 Hum. Reprod. Advance Access published May 5, 2006 doi:10.1093/humrep/del110

Auricular electro-acupuncture as an additional perioperative analgesic method during oocyte aspiration in IVF treatment

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BACKGROUND: The aim of this study was to compare the pain-relieving effect and the subjective well-being between auricular electro-acupuncture (EA) analgesia, auricular acupuncture (A) and conventional analgesia with remifentanil (CO). METHODS: A total of 94 women undergoing IVF were randomized to auricular acupuncture with (EA, *n* = 32) or without (A, *n* = 32) continuous 1 Hz auricular stimulation (using a battery-powered miniaturized stimulator, P-Stim) or with adhesive tapes instead of needles and no electrical stimulation (control group, CO, *n* = 30) at the auricular acupuncture points 29, 55 and 57. All patients received patient-controlled analgesia (PCA) with remifentanil. Pain intensity and psychological well-being were assessed by means of visual analogue scales (VAS); tiredness, nausea and vomiting and analgesic drug consumption were documented. RESULTS: Pain relief and subjective well-being were significantly greater in group EA during and after the procedure as compared with groups A and CO (*P* < 0.001). The patients were significantly more tired in group CO than in groups A and EA (*P* < 0.001). Consumption of the opioid remifentanil was significantly lower in group EA, comparable nausea (*P* < 0.001). CONCLUSION: Auricular EA significantly reduces pain intensity and analgesic consumption of the opioid remifentanil during oocyte aspiration in IVF treatment.

Key words: analgesia/auricular electro-acupuncture/IVF/oocyte aspiration/pain relief/remifentanil

Introduction

Transvaginal ultrasound-guided oocyte aspiration has simplified the process of IVF and embryo transfer. The oocyte aspiration procedure is usually short, lasting 10–15 min, and is generally the most painful component of the IVF treatment. Pain perceived during oocyte aspiration varies to a large extent from one individual to another and is often likened to the pain perceived during menstruation (Soussis *et al*., 1995). The ideal analgesic treatment during oocyte retrieval should guarantee rapid onset, adequate pain relief and rapid recovery without affecting the oocytes. The use of i.v. sedation and analgesia using benzodiazepines, propofol and opioids is a common clinical practice (Soussis *et al*., 1995; Ditkoff *et al*., 1997; Trout *et al*., 1998; Wilhelm *et al*., 2002). The use of opioids and benzodiazepines, however, may frequently be associated with adverse effects such as tiredness, nausea and confusion (Volikas and Male, 2001; Wilhelm *et al*., 2002). Furthermore, many of these agents have been detected in the follicular fluid, albeit clear evidence to indicate negative effects on oocytes, oocyte differentiation, implantation or pregnancy rate is sparse (Stener-Victorin *et al*., 1999; Wilhelm *et al*., 2002; Stener-Victorin 2005). The standard sedoanalgesia during oocyte aspiration at our clinic consists of metamizol 1 g i.v. (Novalgin®, Aventis Pharma Germany, Frankfurt, Germany) and midazolam 2 mg per os (Dormicum®, Hoffmann-La Roche, Basel/Switzerland/F. AG/CH) with supplemental tramundal 100 mg i.v. (Tramal®, Gruenenthal, GMBH, Stolberg, Germany) if required.

Remifentanil (Ultiva®, Glaxo Wellcome Operations, Greenford, UK) is an ultra-short acting μ-agonist opioid with a rapid clearance. Recently, remifentanil has been shown to be beneficial and potentially superior to pethidine in the achievement of patient-controlled analgesia (PCA) during labour (Glass *et al*., 1999; Volikas and Male, 2001).

The underlying mechanism of action of auricular electro-acupuncture (EA) is suggested to be multi-factorial involving

biological responses such as the stimulation of A-delta fibers by the stimulating 'De qi' sensation, as well as psychological aspects (Willer *et al*., 1984; Amanzio and Benedetti, 1999). Other potential mechanisms include the activation of descending inhibitory pain control systems (Sandkühler, 1996, 1997), activation of the propriospinal heterosegmental antinociceptive system leading to down-regulation of pain-induced changes in signal transduction in the spinal cord (Han *et al*., 1991; Mayer, 2000) and the release of endogenous opioid peptides (Tang *et al*., 1997). EA has been found to induce the release of various neurotransmitters such as encephalin and dynorphins (Ghoname *et al*., 1999) and substance P (White *et al*., 2000) in the central nervous system both in animal studies and in humans (Csemiczky and Collins, 2000). Despite both experimental and clinical evidence of the effects claimed for EA, its role in western medicine has been questioned (Renckens, 2002; Sator-Katzenschlager *et al*., 2003, 2004). The effect of EA as a pain-relieving method during surgical procedures has been evaluated in various situations (Stener-Victorin *et al*., 1999, 2003).

Most of the patients ask for non-pharmacological analgesic methods because of the negative side effects of opioids. Acupuncture, especially auricular EA, may be an alternative for patients with intolerance of conventional analgesia. To date, no study has examined the potential benefits of continuous electrical auricular acupuncture during oocyte aspiration in IVF treatment. The aim of this study was to determine the efficacy of auricular EA as a supplement to an i.v. remifentanil bolus via PCA for the short-lasting, but painful, transvaginal puncture for oocyte retrieval. The aim of this study was to test the hypothesis that auricular EA would reduce acute pain, and analgesic consumption (the use of remifentanil), and improve perioperative well-being.

Materials and methods

Study design and patient selection criteria

The study was performed at the IVF unit, Medical University of Vienna, Austria, between April and December 2004. The study protocol was designed to follow the CONSORT guidelines [randomized controlled trial (RCT)] (Moher *et al*., 2001). After obtaining approval from the institutional Ethics Committee at the University of Vienna and written informed consent, 94 healthy, adult female patients undergoing oocyte aspiration for IVF treatment were investigated in a prospective, randomized, double-blind, controlled study. Women undergoing a super-ovulation protocol for oocyte retrieval aged <43 years, with a BMI <28 kg/m^2, who had four or more follicles >18 mm at the time of HCG injection for oocyte maturization, were selected for enrolment. Exclusion criteria were auricular acupuncture in the past, allergy to remifentanil and other opioids, history of drug abuse or chronic pain therapy, presence of a pacemaker, asthma, diabetes, corticosteroid use, eczema of the ear or history of any previous surgery of the ear. For transvaginal ultrasound-guided oocyte retrieval, all patients received metamizol 1 g i.v. (Novalgin®, Aventis Pharma, Frankfurt, Germany) infused 15 min before the procedure and a PCA (Graseby-perfusor 3300, B. Braun, Melsungen, Germany) pump containing remifentanil with a bolus option (20 µg bolus over 30 s, lockout period 1 min). The PCA treatment began before the start of the oocyte retrieval and finished upon completion of oocyte aspiration.

Enrolment and randomization

Only patients who had never had auricular acupuncture before were included in the study.

Randomization was performed by one doctor on the day of the last ultrasound examination before oocyte retrieval. Patients were randomized in proportions of 1:1:1 to treatment with EA group (n = 32), the auricular acupuncture (A) group without electrical stimulation (n = 32) or the control (CO) group without needles and electrical stimulation (n = 30). A computer-generated randomization list was used for allocation. The randomization was continued until at least 30 patients had been allocated to each group.

Each P-Stim™ was programmed by an independent technician for electrical stimulation or no stimulation before the study. To ensure blinding of the investigator, each P-Stim™ was packed in a non-transparent case, in which the respective permanent needles or adhesive tapes were also included. The packages were numbered consecutively, according to the randomization list. Patients and investigators were blinded to the randomization.

Auricular EA

An electrical conductance device meter (multipoint selection pen™, Biegler GmbH, Mauerbach, Austria) that measures the skin resistance and signals the active point with light and noise was used to identify the acupuncture points (Oleson *et al*., 1980). Patients of groups EA and A received auricular acupuncture using special titanium disposable needles (27 gauge, 3 mm length; Biegler GmbH). Disposable acupuncture needles were inserted in the auricular acupuncture points 57 (uterus, a specific auricular acupuncture point for pathologies concerning the uterus and adnexa), 55 (shen men, an auricular acupuncture point with strong analgesic properties) and 29 (cushion, an auricular acupuncture point with strong analgesic and psychological properties) of the dominant side. Needles were covered by adhesive tape and connected to a battery-powered miniaturized stimulator worn behind the ear (P-Stim™, Biegler GmbH) (Figure 1). We choose shen men and cushion as analgesic points and uterus, because most of the patients have uterine contractions during and after the procedure. The P-Stim™ devices were applied 30 min before the oocyte retrieval by only the same gynaecologist trained in auricular acupuncture (diploma of acupuncture, Austrian Medical Chamber with 3 years of clinical experience in acupuncture). A second gynaecologist performed the oocyte retrieval and another doctor asked the outcome parameters to ensure blinding.

In group EA, continuous low-frequency auricular EA with a constant current of 1 Hz biphasic, 2 mA was applied half an hour before the procedure and lasted until 1 h after the procedure. After 3 h of stimulation, a break of 3 h was programmed to minimize the potential of any adaptation or tolerance to the analgesic effects. The investigator removed the P-Stim™ devices from all patients 1 h after the end of surgery.

In groups A and CO, P-Stim™ devices were attached without electrical stimulation. Patients of group CO received only an adhesive tape over the whole ear connected to the P-Stim™. In this group, underneath the adhesive tape placed at the three auricular acupuncture points, no needles were attached.

Outcome parameters

The following outcome parameters were assessed before the application of the P-Stim™, every 3 min during the oocyte retrieval and every 10 min after the treatment until 1 h afterwards. Pain intensity and subjective well-being (Ghoname *et al*., 1999; Sator-Katzenschlager *et al*., 2003) were assessed using a visual analogue scale (VAS; 0 mm, no impairment; 100 mm, worst impairment imaginable). Nausea (0, no nausea; 1, mild nausea; 2, moderate nausea; 3, severe nausea)

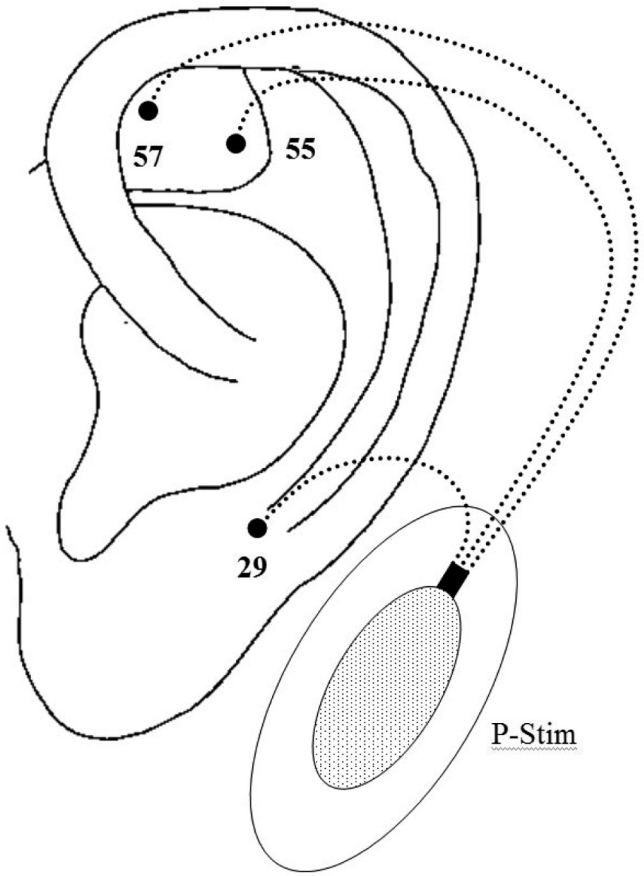

Figure 1. P-Stim™ and auricular acupuncture points. The P-Stim™ was connected to permanent auricular acupuncture needles [auricular electro-acupuncture (EA) and auricular acupuncture group] or to adhesive tapes (control group without needles and stimulation) at the auricular acupoints 57 (uterus), 55 (shen men) and 29 (cushion) and fixed behind the ear.

and tiredness (0, no tiredness; 1, mild tiredness; 2, moderate tiredness; 3, severe tiredness) were also assessed using a visual rating scale. Analgesic drug requirements during the entire study period (requested bolus and maintained bolus) were recorded. The patients' overall satisfaction with the pain treatment was determined at the end of the study period. The questionnaire also included questions concerning blinding success and the patient's evaluation of auricular EA, i.e. side effects, efficacy of acupuncture in relieving post-operative pain and willingness to use a P-Stim™ again. Demographic data and side effects were documented. Clinical parameters included the number of previous IVF cycles, number of retrieved oocytes, number of embryos transferred per embryo transfer, number of positive pregnancy tests and the number of pregnancy rate. An HCG-positive pregnancy test was defined by a plasma β-HCG concentration of >4 mU/ml 14 days after embryo transfer. The pregnancy rate was defined as an intrauterine gestational sac with a heartbeat, 3 weeks after a positive HCG test.

Statistical analysis

The power analysis based on a pilot study revealed that a minimum study size of 30 individuals in each group would provide 80% power (0.05α, two-tailed, 0.20β, two-tailed) of detecting a difference in mean pain intensity during surgery of VAS 2 or greater (SD = 1.1) between groups EA and A.

According to the intention-to-treat principle, data from all randomized patients were used for statistical analysis. Continuous and categorical variables were described by mean ± standard deviation (except where indicated) and frequencies (percentages), respectively. For each patient, mean values of VAS scores were calculated from all assessments during the study period. For the variables, pain intensity and well-being, overall mean VAS values and VAS assessments after the study period were approximately normally distributed as confirmed by a non-significant Shapiro-Wilk test for normality and compared between groups using analysis of covariance and Tukey's post-hoc tests, adjusting for baseline values. The variables requested remifentanil rescue medication, received remifentanil rescue medication, tiredness, nausea and vomiting were not normally distributed and compared using non-parametric Bonferroni-corrected Mann–Whitney *U*-tests. Frequencies of categorical variables (pain qualities, socio-economic status) after study period were compared between groups using the chi-squared test or the Fisher's exact test if any expected cell frequency was lower than five. *P*-values <0.05 were considered as statistically significant. The SAS System Version 8.2 (2001 SAS Institute, Cary, NC, USA) was used for statistical analysis.

Results

Patients and demographic data

Ninety-four female patients scheduled for oocyte aspiration during IVF-treatment were enrolled in the study. One patient of group CO was not eligible for further analysis due to impaired compliance while wearing the P-Stim™ device. This patient refused to further participate in the study, and so no follow-up data were available from this patient (Figure 2).

Accordingly, 93 patients were analysed. There were no relevant differences in age, weight and height between groups EA, A and CO, respectively (Table I).

Pain intensity

Pain intensity increased from baseline in all groups during oocyte aspiration (Figure 3A). Mean (and maximum) pain intensity during surgery, however, was significantly lower in group EA (mean VAS 2.9 ± 1.5; max VAS 6.7) compared with group A (mean VAS 4.9 ± 1.7; max VAS 8.7) and group CO (mean VAS 5.9 ± 1.6; max VAS 10.0). After the procedure, pain intensity remained significantly lower in group EA (VAS 1.1 ± 1.4) compared with group A (VAS 2.6 ± 1.4) and group CO (VAS 3.2 ± 1.4). All patients in group EA experienced pain reduction; no case of non-responding was recorded. Consumption of remifentanil rescue medication was significantly higher in the group CO when compared with groups A and EA (median, minimum–maximum requested bolus: 10, 6–27 versus 6, 2–21 versus 2, 0–5, and received bolus: 8, 4–13 versus 5, 2–8 versus 2, 0–4 during the entire investigation period).

Subjective well-being

All three groups showed deterioration in overall well-being during oocyte aspiration (Figure 3B). However, well-being scores during surgery were significantly better in group EA (VAS 3.3 ± 1.4) compared with group A (VAS 4.5 ± 1.4) and group CO (VAS 4.98 ± 1.4). After the procedure, well-being scores remained significantly better (less impairment) in group EA compared with groups A and CO.

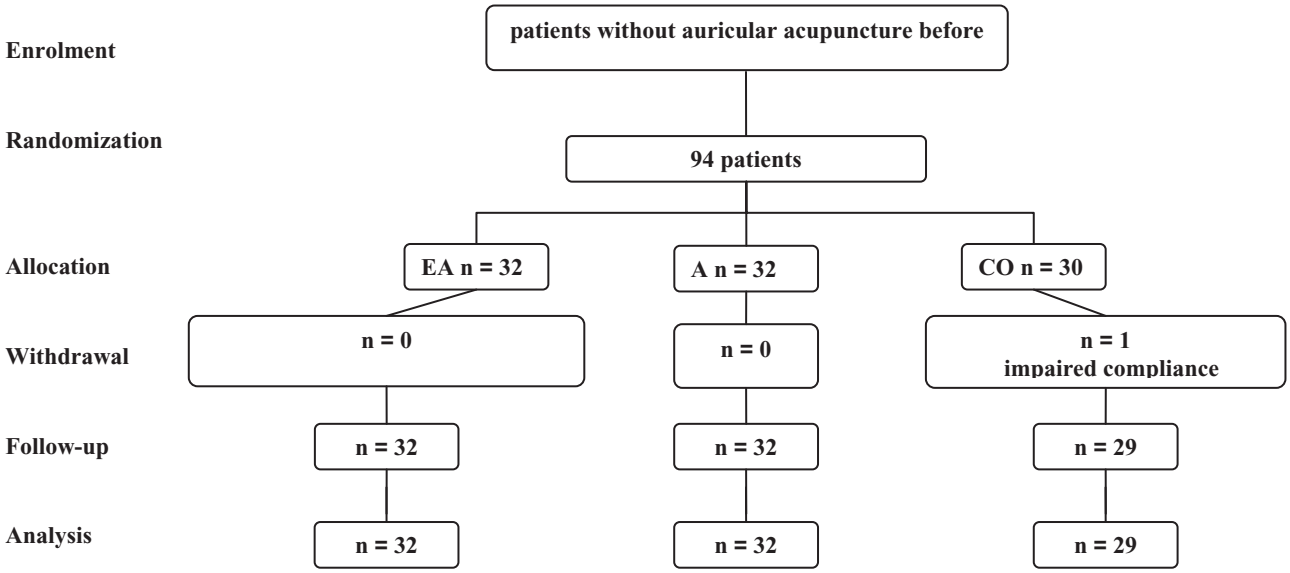

Figure 2. Flow diagram through different stages of the randomized controlled trial (RCT). Withdrawal: number of patients who refused to further participate in the study and in whom no data are available. Follow up: number of patients who continued the study. A, auricular acupuncture; CO, control group (without needles and stimulation); EA, auricular electro-acupuncture.

Table I. Demographics and outcome variables of IVF treatment in the group receiving electro-acupuncture with remifentanil (EA) and acupuncture with remifentanil (A) and the group receiving remifentanil and placebo (CO)

Demographics	EA (n = 32)	A (n = 32)	CO (n = 30)
Age (years)	33.3 ± 1.7	34.2 ± 1.1	33.9 ± 1.9
Weight (kg)	65.2 ± 10.6	64.2 ± 12.5	64.9 ± 12.3
Height (cm)	166.3 ± 6.1	164.9 ± 7.7	164.0 ± 8.1
Cause of infertility [n (%)]			
Male factor	12 (37.5)	13 (40.6)	11 (36.7)
Tubal disease	4 (12.5)	6 (18.8)	4 (13.3)
Endometriosis	5 (15.6)	6 (18.8)	6 (20.0)
PCOS	2 (6.3)	1 (3.1)	0 (0)
Two causes	2 (6.3)	0 (0)	0 (0)
Other causes	1 (3.2)	0 (0)	1 (3.3)
Unexplained	6 (18.8)	7 (28.1)	8 (30.0)
Total	32 (100)	32 (100)	30 (100)
Number of IVF treatments			
Zero attempt	5 (15.6)	6 (19.4)	9 (30.0)
One attempt	12 (37.5)	9 (29.0)	11 (36.7)
Two attempts	9 (28.1)	9 (29.0)	6 (20.0)
Three attempts	3 (9.4)	2 (6.5)	3 (10.0)
Four attempts	1 (3.1)	3 (9.7)	1 (3.3)
Five attempts	0 (0)	1 (3.2)	0 (0)
Six attempts	1 (3.1)	1 (3.2)	0 (0)
Seven attempts	1 (3.1)	0 (0)	0 (0)
Number of follicles	13.4 ± 7.4	12.2 ± 8.8	13.6 ± 7.1
Number of oocytes retrieved	9.9 ± 5.2	8.7 ± 4.8	9.1 ± 5.1
Time for oocyte retrieval (minutes)	9.8 ± 4.2	8.9 ± 5.3	9.6 ± 5.2
Oocyte aspirations	32	32	30
Embryo transfers	32	32	27
Pregnancy rate per transfer	19 (59.4%)	11 (34.4%)	7 (24.1%)

PCOS, polycystic ovary syndrome.
Data are mean ± SD (percentage).

Tiredness and nausea

During and after oocyte aspiration, tiredness was significantly more pronounced in group CO than in groups A and EA (Table II).

Seven patients in group EA (21.9%), five patients in group A (15.6%) and seven patients in group CO (24.1%) reported nausea during the procedure without inter-group statistical significance (P = 0.6904; Table II). After surgery, only two patients of group CO (6.9%) reported nausea and vomiting (Table II).

Side effects of acupuncture and patient satisfaction

No adverse side effects of acupuncture *per se* such as needle-induced hypotension, haematoma or local auricular infection were observed. Ninety-two percent of patients in group EA, 94% in group A and 96% in group CO rated the comfort of wearing the P-Stim™ device as good; 9% in group EA, 6% in group A and 4% in group CO classified the comfort of wearing the device as moderate. Only patients of group CO rejected to use an auricular acupuncture device again because of inadequate comfort (75%) or limited analgesic effects (34.5%). All patients in groups EA and A were satisfied and would repeat pain treatment if necessary.

IVF outcome data

The indications for IVF were male factor infertility, tubal disease, endometriosis, polycystic ovary syndrome as well as unexplained infertility and were equally distributed among the three groups (Table I). The causes of infertility and the number of IVF treatments did not differ between the three groups (Table I). There were no differences between the listed indications for IVF and subsequent pregnancy success. No significant difference was found between the groups EA, A and CO in the mean number of follicles and oocytes retrieved. There were no differences between the mean time (minutes) for oocyte retrieval in the three groups (Table I). The time for mobilization and the total time at the clinic were similar between groups. Two embryos (3 and 4 score) (Steer *et al.*, 1992) were transferred in all patients of the three groups. The transfer of the embryos in all three groups was equal, either on the third or

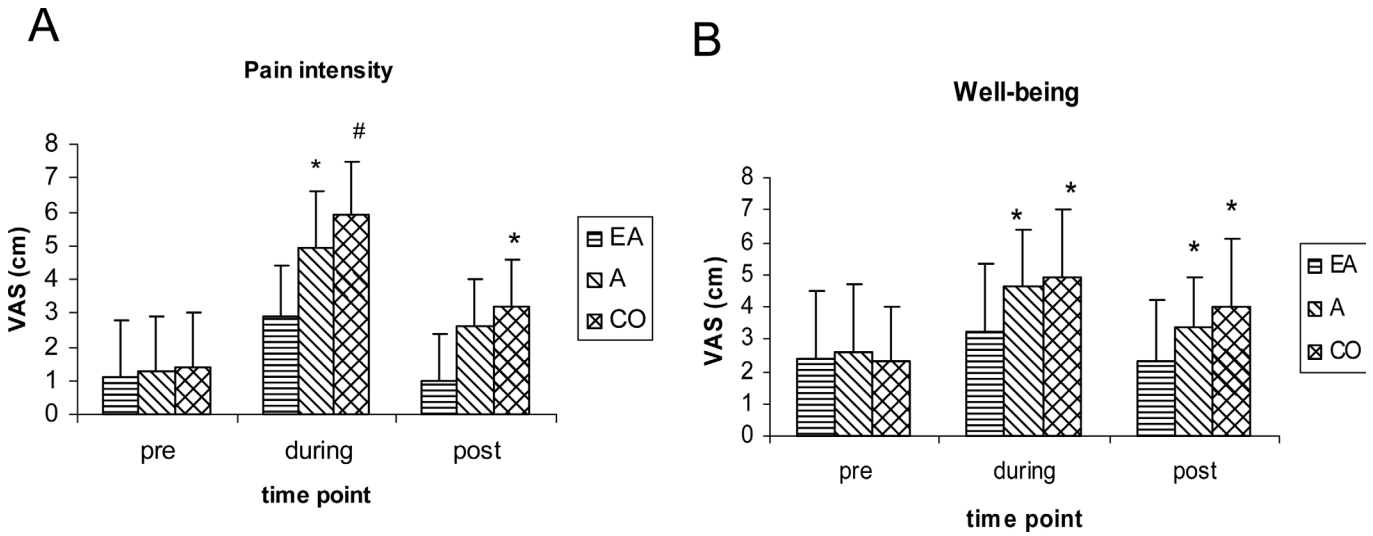

Figure 3. Effect of auricular electro-acupuncture (group EA), acupuncture (group A) or placebo (group CO) on pain intensity (**A**), subjective well-being (**B**) in patients during oocyte aspiration in IVF treatment. Data are presented as means ± SD. Pain intensity and subjective well-being were assessed by visual analogue scale (VAS) ranging from 0 mm = no impairment to 100 mm = worst deterioration imaginable. The degree of tiredness and degree of nausea were assessed by using a verbal rating scale (0, no; 1, mild; 2, moderate; 3, severe), $^{*}P < 0.005$ versus group EA. $^{\#}P < 0.005$ versus group A.

Table II. Tiredness and nausea

	EA (n = 32)	A (n = 32)	CO (n = 30)
Tiredness			
Before treatment	0 (0–2)	0 (0–1)	0 (0–1)
During treatment	0 (0–3)	1.4 (0–3)	2 (0–3)
1 h post-treatment	0 (0–1)	0 (0–2)	1 (0–2)
Nausea			
Before treatment	0 (0–1)	0 (0–0)	0 (0–0)
During treatment	0 (0–1)	0 (0–1)	0 (0–1)
1 h post-treatment	0 (0–0)	0 (0–0)	0 (0–2)
Vomiting			
Before treatment	0 (0–0)	0 (0–0)	0 (0–0)
During treatment	0 (0–0)	0 (0–0)	0 (0–0)
1 h post-treatment	0 (0–0)	0 (0–0)	0 (0–2)

Data are given as median (minimum and maximum)

fifth day. In the EA and A groups, 32 women underwent oocyte aspirations and 32 embryo transfers; in the CO group, 30 underwent oocyte aspirations and 27 embryo transfers. The reasons for not performing embryo transfer were absence of fertilization, no oocytes or spermatozoa found on the day of aspiration or embryo degeneration. Pregnancy per transfer rate was significantly higher in group EA compared with groups A and CO (Table I).

Discussion

This study demonstrates a significant pain relief from adjuvant auricular EA in patients undergoing oocyte aspiration and receiving i.v. PCA with remifentanil. This conclusion is supported not only by the patients' subjective pain assessments (Figure 3A) but also by the opioid requirements. Auricular EA improved subjective well-being of patients during and after surgery and reduced tiredness and nausea, side effects of transvaginal oocyte aspiration and opioid analgesia (Figure 3B). Together, these results suggest major advantages of EA in the clinical management of IVF patients. Previous studies observed no negative side effects of body (not auricular) EA during oocyte aspiration (Stener-Victorin *et al*., 1999, 2003). According to our clinical experience, one major advantage of auricular over body EA is increased patient comfort because of the miniaturized stimulator unit and the lack of body-wrapping wires connecting the stimulator unit and the needles.

Conscious sedation is the most widely used method for the pain relief during oocyte retrieval (Trout *et al*., 1998). Some IVF units perform paracervical blocks which have been successful as an adjunct to conscious sedation for pain relief during oocyte retrieval (Ng *et al*., 1999, 2000). The authors described that the paracervical block is as a good method to reduce the levels of abdominal pain during the surgery (Ng *et al*., 1999, 2000). Paracervical blockades with conscious sedation have been compared with paracervical blockades with body EA, which was a good alternative to the conventional medical analgesia (Stener-Victorin *et al*., 2003). We are the first to evaluate auricular EA. This additive procedure is less invasive and perhaps good for women who are intolerant of conventional analgesia and prefer non-pharmacological analgesic method.

Although in the past, scepticism has been voiced regarding the effects claimed for acupuncture, in recent years, the effect of acupuncture on different conditions (pain and diseases) has been studied from a Western scientific perspective, and the results have demonstrated that acupuncture has both physiological and psychological effects (Andersson and Lundeberg, 1995). Electrical stimulation of acupuncture points is considered to increase acupuncture analgesia (Gejervall *et al*. 2005). The significant pain reduction under EA in patients with chronic cervical and back pain has been reported previously (Sator-Katzenschlager *et al*., 2003, 2004). The present data in acute pain patients extend these previous studies in chronic pain patients (Sator-Katzenschlager *et al*., 2003, 2004) and

confirm that EA induces adequate perioperative analgesia in minor surgery, as well as a significant decrease in opioid requirements and opioid-related side effects (Kho *et al*., 1991; Wang *et al*., 1997; Stener-Victorin *et al*., 1999, 2003). Both low-frequency stimulation and high-frequency stimulation have been found to induce analgesia, but different types of endorphins are released depending on the stimulation pattern (Tang *et al*., 1997; White *et al*., 2000). Cumulative analgesic effects may be achieved by longer electrical stimulation periods (Ghoname *et al*., 1999).

Many couples undergoing IVF suffer great stress and anxiety and may need to repeat the treatment (cycle) before the achievement of pregnancy and delivery. Therefore, it is important to avoid or at least reduce the sensation of disconcerting events during the oocyte aspiration procedure. Psychological well-being may affect the implantation rate (Csemiczky and Collins, 2000). In our study, all patients received remifentanil. Even in this group of patients with higher pregnancy rate compared with general anaesthesia during transvaginal oocyte retrieval (Wilhelm *et al*., 2002), further improvements could be achieved by EA. Interestingly, both well-being and pregnancy rate were significantly higher in patients receiving auricular EA. Although this finding on the effect of EA on pregnancy rate is in accordance with previous observations (Andersson and Lundeberg, 1995; Stener-Victorin *et al*., 1999; Gejervall *et al*., 2005), the number of patients does not allow for generalization of our observations. A clinical study including a larger number of patients is currently in progress to further clarify this issue.

Electrical stimulation of the auricular acupuncture points permitted a fully double-blinded study protocol in this study. The stimulator was either activated or not activated by a technician who was not otherwise involved in the study. Obviously, difficulties with blinding have always been discussed as a critical point of these studies and have proven one of the major problems for adequate validation of the effectiveness of acupuncture (Kleinhenz *et al*., 1999). The data presented cannot refute the hypothesis that all benefits from pain treatments are because of non-specific effects of participation in the study, contact with the pain therapist or patient expectation.

Our findings may have major implications to the clinical management of assisted reproduction. The use of the P-Stim™ is easy and does not require long-lasting, sophisticated training in acupuncture and traditional Chinese medicine. P-Stim™ can be easily applied by the consultant anaesthesiologist, pain therapist or other physician who is trained in acupuncture. We observed no adverse side effects of EA *per se*. EA can be recommended as a safe, additive, non-pharmacological pain treatment in this clinical setting. P-Stim™ achieves our stated demands of treatment in this clinical application with a rapid onset of an adequate pain relief and rapid recovery. However, limitations are the availability of P-Stim™ only in the European community at present and the costs (50 Euro per P-Stim™ device). Furthermore, because all patients requested PCA remifentanil, EA appears to be insufficient as a sole analgesic method. Although small bolus (20 μg) and safe lockout intervals (1 min) minimize the risk of respiratory depression, the use of the i.v. opioid remifentanil PCA requires observation by a physician who is able to diagnose and manage these serious side effects.

In conclusion, EA is a good additive therapy, especially in women who are intolerant to conventional analgesia and prefer a non-pharmacological analgesic method, but cannot be recommended as the sole pain-relieving method at oocyte aspiration.

Prospective randomized controlled studies are needed to evaluate the efficacy of auricular EA in female fertility treatment.

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Submitted on January 7, 2006; resubmitted on February 17, 2006, March 16, 2006; accepted on March 22, 2006