenta. Threatened preterm labor was defined as inpatient conservative treatment before 37 weeks of gestation due to regular uterine contractions and a short cervical length of less than 2.5 cm. Postpartum bleeding was bleeding of more than 1 liter or transfusion due to anemia after delivery. Deliveries scheduled on a date without an event were classified as elective, deliveries due to labor pain were classified as spontaneous, and emergency deliveries due to preeclampsia or poor fetal condition were classified as iatrogenic. To compare the neonatal outcomes of discordant and concordant twins between 20 and 24 weeks of gestation and 28 and 32 weeks of gestation, gestational age at delivery, neonatal birth weight, 1-minute Apgar score, 5-minute Apgar score, NICU (neonatal intensive care unit) admission, neonatal morbidity, and mortality were analyzed. Morbidities included respiratory distress syndrome (RDS), intraventricular hemorrhage (IVH), periventricular leukomalacia (PVL), necrotizing enterocolitis (NEC), and sepsis. We reviewed the rate of developmental delay in cases that had a fine and gross motor disturbance observed through physical examination and the Bayley Scale and in those that required rehabilitation 12 years after birth. This study was approved by the Institutional Review Board (IRB) of Chilgok Kyungpook National University Hospital (IRB No. KNUCH 2020-06-015). Informed consent was not obtained from the study participants due to the retrospective nature of the review of medical records.

Statistical Analyses

All data were analyzed using the SPSS software (version 26.0; SPSS Inc., Chicago, IL) and R version 4.0.0 (Vienna, Austria; www.r-project.org/). The results of the concordant and discordant groups were compared using the Mann–Whitney U test for continuous numerical data, whereas the χ^2 test was used for binary categorical data. Data are presented as mean ± standard deviation for continuous variables with normal distributions and number (percentage) for binary categorical data. A p value of < 0.05 was considered to be statistically significant. Logistic regression analyses were conducted to identify the independent variables predictive of maternal complications and neonatal outcomes among concordant and discordant twin. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated.

Results

The study was conducted on 106 twin pregnancies and 212 neonates. Based on the estimated fetal weights between 20 and 24 weeks of gestation, pregnancies were divided into 95 concordant and 11 discordant weight twin pregnancies. And according to the estimated fetal weights between 28 and 32 weeks of gestation, pregnancies were divided into 90 concordant and 16 discordant weight twin pregnancies.

Table 1 shows the comparison of maternal characteristics and pregnancy-related complications in the concordant and discordant groups using weights at 20–24 weeks of gestation. Between the two groups, no statistically significant differences were observed in maternal age (32.58 ± 4.15 vs 34.18 ± 5.03, p = 0.095) and BMI (pre-pregnancy, 22.33 ± 3.59 vs 23.02 ± 3.35, p = 0.393). However, in the concordant

group, significantly more nulliparous cases (77.89% vs 63.64%, $p < 0.001$) and pregnancies through ART (70.53% vs 63.64%, $p = 0.034$) were confirmed. No significant differences in gestational diabetes (17.89% vs 0%, $p = 0.063$), threatened preterm delivery (46.32% vs 36.36%, $p = 0.508$), premature amniotic membrane rupture (PROM) (14.74% vs 9.09%, $p = 0.695$), and postpartum bleeding (2.11% vs 0.00%, $p = 0.978$) were observed between the two groups. However, the frequencies of preeclampsia (9.47% vs 27.27%, $p = 0.032$) and placenta previa (2.11% vs 18.81%, $p = 0.002$) were significantly higher in the discordant group compared with the concordant group. No differences in the cause of delivery were observed between the two groups.

Table 1
Comparison of maternal characteristics and pregnancy-related complications between concordant and discordant twins at 20–24 weeks of gestation in DCDA twins.

	Concordant twin (n = 95)	**Discordant twin (n = 11)**	***p* value**
Age (years)	32.58 ± 4.15	34.18 ± 5.03	0.095
Nulliparous, n (%)	74 (77.89%)	7 (63.64%)	< 0.001*
Prepregnant BMI (kg/m^2)	22.33 ± 3.59	23.02 ± 3.35	0.393
BMI at delivery (kg/m^2)	27.62 ± 3.88	28.25 ± 3.45	0.465
ART, n (%)	67 (70.53%)	7 (63.64%)	0.044*
Preeclampsia, n (%)	9 (9.47%)	3 (27.27%)	0.032*
Gestational diabetes, n (%)	17 (17.89%)	0 (0.00%)	0.063
Placenta previa, n (%)	2 (2.11%)	2 (18.81%)	0.002*
Threatened preterm, n (%)	44 (46.32%)	4 (36.36%)	0.508
PROM, n (%)	4 (14.74%)	1 (9.09%)	0.692
Postpartum bleeding, n (%)	2 (2.11%)	0 (0.00%)	0.978
Cause of delivery			0.533
Elective, n (%)	45 (47.37%)	5 (45.45%)	
Spontaneous, n (%)	33 (34.74%)	3 (27.27%)	
Iatrogenic, n (%)	17 (17.89%)	3 (27.27%)	

DCDA, dichorionic diamniotic; BMI, body mass index; ART, artificial reproductive technique; PROM, premature rupture of amniotic membrane. *p values of < 0.05 are shown in bold with an asterisk (*)

Table 2 shows the comparison of neonatal outcomes in both groups classified using weights at 20–24 weeks of gestation. No statistically significant differences were observed in gestational age at delivery (weeks, 35.70 ± 1.63 vs 35.80 ± 1.37, $p = 0.778$), gender (male, 58.42% vs 59.09%, $p = 1.000$), and birth weights (grams, 2322.11 ± 411.26 vs 2323.64 ± 500.94, $p = 0.987$). Moreover, no differences were observed in the 1- and 5-minute Apgar scores of 7 or less (13.68% vs 4.55%, $p = 0.193$, 0.00% vs 4.55%, $p = 0.160$, respectively), and NICU hospitalization (64.21% vs 68.18%, $p = 0.894$). The frequency of actual weight discordancy at delivery (17.89% vs 54.55%, $p < 0.001$) and developmental delay (3.68% vs 18.18%, $p = 0.017$) were higher in the discordant group, whereas oxygen supply treatment (42.63% vs 18.18%, $p = 0.038$) was higher in the concordant group. No significant differences were observed in neonatal morbidity, intubation, the use of a ventilator, RDS, sepsis, PDA (patent ductus arteriosus), and ROP (retinopathy of prematurity).

Table 2
Comparison of neonatal outcomes between concordant and discordant twins at 20–24 weeks of gestation in DCDA twins

	Concordant twin (n = 190)	**Discordant twin (n = 22)**	***p* value**
Gestational age at delivery (weeks)	35.70 ± 1.63	35.80 ± 1.37	0.778
Gender, male, n (%)	111 (58.42%)	13 (59.09%)	1.000
Birthweight (grams)	2322.11 ± 411.26	2323.64 ± 500.94	0.987
Weight discordancy at delivery, n (%)	34 (17.89%)	12 (54.55%)	< 0.001*
Apgar score at 1 min (< 7), n (%)	26 (13.68%)	1 (4.55%)	0.193
Apgar score at 5 min (< 7), n (%)	0 (0.00%)	1 (4.55%)	0.160
NICU admission, n (%)	122 (64.21%)	15 (68.18%)	0.894
Neonatal morbidity, n (%)	47 (24.74%)	1 (4.55%)	0.061
Intubation, n (%)	9 (4.74%)	1 (4.55%)	0.944
Ventilator use (nasal cPAP), n (%)	59 (31.05%)	4 (18.18%)	0.315
O2 supply, n (%)	81 (42.63%)	4 (18.18%)	0.047*
Phototherapy, n (%)	39 (20.53%)	5 (22.73%)	1.000
Developmental delay, n (%)	7 (3.68%)	4 (18.18%)	0.017*

DCDA, dichorionic diamniotic; NICU, neonatal intensive care unit. *p values of < 0.05 are shown in bold with an asterisk (*)

Table 3 shows the comparison of the maternal characteristics and pregnancy-related complications in both groups categorized using weight discordancy at 28–32 weeks of gestation. In the discordant group, more ART trials (67.78% vs 81.25%, $p = 0.041$) were observed, but no significant differences in maternal age, parity, and BMI were observed. Preeclampsia was more prevalent in the discordant group (8.89% vs 25.00%, $p = 0.019$) but no significant differences in the frequency of placenta previa (3.33% vs 6.25%, $p = 0.768$) were detected. Moreover, the frequency of iatrogenic cause of delivery was higher in the discordant group (14.44% vs 43.75%, $p < 0.001$). No significant differences in the incidences of gestational diabetes or PROM or threatened preterm labor were detected between the two groups.

Table 3
Comparison of maternal characteristics and pregnancy-related complications between concordant and discordant twins at 28–32 weeks of gestation in DCDA twins

	Concordant twin (n = 90)	**Discordant twin (n = 16)**	***p* value**
Age (years)	32.53 ± 4.05	33.94 ± 5.25	0.158
Nulliparous, n (%)	67 (74.44%)	14 (87.5%)	0.263
Prepregnant BMI (kg/m^2)	22.40 ± 3.62	22.38 ± 3.31	0.976
BMI at delivery (kg/m^2)	27.76 ± 3.89	27.23 ± 3.57	0.471
ART, n (%)	61 (67.78%)	13 (81.25%)	0.041*
Preeclampsia, n (%)	8 (8.89%)	4 (25.00%)	0.019*
Gestational diabetes, n (%)	16 (17.78%)	1 (6.25%)	0.169
Placenta previa, n (%)	3 (3.33%)	1 (6.25%)	0.768
Threatened preterm, n (%)	40 (44.44%)	8 (50.00%)	0.697
PROM, n (%)	11 (12.22%)	4 (25.00%)	0.102
Postpartum bleeding, n (%)	2 (2.22%)	1 (3.12%)	1.000
Cause of delivery			< 0.001*
Elective, n (%)	48 (53.33%)	2 (12.50%)	
Spontaneous, n (%)	29 (32.22%)	7 (43.75%)	
Iatrogenic, n (%)	13 (14.44%)	7 (43.75%)	

DCDA, dichorionic diamniotic; BMI, body mass index; ART, artificial reproductive technique; PROM, premature rupture of amniotic membrane. **p* values of < 0.05 are shown in bold with an asterisk (*)

Table 4 shows the comparison of neonatal outcomes between the two groups categorized based on weight discordancy at 28–32 weeks of gestation. Compared with the concordant group, the discordant group had earlier gestational age at delivery (35.93 ± 1.40 vs 34.47 ± 2.07, $p < 0.001$), lower birth weights (2379.22 ± 370.29 vs 2001.88 ± 533.51, $p < 0.001$), and higher NICU admission (60.56% vs 87.50%, $p = 0.006$). Moreover, discordant twins required intubation (2.78% vs 15.62%, $p = 0.007$), the use of a ventilator (25.56% vs 53.12%, $p = 0.003$), oxygen supply therapy (36.11% vs 62.50%, $p = 0.009$), and photo therapy due to hyperbilirubinemia (16.67% vs 43.75%, $p = 0.001$) more often compared with concordant twins. Developmental delays between 1 and 2 years after birth were also more frequent in the discordant group (2.22% vs 21.88%, $p < 0.001$).

Table 4
Comparison of neonatal outcomes between the concordant and discordant twins at 28–32 weeks of gestation in DCDA twins

	Concordant twin (n = 180)	**Discordant twin (n = 32)**	***p* value**
Gestational age at delivery (weeks)	35.93 ± 1.40	34.47 ± 2.07	< 0.001*
Gender, male, n (%)	104 (57.78%)	20 (62.50%)	0.760
Birthweight (gram)	2379.22 ± 370.29	2001.88 ± 533.51	< 0.001*
Weight discordancy at delivery, n (%)	22 (12.22%)	24 (75.00%)	< 0.001*
Apgar score at 1 min (< 7), n (%)	19 (10.56%)	8 (25.00%)	0.049*
Apgar score at 5 min (< 7), n (%)	0 (0.00%)	1 (3.12%)	0.328
NICU admission, n (%)	109 (60.56%)	28 (87.50%)	0.006*
Neonatal morbidity, n (%)	36 (20.00%)	12 (37.50%)	0.051
Intubation, n (%)	5 (2.78%)	5 (15.62%)	0.007*
Ventilator use (nasal cPAP), n (%)	46 (25.56%)	17 (53.12%)	0.003*
O2 supply, n (%)	65 (36.11%)	20 (62.50%)	0.009*
Phototherapy, n (%)	30 (16.67%)	14 (43.75%)	0.001*
Developmental delay, n (%)	4 (2.22%)	7 (21.88%)	< 0.001*

NICU, neonatal intensive care unit; RDS, respiratory distress syndrome; PDA, patent ductus arteriosus; IVH, intraventricular hemorrhage; PVL, periventricular leukomalacia; ROP, retinopathy of prematurity; NEC, necrotizing enterocolitis; BPD, bronchopulmonary dysplasia. **p* values of < 0.05 are shown in bold with an asterisk (*)

Figure 1 shows the results of the regression analysis to determine whether the estimated fetal weight discordancy in twin pregnancy could predict the occurrence of preeclampsia and placenta previa. The

results were calculated after adjusting for the confounding factors of maternal age, pre-pregnancy BMI, BMI at delivery, and gestational age at delivery. The incidence of preeclampsia was confirmed by an odds ratio of 5.474 (95% CI, 1.682–17.811; $p = 0.005$) for discordancy between 20 and 24 weeks of gestation and an odds ratio of 2.961 (95% CI, 0.958–9.159; $p = 0.059$) for discordancy between 28 and 32 weeks of gestation. Moreover, placenta previa was predicted by the risk of odds ratio of 7.400 (95% CI, 1.562–35.056; $p = 0.012$) for discordancy between 20 and 24 weeks of gestation and an odds ratio of 2.087 (95% CI, 0.313–13.908; $p = 0.447$) for discordant twins between 28 and 32 weeks.

Figure 2 shows the results of the regression analysis to determine neonatal outcomes, including the use of a ventilator and the presence of developmental delay based on discordancy during pregnancy. The results were calculated after adjusting for the confounding factors of neonatal birth weight, gestational age at delivery, and NICU admission. The use of a ventilator was predicted by the odds ratio of discordancy between 20 and 24 weeks was 0.356 (95% CI, 0.086–1.471; $p = 0.154$) and the odds ratio of discordancy between 28 and 32 weeks was 1.232 (95% CI, 0.408–3.722; $p = 0.711$). Developmental delay was predicted by the risk of odds ratio of 8.047 (95% CI, 0.874–34.599; $p = 0.005$) for discordancy between 20 and 24 weeks and odds ratio of 11.113 (95% CI, 2.650–46.597; $p = 0.001$) for discordancy between 28 and 32 weeks.

Discussion

Twin discordancy, a twin-specific condition, has a total incidence of 10–15% and prevalence is not different according to chorionicity [14, 15]. The reasons for discordancy in twin pregnancies are different depending on the chorionicity. In dichorionic twins, discordancy is due to potential differences in genetic growth and placental dysfunction in accounting for the demands for oxygen and nutrition, which increases as the fetus grows. Incomplete conversion of uteroplacental circulation induces ischemic changes in placental tissue, which induces oxidative stress, apoptosis, and, subsequently, fetal growth differences [16–22]. In monochorionic twins, discordancy arises due to differences in sharing the one placenta [22]. The earlier the onset time of discordancy, the lower the long-term survival of the fetus due to the occurrence of twin-to-twin transfusion syndrome [23, 24]. Twin discordancy is related to poor neonatal prognoses, such as respiratory complications, stillbirths, SGA, and maternal morbidity. However, to our knowledge, few studies have investigated the weight discordancy between two fetuses using ultrasound measured during pregnancy and determined the relationship between weight discordancy and maternal pregnancy-related complications and neonatal morbidities. We divided the weight discordancy into two gestational periods, between 20 and 24 weeks of gestation and between 28 and 32 weeks of gestation. The maternal and neonatal outcomes of the concordant and discordant twins were compared at both the gestational periods.

The discordant twins between 20 and 24 weeks of gestation were found to have more complications related to maternal abnormal placentation, such as preeclampsia and placenta previa, compared with the concordant twins. Preeclampsia is more common in twin pregnancies than singleton pregnancies [25]. In dichorionic twins, the incidence of preeclampsia was higher in discordant birth weight twins compared to

concordant twins. In addition, studies show that the more severe the weight discordancy, the greater the occurrence of preeclampsia and gestational hypertension [26]. These findings are consistent with the results of this study; discordancy during pregnancy predicted the occurrence of maternal preeclampsia. The pathophysiology for the relationship of discordancy with preeclampsia during pregnancy is unknown, but there are several possible explanations. Discordancy during pregnancy is either the cause or effect of placental ischemia and hypoxia [27]. Placental hypoperfusion caused by hypoxia may activate maternal endothelial dysfunction, which manifests symptoms due to vascular constriction and high blood pressure [26, 28]. In addition, placental hypoperfusion affects maternal angiogenic factors, such as soluble fms-like tyrosine kinase-1 (sFlt-1) and placental growth factor, which are related to the development of preeclampsia [29)]. Placenta weight also affects twin discordancy and fetal growth [30]. Abnormal placentation, such as placenta previa, may induce placental hypoperfusion, which may cause discordancy.

When comparing concordant and discordant twins using weight discordancy between 28 and 32 weeks of gestation, the discordant twins had a higher tendency to develop preeclampsia, but no significant differences were observed in the incidence of placenta previa. No significant differences were observed in the incidence of gestational diabetes, preterm labor, or the cause for delivery. When discordancy was measured at 20 and 24 weeks of gestation, no significant differences in weeks of gestation at delivery and birth weights were observed. Except for the developmental delay after 1–2 years of birth, neonatal morbidities and complications also showed no significant differences. However, when comparing concordant and discordant twins using weight discordancy between 28 and 32 weeks of gestation, worse neonatal outcomes were observed in the discordant twin. In the discordant group, the average gestational age at delivery was approximately 1 week earlier and the fetuses tended to have smaller birth weights. The delivery was more likely to be an induction delivery or cesarean section for medical reasons rather than an elective or scheduled delivery for discordant twins. Neonatal outcomes were worse, resulting in more NICU hospitalizations and the presence of complications, such as morbidities, need for intubation, use of a ventilator, and phototherapy, tended to be higher in discordant twins. Developmental delays between 1 and 2 years of age also tended to be higher in the discordant group. Halling et al. reported that smaller discordant twins have more developmental disorders in cognition, language, and motor skills than the larger twins. However, preterm birth before 33 weeks of gestation had a greater effect on developmental delay than discordancy [30]. This study is different from other studies in that the study was limited to cases that were delivered after 32 weeks of gestation and the predicted weight during pregnancy, not the actual birth weight, was used. Weight discordancy after the third trimester of pregnancy is not due to the abnormal placentation of the mother but rather the cause and effect of stress or insult of the fetus in the uterus due to various factors. Thus, the long-term intrauterine environment affects not only short-term outcomes but also the long-term outcomes (developmental delay) of the fetus.

According to the regression analyses of fetal weights at 20–24 weeks, preeclampsia is 5.5 times more likely to occur and placenta previa is 7.4 times more likely to occur in discordant weight twins compared to concordant weight twins. However, discordancy between 28 and 32 weeks was less statistically

significant as a diagnostic predictor. Therefore, ultrasound findings in the second trimester of pregnancy may predict abnormal placentation. In contrast, discordant weight fetuses measured between 28 and 32 weeks are 1.2 times more likely to use a ventilator and 11 times more likely to have developmental delays after birth after adjusting for confounding factors. Thus, discordancy at 28–32 weeks is a predictor of neonatal short-term and long-term outcomes. In the discordant twin between 20 and 24 weeks, gestational age at delivery, birth weights, and the baby's short-term outcome were similar to that of the concordant twin. However, there was a significant difference in developmental delay. Intrauterine Insult, which can induce discordancy in early pregnancy, affects fetal neurodevelopment, but more research is needed on this.

This study had several limitations. First, ultrasound is subjective. However, to reduce the intraobserver bias, ultrasound values were measured three or more times in a row. Moreover, to reduce the interobserver's bias, one obstetrician per pregnancy performed ultrasound measurements continuously according to the number of weeks of pregnancy. An expert reviewed the ultrasound images and reevaluated whether the images were appropriate. Second, the number of participants was small. The study included only healthy dichorionic diamniotic twin mothers who had complete medical records and did not have fetal death, fetal anomaly, or twin-specific complications. Further research with a larger sample is needed.

Conclusion

In twin pregnancies, discordancy using the estimated weight of the fetus between 20 and 24 weeks of gestation can predict abnormal placentation, such as preeclampsia or placenta previa, whereas discordancy between 28 and 32 weeks of gestation can predict short-term and long-term neonatal outcomes.

Declarations

Authors' contributions:

Mi Ju Kim: Project development, Data Collection, Manuscript writing

Hyun Mi Kim: Data collection, Data analysis

Hyun Hwa Cha: Data collection, Management

Won Joon Seong: Data collection, Manuscript editing

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Conflicts of interest/Competing interests:

The authors declare that they have no conflict of interest.

Availability of data and material:

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Code availability:

Not applicable

Ethics approval:

This study was approved by the Institutional Review Board (IRB) of Chilgok Kyungpook National University Hospital (IRB No. KNUCH 2020-06-015).

Consent to participate and publication:

Informed consent was not obtained from the study participants due to the retrospective nature of the review of medical records

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Figures

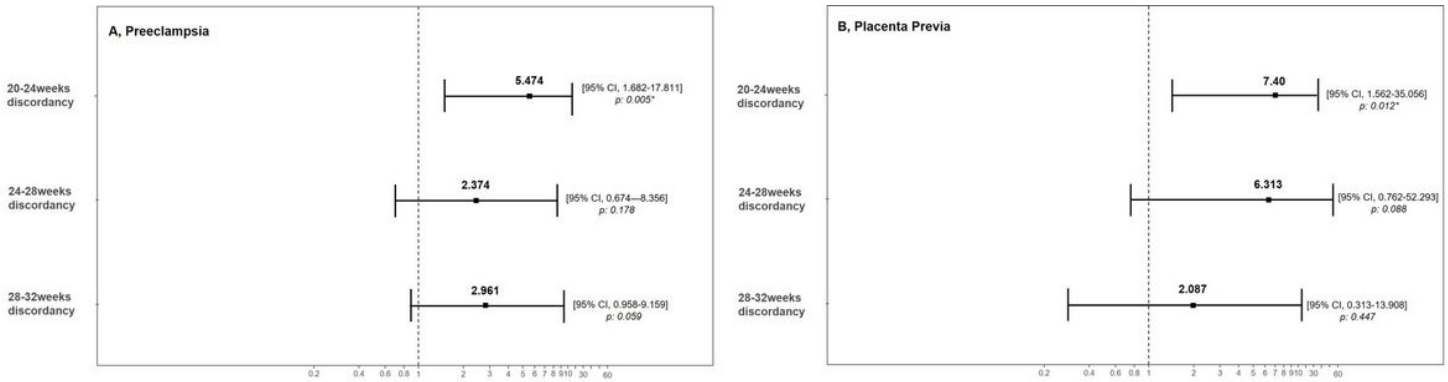

Figure 1

Regression analysis of the relationship between twin discordancy and risk of maternal obstetric complications after adjustment for the confounding factors of maternal age, pre-pregnancy BMI, BMI at delivery, and gestational age at delivery. A. preeclampsia, B, placenta previa. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated and a p value of <0.05 was considered to be statistically significant.

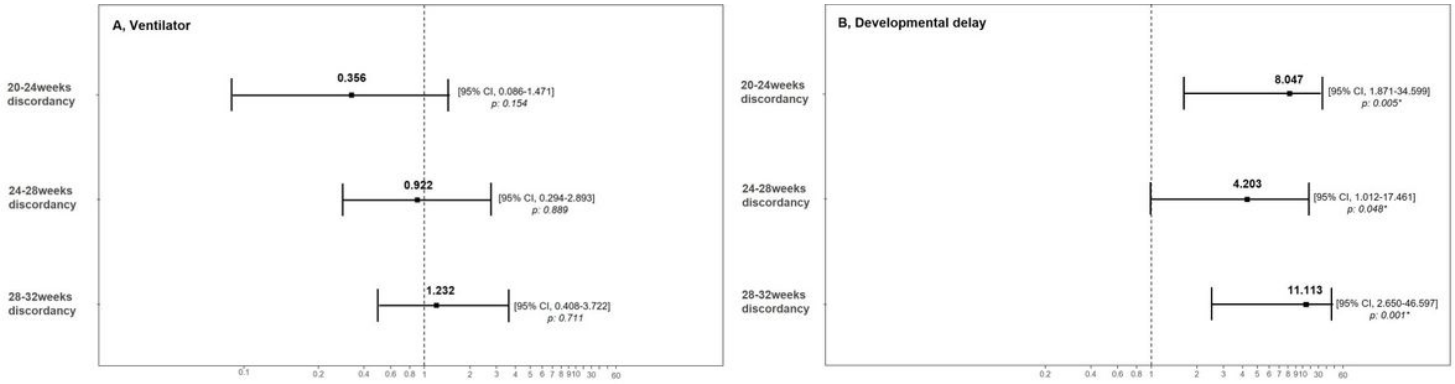

Figure 2

Regression analysis of the relationship between twin discordancy and risk of neonatal outcomes after adjustment for the confounding factors of neonatal birth weight, gestational age at delivery, and NICU admission. A. intubation, B. developmental delay. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated and a p value of <0.05 was considered to be statistically significant.