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Comparative study on the pregnancy outcomes of in vitro fertilization–embryo transfer between patients with different ovarian responses (a STROBE-compliant article)

Hai-Xia Jin, MD[a,b], Ai-Xiang Lv, PG[a,b], Zhao-Ting Wu, MD[a,b], Shuang Wen, MA[a,b], Xiang-Yang Zhang, MD[a,b], Da-Chuan Jin, MA[a,b], Ying-Pu Sun, MD[a,b,*]

Abstract

There have been few studies on large-sample data of cleavage-stage embryo and blastocyst transfers. We compared the pregnancy outcomes of patients with different ovarian responses after the transfer of different numbers of embryos in different developmental stages.

Patients were divided into 3 groups including low response group, medium response group, and high response group according to different ovarian responses. Patients in each group were further divided into 4 subgroups including group A: transfer of 1 D3 embryo, group B: transfer of 2 D3 embryos; group C: transfer of 1 D5 blastocyst; and group D: transfer of 2 D5 blastocysts.

In low ovarian responders, the implantation rate, clinical pregnancy rate and live birth rate were significantly lower in the group A than in the groups B and C. In medium ovarian responders, the implantation rate was significantly higher, but the multiple pregnancy rate was significantly lower in the group C than in the group B. The multiple pregnancy rate was significantly higher in the group D than in the group C. In high ovarian responders, the implantation rate was significantly lower, but the multiple pregnancy rate was significantly higher in the group B than in group C.

Based on the above results, the single blastocyst transfer is preferable for the patients with different ovarian responses.

Abbreviations: ART = assisted reproductive technology, BMI = body mass index, FSH = follicle-stimulating hormone, GnRH-a = gonadotropin-releasing hormone agonist, hCG = human chorionic gonadotropin, IVF/ICSI = in vitro fertilization/intracytoplasmic sperm injection.

Keywords: blastocyst, blastocyst transfer, embryo, embryo transfer, pregnancy

1. Introduction

Since Edwards and Steptoe successfully produced the first test-tube baby, Louis Browns, in 1978, in vitro fertilization and embryo transfer as well as its derived technologies have gradually become major methods for treatment of infertility. Currently, according to incomplete statistical results, more than approximately 5 million test-tube babies have been born in the world.[1] In the past 30 years, assisted reproductive technology (ART) has achieved tremendous progress, especially in embryo culture and cryopreservation, which have increased the live birth rate. In addition, the focus of ART has shifted from the initial acquisition of clinical pregnancy to the safety of the mothers and babies. Currently, the majority of centers in some countries still mainly utilize cleavage-stage embryo transfer. The implantation rate of the cleavage-stage embryo is low while increasing the number of transferred embryos can result in an increase in the multiple pregnancies rate. Multiple pregnancies is considered the most severe complication of ART and can bring enormous danger to the safety of mothers and babies. With the introduction of sequential culture medium and the continuous development of blastocyst culture technologies, blastocyst culture allows cleavage-stage embryos to be further screened, which increases the embryo implantation rate. Single blastocyst transfer is an excellent method to reduce the risk of multiple pregnancies. The American Society for Reproductive Medicine (ASRM) recommends that patients aged under 35 years should receive a single blastocyst transfer, while patients aged between 35 and 40 years may also receive single blastocyst transfer if they had high-quality embryos.[2] In the patients with normal and high ovarian responses, blastocyst culture and transfer have been demonstrated to be capable of obtaining the best clinical outcomes.[3,4] The advantages of blastocyst transfer in patients with low ovarian responses have also been gradually recognized. Although there have been many previous studies on ovarian

responses, these studies have mainly focused on the best ovarian stimulation program, increasing the number of retrieved eggs, and reducing complications rather than targeting the best embryo transfer strategy for the patients with different ovarian responses. There have been few studies on large-sample data of cleavage-stage embryo and blastocyst transfers. This study retrospectively analyzed 15,027 couples who received ART, in vitro fertilization/intracytoplasmic sperm injection (IVF/ICSI), between January 2010 and December 2015 in our center to explore the best pregnancy outcomes for the patients with different ovarian responses, providing guidance for clinical transfer strategies.

2. Subjects and methods

All study methods were approved by the Ethics Committee of the First Affiliated Hospital of Zhengzhou University. All the subjects enrolled into the study gave written formal consent to participate.

2.1. Subjects

Couples who received IVF/ICSI treatment in the Center for Reproductive Medicine of The First Affiliated Hospital of Zhengzhou University between January 2010 and December 2015 were retrospectively analyzed. The inclusion criteria were

(1) female patients aged ≤37 years;
(2) the patients without a history of hereditary diseases; and
(3) the patients with the first assisted reproduction cycle.

The exclusion criteria were

(1) the patients who received preimplantation genetic diagnosis/ screening (PGD/PGS) due to chromosomal or other reasons;
(2) the patients who did not have transferrable embryos and had to cancel their cycles; and
(3) the patients who received whole-embryo cryopreservation due to ovarian hyperstimulation syndrome (OHSS) or other reasons, or who did not receive a fresh cycle transfer.

According to different ovarian responses, these patients were divided into 3 groups including a low response group: number of retrieved eggs ≤5 and a total of 1888 cycles; a medium response group: 6 to 15 eggs and a total of 9732 cycles; and a high response group: number of retrieved eggs >15 and a total of 3407 transfer cycles. According to different numbers of embryos transferred and different developmental stages of embryos, these patients in each group were further divided into 4 subgroups including group A: transfer of 1 D3 embryo; group B: transfer of 2 D3 embryos; group C: transfer of 1 D5 blastocyst; and group D: transfer of 2 D5 blastocysts. A total of 15,027 transfer cycles consistent with inclusion and exclusion criteria were enrolled in this study (the low response group did not contain the patients with transfer of 2 D5 blastocysts). The laboratory indices and clinical outcomes were compared between the 4 transfer methods, respectively, in the patients with different ovarian responses.

2.2. Controlled ovarian hyperstimulation

The ovarian stimulation program was selected based on the patient's conditions including age, body mass index (BMI), basal endocrine level and the number of antral follicles.

2.2.1. The long-acting long protocol in the follicular phase.
On day 2 of the patient's menstrual cycle, 1 to 3 ampoules of long-acting gonadotropin-releasing hormone agonist (GnRH-a Diphereline, Triptorelin Acetate for Injection, Ipsen SA, France, 3.75 mg/ampoule) were injected. After 20 days, a basal endocrine evaluation and transvaginal B-ultrasound were performed. After the down-regulation reached the standard, Gn (r-FSH, Gonal-f, 75 IU/ ampoule, Serono, Switzerland) was administrated 28 days after reaching the standards of down regulation. When there were 2 to 3 dominant follicles, Gn was terminated followed by intramuscular injection of human chorionic gonadotropin (hCG).

2.2.2. The short-acting long protocol in the luteal phase.
If urine hCG was negative in mid-luteal phase, short-acting GnRH-a (Diphereline 0.1 mg/d) was applied. Intramuscular injection of Gn (r-FS, Gonal-f, 75 IU/tube, Serono, Switzerland) was performed after reaching the standards of down-regulation. In addition, 0.05 mg/d Diphereline was continuously applied until hCG day.

2.3. Oocyte collection as well as embryo culture and transfer

The follicular development was monitored using transvaginal ultrasound in all patients. Oocytes were collected by transvaginal ultrasound-guided puncture 36 to 37 hours after hCG injection. The selection of short-time insemination or ICSI insemination depends on the condition of semen. Embryos were cultured in sequential culture medium (G-MOPS, G-IVF, G1, G2, Vitrolife, Sweden) with an atmosphere of 6% CO_2 at 37°C. Sixteen to 18 hours later, pronuclei were observed to evaluate the condition of fertilization. The embryo morphology in the cleavage stage was observed on day 3. The endometrial condition and the willingness of patients were comprehensively considered to decide whether to perform blastocyst culture. On day 3 or day 5, cleavage-stage or blastocyst-stage embryo transfer was performed using a Wallace catheter (Mexico).

According to the Peter's standards, day 3 embryos were divided into the following 6 grades:[5] Grade I: The blastomeres had even sizes, regular shapes, good reflection, and intact zona pellucida; the cytoplasm was clear without granulation; the sizes of the blastomeres might be different, such as 3, 5, and 7-cell embryos; and cell debris was less than 5%. Grade II: The blastomeres had slightly irregular morphology; the cytoplasm might have granulation and cell debris was less than 10%. Grade III: Cell debris was 50% or less; the morphology of blastomeres was similar to that of grade II with certain reflection and intact zona pellucida. Grade IV: Cell debris was more than 50%; blastomeres were viable. Grade V: 2PN or delayed fertilization occurred on day 2. Grade VI: Embryos had no vitality, and blastomeres were dissolved or became dense and dark.

2.4. Blastocyst-stage embryos on day 5 were graded according to the Gardner standard[6]

Staging according to the expansion degree of blastocysts:
Stage 1: The blastocyst cavity basically did not expand and was smaller than 50% of bulk volume of the blastocyst. Stage 2: The blastocyst cavity expanded and was larger than 50% of bulk volume of the blastocyst. Stage 3: The blastocyst cavity completely occupied the entire embryo. Stage 4: The blastocyst

Table 1

Comparison of characteristics between different transfer methods in the patients with low ovarian responders.

	Group A	Group B	Group C	X^2 /F	P
Number of cycles, n	152	1723	13	–	–
BMI, kg/m^2	22.38 ± 2.85	22.55 ± 3.25	21.86 ± 2.51	0.475	.622
Basal FSH, IU/L	10.20 ± 6.70$^{#}$	8.67 ± 3.22	7.74 ± 1.39$^{#}$	7.547	.001
Infertility duration, yr	4.77 ± 1.35	4.69 ± 3.26	6.00 ± 3.65	0.841	.431
Implantation rate, %	25.66 (39/152)$^{#,*}$	33.37 (1150/3446)	69.23 (9/13)$^{#}$	13.866	.001
Clinical pregnancy rate, %	25.66 (39/152)$^{#,*}$	52.93 (912/1723)	69.23 (9/13)	43.340	<.001
Abortion rate, %	23.08 (9/39)	16.67 (159/912)	0 (0/9)	3.237	.198
Multiple pregnancy rate, %	0 (0/39)	0.33 (3/912)	22.22 (2/9)$^{#}$	15.043	.002
Live birth rate, %	17.76 (27/152)$^{#,*}$	42.54 (733/1723)	69.23 (9/13)	39.930	<.001

Compared with group B. BMI = body mass index, FSH = follicle-stimulating hormone, yr = year.
$^{#}$ P < .05; compared with group C.
* P < .05.

expanded, and the zona pellucida became thinner. Stage 5: The blastocyst began to hatch from the zona pellucida. Stage 6: The blastocyst was completely outside the zona pellucida.

Grading of the inner cell mass:

A: There were many cells, and the cell distribution was dense. B: There were a few cells, and the cell distribution was loose. C: There were very few cells.

Grading of the trophectoderm:

A: There were more cells that formed densely connected trophoblasts. B: The number of cells was less and loose. C: there were a few cells with large volume.

2.5. Follow-up

After 14 and 18 days of embryo transfer, a positive β-hCG result was regarded as biochemical pregnancy. Thirty-five days after embryo transfer, a gestational sac via indicated by ultrasound was regarded as clinical pregnancy. The pregnancy conditions and obstetric outcomes were followed up.

2.6. Evaluation indicators

The patient's general conditions, including age, basal follicle-stimulating hormone (FSH), BMI, embryo implantation rate, clinical pregnancy rate, abortion rate, multiple pregnancy rate and live birth rate were compared between the 4 subgroups in the 3 groups. Implantation rate = the total number of early gestational sacs/the total number of transferred embryos × 100%. Clinical pregnancy rate = the number of pregnancy cycles/ the total number of transfer cycles × 100%. Abortion rate = the number of abortion cycles/the total number of pregnancy cycles × 100%. Multiple pregnancy rate = the number of multiple pregnancy cycles/the number of clinical pregnancies × 100%. Live birth rate = the number of live birth cycles/the total number of transfer cycles × 100%.

2.7. Statistical analyses

Statistical analyses were performed using SPSS21.0. The basic conditions of the patients in the 3 groups, including duration of infertility, BMI, basal FSH, total Gn dose, and number of retrieved oocytes, were compared using 1-way analysis of variance. Data are expressed as means ± standard deviations (x̄ ± S). Count data are expressed as percentages. The laboratory indicators and clinical outcomes, such as the implantation rate,

high-quality embryo rate, abortion rate, clinical pregnancy rate, and live birth rate, were compared using X^2 test between the 4 subgroups in the 3 group, respectively. The examination level was α=0.05.

3. Results

3.1. Results of different transfer methods in patients with low ovarian responses

Among the patients with low ovarian responses, the implantation rate (25.66% vs 33.37%), clinical pregnancy rate (25.66% vs 52.93%) and live birth rate (17.76% vs 42.54%) were significantly lower in the group A than in the group B. The implantation rate (25.66% vs 69.23%), clinical pregnancy rate (25.66% vs 69.23%) and live birth rate (17.76% vs 69.23%) were all significantly lower in the group A than in the group C. The implantation rate was significantly lower in the group B than in the group C. Because the number of retrieved eggs for patients with low ovarian responses was low, there were no patients with 2 blastocyst transfer in our center (Table 1).

3.2. Results of different transfer methods in patients with medium ovarian responses

Among the patients with medium ovarian responses, the clinical pregnancy rate in group A was significantly lower than that in the group C (34.43% vs 49.03%). The implantation rate (47.82% vs 39.93%) was significantly higher and the multiple pregnancy rate (1.98% vs 35.36%) was significantly lower in the group C than in the group B. However, the abortion rate (12.33% vs 18.81%) was significantly lower, but the clinical pregnancy (60.23% vs 49.03%) and live birth rates (50.48% vs 38.11%) were significantly higher in the group B than in the group C. The multiple pregnancy rate (33.33% vs 1.98%) in group D was significantly higher than that in group C (Table 2).

3.3. Results of different transfer methods in patients with high ovarian responses

Among the patients with high ovarian responses, the implantation rate was significantly lower (37.13% vs 48.25%), but the multiple pregnancy rate (30.47% vs 2.53%) was significantly higher in the group B than in the group C. Compared with group

Table 2

Comparison of characteristics between different transfer methods in patients with medium ovarian responders.

	Group A	Group B	Group C	Group D	X^2/F	P
Number of cycles, n	61	9208	412	31		
BMI, kg/m²	22.98±2.82	22.42±3.68	22.42±3.09	22.20±3.43	0.499	.683
Basal FSH, IU/L	7.01±1.79	8.67±90.35	6.89±1.74	6.75±1.42	0.064	.979
Infertility duration, yr	4.95±3.55	4.21±2.84	3.94±2.55#	4.21±3.23	2.074	.107
Implantation rate, %	40.98 (25/61)	39.93 (7354/18416)	47.82 (197/412)#	38.71 (24/62)	10.495	.015
Clinical pregnancy rate, %	34.43 (21/61)#	60.23 (5546/9208)	49.03 (202/412)#,*	58.06 (18/31)	36.719	<.001
Abortion rate, %	19.05 (4/21)	12.33 (684/5546)	18.81 (38/202)#	5.56 (1/18)	8.454	.030
Multiple pregnancy rate, %	19.05 (4/21)	35.36 (1961/5546)	1.98 (4/202)*,#	33.33 (6/18)Δ	98.729	<.001
Live birth rate, %	26.23 (16/61)#	50.48 (4648/9208)	38.11 (157/412)#	54.84 (17/31)	38.096	<.001

Compared with group A. BMI=body mass index, FSH=follicle-stimulating hormone, yr=year

* P<.05; Compared with group B.
# P<.05; compared with group C.
Δ P<.05.

C, the multiple pregnancy rate (40.54% vs 2.53%) in group D was significantly higher (Table 3).

4. Discussion

With the development of laboratory technologies and culture media, it has become a reality that embryos are incubated into blastocysts. The sequential culture system can provide substance and metabolism for embryo growth and development, and can allow embryos to develop into blastocysts. Blastocyst culture increases the development potential of embryos. In addition, selective single blastocyst transfer can reduce complications, such as multiple pregnancies.[7–11] However, blastocyst transfer also has certain shortcomings: some embryos cannot develop to the blastocyst stage, thus increasing the cycle cancellation rate. The animal study of Mainigi et al[12] have indicated that under natural physiological conditions, embryos first develop in the oviduct, and then enter the uterine cavity on day 5 because at this time, the intrauterine luteal environment is more suitable for blastocyst implantation. Embryo transfer into the uterine cavity on day 3 will result in asynchronization between the embryo and the endometrial implantation window. During fresh cleavage-stage embryo transfer, the embryo will be prematurely exposed to the luteal environment, which is suitable for blastocyst embryo implantation.[13–15] The study of Cavagna et al[16] showed that the uterine contraction frequency gradually decreases after hCG

injection; at blastocyst transfer, a nearly quiescent state in the uterus can avoid embryo translocation in the uterine cavity, which is more conducive to embryo implantation. Genomics has indicated that blastocyst culture can reduce the aneuploidy formation rate.[17]

The studies of Papanikolaou and Alfaraj[3,18] indicated that in the patients with low ovarian response, the cycle cancellation rate (38% vs 25.2%) was higher, but the pregnancy, clinical pregnancy, and live birth rates were still higher in blastocyst transfer than in embryo transfer. In the patients who had low ovarian response and received oocyte freezing and thawing, the very low cycle cancellation rate (0.01%) and the high blastocyst development capacity were greatly conducive to blastocyst culture, so blastocyst transfer after whole embryo cryopreservation was strongly recommended for the patients with low ovarian response.[19] However, 1 retrospective controlled trial showed that embryo and blastocyst transfers had similar success rates.[20] It was reported that the patients with less retrieved oocytes should receive cleavage-stage embryo transfer, but over 39-year-old patients with better Gn response also had better blastocyst transfer outcomes.[21,22] In this study, the implantation, clinical pregnancy and live birth rates of low-response patients who received 1 D3 embryo transfer were all lower than those who received 1 D5 embryo transfer. Moreover, the implantation rate of patients who received transfer of 2 D3 embryos was also lower than that of patients who received 1 D5 blastocyst transfer,

Table 3

Comparison of characteristics between different transfer methods in patients with high ovarian responders.

	Group A	Group B	Group C	Group D	X^2/F	P
Number of cycles, n	18	2106	1198	85		
BMI, kg/m²	22.20±3.35	22.78±5.17	22.57±3.22	21.91±2.68	1.416	.236
Basal FSH, IU/L	6.65±1.60	6.67±1.62	6.84±13.97	6.50±1.52	0.118	.949
Infertility duration, yr	5.63±4.81	4.06±2.74	3.89±2.69	4.21±3.13	1.641	.194
Implantation rate, %	50 (9/18)	37.13 (1564/4212)	48.25 (578/1198)#	30.59 (52/170)Δ	54.740	<.001
Clinical pregnancy rate, %	50 (9/18)	56.89 (1198/2106)	49.42 (592/1198)#	43.53 (37/85)	21.036	<.001
Abortion rate, %	22.22 (2/9)	13.19 (158/1198)	14.86 (88/592)	27.03 (10/37)	6.718	.085
Multiple pregnancy rate, %	0 (0/9)	30.47 (365/1198)	2.53 (15/592)#	40.54 (15/37)Δ	193.576	<.001
Live birth rate, %	38.11 (157/412)	47.48 (1000/2106)*	40.32 (483/1198)#	32.94 (28/85)	20.895	<.001

Compared with group B. BMI=body mass index, FSH=follicle-stimulating hormone, yr=year

# P<.05; compared with group C.
Δ P<.05; compared with group D.
* P<.05.

suggesting that patients with lower ovarian responses had better clinical outcomes after receiving a single blastocyst transfer. If low-response patients receive multiple cleavage-stage embryo transfers, the repeated implantation failures will cause prolongation of the treatment cycles and will increase treatment costs. In addition, multiple cycles of ovarian stimulation and luteal support treatment after transfer will have adverse effects on the endometrium and will increase the patient's psychological burden.

In the patients with medium ovarian response of this study, the clinical pregnancy rate was lower in the single embryo transfer group than in the single blastocyst transfer group (34.43% vs 49.03%). In the comparison of clinical outcomes between double embryo transfer and single blastocyst transfer showed that, although the transferable embryo, high-quality embryo, and embryo utilization rates were all lower, but the implantation rate (47.82% vs 39.93%) was significantly higher and the multiple pregnancy rate (1.98% vs 35.36%) was lower in the single blastocyst transfer group than in the double embryo transfer group. The clinical pregnancy and live birth rates in the double embryo transfer group were higher than those in the single blastocyst transfer group. The study by Glujovsky et al[23] indicated that the live birth and clinical pregnancy rates in the blastocyst transfer group were significantly higher than those in the cleavage-stage embryo transfer group when the numbers of transferred embryos and blastocysts were the same. The abortion rate in the single blastocyst transfer group (18.81% vs 12.33%) was higher than that in the double embryo transfer group. This may be that

(1) endometrial receptivity increases during the process of the in vitro formation of the blastocyst from cleavage-stage embryos, increasing the chance of defective blast cyst implantation;[24] and

(2) the culture medium affects blastocyst development. Rizos et al[25] showed that differences in culture medium and in vitro culture resulted in some changes in bovine embryos and placental morphology, because compared with their in vivo counterparts, in vitro produced blastocysts were characterized by a lack of desmosomal junctions, duction in the microvilli population, an increase in the average number of lipid droplets as well as increased debris in the perivitelline space and intercellular cavities.

Furthermore, our data indicated that in the patients with medium ovarian response, the double pregnancy rate was significantly decreased in the single blastocyst transfer group when compared with the double blastocyst transfer (1.98% vs 33.33%), but the pregnancy rate was still maintained at 49.03% in the single blastocyst transfer group.

Among the patients with high ovarian response, compared with the single blastocyst transfer group, the implantation rate was lower (37.13% vs 48.25%), but the multiple pregnancy rate (30.47% vs 2.53%), transferable embryo rate (70.41% vs 62.60%), high-quality embryo rate (64.77% vs 58.86%) and embryo utilization rate (71.96% vs 58.80%) were higher in the double embryo transfer group. Compared with single blastocyst transfer, the twin pregnancy rate (2.53% vs 40.54%) significantly increased in double-blastocyst transfer, but the clinical pregnancy rate (49.42% vs 43.53%) was not significantly different between both. Therefore, increasing the number of blastocyst transfers failed to raise the pregnant success rate instead of elevation of the twin pregnancy rate.[26]

With the development of technologies in reproductive medicine, IVF has become the major technology in the treatment of infertility. However, with the increase of embryo transfer implantation rate, multiple pregnancies are also continuously increasing. Overall, the risks of adverse outcomes before and after birth were higher in twin pregnancies than in single pregnancies.[27,28] Furthermore, the perinatal risk of twins born was also higher in IVF-assisted reproduction than in normal pregnancy. Compared with single pregnancy, the disadvantages of multiple pregnancies include increases in the risks of preterm birth and low body weight at birth, the cesarean section rate, and the stillbirth rate; in addition, multiple pregnancies can cause problems such as increased pressure on the parents, marriage disharmony, and economic hardship.[29,30] Therefore, reduction in the number of embryos transferred is an effective method to reasonably reduce multiple pregnancies during the IVF process. Although the pregnancy rate of cleavage-stage transfers in patients with high ovarian responses was remarkable, the multiple pregnancy rate was also quite high. More and more studies in recent years have prolonged the culture of cleavage-stage embryos to the blastocyst stage for transfer, which could increase the fresh cycle pregnancy rate and reduce the risk of multiple pregnancies.[31]

Currently, the extensive implementation of blastocyst transfer still has certain problems. The first is blastocyst formation disorder; the second is that doctors and patients all want to increase the pregnancy rate to reduce the cost of performing multiple cycles of IVF. This study compared pregnancy outcome of embryos at 2 different time periods, but after all, it is a retrospective research. Therefore, large-sample prospective studies are needed for validation.

In summary, in the patients with low ovarian response, compared with single embryo transfer, single blastocyst transfer had better implantation, clinical pregnancy and live birth rates; compared with double embryo transfer, the implantation rate was significantly increased in the single blastocyst transfer, and although there were no statistical differences in the clinical pregnant rate and live birth rate between the single blastocyst transfer and the double embryo transfer, they showed an upturn in the single blastocyst transfer, which may be related to small sample of single blastocyst transfer. Therefore, the single blastocyst transfer is preferable for the patients with low ovarian responses.

In the patients with medium ovarian response, although increasing the number of transferred embryos could obtain higher clinical pregnancy and live birth rates in the double embryo transfer group than in the single embryo transfer group as well as in the double blastocyst transfer group than in the single blastocyst transfer group, the multiple pregnancy rate was significantly increased. Multiple pregnancies can cause a series of complications, which brings enormous danger to the safety of mothers and babies. Moreover, increasing the number of transferred embryos failed to raise the implantation rate; on the contrary, it wasted embryos. Therefore, the single blastocyst transfer is preferable for the patients with medium ovarian responses.

In the patients with high ovarian response, increasing the number of transferred embryos failed to obtain higher clinical pregnancy and live birth rates in the double embryo transfer group as compared with the single embryo transfer group, as well as in the double blastocyst transfer group as compared with the single blastocyst transfer group. The live birth rate was slightly

higher, but the multiple pregnancy rate was significantly higher in the double embryo transfer group than in the single embryo transfer group. The implantation rate was significantly lower, but the multiple pregnancy rate was significantly higher in the double blastocyst transfer group than in the single blastocyst transfer group. Multiple pregnancies can cause a series of complications, which brings enormous danger to the safety of mothers and babies. Moreover, increasing the number of transferred embryos failed to raise the implantation rate; on the contrary, it wasted embryos. Therefore, for the patients with high ovarian response, embryos should be cultured into blastocysts followed by cryopreservation instead of fresh cycle transfer. If the conditions of the patient are suitable to fresh embryo transfer, the single blastocyst transfer is preferable

Author contributions

Conceptualization: Ying-Pu Sun.
Data curation: Ai-Xiang Lv, Zhao-Ting Wu, Shuang Wen, Xiang-Yang Zhang.
Formal analysis: Da-Chuan Jin.
Writing – original draft: Hai-Xia Jin.

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