Effects of Lianggu Decoction Combined with Gonal-F on In Vitro Fertilization Outcomes, Embryo Quality, and Pregnancy Outcomes in Infertile Patients Undergoing IVF-ET: A Postprint

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Abstract

Background Infertility has become a major global public health problem, imposing substantial physical and psychological burdens on patients. In vitro fertilization-embryo transfer (IVF-ET), one of the more common treatments for infertility, is a highly complex technique, yet its success rate remains suboptimal. Gonal-F is a medication used in assisted reproductive technology, whose primary function is to promote follicular development and ovulation. However, the efficacy of Lianggu Decoction combined with Gonal-F for IVF-ET in treating infertility patients remains unclear.

Objective To investigate the effects of Lianggu Decoction combined with Gonal-F on in vitro fertilization outcomes, embryo quality, and pregnancy outcomes in infertility patients undergoing IVF-ET treatment.

Methods A total of 205 infertility patients undergoing IVF-ET treatment admitted to the Department of Reproductive Medicine, Cangzhou Hospital of Integrated Traditional and Western Medicine, Hebei Province, from June 2022 to January 2024 were selected for this study. Patients were randomly divided into an observation group (n=102) and a control group (n=103). The control group received conventional IVF-ET assisted reproduction with a long follicular phase protocol for ovarian stimulation (Gonal-F was administered for ovarian stimulation based on patients' hormone levels and ultrasound findings), while the observation group received Lianggu Decoction in addition to the long follicular phase protocol for combined ovarian stimulation. The clinical efficacy, TCM syndrome scores, sex hormone levels at different time points, ovarian stimulation and oocyte retrieval parameters, in vitro fertilization outcomes, pregnancy

outcomes, and incidence of adverse reactions were compared between the observation and control groups.

Results The total effective rate in the observation group (92.2%) was higher than that in the control group (75.7%) (P<0.05). After treatment, the TCM syndrome scores in the observation group were lower than those in the control group (P<0.05). Compared with the human chorionic gonadotropin (hCG) day (14 days after blastocyst transfer), the baseline estradiol (E2), luteinizing hormone (LH), and progesterone (P) levels in the observation group were higher than those in the control group (P<0.05); on hCG day, the estradiol (E2), luteinizing hormone (LH), and progesterone (P) levels in the observation group were higher than those in the control group (P<0.05). The gonadotropin (Gn) (i.e., Gonal-F for ovarian stimulation) usage duration and total Gn dosage in the observation group were lower than those in the control group, while the metaphase II (MII) oocyte rate was higher than that in the control group (P<0.05); there was no statistically significant difference in endometrial thickness or oocyte retrieval rate between the observation and control groups (P>0.05). After treatment, the fertilization rate, two pronuclei (2PN) formation rate, high-quality embryo rate, blastocyst formation rate, and implantation rate in the observation group were all higher than those in the control group (P<0.05); there was no statistically significant difference in 2PN cleavage rate between the observation and control groups (P>0.05). The clinical pregnancy rate and live birth rate in the observation group were significantly higher than those in the control group, while the miscarriage rate was lower than that in the control group (P<0.05). There was no statistically significant difference in the incidence of adverse reactions between the observation and control groups (P>0.05).

Conclusion Lianggu Decoction combined with Gonal-F can significantly improve TCM syndromes, promote ovulation, increase clinical pregnancy rate, reduce miscarriage rate, and demonstrates a favorable safety profile in infertility patients undergoing IVF-ET treatment.

Full Text

The Combined Effect of Lianggutang and Gonal-f on IVF Outcomes, Embryo Quality, and Pregnancy Outcomes in Infertile Patients Undergoing IVF-ET Treatment

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Abstract

Background: Infertility has emerged as a critical global public health issue, imposing significant physical and psychological burdens on affected individuals. Among various treatment modalities, in vitro fertilization-embryo transfer (IVF-ET) represents one of the most commonly employed yet highly complex assisted reproductive technologies, with success rates of only approximately 30%. Gonal-f, a recombinant follicle-stimulating hormone used in assisted reproductive technology, effectively promotes follicular development and ovulation, even at lower doses. Recent research has demonstrated that Chinese herbal medicine can enhance IVF-ET success rates. Lianggutang, a traditional Chinese medicine formula, focuses on warming and tonifying yang qi, drawing from the principles established in *Jingyue Quanshu* (Complete Works of Jingyue). This formula can consolidate and strengthen the Chong and Ren meridians, warm and tonify kidney yang, and secure the fetal origin. However, the therapeutic efficacy of combining Lianggutang with Gonal-f for infertile patients undergoing IVF-ET remains unclear.

Objective: To investigate the effects of combined Lianggutang and Gonal-f administration on IVF outcomes, embryo quality, and pregnancy outcomes in infertile patients undergoing IVF-ET treatment.

Methods: A total of 205 infertile patients who underwent IVF-ET treatment at the Reproductive Medicine Department of Cangzhou Hospital of Integrated Traditional Chinese and Western Medicine between June 2022 and January 2024 were enrolled in this retrospective study. Patients were randomly assigned to an observation group (n=102) or a control group (n=103). The control group received conventional long follicular phase protocol for ovulation induction and IVF-ET assistance, with Gonal-f administered according to patients' hormone levels and ultrasound findings. The observation group received Lianggutang in addition to the conventional protocol. Clinical efficacy, Traditional Chinese Medicine (TCM) syndrome scores, sex hormone levels at different time points, ovulation induction and oocyte retrieval parameters, IVF outcomes, pregnancy outcomes, and adverse reactions were compared between the two groups.

Results: The observation group achieved a significantly higher total effective rate than the control group (92.2% vs. 75.7%, $P<0.05$). After treatment, TCM syndrome scores were lower in the observation group compared to the control group ($P<0.05$). Baseline levels of estradiol (E2), luteinizing hormone (LH), and progesterone (P) were higher in the observation group than in the control group ($P<0.05$). On human chorionic gonadotropin (HCG) day, E2, LH, and P levels were also significantly higher in the observation group ($P<0.05$). The observation group required fewer days of gonadotropin (Gn) stimulation and lower total Gn dosage, while achieving a higher metaphase II (MII) oocyte rate ($P<0.05$). No statistically significant differences were observed in endometrial thickness or oocyte retrieval rates between groups ($P>0.05$). After treatment, the observation group demonstrated higher fertilization rates, two-pronuclear

(2PN) formation rates, high-quality embryo rates, blastocyst formation rates, and implantation rates (P<0.05). No significant difference was found in 2PN cleavage rates between groups (P>0.05). The observation group exhibited significantly higher clinical pregnancy and live birth rates, along with a lower miscarriage rate, compared to the control group (P<0.05). There was no statistically significant difference in adverse reaction incidence between the two groups (P>0.05).

Conclusion: Lianggutang combined with Gonal-f can significantly improve TCM symptoms, promote ovulation, increase clinical pregnancy rates, reduce miscarriage rates, and demonstrates good safety profiles in infertile patients undergoing IVF-ET treatment.

Keywords: Female infertility; Infertility; Lianggutang; Gonal-f; In vitro fertilization-embryo transfer; Pregnancy outcome

Introduction

According to the latest WHO report published in April 2023, approximately one in six individuals worldwide is affected by infertility, establishing it as a major global public health concern that imposes substantial physical and psychological burdens on patients [1]. Currently, one of the most common treatment approaches for infertility is in vitro fertilization-embryo transfer (IVF-ET) technology [2]. IVF-ET is a highly complex procedure requiring extensive pharmaceutical and equipment resources, yet its success rate remains modest at approximately 30%. Consequently, identifying methods to improve IVF-ET success rates holds significant importance for infertile patients.

Gonal-f, a recombinant follicle-stimulating hormone, exhibits stable clinical responses, a short half-life, strong receptor affinity, and robust biological activity. Even at relatively low dosages, it effectively enables infertile patients to obtain a greater number of high-quality oocytes, thereby substantially improving pregnancy success rates [3]. Recent studies have revealed that Chinese herbal medicine can enhance IVF-ET success rates [4]. This study employed a combination of Lianggutang and Gonal-f for treatment. Lianggutang emphasizes warming and tonifying yang qi, drawing from the principles articulated in *Jingyue Quanshu*, and overall serves to consolidate and benefit the Chong and Ren meridians, warm and tonify kidney yang, and secure the fetal origin. However, the clinical efficacy of this combination remains unclear. To explore the impact of Lianggutang combined with Gonal-f on IVF outcomes and pregnancy results, this study selected 205 infertile patients undergoing IVF-ET treatment at our institution between June 2022 and January 2024, aiming to provide additional evidence to improve pregnancy rates in this patient population.

1. Materials and Methods

1.1 General Information

This retrospective study enrolled 205 infertile patients who underwent IVF-ET treatment at the Reproductive Medicine Department of Cangzhou Hospital of Integrated Traditional Chinese and Western Medicine between June 2022 and January 2024. Inclusion criteria were: (1) Western medical diagnosis of infertility according to *Obstetrics and Gynecology* [5], defined as failure to conceive after one year of regular unprotected intercourse with normal semen parameters in the male partner; (2) TCM diagnosis according to *Guiding Principles for Clinical Research of New Chinese Medicines* [6], with kidney yang deficiency syndrome as the primary pattern, characterized by main symptoms of long-term infertility, lumbosacral soreness, and low libido, and secondary symptoms including dizziness, tinnitus, cold extremities, and insomnia with forgetfulness, accompanied by a pale tongue with white coating and a deep, thin or deep, slow, weak pulse; (3) age between 21-35 years; (4) infertility due solely to tubal obstruction; (5) no hormonal or endocrine-affecting medications taken within three months prior to enrollment. Exclusion criteria included: (1) patients undergoing IVF for reasons other than tubal factors; (2) either partner with severe psychiatric disorders, acute reproductive or urinary system infections, sexually transmitted diseases, substance abuse, exposure to teratogenic radiation, toxins, or medications, or genetic diseases contraindicated for childbearing according to the Maternal and Infant Health Care Law; (3) known allergy to study medications; (4) non-compliance with national fertility policies; (5) poor treatment compliance.

Patients were randomly divided into an observation group (n=102) and a control group (n=103). The observation group had a mean age of $28.56\$\pm3.14 years (range 21-35), while the control group had a mean age of 28.97\pm\$3.61$ years (range 22-35). No statistically significant differences were observed between groups in age, duration of infertility, or body mass index (BMI) (P>0.05). This study was approved by the Medical Ethics Committee of Cangzhou Hospital of Integrated Traditional Chinese and Western Medicine (Ethics Approval No.: CZZX-19052), and all patients and their families provided informed consent.

1.2 Sample Size Calculation

Sample size was estimated using the following formula:

$$n = \left[\frac{(u_\alpha + u_\beta)}{\delta}\right]^2 [\pi_1(1-\pi_1) + \pi_2(1-\pi_2)]$$

Where α represents the test significance level (set at 0.05), β represents the probability of Type II error (set at 0.1), π_1 represents the probability of abnormal E2, LH, or P levels in IVF-ET patients (determined through literature

review as 0.45), π_2 represents the probability of abnormal hormone levels in normal pregnant populations (determined as 0.15), and δ represents the difference in population incidence rates (π_1-π_2), set at 0.3. Consulting the t-value table: u =1.96 and u =1.282. Substituting these values yielded an estimated requirement of 44 IVF-ET patients. With a 1:1.8 pairing ratio between observation and control groups, the control group required approximately 80 cases. Ultimately, this study enrolled 102 patients in the observation group and 103 in the control group, meeting the sample size requirements.

1.3 Treatment Methods

The control group received conventional long follicular phase protocol for ovulation induction and IVF-ET assistance. Gonadotropin (Gn) (Gonal-f; manufacturer: Ma' anshan Fengyuan Pharmaceutical Co., Ltd.; National Drug Approval No.: H34023587) was administered according to patients' hormone levels and ultrasound findings. Follicular development was monitored during medication, and when $ $3 follicles reached $ $1.8 cm in diameter by transvaginal ultrasound, Gn was discontinued and 4,000-10,000 IU of human chorionic gonadotropin (HCG) (manufacturer: Livzon Pharmaceutical Group; National Drug Approval No.: H44020673) was administered intramuscularly. Oocyte retrieval was performed 37 hours after HCG injection under transvaginal ultrasound guidance. Embryos were cultured in vitro for 3-6 days before blastocyst transfer. Postoperative medication included dydrogesterone, progesterone injections, and vaginal sustained-release gel. Serum HCG testing was performed 14 days after blastocyst transfer to confirm pregnancy, and transvaginal ultrasound was conducted at 28 days to detect gestational sac, fetal bud, and primitive cardiac activity for clinical pregnancy confirmation. Pregnant patients were followed up at 12 weeks, 28 weeks, and within two weeks of the expected delivery date.

The observation group received Lianggutang in addition to the conventional protocol. The Lianggutang formula consisted of: Rehmannia glutinosa 15g, Angelica sinensis 12g, Cuscuta chinensis 15g, Lycium barbarum 15g, Dioscorea opposita 15g, Rubus chingii 15g, Epimedium 12g, Cynomorium songaricum 10g, Achyranthes bidentata 12g, Dipsacus asper 12g, and Morinda officinalis 10g. One daily decoction was prepared by soaking the herbs for 30 minutes, boiling for 30 minutes over low heat, and decocting twice to obtain 150 mL of medicinal juice, administered as 75 mL twice daily. Modifications included: Rosa rugosa and Curcuma aromatica for emotional depression and breast distension; Codonopsis pilosula, fried Atractylodes macrocephala, and honey-fried Astragalus for fatigue; Carthamus tinctorius and Prunus persica for heavy menstrual clots; and Cinnamomum cassia and Foeniculum vulgare for cold lower abdomen and extremities. Lianggutang was initiated at the beginning of the long protocol and discontinued before HCG injection.

1.4 Evaluation Indicators

1. **Clinical Efficacy:** Evaluated according to *Guiding Principles for Clinical Research of New Chinese Medicines* [7]. Recovery was defined as pregnancy or $ $95% reduction in symptom index with disappearance of clinical symptoms; markedly effective as 70-95% reduction with symptom disappearance or improvement; effective as 30-70% reduction with symptom alleviation; and ineffective as <30% reduction with no improvement or worsening. Total effective rate = recovery rate + markedly effective rate + effective rate. Efficacy index = (pretreatment score - posttreatment score)/pretreatment score × 100%.

2. **TCM Syndrome Score:** Main symptoms included long-term infertility, lumbosacral soreness, and low libido. Secondary symptoms included dizziness, tinnitus, cold extremities, and insomnia with forgetfulness. Each symptom was graded as absent (0), mild (1), moderate (2), or severe (3). Tongue and pulse findings were not scored. Total possible score was 30 points.

3. **Sex Hormone Levels:** Morning fasting venous blood (4 mL) was collected at baseline (oocyte retrieval day) and HCG day (14 days after blastocyst transfer). Samples were centrifuged at 2,000 rpm for 10 minutes (radius 10 cm), and supernatants were stored for testing. Estradiol (E2), luteinizing hormone (LH), and progesterone (P) levels were measured using Roche Cobas 8000 e602 electrochemiluminescence immunoanalyzer and 配套 reagent kits.

4. **Ovulation Induction and Oocyte Retrieval:** Endometrial thickness was measured using GE-E8 four-dimensional color Doppler ultrasound. Gn stimulation duration and total dosage were recorded. Oocyte retrieval rate, metaphase II (MII) oocyte rate, fertilization rate, two-pronuclear (2PN) formation rate, 2PN cleavage rate, high-quality embryo rate, blastocyst formation rate, and implantation rate were calculated.

5. **IVF Outcomes:** Calculated as follows: Oocyte retrieval rate = (number of oocytes retrieved/number of follicles) × 100%; MII oocyte rate = (total MII oocytes/total oocytes retrieved) × 100%; Fertilization rate = (2PN + 1PN + multi-PN + late cleavage)/number of oocytes retrieved × 100%; 2PN formation rate = (total 2PN/total oocytes retrieved) × 100%; 2PN cleavage rate = (2PN cleavage number/2PN fertilization number) × 100%; High-quality embryo rate = (number of high-quality embryos/2PN cleavage number) × 100%; Blastocyst formation rate = (number of blastocysts formed/number of embryos cultured) × 100%; Implantation rate = (total implanted embryos/total transferred embryos) × 100%.

6. **Pregnancy Outcomes:** Clinical pregnancy rate, miscarriage rate, and live birth rate were recorded. Pregnancy was determined by serum HCG testing 14 days after embryo transfer; positive results indicated early preg-

nancy. At 28 days post-transfer, transvaginal ultrasound confirmation of intrauterine gestational sac and primitive cardiac activity established clinical pregnancy. Miscarriage was defined as pregnancy termination before 28 weeks with fetal weight <1,000g. Live birth was defined as delivery at $ $28 weeks or birth weight >1,000g with at least one vital sign (heartbeat, spontaneous breathing, umbilical cord pulsation, or skeletal muscle contraction).

7. **Adverse Reactions:** Ovarian enlargement, gastrointestinal reactions, and abdominal pain were recorded.

1.5 Statistical Analysis

All data were analyzed using SPSS 26.0. Normally distributed continuous variables were expressed as mean ± standard deviation ($\bar{x}\pm s$) and compared between groups using t-tests; paired t-tests were used for within-group comparisons. Categorical data were expressed as frequencies and compared using ^{2} tests. Statistical significance was set at $P<0.05$.

2. Results

2.1 Comparison of Clinical Efficacy

The observation group demonstrated a significantly higher total effective rate than the control group (92.2% vs. 75.7%, $P<0.05$) .

2.2 Comparison of TCM Syndrome Scores

After treatment, TCM syndrome scores in the observation group were significantly lower than those in the control group ($P<0.05$) .

2.3 Comparison of Sex Hormone Levels at Different Time Points

No significant differences were observed in baseline E2, LH, or P levels between groups ($P>0.05$). Compared to HCG day, baseline levels of E2, LH, and P were significantly elevated in both groups ($P<0.05$). On HCG day, E2, LH, and P levels were significantly higher in the observation group than in the control group ($P<0.05$) .

2.4 Comparison of Ovulation Induction and Oocyte Retrieval

The observation group required significantly fewer days of Gn stimulation and lower total Gn dosage, while achieving a higher MII oocyte rate ($P<0.05$). No statistically significant differences were found in endometrial thickness or oocyte retrieval rates between groups ($P>0.05$) .

2.5 Comparison of IVF Outcomes

After treatment, the observation group exhibited significantly higher fertilization rates, 2PN formation rates, high-quality embryo rates, blastocyst formation rates, and implantation rates compared to the control group ($P<0.05$). No significant difference was observed in 2PN cleavage rates between groups ($P>0.05$) .

2.6 Comparison of Pregnancy Outcomes

The observation group demonstrated significantly higher clinical pregnancy and live birth rates, along with a significantly lower miscarriage rate, compared to the control group ($P<0.05$) .

2.7 Comparison of Adverse Reactions

No statistically significant difference in adverse reaction incidence was observed between the observation and control groups ($P>0.05$) .

3. Discussion

Tubal obstruction represents a primary cause of infertility, with increasing prevalence in recent years [8]. Current Western medical treatments for tubal obstructive infertility include hysteroscopic tubal cannulation, tubal catheterization, and adhesiolysis, which carry substantial risks of complications such as recurrence and ectopic pregnancy [9]. IVF-ET has become a common treatment option for patients with fertility desires. However, infertile patients undergoing IVF may face challenges including low quantity and quality of oocytes and embryos, high miscarriage and fetal malformation rates, and low live birth rates, along with increased risk of ovarian hyperstimulation during ovulation induction. In summary, IVF-ET is a highly complex technology requiring extensive pharmaceutical and equipment resources with suboptimal success rates [10]. Therefore, identifying methods to improve IVF-ET success rates is crucial for infertile patients.

From a TCM perspective, infertility falls under categories of menstrual cycle disorders, hypomenorrhea, irregular menstruation, amenorrhea, sterility, and premature ovarian failure [11]. The kidney constitutes the foundation of congenital essence. As stated in *Lingshu· Jingmai*: "When a human being begins to form, essence is generated first" [12]. Kidney-stored congenital essence is closely related to genetic material. The pathogenesis of kidney yang deficiency infertility primarily involves insufficient kidney yang and declining mingmen (life gate) fire. The kidney governs reproduction; when kidney yang is deficient and mingmen fire declines, organ dysfunction and Chong-Ren disharmony can impair reproductive function, leading to infertility [13]. Main manifestations include prolonged menstrual cycles or amenorrhea, decreased menstrual volume, pale red color, accompanied by lumbar soreness, cold extremities, decreased libido,

and cold uterus. *Suwen · Shengqi Tongtian Lun* states: "Yang qi is like heaven and the sun; when it loses its proper place, life withers and cannot flourish, thus the celestial movement should be illuminated by sunlight," illustrating that normal human physiological function depends on yang qi. The principle that "warmth generates life while cold destroys it" suggests that conception resembles cultivating seedlings, with human yang qi being essential for embryo implantation and development, much as sunlight is crucial for plant growth [14]. The TCM treatment principle for kidney yang deficiency infertility involves tonifying the kidney and warming yang, supplemented by essence and blood nourishment.

Lianggutang, a classical foundational formula developed by Professor Guo Zhiqiang for infertility treatment, is derived from modifications of Liuwei Dihuang Wan and Wuzi Yanzong Wan, emphasizing warming and tonifying yang qi based on the principles from *Jingyue Quanshu* [15]. Rehmannia glutinosa nourishes blood and yin while benefiting essence and marrow; Angelica sinensis and Achyranthes bidentata tonify liver and kidney, nourish blood, and activate blood circulation; Cuscuta chinensis secures the fetus and nourishes liver and kidney; Lycium barbarum nourishes yin and blood; Dioscorea opposita strengthens spleen qi; Rubus chingii nourishes liver and kidney and astringes; Epimedium warms and tonifies kidney yang; Cynomorium songaricum tonifies kidney yang and nourishes essence and blood; Dipsacus asper and Morinda officinalis benefit essence marrow, tonify kidney yang, and strengthen bones and muscles, promoting endometrial and basal follicle growth [16]. The combination of Epimedium and Cynomorium within yin-nourishing herbs follows the principle of "seeking yang within yin." Epimedium, warm in nature and entering liver and kidney meridians, warms kidney yang and strengthens bones and muscles; Cynomorium, sweet in taste and entering kidney meridian, warms kidney yang and nourishes essence and blood. When combined with yin-nourishing herbs such as Rehmannia, Dioscorea, and Cornus officinalis, these ingredients collectively tonify kidney qi and secure the fetus. Epimedium, as a warming herb, effectively treats kidney yang deficiency but should be used in appropriate amounts. Therefore, Lianggutang possesses warming kidney yang, activating blood circulation, and securing fetal origin functions. Additionally, although no statistically significant difference in adverse reaction incidence was observed between groups ($P>0.05$), the observation group showed a slightly lower rate, likely because adverse reactions were primarily caused by Gonal-f, and Lianggutang may have mitigated some Western medication side effects, enhancing safety.

This study demonstrates that the observation group achieved a significantly higher total effective rate than the control group (92.2% vs. 75.7%, $P<0.05$), indicating that Lianggutang combined with exogenous sex hormones produces synergistic effects that improve TCM symptoms, increase high-quality oocyte and embryo rates, and enhance pregnancy rates. Post-treatment TCM syndrome scores were significantly lower in the observation group ($P<0.05$), and E2, LH, and P levels on HCG day were significantly higher ($P<0.05$). These findings suggest that Lianggutang substantially improves TCM symptomatol-

ogy, regulates hormonal imbalances, enhances reproductive capacity, improves endometrial receptivity, and creates a favorable environment for embryo implantation and development.

Poor follicular development often stems from insufficient kidney essence and qi. Maternal kidney qi ensures normal follicular growth and maturation; abundant kidney qi promotes oocyte development, while kidney yin deficiency results in fewer, slower-developing oocytes [19]. This study showed that the observation group required significantly fewer Gn stimulation days and lower total Gn dosage while achieving higher MII oocyte rates ($P<0.05$), with no significant differences in endometrial thickness or oocyte retrieval rates ($P>0.05$). These results indicate that Lianggutang reduces the duration and dosage of ovulation-inducing medications, avoiding side effects from prolonged hormone use while effectively improving high-quality oocyte rates.

Most patients with tubal obstruction have pelvic adhesions that may compromise ovarian blood supply, leading to nutritional deficiencies and functional impairments such as poor follicular maturation, ovulation difficulties, and luteal phase defects [20]. This study demonstrated that the observation group achieved significantly higher fertilization rates, 2PN formation rates, high-quality embryo rates, blastocyst formation rates, and implantation rates ($P<0.05$), with no significant difference in 2PN cleavage rates ($P>0.05$). The observation group also showed significantly higher clinical pregnancy and live birth rates and lower miscarriage rates ($P<0.05$). These findings indicate that Lianggutang combined with exogenous hormones effectively improves fertilization rates, high-quality embryo rates, and implantation rates, thereby increasing clinical pregnancy rates and reducing miscarriage rates. This may be attributed to the blood-activating and stasis-resolving effects of Angelica sinensis and Achyranthes bidentata, which improve ovarian blood supply and regulate tubal and pelvic tissue metabolism, promoting functional recovery. Rehmannia glutinosa and Lycium barbarum nourish qi and blood, enhance immunity, and improve constitution, while Cuscuta chinensis and Epimedium exhibit hormone-like effects that tonify kidney qi and secure the fetus.

In conclusion, Lianggutang combined with Gonal-f significantly improves TCM symptoms, promotes ovulation, increases clinical pregnancy rates, reduces miscarriage rates, and demonstrates favorable safety in infertile patients undergoing IVF-ET treatment. Due to limitations in sample size and study duration, long-term follow-up of neonatal outcomes was not conducted. Future research will expand sample sizes and extend follow-up periods to further validate the effectiveness of Lianggutang as an adjuvant therapy in IVF-ET treatment for infertility.

Author Contributions: WANG Yan conceived the study, designed the research, and supervised implementation. PENG Peng and HAO Meijuan collected and organized data, performed statistical analysis, and prepared tables and figures. WU Shangqing and WANG Xuchu revised the manuscript, ensured quality control, and provided overall supervision.

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Note: Figure translations are in progress. See original paper for figures.