

# Pregnancy Characteristics and Outcomes in Monochorionic Diamniotic Twin Pregnancies Complicated by Proximal Placental Cord Insertions From a Single Center



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**BACKGROUND:** Proximal placental cord insertion (pPCI), defined as a  $\leq 4$  cm distance between umbilical cord insertions, is a distinct anomaly observed in monochorionic diamniotic (MCDA) twin pregnancies, characterized by the umbilical cords of both fetuses inserting in close proximity within the placental tissue. There is limited available data on the pregnancy characteristics and outcomes in monochorionic diamniotic twins with proximal placental cord insertions (pPCI).

**OBJECTIVES:** To investigate pregnancy characteristics in monochorionic diamniotic (MCDA) twins complicated by pPCI and compare outcomes with nonproximal PCI (nPCI) cases.

**METHODS:** Single center retrospective cohort study of MCDA pregnancies evaluated from 2010 to 2023. pPCI was defined as a  $\leq 4$  cm distance between cord insertions on standardized prenatal ultrasound. Maternal characteristics, prenatal diagnoses, interventions, and perinatal outcomes were compared between pPCI and nPCI groups. The primary outcome was perinatal loss, defined as no live births or survival of only 1 fetus to hospital discharge. Multivariable logistic regression was performed to identify predictors of adverse outcomes.

**RESULTS:** A total of 59 pregnancies with pPCI and 1319 pregnancies with nPCI were identified. The pPCI group had higher rates of selective fetal growth restriction (sFGR; 42.4% vs 26.3%,  $p=0.$ ), type III sFGR (20.3% vs 8.8%,  $p=.009$ ), and abnormal umbilical artery (UA) Dopplers

without definitive diagnosis (11.9% vs 0.2%,  $p<.0001$ ). Twin to twin transfusion syndrome (TTTS) was less common in the pPCI group (23.7% vs 48.2%,  $p=.0003$ ). Intervention was performed less frequently in pPCI (45.8% vs 58.5%,  $p=.05$ ), with higher use of radiofrequency ablation (RFA) (37.3% vs 17.1%,  $p=.0004$ ) and lower use of laser photocoagulation (3.4% vs 38.3%,  $p<.0001$ ). Overall perinatal loss did not differ significantly (25.9% vs 21.2%,  $p=.25$ ), but in the intervention subgroup, the pPCI group had significantly higher rates of “no survivors to hospital discharge” (25.9% vs 11.8%,  $p=.04$ ). pPCI, sFGR, and gestational age at delivery were independently associated with no survivors to hospital discharge.

**CONCLUSION:** Proximal cord insertion is an uncommon but clinically relevant finding in MCDA twin pregnancies, associated with a distinct prenatal phenotype. While overall perinatal loss was similar, pPCI was independently associated with adverse outcomes following intervention. Early recognition of pPCI may inform risk stratification, surveillance, and counseling in monochorionic pregnancies. Abnormal UA Dopplers in the absence of other monochorionic pathology should prompt consideration of pPCI.

**Key words:** Monochorionic diamniotic twins, non-proximal placental cord insertion, proximal placental cord insertion, selective fetal growth restriction, umbilical artery Dopplers

## Introduction

Monochorionic placentas have unique characteristics that predispose these pregnancies to various complications. Some well-known complications include twin to twin transfusion syndrome (TTTS), selective fetal growth restriction (sFGR), and twin anemia polycythemia sequence

(TAPS).<sup>1–3</sup> Monochorionic twins also have a higher rate of congenital anomalies than dichorionic twins and singletons, that can be concordant or discordant.<sup>4,5</sup> Anomalies of umbilical cord insertion (UCI) into the placenta, such as velamentous cord insertion, are more commonly seen in monochorionic placentas.<sup>6</sup> Monochorionic pregnancies with velamentous cord insertion have a higher rate of birth-weight discordance and sFGR.<sup>6</sup>

Though most of the data in the literature focuses on the association of perinatal outcomes and velamentous cord insertion of one of the fetuses, another special kind of anomalous UCI is the proximity of the cord insertions.<sup>7</sup> Zhao et al<sup>8</sup> established a 4 cm distance between the placental

cord insertions (PCI) as the threshold for proximal PCI (pPCI) (5th centile). The authors also reported a 3% incidence of pPCI in the monochorionic population.<sup>8</sup> Though perinatal outcomes in the setting of pPCI have not been well studied, some authors have reported that PCI distance may influence timing of onset of TTTS.<sup>9</sup> The same group also reported that the PCI distance was greater in cases of TAPS.<sup>10</sup> Small case series have also reported a higher rate of umbilical artery (UA) Doppler abnormalities in the setting of pPCI.<sup>11</sup> In addition, fetoscopic laser photocoagulation for TTTS in the setting pPCI is extremely challenging and associated with additional risk including incomplete laser.<sup>12</sup> The available data is limited

**Cite this article as:** Soni S, Gebb JS, Paidas Teefey C, et al. Pregnancy Characteristics and Outcomes in Monochorionic Diamniotic Twin Pregnancies Complicated by Proximal Placental Cord Insertions From a Single Center. *Am J Obstet Gynecol MFM* 2025;7:101761.

2589-9333/\$36.00

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<http://dx.doi.org/10.1016/j.ajogmf.2025.101761>

## AJOG MFM at a Glance

## Why was this study conducted?

- There is limited available data on the pregnancy characteristics and outcomes in mono-chorionic diamniotic twins with proximal placental cord insertions (pPCI).

## Key findings

- pPCI was associated with higher rates of selective fetal growth restriction and abnormal umbilical artery Dopplers, even in the absence of classic monochorionic diagnoses.
- pPCI was independently associated with increased risk of no survivors to hospital discharge, particularly following invasive interventions.

## What does this study add to what is known?

- Given the correlation between pPCI and adverse outcomes, we propose the routine evaluation of placental cord insertions for their proximity to enhance patient counseling and shared decision making. Abnormal UA Dopplers in the absence of other monochorionic pathology should prompt consideration of pPCI.

and the effects of pPCI on pregnancy characteristics and outcomes are not fully understood.

The objective of the study was to evaluate pregnancy characteristics in monochorionic diamniotic (MCDA) twins with pPCI and compare outcomes to pregnancies with nonproximal PCI (nPCI) from a single center.

## Materials and methods

This was a retrospective study from a prospectively collected registry cohort of complex MCDA twin pregnancies evaluated at a single fetal center between January 2010 and December 2023. The study was approved by the local Institutional Review Board (IRB# 09-007085). Information was extracted from electronic medical records.

Higher order multiple gestations and twin pregnancies with the diagnosis of twin reversed arterial perfusion (TRAP) were excluded. Patient evaluation included detailed ultrasound and fetal echocardiogram. Placental cord insertions were noted on ultrasound and the distance between the 2 insertion sites was measured prospectively as part of the center's standardized monochorionic scan protocol; these data were stored in the twin registry before delivery, ensuring that sonographers were blinded to pregnancy outcomes. Proximal cord insertions were defined as a

distance of 4 cm between the placental insertion sites (Figures 1 and 2). The 2 cohorts included pPCI and nPCI.

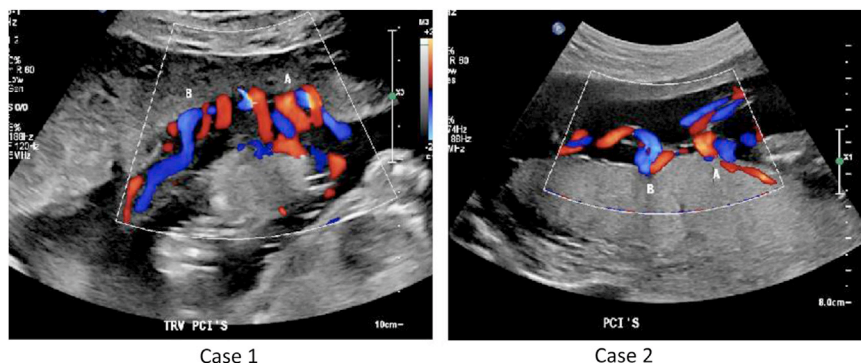
Fetal diagnosis was classified as unaffected (not meeting criteria for any monochorionic complication), sFGR, TTTS, TAPS, discordant malformation, or isolated Doppler abnormality without meeting any specific monochorionic diagnostic criteria. sFGR was defined by the Gratacos criteria.<sup>13</sup> Staging for TTTS was assigned according to previously published Quintero staging and TAPS staging was based on the Leiden system.<sup>14,15</sup> Counseling included consultation with a maternal-fetal medicine specialist and management options

were discussed including expectant management or prenatal interventions such as selective laser photocoagulation (SLPC), selective fetal reduction (SFR), or amnioreduction (AR). After appropriate intervention, further prenatal care and delivery decisions were made by local providers. Similarly, patients who chose expectant management received ongoing care from their local healthcare provider. Delivery data was obtained from referring centers as per an established twin registry protocol. Maternal characteristics, presenting diagnosis, intervention and delivery outcomes were compared between the 2 cohorts (pPCI and nPCI). The primary outcome was perinatal loss, defined as the survival of one or no fetuses to hospital discharge in cases managed expectantly or treated with selective laser photocoagulation (SLPC). In cases undergoing selective reduction (SR), perinatal loss was defined as the absence of any survivors to discharge.

## Statistical analysis

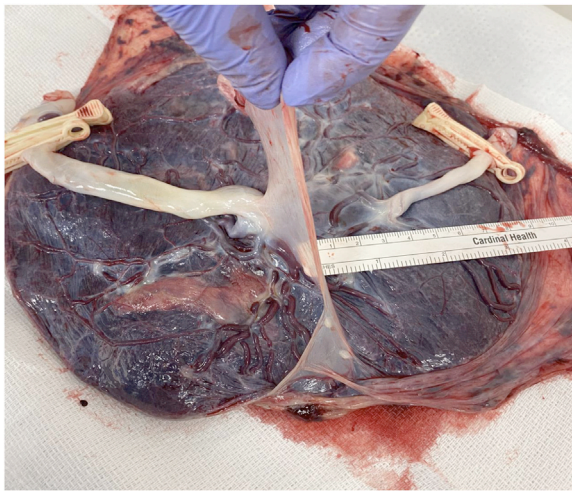
Continuous variables are presented as median (interquartile range [IQR]), and categorical variables are presented as a fraction of the total with percentages. Mann–Whitney U test was used for continuous variables and Fisher's exact test was used for categorical variables. A multivariable logistic regression model was created to examine predictors of perinatal loss, “no live births” and “no

FIGURE 1  
Ultrasound image of pPCI.



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**FIGURE 2**  
Placental image of pPCI.



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survivors to hospital discharge”. The model included presence of pPCI (yes/no), TTTS diagnosis (yes/no), sFGR (yes/no), abnormal UA Dopplers (yes/no), intervention (yes/no) and gestational age at delivery. Statistical analysis was performed using statistical software STATA version 16 (Statacorp, College Station, TX).

## Results

During the study period, a total of 59 pregnancies with pPCI and 1319 pregnancies with nPCI were identified. Fetal diagnosis within the pPCI category is outlined as follows and illustrated in [Figure 3](#). Seven pregnancies (11.9%) had abnormal UA Dopplers without meeting criteria for any classic monochorionic diagnoses such as TTTS or TAPS and 2 (3.4%) had elevated MCA PSV defined as  $>1.5$  MoM in at least 1 twin without meeting diagnostic criteria for TAPS and in the absence of sFGR. Fourteen pregnancies (23.7%) presented with TTTS and 3 (5.1%) had amniotic fluid discordance without meeting classic cut-off for polyhydramnios/oligohydramnios and diagnostic criteria for TTTS.<sup>14</sup> Twenty-five pregnancies (42.4%) were diagnosed with sFGR. Dual fetal growth restriction was noted in 1 pregnancy (1.7%). Four

pregnancies (6.8%) had discordant malformation. Three pregnancies (5.1%) were unaffected without any definitive monochorionic diagnosis. Intervention was performed in 27/59 cases (45.8%) including SLPC in 2 (3.4%) and SFR via RFA in 22 (37.3%) pregnancies. Amnioreduction alone was performed in 3 (5.1%) cases. Of the 12 cases of TTTS that did not undergo SLPC, 2 were stage 1 and intervention was not indicated. Fetoscopy was attempted in 2 of the 10 cases and was deemed to be technically challenging, and the procedure was abandoned. The remaining 8 cases opted to not proceed with this option after counseling due to technical infeasibility or high procedural risk. The median gestational age at delivery was 33.4 weeks [IQR 30–36 weeks]. One patient elected to terminate the pregnancy and perinatal loss occurred in 15 pregnancies (25.9%). After excluding the termination, “no live births” was observed in 10 (17.2%) cases and “no survivors to hospital discharge” were seen in 11 (19.0%) cases.

When compared to the nPCI group ([Table 1](#)), baseline maternal characteristics, including age, BMI, and gestational age at consultation, were similar between groups. The intertwin estimated fetal weight discordance was

similar in the 2 groups (20% in pPCI vs 18% in nPCI,  $p=.82$ ). The incidence of TTTS was lower in the pPCI group (23.7% vs 48.2%;  $p=.0003$ ), while rates of sFGR (42.4% vs 26.3%;  $p=.01$ ), type III sFGR (20.3% vs 8.8%;  $p=.009$ ), and abnormal UA Dopplers without a definitive diagnosis (11.9% vs 0.2%;  $p<.0001$ ) were significantly higher. Intervention was less frequently performed in the pPCI group (45.8% vs 58.5%;  $p=.05$ ), with lower use of SLPC (3.4% vs 38.3%;  $p<.0001$ ) and higher use of RFA (37.3% vs 17.1%;  $p=.0004$ ). Overall perinatal loss did not differ significantly between groups (25.9% vs 21.2%;  $p=.25$ ).

Delivery data was available for all cases with pPCI ( $n=59$ ) and 1200 pregnancies with nPCI. One patient in pPCI group and 13 in nPCI group elected to terminate the pregnancy. Among pregnancies managed expectantly (no intervention, [Table 2](#)) (32 in pPCI group and 464 in nPCI group), gestational age at delivery was similar between groups (33.7 vs 32.3 weeks;  $p=.20$ ). Rates of “no live births” (9.4% vs 8.2%;  $p=.74$ ), “no survivors to discharge” (12.5% vs 11.0%;  $p=.77$ ), and perinatal loss (21.9% vs 20.0%;  $p=.82$ ) were not significantly different. The incidence of “two live births” (83.3% vs 89.2%;  $p=.63$ ) in the sFGR group managed expectantly were similar. The rate of “two survivors to discharge” was lower in the pPCI group with sFGR and expectant management (66.7% vs 82.5%;  $p=.24$ ).

In the intervention subgroup ([Table 2](#)) [27 in pPCI group and 723 in nPCI group], gestational age at delivery remained comparable (34.0 weeks in both groups;  $p=.92$ ). Overall perinatal loss was higher in pPCI group though not statistically different (29.6% vs 25.8%;  $p=.66$ ). However, the pPCI group experienced significantly higher rates of “no live births” (25.9% vs 8.8%;  $p=.01$ ) and “no survivors to hospital discharge” (25.9% vs 11.8%;  $p=.04$ ). SFR via RFA was associated with a higher rate of dual demise in pPCI group (18.2% vs 5.7%;  $p=.05$ ). SLPC was rarely used in pPCI (7.4% vs 68.9%;  $p<.0001$ ), though dual survival outcomes among laser-treated cases did not differ significantly.

TABLE 1

## Comparison of demographics, characteristics, and outcomes of pPCI vs nPCI pregnancies

	pPCI (n=59)	nPCI (n=1319)	p-value
Maternal age, years	32 [27-34]	30 [27-35]	.51
BMI, kg/m <sup>2</sup>	27.5 [25-31.1]	27.2 [24.3-32.4]	.71
GA at consult, weeks	19.1 [17.3-22.5]	19.5 [17.5-21.6]	.75
Distance between placental cord insertions, cm, [IQR] (range)	2.4 [0.7-2.7] (0-4)	14 [9.7-16.9] (4.2-30)	<.0001
EFW discordance, %	20 [12-26]	18 [9-27]	.76
TTTS, N (%)	14 (23.7)	636 (48.2)	.0003
Time of onset of TTTS, weeks	18.3 [17.2-19.5]	19.4 [17.5-21.3]	.16
sFGR, N (%)	25 (42.4)	347 (26.3)	.01
Type III sFGR, N (%)	12 (20.3)	116 (8.8)	.009
TAPS, N (%)	-	31 (2.4)	.64
Abnormal UA Dopplers, <i>without definitive diagnosis</i> , N (%)	7 (11.9)	2 (0.2)	<.0001
Intervention, N (%)	27 (45.8)	771 (58.5)	.05
SLPC, N (%)	2 (3.4)	505 (38.3)	<.0001
SLPC/TTTS (%)	2/14 (14.3)	505/636 (79.4)	<.0001
SR via RFA, N (%)	22 (37.3)	226 (17.1)	.0004
AR only, N (%)	3 (5.1)	32 (2.4)	.19
TOP	1 (1.7)	13 (0.1)	.46
Perinatal loss (58/1187)	15 (25.9)	280 (21.2)	.42

pPCI, proximal placental cord insertion; nPCI, nonproximal cord insertions; BMI, body mass index; GA, gestational age; EFW, estimated fetal weight; TTTS, twin to twin transfusion syndrome; sFGR, selective fetal growth restriction; TAPS, twin anemia polycythemia sequence; SLPC, selective laser photocoagulation; SR, selective reduction; RFA, radiofrequency ablation; AR, amnioreduction; TOP, termination of pregnancy.

Data is presented as median or n (%).

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The diagnosis of TTTS and GA at delivery were independently associated with perinatal loss whereas presence of pPCI, sFGR and GA at delivery were independently associated with “no survivors to hospital discharge” on multivariable logistic regression (Table 3).

## Comment

### Principal findings

In this study, we describe distinct prenatal diagnostic patterns and postnatal outcomes of pregnancies with pPCI, specifically a higher likelihood of type III sFGR presentation and abnormal UA Dopplers in the absence of definitive monochorionic twin pathology. Importantly, while overall perinatal loss did not significantly differ between groups, pPCI was independently associated with the adverse outcome of “no

survivors to hospital discharge” in multivariable analysis. The pPCI group underwent significantly more SFR procedures with lower rates of SLPC.

### Results in the context of what is known

Zhao et al<sup>8</sup> established a 4-cm threshold for pPCI, corresponding to the 5th percentile of PCI distances in monochorionic placentas based on 369 cases. The study revealed a 3% prevalence of pPCI and observed minimal variation throughout the gestation. However, the pPCI cohort was limited and comprised only 18 cases. Despite representing a relatively selected and potentially biased population from a fetal center, the incidence of pPCI in our cohort was comparable to previous reports (59/1378, 4.3%). Wang et al noted a positive

correlation between gestational age of onset of TTTS and PCI distance, suggesting that as the distance increased onset of TTTS was delayed.<sup>9</sup> Although the study examined 48 placentas, specific data on number of pPCI cases was not provided. The same group also demonstrated that the distance between cord insertions was longer in cases of TAPS.<sup>10</sup> In our study, we did not observe a significant correlation between the presence of pPCI and the timing of TTTS onset; however, as a fetal therapy referral center, our cohort consisted of patients who often presented at different gestational ages, frequently after complications had already been identified or suspected. There were no cases of TAPS in our pPCI cohort, however, there was no statistical difference when compared to the small

**TABLE 2**  
**Outcomes of pPCI vs nPCI pregnancies stratified by intervention**

No intervention	pPCI (n=31)	nPCI (n=464)	p-value
GA at delivery, weeks	33.7 [31.4-35.5]	32.3 [29.6-34.6]	.20
No live births, N (%)	3 (9.7)	38 (8.2)	.73
No survivors to hospital discharge, N (%)	4 (12.9)	51 (11)	.48
Perinatal loss, N (%)	7 (22.6)	93 (20)	.82
sFGR, N (%)	12 (38.7)	166 (35.8)	.85
Two live births, N (%)	10/12 (83.3)	148/166 (89.2)	.63
Two survivors to hospital discharge, N (%)	8/12 (66.7)	137/166 (82.5)	.24

Intervention	pPCI (n=27)	nPCI (n=723)	p-value
GA at delivery, weeks	34 [26.6-37.1]	34 [29.1-36.3]	.92
No live births, N (%)	7 (25.9)	64 (8.8)	.01
No survivors to hospital discharge, N (%)	7 (25.9)	85 (11.8)	.04
Perinatal loss, N (%)	8 (29.6)	187 (25.8)	.66
sFGR, N (%)	13 (48.1)	99 (13.7)	<.0001
TTTS, N (%)	12 (44.4)	546 (75.5)	.001
SR via RFA, N (%)	22 (81.5)	193 (26.7)	<.0001
Dual demise, N (%)	4/22 (18.2)	11/193 (5.7)	.05
SLPC, N (%)	2 (7.4)	498 (68.9)	<.0001
Two live births, N (%)	1/2 (50)	374/498 (75.1)	.44
Two survivors to hospital discharge, N (%)	1/2 (50)	352/498 (70.7)	.50

pPCI, proximal placental cord insertion; nPCI, nonproximal cord insertions; GA, gestational age; sFGR, selective fetal growth restriction; TTTS, twin to twin transfusion syndrome; SR, selective reduction; RFA, radiofrequency ablation; SLPC, selective laser photocoagulation.

Data is presented as median or n (%).

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number in the nPCI group (N=31). It is possible that the lack of statistical comparison was driven by the sample size.

A small case series previously identified an association between abnormal UA Dopplers and pPCI in the absence of any monochorionic pathology.<sup>11</sup> In this case series, 64% (7/11) of pPCI cases presented with intermittent absent and reversed end diastolic flow. Upon placental examination, the diameter of arterio-arterial (AA) anastomoses was higher in the pPCI population in that study group. Similarly, our study observed a higher incidence of abnormal UA Dopplers in cases with pPCI though we lacked placental pathology examination to explain these findings.

This type of UA flow pattern has been described by Gratacos et al in cases of sFGR and characterized as type III sFGR.<sup>13</sup> We also identified a higher rate of type III sFGR in this group potentially attributable to larger AA anastomoses.

An additional challenge in cases of pPCI in the setting of TTTS is performing fetoscopic laser coagulation surgery. There are technical difficulties in identifying the vascular equator. Furthermore, the presence of potentially larger anastomoses may introduce additional complexities, compromising the safety and feasibility of the procedure. Zhao et al<sup>16</sup> reported residual anastomoses in all pPCI cases undergoing laser

photocoagulation with subsequent development of TAPS in each case. Another small case series documented a remarkably high perinatal mortality of 42% (5/12) among pPCI complicated by TTTS, with dual fetal demise occurring in the sole case treated with laser photocoagulation.<sup>17</sup> For these reasons, pPCI has been suggested as a potential contraindication to perform laser photocoagulation. In our case series, only 2 patients underwent laser photocoagulation for TTTS. Outcomes included a donor demise in 1 case and the other had a successful laser surgery with delivery at 34 weeks of dual survivors.

Importantly, perinatal outcomes diverged among pregnancies that underwent intervention. In the pPCI group undergoing intervention, rates of no live births and no survivors to hospital discharge were significantly higher compared to the nPCI group, even though gestational ages at delivery were comparable. In contrast, among expectantly managed cases, neonatal survival outcomes were largely similar between pPCI and nPCI groups, suggesting that the adverse outcomes observed in the pPCI cohort may be more pronounced in the setting of invasive intervention. The observed increase in dual demise following RFA in pPCI pregnancies is concerning and may be reflective of vascular proximity that warrants further investigation and emphasizes the importance of comprehensive patient counseling.

Twin pregnancies complicated by TRAP sequence were excluded as the UCI are typically close in proximity to each other and their unique vasculature is distinct from the remaining monochorionic pathologies.<sup>1,18,19</sup>

## Clinical and research implications

This study represents the largest cohort of pPCI cases to date, detailing their presentation and outcomes. Multivariable regression confirmed that the presence of pPCI was an independent predictor of “no survivors to discharge,” even after adjusting for TTTS, sFGR, and gestational age at delivery. This highlights pPCI as a potentially

**TABLE 3**

**Multivariate logistic regression investigating factors associated with perinatal loss and “no survivors to hospital discharge”**

Variables in perinatal loss model	Odds ratio	P value	95% CI
Presence of pPCI	1.01	.98	0.35-2.96
TTTS diagnosis	2.29	<.0001	1.52-3.44
sFGR diagnosis	2.22	.31	0.47-10.35
Abnormal UA Dopplers	0.83	.85	0.12-5.84
Intervention done	0.94	.78	0.62-1.42
GA at delivery	0.79	<.0001	0.76-0.81
Variables in “no survivors to hospital discharge” model	Odds ratio	P value	95% CI
Presence of pPCI	37.69	<.0001	5.58-254.73
TTTS diagnosis	0.77	.51	0.34-1.71
sFGR diagnosis	0.03	.04	0.00-0.90
Abnormal UA Dopplers	0.08	.06	0.01-1.16
Intervention done	0.79	.58	0.35-1.81
GA at delivery	0.41	<.0001	0.35-0.48

pPCI, proximal placental cord insertion; TTTS, twin to twin transfusion syndrome; sFGR, selective fetal growth restriction; UA, umbilical artery; GA, gestational age.

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outcomes, we propose evaluating placental cord insertions in monochorionic twins to investigate for their proximity to enhance patient counseling. Abnormal UA Dopplers in the absence of specific monochorionic twin pathology should prompt consideration of pPCI. Also, patients who develop TTTS in the setting of pPCI should be informed about technical challenges associated with laser photocoagulation, and alternative management options should be offered. Further studies and additional data will provide valuable insights into the underlying pathological mechanisms involved in pPCI and their correlation with clinical outcomes.

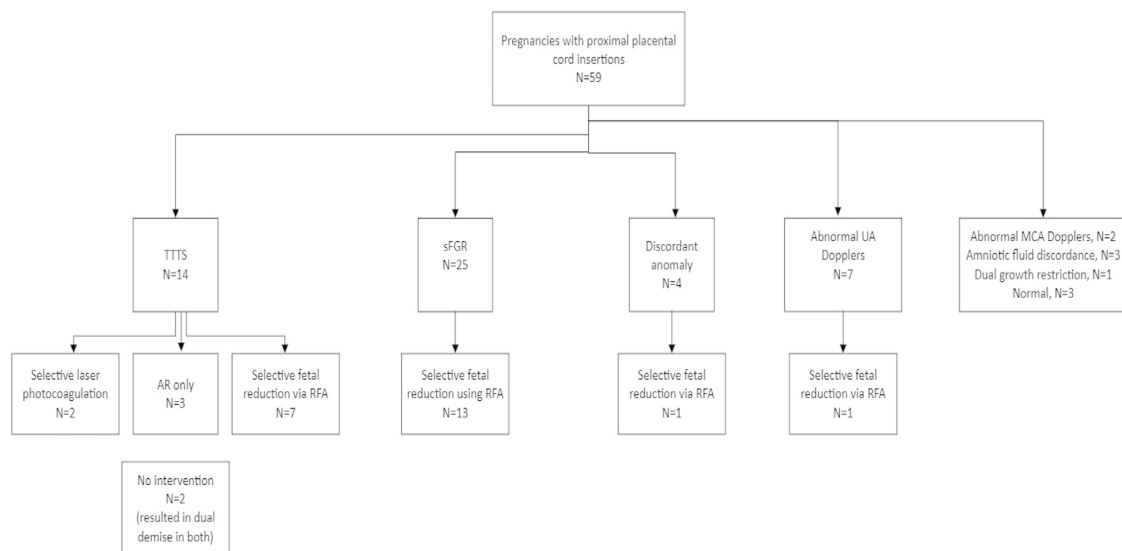
**Strengths and limitations**

The strengths of this study include a relatively large sample size, as well as uniformity and standardization in diagnosis and management. Limitations include biases associated with a retrospective design. Our findings should be interpreted with caution since the data on pPCI pregnancy outcomes come from a referral center and may introduce selection bias with the presence of definitive pathology rather than the full clinical

underrecognized risk factor for poor outcomes. Moreover, the strong association of pPCI with abnormal UA Dopplers and specific sFGR presentation

raises the question of whether early identification of pPCI might influence surveillance strategy. Given the correlation between pPCI and adverse

**FIGURE 3**  
**Flowchart of pPCI patient population.**



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spectrum. However, the robust sample size of the nPCI group enhances comparative validity. An additional limitation is the lack of placental pathologic evaluation for analysis and comparison. While post-natal placental examination would have strengthened the study, it was not routinely available due to the referral nature of our center and delivery at outside institutions. Nonetheless, our findings remain clinically meaningful, based on standardized prenatal imaging by experienced providers. We acknowledge the lack of genetic testing and maternal comorbidity data, which may impact outcomes. However, all pregnancies underwent detailed anatomical surveys, and cases with anomalies were classified as “discordant malformations,” comprising a small portion of the cohort (8.1%). In the absence of structural abnormalities, the risk of chromosomal anomalies in MC twins is estimated to be <1%. We acknowledge that missing pregnancy outcome data can introduce bias and affect interpretation.

## Conclusion

In conclusion, proximal cord insertion is a relatively uncommon but clinically meaningful finding in MCDA twin pregnancies. It is associated with a higher rate of sFGR and UA Doppler abnormalities, and lower rates of TTTS. It may be associated with worse neonatal outcomes following intervention. Abnormal UA Dopplers in the absence of other monochorionic pathology should prompt consideration of pPCI. These findings support the incorporation of PCI mapping into routine ultrasound assessment of MCDA pregnancies and underscore the importance of tailored counseling and management when pPCI is identified. ■

## CRedit authorship contribution statement

**Shelly Soni:** Writing — original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Juliana S.**

**Gebb:** Writing — review & editing, Conceptualization. **Christina Paidas Teefey:** Writing — review & editing. **Beverly G. Coleman:** Writing — review & editing, Resources. **Julie S. Moldenhauer:** Writing — original draft. **Nahla Khalek:** Writing — review & editing.

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Received Apr. 7, 2025; revised July 17, 2025; accepted Aug. 2, 2025.

The authors have no conflicts of interest to declare.

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