Acupuncture and *In Vitro* Fertilization: A Retrospective Chart Review

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Abstract

Objectives: In 2007, Craig et al. reported the results of a randomized controlled trial in which a standardized acupuncture protocol performed on the day of embryo transfer (ET) resulted in lower pregnancy rates after *in vitro* fertilization (IVF). Between 2005 and 2007, the Craig protocol was used by one of the authors (LHR) at an infertility clinic unaffiliated with the Craig et al. trial. The objective was to retrospectively review clinic records to evaluate the effect of the Craig protocol in both donor and nondonor IVF cycles on four outcomes: (1) live births; (2) biochemical pregnancies; (3) adverse outcomes; and (4) live births in nondonor cycles across age groups established by the Society for Assisted Reproductive Technology.

Design: The study design was a retrospective chart review.

Setting: The study was conducted at a private infertility clinic.

Patient(s): Patients underwent fresh, donor ($N=70$) or nondonor ($N=402$) IVF-ET.

Intervention(s): The Craig protocol included the following points before ET: GV-20, CV-6, ST-29, SP-8, PC-6, LV-3; *Shenmen* and Brain on the left ear; and Uterus and Endocrine on the right ear. After transfer the points were LI-4, SP-10, ST-36, SP-6, KI-3; Uterus and Endocrine on the left ear; and *Shenmen* and Brain on the right ear.

Main outcome measure(s): Live births (LB) beyond 24 weeks' gestation was the main outcome measure.

Result(s): In *nondonor* IVF cycles, there were no differences in LB across age groups (odds ratio [OR]=1.04, 95% confidence interval [CI] 0.68–1.57), biochemical pregnancies (OR=0.60, 95% CI 0.27–1.33), or adverse outcomes (OR=0.63, 95% CI 0.31–1.26). In *donor* cycles, LB were higher in the acupuncture group (relative risk=1.31, 95% CI 1.02–1.71).

Conclusions: In this observational study, the Craig protocol was not found to lower IVF LB. In fact, the Craig protocol was associated with higher LB in donor cycles. These findings should be considered cautiously because more adequately powered, randomized research is needed.

Introduction

THE EVIDENCE OF ADJUVANT acupuncture's effectiveness to increase births around *in vitro* fertilization–embryo transfer (IVF-ET) is inconclusive. To date, eight meta-analyses have yielded contradicting conclusions. Manheimer et al. (7 trials, $N=1366$),¹ Ng et al. (10 trials, $N=2003$),² Cheong et al. (13 trials, $N=2300$),³ and Zheng et al. (24 trials, $N=5807$)⁴ all found that acupuncture improved IVF-ET clinical pregnancy outcomes. Conversely, El-Toukhy et al. (13 trials, $N=2500$),⁵ Cheong et al. (14 trials, $N=2670$),⁶ El-Toukhy et al. (14 trials, $N=2870$),⁷ and Sunkara et al. (14 trials, $N=2870$)⁸ all reported that acupuncture did not improve these outcomes. Meta-analysis methodology varied considerably and contributed to the varying results.⁹ For

this reason, reproductive endocrinologists and infertility specialists cautiously include acupuncture as part of an IVF treatment plan, primarily due to demand by IVF patients.^{10–12}

Paulus et al. were first to report an increase in clinical pregnancy rates (CPR) when a standardized acupuncture protocol was performed immediately before and after fresh, nondonor IVF-ET.¹³ CPR was defined by a positive pregnancy test and intrauterine fetal sac observed on ultrasound at six weeks in that study. In the acupuncture group, acupoints needled before the transfer were: *Baihui* GV-20, *Guilai* ST-29, *Diji* SP-8, *Neiguan* PC-6, *Taichong* LV-3, *Shenmen*, and Brain in one ear; and, Uterus and Endocrine in the other ear. Acupoints needled after the transfer were as follows: *Hegu* LI-4; *Xuehai* SP-10; *Zusanli* ST-36; and *Sanyinjiao* SP-6;

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with the ear points applied on the ear opposite as to what was needled in the pre-ET treatment.¹³ Of 160 subjects in the Paulus et al. study, 80 were randomized to the acupuncture group and 80 to the control group. The CPR was higher in the acupuncture group compared to the control group (42.5% versus 26.3%, $p=0.03$).¹³

Several trials followed, often with modifications to the original Paulus et al. protocol,¹³ with mixed results.^{14–24} Of those, only the Craig et al. trial reported lower CPR.²⁴ Craig et al. found acupuncture lowered IVF-ET CPR in a multicentered, randomized controlled trial. In that study, 94 patients undergoing a fresh, nondonor or donor cycle at three IVF centers were randomized to receive adjuvant acupuncture ($N=46$) or treatment as usual ($N=48$), regardless of embryo quality.²⁴ The standardized acupuncture protocol used by Craig and colleagues (Craig protocol) was the Paulus et al. acupuncture protocol¹³ with the addition of one point, *Qihai* CV-6, before the transfer and another point, *Taixi* KI-3, after the transfer.²⁴ This modification was made based on Traditional Chinese Medicine (TCM) theory to provide more direct support to the Kidney, which according to TCM theory, is the organ that regulates and governs reproduction.^{25–27} The acupuncture was performed on acupuncture-naïve subjects, off-site from the IVF clinic at an acupuncture clinic centrally located between three IVF centers. The main outcome measure was CPR as defined by a pregnancy confirmed by positive human chorionic gonadotropin (HCG) blood test and fetal cardiac activity on ultrasound. The control group's CPR (69.6%) was significantly higher than the treatment group (43.8%, $p\leq 0.03$).²⁴ Although only the abstract was published, the Craig et al. study²⁴ was included in several meta-analyses.^{3–8} It was criticized as poorly designed due to the use of a previously untested acupuncture protocol²⁸ and for the unusually high CPR in the control group.⁹

The Craig et al. trial²⁴ is of specific interest to this chart review. This study's first author assisted in the design and implementation of that trial, but left the study in 2005 before its completion to work with a non-study-affiliated IVF center: the Northwest Center for Reproductive Sciences (NCRS). Between 2005 and 2007, before the results of the Craig et al. trial¹ were known, the Craig protocol²⁴ was performed on all patients who elected acupuncture at NCRS. As soon as the results of the Craig et al. study²⁴ were reported, the Craig protocol²⁴ was discontinued; and a retrospective review of clinic records was undertaken to assess its effects at NCRS.

This retrospective chart review reports the IVF-ET outcomes of patients who elected acupuncture and received the Craig protocol²⁴ on the day of embryo transfer compared to those who did not elect acupuncture in an uncontrolled setting. The primary objective is to evaluate the effect of the Craig protocol²⁴ when performed onsite at a single IVF center for both donor and nondonor cycles on four outcomes: (1) IVF live births (LB), (2) biochemical pregnancies, (3) adverse outcomes, and among nondonor cycles, (4) LB across the age groups established by the Society for Assisted Reproductive Technology (SART).

Materials and Methods

Setting and design

This study is a retrospective chart review of records from a private infertility clinic and analysis of LB, biochemical

pregnancies, and adverse outcomes in patients who elected acupuncture compared to those who did not elect acupuncture. Between August 2005 and December 2007, IVF patients at NCRS could elect adjuvant acupuncture on the day of IVF-ET.

Fresh donor and nondonor IVF cycle types were included in this study, regardless of embryo quality. Cycles with preimplantation genetic diagnostic testing or intracytoplasmic sperm injection were also included. The main outcome measure was live birth after 24 weeks' gestation. Secondary outcome measures were biochemical pregnancies and adverse outcomes.

Patients who elected acupuncture on the day of ET were treated individually by the first author or 1 of 3 acupuncturists legally contracted by Abundant Spring LLC. All acupuncturists were board certified nationally, licensed in Washington State, and had 1–6 years' experience. All were individually trained to perform the acupuncture protocol in the same way. A gentle needle technique was employed, with the intention that patients not feel any needle insertion. Three (3) of the acupuncturists had no previous experience treating IVF patients in an IVF clinic setting.

Patients were notified by the center nursing staff that acupuncture was available on the day of ET. Notification generally happened on the day of embryo retrieval or when the patient received a report of how many eggs fertilized. Patients electing acupuncture contacted the acupuncture clinic directly and were instructed to arrive at the IVF clinic with a full bladder 1 hour and 15 minutes prior to their scheduled ET. Upon arrival, they were told by the acupuncturist to urinate and if desired, to take clonazepam as part of the center's usual care. Consent for treatment was received from all acupuncture recipients. The Oregon College of Oriental Medicine Institutional Review Board approved this retrospective chart review.

The acupuncture group (Acu) received the Craig protocol²⁴ before and after ET. See Table 1 for a summary of the acupuncture points. The acupuncture needles were needled with a guide tube on the body points. The needle types were Vinco® brand 0.20-mm×25-mm needles (Heliomed, San Jose, CA) or Yellow Seirin® brand 0.20-mm×30-mm, J-type

TABLE 1. ACUPUNCTURE PROTOCOL PERFORMED FOR ALL EMBRYO TRANSFERS DURING 2005–2007

Time of acupuncture	Acupuncture points
Pre-ET	GV-20/ <i>Baihui</i> PC-6/ <i>Neiguan</i> CV-6/ <i>Qihai</i> ST-29/ <i>Guilai</i> SP-8/ <i>Diji</i> LV-3/ <i>Taichong</i> Right ear: Uterus, Endocrine Left ear: <i>Shenmen</i> , Brain
Post-ET	LI-4/ <i>Hegu</i> SP-10/ <i>Xuehai</i> ST-36/ <i>Zusanli</i> SP-6/ <i>Sanyinjiao</i> KI-3/ <i>Taixi</i> Right ear: <i>Shenmen</i> , Brain Left ear: Uterus, Endocrine

ET, embryo transfer.

needles (People's Herbs, Portland, OR). Red Seirin® brand (People's Herbs) 0.16-mm×15-mm, D-type needles used without a guide tube on the ears.

The acupuncturist administered treatments based on the procedures described by Paulus et al.¹³ and Craig et al.²⁴ Needles were retained for 25 minutes for each treatment. Points were needled in the following order: ears first, then abdomen, upper limbs, followed by the lower limbs. Body points were stimulated with a mild lifting and thrusting technique until the patient reported some sensation at the

point, or a very mild *de qi* sensation,²⁹ and restimulated after 10 minutes. After the ET, the patient was encouraged to urinate in a bedpan prior to the second acupuncture treatment. Post-ET acupuncture was performed in the recovery bay, typically within 15 minutes after the ET was completed. The acupuncturist again needled patients according to the points summarized in Table 1, with the ears first, the upper limbs next, and the lower limbs last. The body points were stimulated in the same way as pre-ET. During each acupuncture session, patients were offered an optional eye

TABLE 2. NONDONOR AND DONOR *IN VITRO* FERTILIZATION PATIENT DESCRIPTION

	Nondonor		Donor	
	Acupuncture group	No acupuncture group	Acupuncture group	No acupuncture group
N ^a	199	203	23	47
Patient diagnosis				
Primary infertility ^b	104 (52.2)	115 (56.7)	9 (39.1)	17 (36.2)
Male factor ^b	69 (34.7)	79 (38.9)	3 (13.04)	12 (24.5)
Diminished ovarian reserve ^b	62 (31.2)	56 (27.6)	21 (91.3)	46 (97.9)
Endometriosis ^b	26 (13.1)	33 (16.3)	3 (13.0)	6 (12.8)
Ovulatory dysfunction ^b	43 (21.6)	51 (25.1)	0 (0)	0 (0)
Tubal ^b	20 (10.1)	36 (17.7)	1 (4.4)	2 (4.3)
Uterine ^b	12 (6.0)	12 (5.9)	3 (13.0)	4 (8.5)
Other ^b	23 (11.6)	16 (7.9)	3 (13.0)	4 (8.5)
Unknown ^b	25 (12.6)	21 (10.3)	0 (0)	0 (0)
Multiple diagnoses ^b	68 (34.2)	78 (38.4)	8 (34.8)	20 (42.6)
Male only ^b	35 (17.6)	32 (15.8)	0 (0)	0 (0)
Female only ^b	130 (65.3)	124 (61.1)	20 (87.0)	35 (74.5)
Male & female ^b	34 (17.1)	47 (23.5)	3 (13.0)	12 (25.5)
Cycle number				
First cycle ^b	146 (73.4)	163 (80.3)	19 (82.6)	29 (61.7)
Repeated cycle ^b	53 (26.6)	40 (19.7)	4 (17.4)	18 (38.3)
Fertilization method				
Conventional ^b	113 (56.8)	109 (53.7)	16 (69.6)	22 (46.8)
ICSI ^b	73 (36.7)	82 (40.4)	5 (21.8)	18 (38.3)
Mixed ^b	13 (6.5)	12 (5.9)	2 (8.7)	7 (14.9)
PGD ^b	17 (8.5)	15 (7.4)	0 (0)	6 (12.8)
Total antral Follicle count ^{c,d}	7.4±2.5 (2–14)	7.8±2.3 (2–15)		
Number of days stimulated ^{c,d}	9.8±1.3 (6–13)	9.8±1.3 (7–13)		
Dosage IU ^{c,d}	3697.7±1491.9 (863–7650)	3528.5±1410.0 (832–6900)		
Estradiol peak ^c	3383.6±1900.5 (606–11,065)	3545.8±1720.8 (690–9232)	5445.6±2968.1 (1909–13,298)	4863.6±2057.2 (1521–10,218)
Endometrial thickness ^c	10.7±2.2 (6–21.9)	10.9±2.6 (5.9–20.4)	10.0±2.3 (6.1–14.6)	10.7±2.3 (6.4–17.8)
No. of oocytes obtained ^{c,d}	16.2±8.8 (2–43)	17.7±9.6 (2–53)		
No. of embryos transferred ^c	2.99±1.1 (1–6)	2.98±1.1 (1–8)	2.04±0.56 (1–3)	2.30±0.66 (1–4)
Gestational age ^c	34.1±9.5 (6.1–45.1)	33.0±10.4 (6–44.4)	34.3±8.2 (9–40.9)	33.5±10.3 (6.4–43.4)
Singleton birth ^b	66 (55.9)	83 (64.3)	9 (40.9)	17 (47.2)
Twin birth ^b	47 (39.8)	36 (27.9)	12 (54.6)	17 (47.2)
Triplet birth ^b	5 (4.2)	9 (7.0)	1 (4.6)	2 (5.6)
Quadruple birth ^b	0 (0)	1 (0.8)		

^aNumber.

^bMeasure not applicable in donor cycles.

^cN (proportion).

^dMean±standard deviation (range).

ICSI, intra-cytoplasmic sperm injection; PGD, pre-implantation genetic diagnosis; IU, international unit.

pillow, soft music before the transfer, and a post-ET meditation from "Imagery and Meditation to Support *In-Vitro* Fertilization (IVF)" by Anji, Inc.

Statistical methods

Pregnancy outcomes were categorized as the proportion of LB, biochemical pregnancies, and adverse outcomes in the two treatment groups. Biochemical outcomes were defined as β -HCG serum levels >5 to <50 mIU/mL. Adverse outcomes included miscarriages, therapeutic abortions, and ectopic pregnancies. Data were collected and analyzed in the following order. Overall live birth rates in the acupuncture (Acu) and no acupuncture (no Acu) groups were compared. Then pregnancy rates were analyzed separately in the nondonor and donor groups. In the nondonor group, LB were also compared across age groups as established by SART. The exception was the "41–42" and ">42" age groups, which were combined as ">40" in the fresh, nondonor cycles due to the low number charts.

Among nondonor cycles, this study compared age, cause of infertility, cycle number, fertilization method, pre-implantation genetic diagnosis testing status, follicle-stimulating hormone (FSH), antral follicle count, number of days stimulated with gonadotropins, gonadotropin dosage, peak estradiol, endometrial thickness, number of oocytes obtained, number of mature oocytes, number of embryos transferred, and gestational age.

Analyses were completed by calculating unadjusted relative risk ratios in donor cycles and logistic regression models adjusted for FSH level, age, and number of mature oocytes, because these were found to differ and may be related to outcomes independently in nondonor cycles. All were performed with Stata Statistical Software: Release 10 (College Station, TX: StataCorp LP).

Results

From 2005 to 2007, NCRS performed 528 ET procedures. Fifty-six (56) were excluded from this analysis for the following reasons: (1) frozen embryos were transferred, $N=50$; (2) the IVF cycle was part of another research protocol, $N=3$; (3) acupuncture was not completed, $N=2$; and (4) acupuncture was performed by a noncontracted acupuncturist, $N=1$.

In the 402 nondonor cycles, 199 elected acupuncture and 203 did not (Table 2). The two groups are comparable in causes of infertility, cycle number, fertilization methods, pre-implantation genetic diagnosis testing status, antral follicle count, number of days stimulated, peak estradiol, endometrial thickness, number of oocytes obtained, and number of embryos transferred. The FSH level, however, was higher in the Acu group than in the no Acu group (10.8 ± 3.26 versus 10.2 ± 3.11) (see Table 3). Age, FSH levels, and number of oocytes retrieved were associated with LB. Increasing age was associated with lower LB (odds ratio [OR]=0.87, 95% CI=0.83–0.92) and higher FSH levels were associated also with lower LB (OR=0.92, 95% CI=0.86–0.98). After adjusting for age, FSH levels, and number of mature oocytes, no difference was detected in LB between treatment groups (OR=1.04, 95% CI 0.68–1.57). LB in the Acu group were 52% (104/199) compared with 56% (113/203) in the control group. There was no difference in biochemical (OR=0.60, 95% CI 0.27–1.33) or adverse outcomes between the groups (OR=0.62, 95% CI 0.31–1.25).

Among the 70 donor cycles, 23 patients elected acupuncture and 47 did not (Table 2). The LB were 31% higher with acupuncture (RR=1.31, 95% CI 1.02–1.71). (Table 3) There was no difference in biochemical pregnancies or adverse events. The Acu group had no biochemical pregnancies compared to six in the control group (RR=0.22, 95% CI 0.01–3.96). There were two adverse outcomes in the Acu group versus nine in the control group (RR=0.45, 95% CI 0.11–1.93).

In Table 4, LB in the nondonor group are compared across SART age groups. Although age was found to be an important predictor of LB outcomes in the logistic regression models, there were no differences in LB between Acu and control groups in any of the age categories. The proportion of LB in the Acu group under 35 years old was 70% and in the control group it was 65% (RR=1.07, 95% CI=0.89–1.30). In the 35–37 age group, the proportion of LB was 46% in the Acu group compared with 61% in the control group (RR=0.73, 95% CI 0.49–1.09). In the 38–40 age group, the LB proportion in the Acu group was 35% and not different than the 42% in the control group (RR=0.83, 95% CI 0.47–1.46). In the over-40 age category, the respective LB proportions were 16% and 11% (RR=1.42, 95% CI 0.27–7.54).

Discussion

To the authors' knowledge, this is the only retrospective chart review investigating the effect of adjuvant acupuncture on IVF LB and other outcomes. In this study, the Craig protocol LB were 30% higher in the donor cycles. There were no differences in the nondonor cycles. Because the donor cycle acupuncture group's numbers are significantly underpowered, this finding should be taken cautiously as more rigorously designed research is needed to support this finding.

This observational study offered an opportunity to look back at IVF outcomes with an acupuncture protocol that was previously reported to lower CPR in a controlled setting. The results presented here differ from those of the original Craig et al. trial in which the Craig protocol adversely affected IVF CPR compared to a no-acupuncture control.²⁴ The LB outcomes have not been published from that study.²⁴ Also of note, Craig et al. included embryos from fresh, nondonor and donor cycles, regardless of quality.²⁴ Paulus et al. only included fresh, nondonor cycles with good-quality embryos.¹³

Several differences in the study methods may explain the differences we observed. Location of acupuncture treatment may be an influential factor. In the Craig et al. study, participants received acupuncture at a location offsite from the IVF clinic.²⁴ The additional stress of traveling to an unfamiliar location for an acupuncture-naïve patient on IVF-ET day may have negated acupuncture's effect in the Craig et al. study.²⁴ For this study, acupuncture was performed onsite on the day of ET. By minimizing the exposure to additional stress due to travel, acupuncture may be more effective in this setting.

More importantly, Craig et al. did not consider differences between cycle types (i.e., donor versus nondonor) in their data analysis. The nondonor IVF cycle procedure differs significantly from the fresh, donor cycle. Nondonor IVF cycles require that the embryo recipient's ovaries be stimulated with gonadotropin-stimulating medication to develop

TABLE 3. COMPARISON OF *IN VITRO* FERTILIZATION LIVE BIRTH OUTCOMES IN ACUPUNCTURE AND NO ACUPUNCTURE GROUPS

<i>Nondonor</i>	<i>Acupuncture group</i>	<i>No acupuncture group</i>	OR (SE) (95% CI) ^a
Acupuncture ^b	104 (52.2)	113 (55.7)	1.04 (0.22) (0.68–1.57)
Age (yr) ^c	34.8 ± 4.32 (34.2–35.4)	34.4 ± 4.46 (33.8–35.0)	0.87 (0.02) (0.83–0.92)
FSH mIU/mL ^c	10.8 ± 3.26 (10.4–11.3)	10.2 ± 3.11 (9.8–10.7)	0.92 (0.03) (0.86–0.98)
Number of mature oocytes retrieved ^c	13.4 ± 8.0 (2–38)	15.0 ± 9.0 (2–49)	1.05 (0.02) (1.01–1.07)
Biochemical pregnancies ^{b,d}	11 (5.5)	17 (8.4)	0.60 (0.24) (0.27–1.33)
Adverse outcomes ^{b,e}	15 (7.5)	22 (10.8)	0.62 (0.22) (0.31–1.25)
<i>Donor</i>	<i>Acupuncture group</i>	<i>No acupuncture group</i>	RR (95% CI) ^f
Acupuncture ^{b,g}	20 (87.0)	31 (66.0)	1.31 (1.02–1.71)
Biochemical pregnancies ^{b,d}	0 (0)	4 (8.5)	0.22 (0.01–3.96)
Adverse outcomes ^{b,e}	2 (8.7)	9 (19.1)	0.45 (0.11–1.93)

^aLogistic regression models included age, follicle-stimulating hormone (FSH), and number of mature oocytes as covariates and live birth, biochemical pregnancies or adverse events as outcomes.

^bData are *N* (%).

^cMean ± standard error (95% confidence interval [CI] for mean).

^dPositive serum β -human chorionic gonadotropin level ≥ 11 days after embryo transfer.

^eIncludes spontaneous abortions, therapeutic abortions, and ectopic pregnancies.

^fCrude, unadjusted risk ratio.

^gLive birth at greater than 24 weeks gestation.

OR, odds ratio; RR, relative risk; SE, standard error.

several follicles simultaneously and the endometrium. Donor cycles do not require ovarian stimulation, rather only endometrial development with medications such as estrogen patches or suppositories. These differences may require different acupuncture protocols. The outcomes observed in this

TABLE 4. LIVE BIRTHS IN THE NONDONOR GROUP BY SOCIETY FOR ASSISTED REPRODUCTIVE TECHNOLOGY-DEFINED AGE CATEGORIES

<i>Nondonor</i>	<i>Acupuncture group</i>	<i>No acupuncture group</i>	RR ^a (95% CI)
<35 ^b	94	107	
Live births ^{c,d}	70.2 (66) (60.7–79.3)	65.4 (70) (56.0–74.0)	1.07 (0.89–1.30)
35–37 ^b	46	40	
Live births ^{c,d}	45.7 (21) (30.6–59.4)	62.5 (25) (45.0–75.0)	0.73 (0.49–1.09)
38–40 ^b	40	38	
Live births ^{c,d}	35.0 (14) (20.2–49.8)	42.1 (16) (25.6–56.4)	0.83 (0.47–1.46)
>40 ^b	19	18	
Live births ^{c,d}	15.8 (3) (-1.1–31.1)	11.1 (2) (-3.5–25.5)	1.42 (0.27–7.54)

^aCrude (unadjusted) risk ratio.

^bData are *N*.

^cData are percents (*N*) (95% confidence interval [CI]).

^dLive births beyond 24 weeks' gestation.

study suggest that the type of cycle should be considered when developing the acupuncture protocol and data analysis plan in future studies.

Craig et al. used CPR as their main outcome measure,²⁴ whereas LB after 24 gestation weeks were used in this study. LB are the most important outcome measure of an IVF cycle's success, whereas CPR outcomes confirm pregnancy in the first trimester.^{30,31} It is typical for IVF centers in the United States to report both to Centers for Disease Control, and LB rates are typically lower than CPR rates in the national data.³² The proportion of LB is also typically higher in donor cycles when compared to nondonor cycles.³²

Finally, the significant difference observed in mean FSH level, age, and number of mature oocytes between the nondonor Acu and control groups is noteworthy in this study. The Acu group's mean FSH level and age were significantly higher and the number of mature oocytes retrieved was significantly lower than the control group. Elevated FSH, age, and decreased numbers of mature oocytes retrieved are predictive of poor IVF outcomes.³³ However, controlling for these factors in this study's logistic regression models should have minimized any potential bias. Craig et al. used χ^2 and Student's *t*-test analysis.²⁴ The results reported here might be different due to the data analysis method.

There are several limitations to this study. The first is implicit with a retrospective chart review: it is an

uncontrolled study with no randomization, and therefore potential confounders that may affect IVF success were not measured and could not be adequately controlled in this study's regression models. Women who elect to have acupuncture may differ in unknown ways that may affect IVF outcomes.

Second, it is possible patients in the control group received acupuncture elsewhere on the day of embryo transfer at an offsite location. If that happened, the effect of acupuncture may be greater than was observed in this analysis.

Third, the acupuncture group was offered an eye pillow, music, or a guided meditation during treatments. These data were not recorded and, therefore, could not be included in the logistic regression models of this study. Guided meditation, which is known to enhance relaxation, may be a confounder not accounted for in this analysis.

Finally, patients who elected acupuncture did not receive a TCM pattern diagnosis assessment. In TCM clinical practice, treatment is based on assessment of specific patterns of imbalance with the goal of correcting the underlying imbalance. Infertility may be associated with several different underlying patterns. If this information had been available, it would have been possible to evaluate which patterns were more or less responsive to the standardized acupuncture protocol at ET.

Conclusions

In this retrospective observational study, the Craig protocol²⁴ improved IVF-ET LB in donor cycles, but not in non-donor cycles. This finding is in contrast to the previous finding of significantly lower pregnancy rates when the Craig protocol was performed offsite.²⁴ The present study suggests that the impact of acupuncture at the time of ET might lie in the type of IVF cycle, with fresh donor cycles yielding the best outcomes. Future research should consider IVF cycle type and adjust acupuncture protocols to fit the needs of each cycle. Chinese medicine pattern differentiation should also be included in future studies to permit analysis of the TCM patterns that may be more responsive to IVF adjuvant acupuncture.

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