Pregnancy and Obstetric Outcomes of Dichorionic and Trichorionic Triamniotic Triplet Pregnancy with Multifetal Pregnancy Reduction: A Retrospective Analysis Study

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Research Article

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Abstract

Background: It is generally beneficial for triplet gestation or high-order multiple pregnancies to operate multifetal pregnancy reduction (MFPR) after assisted reproductive techniques. However, data on pregnancy outcomes is lacking regarding dichorionic triamniotic (DCTA) and trichorionic triplets (TCTA) pregnancy.

Method: This research analyzes the difference between 128 DCTA and 179 TCTA pregnancies with or without MFPR after in vitro fertilization/intracytoplasmic sperm injection cycles between January 2015 and June 2020. The subdivided subgroups of the two groups are reduction to singleton, reduction to dichorionic twins, and anticipation management groups. We also compare the pregnancy and obstetric outcomes between 2104 dichorionic twins and 122 monochorionic twins.

Result: The research subgroups were DCTA to monochorionic singleton pregnancies (n=76), DCTA to dichorionic twin pregnancies (n=18), DCTA-anticipation management (n=34), TCTA to monochorionic singleton pregnancies (n=31), TCTA to dichorionic twin pregnancies (n=130), and TCTA-anticipation management (n=18). In DCTA-anticipation management group, the complete miscarriage rate is dramatically higher, and the survival rate and the rate of take-home babies are lower. However, there was no difference between the rates of complete miscarriages, survival rates, and take-home babies in TCTA-anticipation management group. But the complete miscarriage rate of DCTA-anticipation management was obviously higher than that of TCTA-anticipation management group (29.41 vs. 5.56%, p=0.044). For obstetric outcomes, MFPR to singleton group had higher gestational week and average birth weight, but lower premature delivery, gestational hypertension rates and low birth weight in both DCTA and TCTA pregnancy groups (all p<0.05). Monochorionic twins have higher rates of complete, early, and late miscarriage, premature delivery, and late premature delivery, and lower survival rate and twin survival rate rates (p<0.05).

Conclusion: MFPR could improve gestational week and average birth weight, reducing premature delivery, LBW, and gestational hypertension rates in DCTA and TCTA pregnancies. Monochorionic twins have worse pregnancy and obstetric outcomes. MFPR to singleton is preferable recommended in the pregnancy and obstetric management of complex triplets with monochorionic pair.

Introduction

Over the past decades, the incidence of multiple pregnancies has obviously increased [], mainly owing to the wide application of assisted reproductive techniques (ART) [] and the trend towards advanced maternal age in recent years. Controlled ovarian hyperstimulation is involved in ART for the initial step, which is used to obtain multiple embryos [], and multiple embryo transplants are used to maximize pregnancy rates in ART [,]. In assisted reproduction, the young mother's age, high-quality embryos and the micromanipulation of the zona pellucida can also cause multiple pregnancy []. With the increase in the number of embryos, the incidence of fetal and maternal complications also increases. These risks

include gestational diabetes mellitus, gestational hypertension and medical and surgical conditions aggravation. Meanwhile, there are higher risks of miscarriage, embryonic growth restriction, premature delivery, and the complications of fetal respiratory diseases and cerebral palsy caused by premature delivery [,]. In addition, a monochorionic pregnancy is associated with specific complications caused by vascular anastomoses in the common placenta, which impact infant and maternal morbidity and mortality[]. Monochorionic twins have attracted extensive attention as a result of the associated complications, for example twin anemia-polycythemia sequence (TAPS), twin-to-twin transfusion syndrome (TTTS), and selective intrauterine growth restriction (SIGR).

Multifetal pregnancy reduction (MFPR) is extensively used to decrease maternal and fetal risks to raise the likelihood of good pregnancy outcomes [–], but no agreed optimal strategy exists. Some scholars think that reduction to single can achieve the most perfect pregnancy and obstetric outcomes [,], however other studies have found that the rate of miscarriage could be increased after early MFPR [–]. In addition, there are few published reports concerning the anticipation management of DCTA pregnancies, in which a pair of monochorionic diamniotic twins use a placenta at the same time.

This study aimed to analyze the differences between MFPR and anticipation management in DCTA and TCTA pregnancies, and analyze the differences between monochorionic and dichorionic twins pregnancies.

Materials And Methods

We retrospectively analyzed 128 DCTA cases, 179 TCTA cases, 2104 dichorionic twin cases, and 122 monochorionic twin cases from January 2015 to June 2020 at the Reproductive Medicine Center, Department of Obstetrics and Gynecology, the First Affiliated Hospital of Anhui Medical University. The subdivided subgroups of the two groups are DCTA reduction to monochorionic singleton (n = 76), DCTA reduction to dichorionic twin (n = 18) and DCTA-anticipation management (n = 34) groups, and TCTA reduction to monochorionic singleton (n = 31), TCTA reduction to dichorionic twin (n = 130), and TCTA-anticipation management (n = 18) groups.

All of MFPRs were performed 6–8 weeks after embryo transplant (ET).One experienced doctor in reproductive medicine carried out these operations, which involve the puncture and aspiration of selected embryonic parts without administering any medications, under transvaginal ultrasound guidance. Pregnancies were diagnosed by transvaginal ultrasound to determine the number of fetal and monochorionic or dichorionic pregnancies according to the ultrasound presence of the “T sign” or “lambda sign.” Couples were informed about the disadvantages of triplet or high-order multiple pregnancies. We finally decided to perform the operation based on the couples’ intention, the situation, and the fetus's condition. Pregnant mothers had been protected from infection by administering antibiotics for 1 week preoperatively, and the fetuses were inspected in utero on the 1st and 5th day postoperatively.

Statistical analysis

Statistical analysis were performed using the SPSS 22.0 software package (SPSS Inc, Chicago, IL). Because the data were normally distributed, continuous variables are expressed as mean ± standard deviation (SD). Between-group differences were evaluated using a t-test, and the fisher's exact test or the chi-squared test were used to analyze the difference between percentages. The threshold of the data discrepancies was set at $p < 0.05$.

Results

The maternal demographics and clinical characteristics in TCTA and DCTA pregnancies.

The clinical features of DCTA and TCTA groups included in this study are listed in Table 1 and Table 2. There was no statistically significant differences of the maternal age between the subgroups.Body mass index (BMI), the interval between transplantation and MFPR, duration and type of infertility, frozen embryo transplant (FET), and insemination methods were also matched in both groups with no significant differences($P > 0.05$).

Table 1
Maternal demographics and clinical characteristics in DCTA pregnancy.

	DCTA reduction to twin (n = 18)	DCTA reduction to singleton (n = 76)	DCTA-anticipation management (n = 34)	*P* value
Clinical characteristic				
Maternal age (years)	30.33 ± 4.37	29.47 ± 4.07	29.21 ± 4.35	0.645
Interval between transplantation and MFPR (days)	41.83 ± 6.38	40.08 ± 6.19		0.285
BMI (kg/m^2)	21.09 ± 2.70	22.39 ± 2.93	21.05 ± 2.10	0.069
Duration of infertility (years)	3.53 ± 2.05	3.46 ± 2.56	3.41 ± 2.16	0.986
Infertility type				
Primary, n (%)	(14/18) 77.78%	(42/76) 55.26	(17/34) 50.00	0.139
Secondary, n (%)	4	34	17	
FET (N)				
not-used (%)	(7/18) 38.89%	(26/76) 34.21	(9/34) 26.47	0.610
used (%)	11	50	25	
Insemination methods				
ICSI, n (%)	(7/18) 61.70	(29/76) 63.64	(11/34) 47.83	0.826
IVF, n (%)	11	47	23	
No significant difference was found between the three sets of data in the three groups				

Table 2
Comparison of the maternal demographics and clinical characteristics in TCTA pregnancies.

	TCTA reduction to single (n = 31)	TCTA reduction to twin (n = 130)	TCTA-anticipation management (n = 18)	*P* value
Clinical characteristic				
Maternal age (years)	32.57 ± 3.77	32.20 ± 4.57	32.00 ± 3.48	0.634
Interval between transplantation and MFPR (days)	38.86 ± 3.34	37.52 ± 5.19		0.707
BMI (kg/m^2)	21.41 ± 1.89	22.31 ± 2.92	22.14 ± 3.16	0.235
Duration of infertility (years)	3.94 ± 1.67	4.06 ± 2.51	5.11 ± 3.09	0.073
Infertility type				
Primary, n (%)	(19/31)61.29	(79/130)60.77	(9/18)50.00	0.671
Secondary, n (%)	12	51	9	
FET (N)				
not-used (%)	(7/31)22.58	(26/130)20.00	(6/18)33.33	0.435
Used (%)	24	104	12	
Insemination methods				
ICSI, n (%)	(7/31) 22.58	(35/130) 26.92	(3/18) 16.67	0.602
IVF, n (%)	24	95	15	
No significant difference was found between the three sets of data in the TCTA group				

Pregnancy and obstetric outcomes in DCTA and TCTA pregnancies

DCTA reduction to singleton group had lower rates of complete miscarriage,early miscarriage, higher rates of survival rate and take-home babies than DCTA-anticipation management group (Tables 3). Furthermore, the obstetric outcomes were better in DCTA reduction to singleton pregnancy group than DCTA reduction to twin and DCTA-anticipation management groups, which shows that DCTA redcution to singleton group had the longest gestational week and the highest average birth weight, while the rates of premature delivery, late premature delivery, and LBW were the lowest. Compared DCTA to singleton group with DCTA to twin group,rates of late miscarriage, early premature delivery, survival rate, gestational hypertension, and LBW were no significant difference. Similarly, rates of surviving, gestational diabetes mellitus, gestational hypertension, LBW, premature delivery, early premature delivery, late premature

delivery, and take-home-babies were no significant difference between DCTA reduction to twin and DCTA-anticipation management groups.In addition,cesarean section rate, the rate of VLBW, and the percentage of boys were no significant difference between three DCTA subgroups .

Table 3
Pregnancy and obstetric outcomes in DCTA pregnancy

	DCTA reduction to twin (n = 18)	DCTA reduction to singleton (n = 76)	DCTA-anticipation management (n = 34)	*P* value
pregnancy outcomes				
gestational week (weeks)	37.19 ± 2.90[a]	38.85 ± 1.69[a,b]	35.33 ± 2.35	p < 0.001
Average birth weight (g)	2734.09 ± 615.55[a]	3276.49 ± 515.64[a,b]	2232.65 ± 603.53	p < 0.001
Complete miscarriage rate (%)	(2/18) 11.11	(2/76) 2.63[a]	(10/34) 29.41	p < 0.001
Early miscarriage rate(< 12 weeks) (%)	(1/18)5.55	(0/76) 0.00[a,b]	(5/34) 14.71	p = 0.003
Late miscarriage rate (12–28 weeks)	(1/18)5.55	(2/76) 2.63[a]	(5/34) 14.71	p = 0.042
Premature delivery rate (%)	(7/16)43.75	(7/74) 9.46[a,b]	(16/24) 66.67	p < 0.001
Early premature delivery (28–34 weeks) (%)	(1/16)6.25	(3/74)4.05[a]	(5/16) 31.25	p = 0.006
Late premature delivery (34-37weeks) (%)	(6/16)37.5	(4/74) 5.4[1a,b]	(11/16) 68.75	p < 0.001
survival rate(%)	(16/18)88.89	(74/76) 97.37[a]	(24/34) 70.59	p < 0.001
One survivor	10	74	6	/
Two survivors	6	-	11	/
Three survivors	-	-	7	/
Take baby home rate (%)	(16/18) 88.89	(74/76) 97.37[a]	(24/34) 70.59	p < 0.001
Cesarean section rate (%)	(13/16) 81.25	(60/74) 81.08	(23/24) 95.83	p = 0.220
LBW < 2500 g (%)	(9/22) 40.91	(3/74) 4.05[a,b]	(24/49) 48.98	p < 0.001

[a] Significant difference compared with the anticipation management group.

[b] Significant difference compared with the DCTA to twin group.

	DCTA reduction to twin (n = 18)	DCTA reduction to singleton (n = 76)	DCTA-anticipation management (n = 34)	*P* value
VLBW < 1500 g (%)	(1/22) 4.55	(1/74) 1.35	(3/49) 6.12	p = 0.358
Percentage of boys (%)	(10/12) 83.33	(42/74) 56.76	(26/49) 6.12	p = 0.161
obstetric outcomes				
Gestational hypertension (%)	(2/18) 11.11	(3/76) 3.95[a]	(6/34) 17.65	p = 0.034
Gestational diabetes mellitus (%)	(3/18) 16.67	(1/76) 1.32[a,b]	(4/34) 11.76	p = 0.006
[a] Significant difference compared with the anticipation management group.				
[b] Significant difference compared with the DCTA to twin group.				

The premature delivery rate was highest in TCTA-anticipation management group, but gestational week and average birth weight were lowest. However, complete miscarriage, survival rate, cesarean section, and take-home baby rates or the percentage of boys were no significant difference between three TCTA subgroups (Tables 4). The obstetric outcomes were similar in DCTA and TCTA pregnancies, and the MFPR to singleton group had the longest gestational week, highest average birth weight, and lowest rate of LBW. Conversely, the premature delivery and LBW rates were highest in DCTA-anticipation management and TCTA-anticipation management groups.

Table 4
Pregnancy and obstetric outcomes in TCTA pregnancy

	TCTA reduction to twin (n = 130)	TCTA reduction to singleton (n = 31)	TCTA-anticipation management(n = 18)	P value
pregnancy outcomes				
gestational week (weeks)	35.99 ± 2.33[a]	38.00 ± 2.64[a,b]	34.64 ± 2.79	p < 0.001
Average birth weight (g)	2567.66 ± 571.38[a]	3105.38 ± 691.46[a,b]	2285.43 ± 613.71	p < 0.001
Complete miscarriage rate (%)	(5/130) 3.85	(3/31) 9.68	(1/18) 5.56	p = 0.309
Early miscarriage rate(< 12 weeks) (%)	(1/130) 0.77	(2/31) 6.45	(1/18) 5.56	p = 0.063
Late miscarriage rate (12–28 weeks)	(4/130) 3.08	(1/31) 3.23	(0/18) 0.00	p = 1.000
Premature delivery rate	(60/125) 48.00[a]	(5/28) 17.86[a,b]	(15/17) 88.24	p < 0.001
Early premature delivery (28–34 weeks) (%)	(20/125) 16.00	(1/28) 3.57	(2/17) 11.76	p = 0.235
Late premature delivery (34–37 weeks) (%)	(40/125) 32.00[a]	(4/28) 14.29[a]	(13/17) 74.47	p < 0.001
survival rate(%)	(124/130) 95.38	(28/31) 90.32	(17/18) 94.44	p = 0.482
One survivor	16	74	2	/
Two survivors	108	-	5	/
Three survivors	-	-	10	/
Take baby home rate (%)	(124/130) 95.38	(28/31) 90.32	(17/18) 94.44	p = 0.482
Cesarean section rate	(13/16) 81.25	(60/74) 81.08	(15/17) 88.24	p = 0.858
LBW < 2500 g (%)	(9/22) 40.91	(3/74) 4.05[a,b]	(23/42) 54.76	p < 0.001
VLBW < 1500 g (%)	(1/22) 4.55	(1/74) 1.35[a]	(6/42) 14.29	p = 0.014

[a] Significant difference compared with the anticipation management group.

[b] Significant difference compared with the TCTA to twin group.

	TCTA reduction to twin (n = 130)	TCTA reduction to singleton (n = 31)	TCTA-anticipation management(n = 18)	P value
Percentage of boys (%)	(10/12)83.33	(42/74)56.76	(26/49)53.06	P = 0.642
obstetric outcomes				
Gestational hypertension (%)	(9/130)6.92	(0/31)[a]	(4/18)22.22	P = 0.016
gestational diabetes mellitus (%)	(5/130)3.85	(1/31)3.23	(3/18)16.67	P = 0.077
[a] Significant difference compared with the anticipation management group.				
[b] Significant difference compared with the TCTA to twin group.				

Comparison of pregnancy and obstetric outcomes in monochorionic and dichorionic twins pregnancies

We analyzed 2226 cases of twin pregnancies, including 122 cases of monochorionic and 2104 cases of dichorionic twins. The pregnancy and obstetric outcomes of the two groups were shown in Table 5. The results showed that monochorionic twin have higher rates of complete miscarriage (24.59 vs. 7.27%, $p < 0.001$), early miscarriage (13.93 vs. 2.04%, $p < 0.001$), late miscarriage (10.66 vs. 5.23%, $p < 0.05$), premature delivery (60.87 vs. 48.23%, $p < 0.05$), late premature delivery (50.00 vs. 36.90%, $p < 0.05$), and TTTS (3.28 vs. 0%, $p < 0.001$), but lower rates of survival rate (75.41 vs. 92.16%, $p < 0.001$), and multiple survival rates (61.48 vs. 78.33%, $p < 0.001$) than dichorionic twins.

Table 5
Comparison of pregnancy and obstetric outcomes in monochorionic and dichorionic twins pregnancies

	Dichorionic twins (n = 2104)	Monochorionic twins (n = 122)	P value
Clinical characteristic			
Maternal age (years)	29.49 ± 3.69	29.58 ± 4.17	0.797
gestational week (weeks)	36.20 ± 2.27	36.05 ± 2.30	0.542
Average birth weight (g)	2612.53 ± 523.61	2566.37 ± 507.27	0.263
Proportion of primary infertility (%)	(1250/2104)59.41	(73/122)59.84	0.926
Fresh cycle ratio (%)	(632/2104)30.04	(34/122)27.87	0.611
pregnancy outcomes			
Complete miscarriage rate (%)	(153/2104)7.27	(30/122)24.59	p < 0.001
Early miscarriage rate(< 12 weeks) (%)	(43/2104)2.04	(17/122)13.93	P < 0.001
Late miscarriage rate (12–28 weeks)	(110/2104)5.23	(13/122)10.66	0.011
Premature delivery rate (%)	(941/1951)48.23	(56/92)60.87	0.018
Early premature delivery (28–34 weeks) (%)	(221/1951)11.33	(10/92)10.87	0.892
Late premature delivery (34-37weeks) (%)	(720/1951)36.90	(46/92)50.00	0.011
survival rate rate (%)	(1939/2104)92.16	(92/122)75.41	p < 0.001
Singleton survival rate rate (%)	(291/2104)13.83	(14/122)11.48	0.462
Twin survival rate rate (%)	(1648/2104)78.33	(75/122)61.48	p < 0.001
Percentage of twins, one live, one stillbirth (%)	(0/2104)0	(3/122)2.46	p < 0.001
Double stillbirth (%)	(12/2104)0.57	(0/122)0.00	1.000
Cesarean section rate (%)	(1776/1951)91.03	(86/92)93.48	0.419
LBW rate (%) (< 2500 g)	(1293/3611)35.81	(69/170)40.59	0.204
VLBW rate (< 1500 g) (%)	(100/3611)2.77	(3/170)1.76	0.628

	Dichorionic twins (n = 2104)	Monochorionic twins (n = 122)	P value
Birth weight discordance≥25% (%)	(119/3320)3.58	(5/78)6.41	0.207
Percentage of boys (%)	(1997/3611)55.30	(100/170)58.82	0.367
obstetric outcomes			
Gestational hypertension (%)	(105/2104)4.99	(8/122)6.56	0.443
gestational diabetes mellitus (%)	(48/2104)2.28	(5/122)4.10	0.210
intrahepatic cholestasis of pregnancy (%)	(8/2104)0.38	(2/122)1.64	0.101
twin-twin transfusion syndrome (%)	(0/2104)0	(4/122)3.28	p < 0.001
Neonatal deformities (%)	(24/3611)0.66	(1/170)0.59	1.000

Discussion

Multiple pregnancies significantly increase the incidence of severe fetal and maternal complications. It is difficult to decide whether MFPR or not while considering the risk of abortion.The aim of this research was to compare the pregnancy and obstetric outcomes of different reduction tactics and anticipation management in DCTA and TCTA pregnancies.

DCTA pregnancies have many associated risks, such as premature delivery, selective growth restriction, and fetal malformations. Monochorionic twins are associated with single placental bed vascular anastomoses, such as TTTS and selective intrauterine growth restriction [16–17]. These adverse pregnancy and obstetric outcomes have led to search for a favorable fetal reduction strategy for reducing the occurrence of the aforementioned adverse events. However, although MFPR can reduce the premature delivery rate, the miscarriage rate will increase correspondingly. Therefore, no consensus exists on whether MFPR should be performed and the optimal number of fetal reductions in DCTA pregnancies[18]. Some research has shown that MFPR to singleton in DCTA may improve the pregnancy outcomes and positively alter gestational week, related to infant mortality and disability[9, 18,19–21].

A systematic review of different treatment strategies in DCTA suggested that anticipation management is a reasonable option When survival rates are prioritized.Conversely, if minimizing the rate of severe premature delivery is the top priority,the best desirable choice is to reduce the number of fetuses [20]. The research of Chaveeva et al. supports the conclusion that embryo reduction increases the miscarriage rate but reduces the premature delivery rate in DCTA pregnancy [21]. However, our research found that the complete miscarriage rate was significantly reduced from 29.41 to 2.63% in DCTA reduction to singleton than DCTA-anticipation management group. In addition, there was no significant difference in the complete miscarriage rate between TCTA reduction and anticipation management groups. And in this

study, the complete miscarriage rate after reduction was lower than previous addressed. This finding demonstrates that DCTA reduction to singleton may be an effective choice during the 6–8 weeks gestational period.

Because of the vascular anastomosis between monochorionic twins [22], when reducing one of the monochorionic twins, more caution should be undertaken while performing fetal reduction surgery, and the complete miscarriage rate of TCTA- anticipation management was significantly lower than that of DCTA-anticipation management in our study.

There were significant differences between the subgroups of participants who underwent MFPR to singleton compared to those who choose MFPR to twin or anticipation management in DCTA and TCTA pregnancies, which shows that DCTA reduction to singleton improved pregnancy and obstetric outcomes by obviously reducing the risks of premature delivery and LBW,and obviously raising gestational week and average birth weight in DCTA and TCTA pregnancies. Thus, we didn't advocate anticipation management for DCTA pregnancy.

Potassium chloride injection is not recommended for monochorionic pregnancy because the remaining fetus can be embolized by the drug through vascular anastomosis in the common placenta[23]. However, the laser technique of intrafetal interstitia to remove one monochorionic twin can also imperil the remaining twin [24]. Chaveeva et al. reported 61 pregnant women with DCTA whose pregancies were reduced to dichorionic twins pregnancy by intrafetal laser ablation;although 3% of cases of miscarriage occurred after reduction, nearly half of the cases occurred within two weeks after reduction [15]. Other studies show that the mechanical method of intracardiac puncture and aspiration is an effective and feasible MFPR method for reducing adverse pregnancy outcomes, including those in monochorionic twin pregnancies [25–28]. Therefore, we adopted the mechanical method of intracardiac puncture and aspiration to reduce the fetus during the 6–8 weeks gestational period.

The miscarriage rate of DCTA-anticipation management group was obviously higher than DCTA reduction to singleton group, although the mechanism of miscarriage is not clear. Some researchers think the relative lack of adequate uterine cavity and blood provision is related to spontaneous fetal reduction in multifetal pregnancy [29]. However, we also found that pregnancy loss occurs after embryo reduction in DCTA and TCTA pregnancies. Compared TCTA reduction to twin with DCTA reduction to twin group, TCTA reduction to twin group would obtain the proportion of two babies is significantly higher than that of DCTA reduction to twin group. This dramatically higher singleton survival rate and dramatically lower twin survival rate in DCTA pregrancy is consistent with the findings of Li et al [26]. According to some studies, the related mechanism of miscarriage caused by fetal reduction in DCTA may be considered as follows: firstly, injuries and infections caused by fetal reduction surgery in cases where miscarriage occurred within 2 weeks of fetal reduction. Secondly, the necrotic embryonic placental tissue causing the inflammation reaction is reabsorbed, which could cause miscarriage several weeks or months after fetal reduction [30, 31]. Therefore, when considering reducing the complications of pregnancy and adverse obstetric outcomes and choosing to reduce fetuses to dichorionic twins in DCTA pregnancies, couples

should be informed about the higher risk of pregnancy loss. There was no significant difference in cesarean section rate and the percentage of boy between the three subgroups in DCTA and TCTA pregnancies. The main reason why there is no difference in the rate of cesarean section may be due to human factors rather than medical needs.

Due to the unique characteristics of monochorionic twin pregnancies in terms of the placental structure, some studies conclude that monochorionic twins have dramatically worse outcomes than dichorionic twins [24, 32–33]. This may be attributable to the complications associated with monochorionic twins, including TTTS, TAPS, and SIGR, which are detrimental to maternal and fetal health. Liu et al.'s study shows that the pregnancy and obstetric outcomes of DCTA-monochorionic twin pregnancies are relatively worse than those retaining a single fetus but without statistical difference. It is concluded that compared with reducing one fetus in monochorionic twins, reduction with a separate placenta might be an acceptable reduction strategy with a relatively lower miscarriage rate, despite the potential risks to monochorionic twins[19]. However, this research found that the complete miscarriage rate of the DCTA reduction to twin group is slightly higher than that of the DCTA reduction to singleton group, but there is no significant difference. Therefore, regarding the choice of DCTA to twin pregnancy, we must weigh the pros and cons and solicit the choice of couples, informing patients of the risks and benefits of reduction to one or two or anticipation management.

This was a single-center retrospective comparative study, and some of the statistically insignificant results may be due to the limited number of patients in some subgroups.The Eligible patients are not randomly assigned to each group, so the results of the study may have some deviations. Due to different wishes and internal factors of the family,and ethical considerations, some couples may choose to undergo MFPR or not, and this research is unlikely to be suitable for randomized controlled trials. Some of the data were collected through telephonic interviews with women who had been pregnant many years before thereby the data could be prone to recall bias.Some of the strengths of our study i nclude the relatively abundant reduction data, an extended research time frame, strict inclusion criteria, and detailed statistical methods. All reduction operations were performed by several highly skilled doctors in our center, thereby preventing significant differences in surgical results.

Conclusions

MFPR could improve pregnancy and obstetric outcomes for DCTA and TCTA pregnancies, and MFPR to single fetus could achieve a longer gestational week and higher average birth weight. It seems that dichorionic twins have better pregnancy outcomes than monochorionic twins. For DCTA pregnancy, it is highly recommended to reduce fetus to single for the best pregnancy and obstetric results. Fetal reduction is simply a remedy to reduce the risks related to multifetal pregnancy, and we believe that the most effective method to prevent the reduction of unnecessary multifetal pregnancy is to limit the number of embryo transplant and encourage single blastocyst transplant.

Abbreviations

MFPR: multifetal pregnancy reduction; DCTA: dichorionic triamniotic triplet pregnancy; TCTA:trichorionic triamniotic triplet pregnancy; ICSI: intracytoplasmic sperm injection; IVF: in vitro fertilization; ART: assisted reproductive technology; TTTS: twin-to-twin transfusion syndrome; SIGR: selective intrauterine growth restriction; TAPS: twin anemia-polycythemia sequence; ET: embryo transplant; FET: frozen embryo transplant; BMI: body mass index;LBW:low birth weight ;VLBW:very low birth weight

Declarations

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Authors' contributions

SL and BS contributed to the conception and design. GL, CW, XC and PZ contributed to the development of the methodology. BS and CW collected and analyzed the data. SL and BS contributed to the writing, review, and/or revision of the manuscript. PZ, BS and ZW contributed to administrative, technical, or material support. All authors read and approved the final manuscript.

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Availability of data and materials

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

Ethics approval and consent to participate

This study was approved by the Ethical Review Board of The First Affiliated Hospital of Anhui Medical University (PJ20180707) and was conducted according to the Declaration of Helsinki principles. Written informed consents were obtained from all enrolled patients after an explanation of the study.

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

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