

Clinical Research

Effect of electroacupuncture on egg quality and tumor necrosis factor - α of patients with polycystic ovarian syndrome*

电针干预对多囊卵巢综合征患者卵子质量及肿瘤坏死因子- α 的影响*

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ABSTRACT

Objective To observe the effect of electroacupuncture (EA) on egg quality of polycystic ovarian syndrome (PCOS) patients, and to explore its mechanism. **Methods** Two hundred patients who received in vitro fertilization-embryo transfer (IVF-ET) were divided into an EA group (102 cases) and a control group (98 cases) according to random number table. All the patients in the two groups were given Diane-35 and gonadotropin-releasing hormone agonist (GnRH-a) for ovarian hyperstimulation. Besides, EA intervention was applied to Shènshù (肾俞 BL 23), Qìhǎi (气海 GV 6), Zú sān lǐ (足三里 ST 36), Sānyīnjiāo (三阴交 SP 6), Nèiguān (内关 PC 6) and Zǐgōng (子宫 EX-CA1), etc. in the EA group. Then egg quality, final outcome of pregnancy and levels of tumor necrosis factor- α (TNF- α) were compared between the two groups. **Results** (1) EA intervention significantly improved high quality embryo rate of PCOS patients ($P < 0.05$), and clinical pregnancy rate was increased by 8.36%; (2) EA intervention significantly reduced the TNF- α levels of follicular fluid (13.61 ± 15.46 vs 34.09 ± 93.53 , $P < 0.05$); (3) TNF- α levels of serum and follicular fluid in the pregnancy group were lower than those of non-pregnancy group [pregnancy group: (53.91 ± 63.32) pg/mL, (14.93 ± 25.37) pg/mL, non-pregnancy group: (76.82 ± 82.96) pg/mL, (25.04 ± 35.79) pg/mL], and the differences were significant (both $P < 0.05$). **Conclusion** EA improves egg quality of PCOS patients and increases the clinical pregnancy rate of IVF-ET, the mechanism may be related to TNF- α levels.

KEY WORDS: polycystic ovarian syndrome (PCOS); electroacupuncture; controlled ovarian hyperstimulation (COH); tumor necrosis factor - α

Polycystic ovarian syndrome (PCOS) is a kind of endocrine disease featured by hyperandrogenism, insulin resistance, chronic anovulation and polycystic ovaries. The incidence rate of PCOS among women at the childbearing age is 6%–10%, and PCOS blames for 75% of anovulatory infertility^[1]. PCOS patients with ovulation failure, especially accompanied by tubal factors, get pregnant with aid of in vitro fertilization-embryo transfer (IVF-ET). Because hyperandrogenism

and insulin resistance contribute to disorders of endocrine and metabolic system, in vitro fertilization (IVF) encounters a multitude of challenges such as a big dosage of gonadotropin (Gn), long medication time, follicles' refusal to grow or excessive follicles; increased incidence rate and cycle cancellation rate of ovarian hyperstimulation syndrome (OHSS); reduced rate of fertilization and high qualified embryo rate; high spontaneous abortion rate and so on^[2]. Thus, the



pregnancy rate only reaches 30% to 40%. Therefore, it is urgent that the clinical pregnancy rate of PCOS patients undergoing IVF-ET be improved. The author treated PCOS patients undergoing IVF-ET with EA intervention in the course of COH, and positive clinical results were achieved. The report is as follows.

CLINICAL DATA

General data

Two hundred PCOS patients received IVF-ET in Genitourinary Department, Second Affiliated Hospital of Shandong University of TCM from January 2009 to December 2012. They were divided into an EA group (102 cases) and a conventional group (98 cases) according to the random number table, they were aged from 21 to 42 years old with an average of 31 years old, with 1 to 15 years of infertility with an average of 4.52 years.

It was shown in table 1 and table 2 that the differences in general information and levels of blood hormone between the two groups before the treatment were not significant (all $P>0.05$) and were comparable.

Diagnostic criteria

PCOS diagnostic criteria (2003 Rotterdam criteria^[3]): ① sporadic ovulation and /or anovulation; ② clinical and/or biochemical indicators reveal hyperandrogenism, excluding other potential pathogenic factors, such as congenital adrenal hyperplasia, androgen-secreting tumors, Cushing's syndrome and so on; ③ polycystic ovaries, and B-ultrasonic examination showed there were more than 12 follicles with diameter of 2–9 mm at each section and/or ovaries increase >10 mL in volume. Any patient that meets two of the items above was diagnosed with PCOS.

Inclusive criteria

According to IVF-ET indications stipulated in "Notice on the Revision of Related Technical Specifications, Basic Standards and Ethical Principles

of Assisted Reproductive Technology and Human Sperm Bank" (WKJF [2003] No. 176) issued by the Ministry of Health, the following patients were selected: ① PCOS patients with a plan for undergoing IVF-ET due to tubal factors or oligospermia or asthenospermia; ② patients compliant with the criteria above, and long protocol of ovarian hyperstimulation was planned to given.

Exclusive criteria

① Endometriosis; ② immune infertility; ③ unexplained infertility; ④ patients undergoing intracytoplasmic sperm injection (ICSI) due to male factors; ⑤ chromosomal abnormalities; ⑥ uterine malformations and/or ovarian surgeries; ⑦ age ≥ 40 years; ⑧ application of steroids in the past three months.

METHODS

Long protocol of ovarian induction adopted by patients in the two groups

On the 3rd day of the previous menstrual cycle, patients were given Diane-35 (produced by Bayer Healthcare Limited), one pill one day for 21 days in total. On the 18th day, they were given subcutaneous injection of decapepty, (produced by Ferring Pharmaceuticals, 0.1 mg/bottle), 0.1 mg daily for 10 days in total. Then the dosage was reduced to 0.05 mg. Four days later, the fasting levels of follicle stimulating hormone (FSH), estradiol (E_2), luteinizing hormone (LH) and progesterone (P) were tested while endometrium and antral follicles were tested via B-ultrasound. If down-regulation was up to standard, intramuscular injection of 150–225 IU/d of recombinant human follicle stimulating hormone (Gonal-F, produced by Merck Serono GmbH, 75 IU/ bottle) was given. Five days later, vaginal B-ultrasound was used to monitor follicle growth and E_2 and LH were tested, and the amount of Gn was adjusted appropriately according to age, follicle growth and hormone levels. When B-ultrasound identified at least one follicle with diameter up to 20 mm or two up to

Table 1 Comparison of general data of PCOS patients between the two groups

Groups	Patients	Age (years)	Duration of infertility (years)	BMI	Type of infertility (case)	
					primary	secondary
EA	102	31±5	4.36±3.16	23.36±6.40	50	52
Control	98	31±5	4.69±3.41	23.33±3.58	46	52

Table 2 Comparison of levels of blood hormone of PCOS patients in the two groups before the treatment ($\bar{x} \pm s$)

Groups	Patients	FSH (IU/L)	LH (IU/L)	E_2 (pmol/L)	T (nmol/L)
EA	102	6.43±2.02	4.65±2.96	150.76±149.52	1.47±1.95
Control	98	6.66±2.16	4.76±2.96	157.86±67.05	1.54±2.36

18 mm, patients should stop taking Gn and decepepty. At 9 o'clock that night, intramuscular injection of 5 000–10 000 IU of human chorionic gonadotropin (hCG, produced by Livzon Group, China) was given. Thirty-six h later, transvaginal oocyte retrieval was conducted under B-ultrasound guidance. Seventy-two h later, 2 to 3 high quality embryos were transplanted (2 embryos for women below 35 years old in the first assisted reproductive cycle), and then intramuscular injection of 60 mg/d progesterone was given for luteal support. Fourteen days following the transplantation, urinary hCG was tested to determine the biochemical pregnancy. Five weeks after the transplantation, ultrasound revealed gestational sac and primitive impulse of heart tube to determine clinical pregnancy. If gestational sac and primitive impulse of heart tube terminated within the first 12 weeks of pregnancy, it was identified as early abortion.

EA intervention protocol

The patients in the EA group received electroacupuncture therapy during the menstrual cycle prior to COH and during COH (except the menstrual period).

Acupoints selection: Shènshū (肾俞 BL 23), Qìhǎi (气海 CV 6), Zú sān lǐ (足三里 ST 36), Sānyīnjiāo (三阴交 SP 6), Nèiguān (内关 PC 6) and Zǐgōng (子宫 EX-CA 1).

Manipulation: Before needling, acupoints area was disinfected with 75% ethanol cotton balls. *Hwato* sterile needles were twisted into the skin and manipulated to the extent of *deqi*. Then needles were connected to the electrode wire of G6805-1 pulse therapy EA apparatus (produced by *Qingdao Xin Sheng Industrial Co., Ltd*, China). The dilatational wave was applied and the current intensity reached the degree that patients felt comfortable. They were treated once a day, 30 min each time, for 5 days, with 1 to 2 days off, until oocyte retrieval.

Observation indices

(1) Blood hormone levels: on the 3rd day of the menstrual phase and on the hCG day, 3 mL of fasting venous blood was collected and analyzed by Bayer ACS-180 automated chemiluminescence immunoassay

system.

(2) On the day of oocyte retrieval, 3 mL of venous blood was collected. After the blood was centrifuged at the speed of 3 000 r/min for 10 min, the supernatant was collected and stored in refrigerator at -80°C . Transvaginal oocyte retrieval was conducted under B-ultrasound guidance to retain mature, clear and non-ensanguined follicular fluid containing oocytes with diameter of ≥ 18 mm. After the follicular fluid was centrifuged at the speed of 3 000 r/min for 10 min at room temperature, the supernatant was collected and stored in refrigerator at -80°C .

(3) Gn dosage, days of medication, number of oocytes, fertilization rate, cleavage rate, high quality embryo rate, endometrial thickness on the hCG day, OHSS incidence, cycle cancellation rate, clinical pregnancy rate, rate of early spontaneous abortion were observed.

Statistical analysis

Statistical analysis was performed using SPSS17.0 software package. Measurement data were expressed as mean \pm standard deviation ($\bar{x} \pm s$), *t* test was used; enumeration data were expressed as a percentage (%), and χ^2 test was used; ranked data were tested by Mann-Whitney *U*; correlation analysis of the two variables was conducted by Spearman rank correlation analysis; if $P < 0.05$, the difference was significant.

RESULTS

(1) Effect of EA on egg quality and pregnancy rate of IVF-ET (Table 3 and Table 4)

Table 3 Comparison of retrieved oocytes of PCOS patients between the two groups ($\bar{x} \pm s$)

Groups	Patients	Eggs
EA	102	15.22 \pm 5.23
Conventional	98	16.45 \pm 6.49

It was shown in Table 3 that difference of retrieved oocytes of PCOS patients between the two group was not statistically significant. But Table 4 showed that the high quality embryo rate of the EA group was significantly higher than that of the control

Table 4 Comparison of egg quality and pregnancy rate of IVE-EF between the two groups (%)

Groups	Patients	Fertility rate (%)	Cleavage rate (%)	High-quality embryonic rate (%)	Pregnancy rate(%)	OHSS incidence rate (%)	Cancellation rate (%)
EA	102	79.12	97.36	50.81 ¹⁾	53.19 (50/94)	7.84 (8/102)	7.84 (8/102)
Conventional	98	76.85	95.89	42.33	44.83 (39/87)	11.22 (11/98)	11.22 (11/98)

Note: compared with that in the conventional group, ¹⁾ $P < 0.05$.



group ($P < 0.05$).

(2) Effect of EA on TNF- α levels of PCOS patients (Table 5)

Table 5 Comparison of TNF- α levels in serum and follicular fluid of PCOS patients between the two groups ($\bar{x} \pm s$, pg/mL)

Groups	Patients	serum TNF- α	follicular fluid TNF- α
EA	102	56.23 \pm 74.95	13.61 \pm 15.46
Control	98	79.38 \pm 117.45	34.09 \pm 93.53
<i>t</i> value		6.423	-2.139
<i>P</i> value		>0.05	0.035

It could be seen that TNF- α level in follicular fluid in the EA group was significantly lower than that of the control group, and the difference was statistically significant ($P < 0.05$).

(3) Comparison of TNF- α levels in pregnancy patients and non-pregnancy patients (Table 6)

Table 6 Comparison of TNF- α levels of serum and follicular fluid between pregnancy and non-pregnancy patients ($\bar{x} \pm s$, pg/mL)

Groups	Patients	Serum TNF- α	Follicular fluid TNF- α
Pregnancy	89	53.91 \pm 63.32	14.93 \pm 25.37
non-pregnancy	92	76.82 \pm 82.96	25.04 \pm 35.79
<i>t</i> value		-2.083	-2.199
<i>P</i> value		0.039	0.029

It could be seen that TNF- α levels in serum and follicular fluid of pregnancy patients were lower than those in non-pregnancy, and the differences were statistically significant (both $P < 0.05$).

(4) Comparison of Gn dosage and medication time in the EA group and in the conventional group (Table 7)

Table 7 Comparison of Gn dosage and medication time of PCOS patients between the two groups ($\bar{x} \pm s$)

Groups	Patients	Gn dosage (IU)	Gn medication time (days)
EA	102	2 062.50 \pm 696.06	9.78 \pm 1.30
Control	98	2 271.30 \pm 728.91	10.30 \pm 1.81
<i>t</i> value		-2.072	-2.290
<i>P</i> value		0.04	0.023

It could be seen that Gn Dosage and medication time in the EA group were significantly less than those in the control group (both $P < 0.05$).

(5) Correlation between TNF- α levels and amount and rate of high quality embryos (Figure 1–Figure 4)

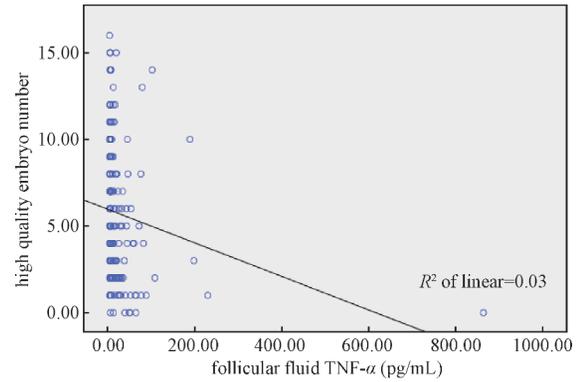


Figure 1 Correlation between TNF- α levels in follicular fluid and number of high quality embryos

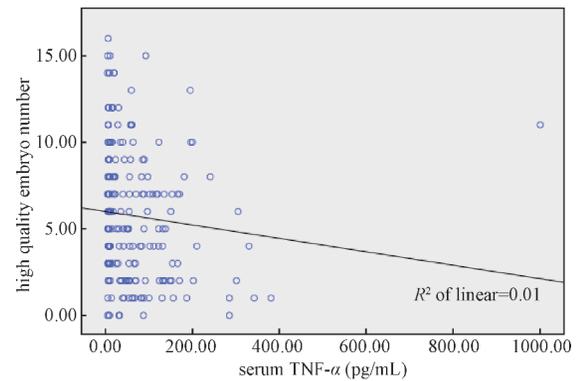


Figure 2 Correlation between TNF- α levels in serum and number of high quality embryos

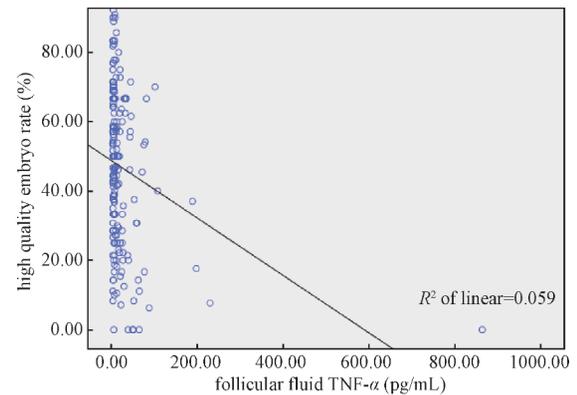


Figure 3 Correlation between TNF- α levels in follicular fluid and rate of high quality embryos

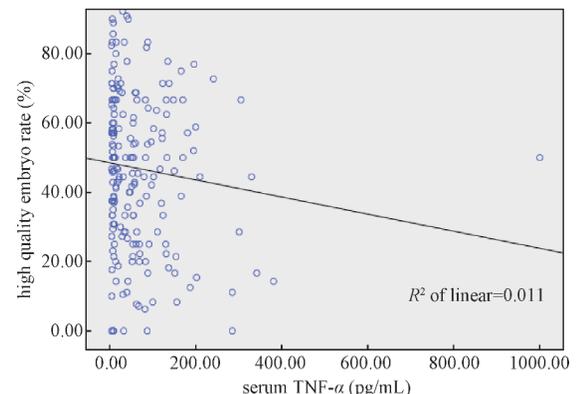


Figure 4 Correlation between TNF- α levels in serum and rate of high quality embryos

It could be seen that TNF- α levels in serum and follicular fluid were significantly negatively correlated with amount and rate of high quality embryos ($P < 0.05$).

DISCUSSION

In recent years, acupuncture is used in assisted reproductive technology (ART) to increase the pregnancy rate, which has been widely studied. Studies such as acupuncture-induced ovulation, restored ovarian function and adjustment of the menstrual cycle provide a basis for the therapy combining acupuncture and ART to improve the rate of pregnancy. WANG Shao-jin, et al^[4] proposed that the realization of acupuncture effect was closely related to the conduction of cell information by analyzing nerve-endocrine mechanism produced by acupuncture effects, and found that endocrine function of the hypothalamic-pituitary-ovarian axis of PCOS patients had benign adjustment effect, thus normal secretion of gonadal hormone could be achieved and ovulation is improved.

ART involves three stages: COH, transvaginal oocyte retrieval under B-ultrasound guidance and embryo transplantation. The function of acupuncture intervention in transvaginal oocyte retrieval under B-ultrasound guidance and embryo transplantation to increase the pregnancy rate has been reported^[5-10], and the mechanism was discussed in various aspects^[11-19]. But the effect of EA intervention on egg quality and pregnancy outcome during the COH has not been studied adequately. The study mainly discussed the effect of EA intervention on pregnancy of PCOS patients undergoing IVF-ET during the COH.

Chinese medicine believes that pathogenesis of PCOS is very complex, involving dysfunction of kidney, spleen and liver as well as adjustment disorders of kidney-*tiangui*-thoroughfare vessel and conception vessel caused by pathological products like phlegmatic hygrois and blood stasis. The key factor responsible for the disease is kidney deficiency, and phlegmatic hygrois and blood stasis are its common pathological links. BL 23, CV 6, ST 36, SP 6, PC 6 and EX-CA1 were selected as main acupoints. BL 23 belongs to the bladder meridian of foot-*taiyang* as back-*shu* point of the kidney, tonifying the kidney and supporting *yang*, strengthening waist and alleviating water retention. Kidney dominates bones to produce marrow, stores the essence of life and is concerned with reproduction. BL 23 is where channel *qi* of kidney comes in and out. Needling at BL 23 can help warm kidney and tonify

yang and circulate *qi*-blood. Starting from the uterus, CV 6 belongs to the conception vessel, related to pregnancy and interlinked with vitality, and breeding genuine *qi* as root of primordial *yang*. Besides, it is where conception vessel, governor vessel and thoroughfare originate from, and *qi*-blood in the body gathers, adjusting the vitality. Needling CV 6 can help warm kidney, tonify and consolidate menstruation and help BL 23 to supplement kidney *qi* and *yang*. ST 36 is one of the main points of stomach meridian of foot-*yangming*, regulating spleen and stomach, tonifying middle energizer and *qi*, clearing and activating the meridians and collaterals, dispelling wind and dampness and strengthening body resistance and eliminating evil; SP 6 governs diseases of the three *yin* meridians of spleen, liver and kidney, strengthening the spleen and stomach, nourishing the liver and tonifying the kidney, and mild reinforcing-reducing two points makes blood exuberant, and helps dredge channel *qi*, promote the flow of energy and blood and regulate and invigorate *qi* activity, thus dredging conception vessel and replenishing *qi* and blood in great thoroughfare vessel, resulting in menophania and fertility. PC 6 treats emotional stress and blocked *qi* activity. Needling at PC 6 regulates *qi* activity and tonifies *qi* in liver, spleen and kidney. EX-CA1 is an important extra points, which governs birth, thus needling EX-CA1 nurses and nourishes the uterus. EX-CA1 is a main point for treating infertility.

Profusion blood and vigor is the base of female physiological activities. Blood is controlled by spleen, stored in liver and discharged by kidney, endlessly supplying and irrigating the whole body, indicating physiological characteristics of women are related to liver and spleen and have an even closer relationship with kidney. Thoroughfare can regulate twelve meridians, so with exuberant blood and essence, thoroughfare can nourish the uterus and store and distribute blood to nurture the fetus. Conception vessel is known as “sea of *yin* meridian”, commanding *qi* of *yin* meridians. WANG Bing, a well-known medical scientist in *Tang* Dynasty, said: “conception vessel plays a dominant role in pregnancy”. Therefore, unobstructed flow of *qi* in conception vessel can help conceive a baby. In this study, needling BL 23 and CV 6 tonified kidney *qi*; ST 36 and SP 6 harmonized the spleen and stomach and eliminated phlegm and dampness; SP 6 dominates blood, a confluent acupoint of the three *yin* meridians of spleen, liver and kidney, and the blood is taken from the three *yin* meridians to treat infertility; infertile females usually suffer from stagnation of liver *qi* and poor flow of *qi* and blood, leading to blood stasis. PC 6 dispels melancholy and

achieves catharsis of liver and gallbladder *qi*; EX-CA1 is one of main extra points of conception vessel, which governs birth and cures infertility. Needling at all the points regulates liver, spleen and kidney, tonifies kidney *qi*, regulates spleen and stomach, eliminates phlegm and dampness, regulates the flow of blood, smoothes liver-*qi* stagnation, and regulates the function of the kidney-*tiangui*-thoroughfare axis.

TNF- α is a non-glycosylated protein with various biological functions. Because increased concentration of TNF- α of Th1-typed cytokines is associated with adverse pregnancy outcomes, its role in IVF-ET has attracted attention from many scholars and scientists^[20]. Studies showed^[21-23] that quality of oocyte with significantly increased concentrations of TNF- α in follicular fluid was poor, and TNF- α concentration of follicular fluid was associated with IVF-ET clinical pregnancy outcome, suggesting that increased concentrations of TNF- α in follicular fluid may affect egg quality, thereby affecting embryo implantation and resulting in adverse outcomes. The results of this study showed that: TNF- α levels of serum and follicular fluid in the pregnancy patients were significantly lower than those in non-pregnancy patients (both $P < 0.05$), indicating that TNF- α levels have great negative correlation with egg quality and pregnancy outcome.

Cumulus granulosa cells are granule cell layers wrapped around oocytes, which have an extensive and complex intercellular coupling mechanism with oocytes, including gap junctions, regulating the growth of the oocyte. Susan, et al^[24] found by in vitro culture of mouse granulosa cells that recombination of TNF- α could enhance the expression of Fas antigen and promote apoptosis of granulosa cells. Basini, et al^[25] further proved by in vitro culture of bovine cumulus granulosa cells that recombination of TNF- α could inhibit granulosa cells from secreting progesterone and promote apoptosis of granulosa cells. Host, et al^[26] found that apoptosis of granulosa cells was related to maturation and fertilization of oocytes. Ramane, et al^[27] found that eggs' ability to fertilize was related to apoptosis of cumulus granulosa cells; Lee, et al^[28] reported that cumulus granulosa cells are related to fertilization rate of patients and IVF outcome. It was found in this study that with EA intervention, TNF- α levels of follicular fluid were significantly lower than that in the control group, and the differences were significant ($P \leq 0.05$); TNF- α level of serum was lower than those of the control group, but the difference was not significant ($P > 0.05$), proving that EA intervention improved the quality of eggs by lowering TNF- α level in follicular fluid, and its mechanism may be

explained as follows: EA intervention lowered the TNF- α level in follicular fluid, reduced apoptosis of cumulus granulosa cells and improved egg quality, thus improving clinical pregnancy rate of patients receiving IVF-ET, which needed to be confirmed by further studies.

REFERENCES

- [1] Michael F Costello, John A Eden. A systematic review of the reproductive system effects of metformin in patients with polycystic ovary syndrome. *Fertil Steril* 2003; 79(1): 1-13.
- [2] Chen ZJ, Liu JY. Polycystic ovarian syndrome (PCOS)-foundation and clinical (Chin). Beijing: People's Medical Publishing House; 2009: 392-395.
- [3] Rotterdam ESHRE/ASRM-Sponsored PCOS Concensus Workshop Group. Revised 2003 consensus on diagnostic criteria and long-term health risks related to polycystic ovary syndrome. *Fertil Steril* 2004; 81(11): 19-25.
- [4] Wang SJ. Preliminary study of the relationship between acupuncture effect and cell information transduction. *Chin J Basic Med Tradit Chin Med (Chin)* 2004; 10(11): 31-33.
- [5] Elisabet Stener-Victorin, Urban Waldenström, Lars Nilsson, Matts Wikland, Per Olof Janson. A prospective randomized study of electroacupuncture versus alfentanil as anaesthesia during oocyte aspiration in in vitro fertilization. *Hum Reprod* 1999; 14(10): 2480-2484.
- [6] Elisabet Stener-Victorin, Peter Humaidan. Use of acupuncture in female infertility and a summary of recent acupuncture studies related to embryo transfer. *Acup Med* 2006; 24(4): 157-163.
- [7] Wolfgang E Paulus, Mingmin Zhang, Erwin Strehler, Imam El-Danasouri, Karl Sterzik. Influence of acupuncture on the pregnancy rate in patients who undergoing assisted reproduction therapy. *Fertil Steril* 2002; 77(4): 721-724.
- [8] Zhang MM, Huang GY, Lu FE. Effect of acupuncture on pregnancy rate in embryo transfer and mechanism: a randomized and control study. *Chin Acup-mox (Chin)* 2003; 23(1): 3-5.
- [9] Smith C, Coyle M, Norman RJ. Influence of acupuncture stimulation on pregnancy rates for women undergoing embryo transfer. *Fertil Steril* 2006; 85(5): 1352-1358.
- [10] Dieterle S, Ying G, Hatzmann W, Neuer A. Effect of acupuncture on the outcome of in vitro fertilization and intracytoplasmic sperm injection: a randomized, prospective, controlled clinical study. *Fertil Steril* 2006; 85(5): 1347-1351.
- [11] Dong JC. The clinical observation of follicular maldevelopment. *Chin J Info Tradit Chin med* 2007; 14(9): 68-69.
- [12] Stener-Victorin E, Kobayashi R, Watanabe O, Lundeberg T, Kurosawa M. Effects of electroacupuncture stimulation of different frequencies and intensities on ovarian blood flow in anaesthetized rats with steroidinduced polycystic

- ovaries. *Repro Biol Endocrinol* 2004; 2(1): 16-21.
- [13] Goswamy RK1, Williams G, Steptoe PC. Decreased uterine perfusion—a cause of infertility. *Hum Reprod* 1988; 3(8): 955-959.
- [14] Gong XH, Li QS, Zhang QP, Zhu GJ. Predicting endometrium receptivity with parameters of spiral artery blood flow. *J Huazhong Univ Sci Technolog Med Sci* 2005; 25(3): 335-338.
- [15] Stener-Victorin E, Waldenström U, Andersson SA, Wikland M. Reduction of blood flow impedance in the uterine arteries of infertile women with electroacupuncture. *Hum Reprod* 1996; 11(6): 1314-1317.
- [16] Zhang XQ, Chen CH, Edmond Confino, Randall Barnes, Magdy Milad, Ralph R Kazer. Increased endometrial thickness is associated with improved treatment outcome for selected patients undergoing invitro fertilization embryo transfer. *Fertil Steril* 2005; 83(2): 336-340.
- [17] Liu XY, Huang GY, Zhang MM. Effects of acupuncture promoting embryo implantation and development in the rat with dysfunctional embryo implantation. *Chin Acup-mox (Chin)* 2007; 27(6): 439-442.
- [18] Yu W, Horn B, Acacio B. A pilot study evaluating the combination of acupuncture with sildenafil on endometrial thickness. *Fertil Steril* 2007; 87(Suppl 2): S23.
- [19] Elisabet Stener-Victorin, Urban Waldenström, Matts Wikland, Lars Nilsson, Leif Häggglund, Thomas Lundeborg. Electroacupuncture as a peroperative analgesic method and its effects on implantation rate and neuropeptide Y concentrations in follicular fluid. *Hum Reprod* 2003; 18(7): 1454-1460.
- [20] Shang DK, Zheng XQ, Yan WH, Jin ZY, Liu XY, Xu XP. Study of relationship between TH1/TH2 cytokine and habitual abortion. *Chin J Birth Health Heredity (Chin)* 2008; 16 (4): 25-26.
- [22] Wang XX, Yi XF, He LX, Xu XY, Yang DL, Kong L. The effect of TNF- α and IFN- γ levels in follicular fluid on pregnancy outcome of in vitro fertilization. *Chin J Pract Gynecol Obstetr (Chin)* 2009; 25(11): 859-860.
- [23] Li F, Zheng YH, Xiao QX. TNF- α and egg generation. *Reproduct Contracept (Chin)* 2007; 27(7): 479-483.
- [24] Susan M. Quirk, Dale A. Porter, Sarah C. Huber, Robert G. Cowan. Potentiation of Fas-Mediated Apoptosis of Murine Granulosa Cells by Interferon- γ , Tumor Necrosis Factor- α , and Cycloheximide. *Endocrinology* 1998, 139(12): 6353.
- [25] Basini G, Mainardi GL, Bussolati S, Tamanini C. Steroidogenesis, proliferation and apoptosis in bovine granulosa cells: role of tumour necrosis factor-alpha and its possible signalling mechanisms. *Reprod Fertil Dev* 2002; 14(3-4): 141-150.
- [26] Erik Host, Anette Gabrielsen, Svend Lindenberg, Steen Smidt-Jensen. Apoptosis in human cumulus cells in relation to zona pellucida thickness variation, maturation stage, and cleavage of the corresponding oocyte after intracytoplasmic sperm injection. *Fertil Steril* 2002; 77(3): 511-515.
- [27] R S Raman, P J Chan, J U Corselli, W C Patton, J D Jacobson, S R Chan, A King. Comet assay of cumulus cell DNA status and the relationship to oocyte Fertilization via intracytoplasmic sperm injection. *Hum Reprod* 2001; 16(5): 831-835.
- [28] Lee KS, Joo BS, Na YJ, Yoon MS, Choi OH, Kim WW. Cumulus cells apoptosis as an indicator to predict the quality of oocytes and the outcome of IVF-ET. *Assist Reprod Genet* 2001; 18(9): 490-498.

ABSTRACT IN CHINESE

[摘要] 目的: 观察电针对多囊卵巢综合征(PCOS)患者卵子质量的影响,并探讨其作用机制。方法: 将接受体外受精-胚胎移植(IVF-ET)的PCOS患者200例按照随机数字表法分为电针组(102例)、对照组(98例),两组均给予达英-35及促性腺激素释放激素激动剂超促排卵,电针组在超促排卵过程中加肾俞、气海、足三里、三阴交、内关、子宫等穴位电针干预,比较两组患者卵子质量、最终的妊娠结局及肿瘤坏死因子- α (TNF- α)水平。结果:(1)电针干预可显著提高PCOS患者的优胚率($P<0.05$),并将临床妊娠率提高8.36%;(2)电针干预可明显降低卵泡液TNF- α 水平(13.61 ± 15.46 vs 34.09 ± 93.53 , $P<0.05$);(3)妊娠患者血清、卵泡液TNF- α 水平均低于非妊娠患者[妊娠:(53.91 ± 63.32) pg/mL, (14.93 ± 25.37) pg/mL,非妊娠:(76.82 ± 82.96) pg/mL, (25.04 ± 35.79) pg/mL]差异有统计学意义(均 $P<0.05$)。结论:电针能够改善PCOS患者卵子质量,提高IVF-ET的临床妊娠率,其机制可能与TNF- α 水平有关。

[关键词] 多囊卵巢综合征 电针 控制下超促排卵 肿瘤坏死因子- α