ACUPUNCTURE AS A COMPLIMENTARY AND ALTERNATIVE METHOD OF MANAGING POLYCYSTIC OVARIAN SYNDROME

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ACUPUNCTURE AS A COMPLIMENTARY AND ALTERNATIVE METHOD OF MANAGING POLYCYSTIC OVARIAN SYNDROME

Abstract

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The purpose of this paper is to evaluate the efficacy of acupuncture therapy in the treatment of polycystic ovarian syndrome (PCOS) by reviewing clinical trials and randomized and observational studies. The mechanism of acupuncture treatment in PCOS and implications for future use are also reviewed. A comprehensive literature search was conducted through the databases Medline, PubMed, Allied and Complimentary Medicine (AMED), and The National Center for Complimentary and Alternative Medicine (NCCAM) to identify all relevant articles. Available acupuncture studies on human subjects with PCOS from 1976 to 2009 were reviewed. Even though more research is needed to discover the true effect of acupuncture, studies imply that its safety and low incidence of side effects make it an excellent alternative treatment option for women with PCOS.
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Acupuncture as a Complimentary and Alternative Method of Managing Polycystic Ovarian Syndrome

Polycystic ovarian syndrome (PCOS) is one of the most common female endocrine disorders affecting approximately 10% of women of reproductive age and is strongly associated with clinical and biochemical evidence of hyperandrogenism and chronic ovulatory dysfunction (Diamanti-Kandarakis, 2008). PCOS increases the risk of metabolic disturbances such as abdominal obesity, hyperinsulinemia, and insulin resistance, which can lead to type 2 diabetes, dyslipidemia (Norman, Dewailly, Legro, & Hickey, 2007), as well as hypertension and other cardiovascular diseases. Common features of PCOS are hirsutism, alopecia, acne, and obesity. These disturbances can be distressing and can lead to an altered body image which is strongly associated with depression, and high psychological and psychosexual morbidity (Himelein & Thatcher, 2006). To manage all these symptoms, common in PCOS, many women require prolonged treatment, including lifestyle modifications, conventional (medicinal) approaches, surgery (laparoscopic ovarian drilling/electrocautery), and optionally, alternative treatments such as acupuncture.

Pharmacological and surgical approaches are effective, but they have adverse effects, risks, and possible complications. First line therapy in PCOS is often oral contraceptives, which reduce hirsutism and acne, but adversely affect glucose tolerance, coagulability, and fertility. Laparoscopic ovarian drilling/electrocautery is a surgical procedure in which a laser fiber or electrosurgical needle punctures ovaries 4 to 10 times. Destroying a portion of the ovaries has been reported to restore regular ovulation cycles. Possible complications of surgical electrocautery may include adhesion formation, bleeding, infection, anesthesia risks, and premature ovarian failure.
The word acupuncture is derived from Latin words *acus* (needle) and *pungere* (to puncture). It is defined as the insertion of needles into the body at specific points (acupoints) to relieve pain or for therapeutic purposes. After insertion, needles may be further stimulated by manual manipulation or by electrical stimulation (electro-acupuncture). In electro-acupuncture, an electrical current is passed between two needles. It has been suggested that low-frequency (1-15 Hz) electro-acupuncture with resultant repetitive muscle contraction results in activation of physiological processes similar to those resulting from physical exercise.

All types of acupuncture are essentially harmless with minimal side effects and contraindications. The most common side effect from acupuncture is a feeling of deep relaxation and an increased sense of well-being. As with any puncture, a slight discoloration at the acupuncture site may occasionally occur. This is temporary and not dangerous. Although adverse effects can occur if acupuncture is improperly performed, only 10 cases of internal injuries from acupuncture have been reported in the United States from 1965-1997. Thus, while many clinicians will continue to prescribe pharmaceutical products and lifestyle changes to women with ovulatory dysfunction, acupuncture may also be offered to patients as an alternative treatment methodology.

**The pathogenesis of polycystic ovarian syndrome**

A normally functioning hypothalamic-pituitary-ovarian axis supports the maturation of ovarian follicles via the release of luteinizing hormone (LH) from the anterior pituitary gland. Follicle-stimulating hormone (FSH), secreted from the anterior pituitary gland, stimulates the production of the ovarian follicles. Within the ovarian follicle, theca cells synthesize androgen. Once formed, the androgens diffuse into the ovarian granulose cells where they are converted
into estrogen. Patients with PCOS experience increased ovarian androgen biosynthesis as a result of the following abnormalities occurring at all levels of the hypothalamic-pituitary-ovarian axis:

- Women who have PCOS appear to have more frequent releases of LH, suggesting that the pulse frequency of gonadotropin-releasing hormone (GnRH) is accelerated in PCOS (Futterweit, 2007). Increasing the GnRH pulse generator favors the synthesis and release of LH over FSH.
- When the concentration of LH increases relative to FSH, the ovaries preferentially synthesize testosterone.
- Insulin acts synergistically with LH to increase androgen production within the theca cell. It also inhibits the hepatic synthesis of sex-hormone binding globulin (SHBG), which normally binds testosterone. The higher levels of unbound or “free” testosterone increase the biological activity of the circulating hormone.
- Testosterone further inhibits (whereas estrogen stimulates) the hepatic synthesis of SHBG. (Futterweit, 2007, p.762)

An increase in free and total serum testosterone levels results in androgenization, the most obvious features of which are hirsutism, acne, and diffuse alopecia. Hyperandrogenemia interferes with the hypothalamic-pituitary axis, leading to anovulation (Fig. 1). The absence of a dominant follicle prevents development of nondominant follicles, resulting in the formation of multiple ovarian cysts. High androgen levels also affect metabolic parameters such as lipid concentrations and blood glucose levels. Left untreated, high levels of androgens are associated with serious health consequences, such as insulin resistance and diabetes, high cholesterol, high blood pressure and heart disease.
Figure 1: Pathogenesis of PCOS neuroendocrine dysfunction. (Futterweit, 2007, p. 763)

**Diagnosis**

A broad range of opinions has prevailed about the definition of PCOS. According to the Rotterdam expert conference on Polycystic Ovary Syndrome in 2003, the clinical diagnosis of PCOS should be made based on two of the following criteria:

- Oligo- or anovulation
- Clinical and/or biochemical signs of hyperandrogenism
- Polycystic ovaries with 12 or more subcapsular follicular cysts two to nine millimeters in diameter and/or an increase in ovarian volume up to 10 ml determined by transvaginal
ultrasound (The Rotterdam ESHRE/ ASRM-sponsored PCOS Consensus Workshop Group, 2004).

Most authorities in the field of clinical endocrinology of United States (U.S.) accept the following three criteria as a basis for diagnosis of the syndrome:

- A history of irregular menstrual cycles and anovulation, with onset at puberty. Many investigators believed that 25% of women with PCOS, in fact, do have regular menstrual cycles, although these periods of menstrual bleeding may represent anovulatory cycles.

- The presence of chemically measurable hyperandrogenism, with documentation of high plasma levels of ovarian androgens, including total and free testosterone.

- The exclusion of other hormonal disorders with similar clinical features, including adult-onset congenital adrenal hyperplasia, hyperprolactinemia, adrenal or ovarian androgen-producing adenomas, hyperthecosis, and Cushing’s syndrome (AACE Writing Committee, 2005, p.126).

Prolactin, human chorionic gonadotropin, and thyroid stimulating hormone (TSH) serum levels should be obtained as part of the initial evaluation of menstrual irregularity. Serum androgen levels are only necessary to rule out other secondary causes of hyperandrogenism, such as ovarian or adrenal neoplasms and seventeen-hydroxylase deficiency. Serum-free and total testosterone, sex-hormone binding globulin (SHBG), and dehydroepiandrosterone sulfate (DHEAS) can be evaluated for ovarian (testosterone) or adrenal (DHEAS) neoplasms. Seventeen-Hydroxy progesterone (17-OHP) levels can be evaluated for any patient suspected of having late-onset congenital adrenal hyperplasia. When serum androgen levels are checked, they are most often only mildly elevated in women with PCOS. Serum testosterone levels are
Acupuncture as a generally between 50 and 150 ng/dL (Buccola & Reynolds, 2003). DHEAS levels may be as high as 7000 mg/dL in PCOS (with normal range between 35 and 430 mg/dL) (Futterweit, 2007); higher levels should trigger evaluation for other secondary causes of hyperandrogenism. Conversely, normal DHEAS levels, in the appropriate clinical context, should not exclude a diagnosis of PCOS.

Classically, serum luteinizing hormone (LH) and follicle stimulating hormone (FSH) levels have been evaluated in any patient suspected of having PCOS. Many women show an abnormal hypothalamic-pituitary function which is manifest by elevated serum levels of LH with low-normal levels of FSH, resulting in an elevated ratio of LH/FSH. It is generally accepted that an LH/FSH ratio greater than 2/1 is evidence for the presence of PCOS (National Guideline Clearinghouse, 2006). However, as with serum androgen levels, a normal LH/FSH ratio does not rule out PCOS.

The role of ultrasonography in diagnosis is also controversial. Pelvic ultrasound, preferably transvaginal ultrasound, frequently shows ovaries of increased size due to either a greater number of follicles/cysts or an increased ovarian volume (Fig.2). For example, ovaries may also be enlarged in women taking oral contraceptive pills, in non-obese women, or in women without symptoms of anovulation or hyperandrogenism (National Guideline Clearinghouse, 2006).

Current therapies

Following diagnosis, treatment should begin with lifestyle modification with an emphasis on controlled eating patterns (reduced fat intake and increased fiber) and regular aerobic exercise to achieve weight control. The most effective first-line intervention for patients with a body mass index (BMI) greater than 26 is weight loss. Weight loss from lifestyle modification alone has resulted in resumption of regular menstruation, decreased LH levels, induction of ovulation,
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Figure 2: Classic appearance of a polycystic ovary on ultrasound examination (from: http://www.morethancardio.com)

improved fertility, decreased androgens, improvement of insulin resistance, and decreased risk for diabetes and cardiovascular disease (National Guideline Clearinghouse, 2006).

Due to the complexity of PCOS, there is no single-option pharmacologic treatment available; there are specific treatments for the components of PCOS which include insulin resistance, hyperandrogenism, hirsutism, hyperlipidemia, and hypertension. Combined oral contraceptives are used for first-line treatment and long-term management of PCOS. These medications are contraindicated in patients with the following conditions: previous thromboembolic event or stroke, current or past history of cerebrovascular or coronary artery disease, and known or suspected cancer. A second medication choice with fewer restrictions includes medroxyprogesterone acetate which induces menses, reduces endometrial hyperplasia, and restores menstrual regularity (National Guideline Clearinghouse, 2006). It is contraindicated in known or suspected pregnancy, undiagnosed abnormal uterine bleeding, known or suspected breast cancer, and active thrombophlebitis. In addition, to improve menstrual regularity and
ovulation, and reduce androgen synthesis, the insulin sensitizers (Thiazolidinediones or Metformin) could be prescribed. These medications are contraindicated in renal and liver diseases, congestive heart failure, and acute or chronic metabolic acidosis with or without coma (including diabetic ketoacidosis). Antiandrogens such as Spironolactone and Flutamide work synergistically when used in combination with oral contraceptives by suppressing androgen levels through different mechanisms. Each has teratogenic and hepatotoxic potentials. Side effects include polydipsia, polyuria, nausea, headache, fatigue, and gastritis. In addition, some normally ovulating women may experience menstrual irregularity (Futterweit, 2007).

Ovulation inducers such as Clomiphene Citrate and Tamoxifen, act on the hypothalamus, pituitary gland, and ovary to increase levels of FSH and LH by stimulating the release of pituitary gonadotropins. In women who are resistant to Clomiphene, exogenous gonadotropins such as Metrodin, may be utilized. Gonadotropins are contraindicated in patients with high follicle stimulating hormone (FSH) levels, thyroid or adrenal dysfunction, and undiagnosed abnormal uterine bleeding. Lipid-lowering medications such as statins, fibrates, niacin, or a combination of these medications, reduce triglyceride levels in the blood stream. Contraindications for these medications include a history of liver disease, alcoholism, renal impairment, uncontrolled seizures, and myopathy. Treatment of hypertension and inclusion of aspirin therapy are recommended to reduce cardiovascular risk in women with PCOS (“PCOSWC“, 2005). These medications, as well, have contraindications specific for each therapeutic class.

Thus, the spectrum of pharmacological agents to manage PCOS is broad and the treatment plan is individualized. With the conventional (medicinal) approach there are benefits
but adverse side effects and multiple contraindications may occur. Some women with PCOS prefer to use nontraditional, safer options, such as acupuncture.

**Acupuncture**

Acupuncture, a treatment that dates back 3000-5000 years, is an integral part of traditional Chinese medicine. It has become more established in Western medicine as a complimentary or alternative option to conventional therapies. It was brought to the Far East (Korea, Japan, etc) and Southeast Asia in the sixth century, and subsequently, to Europe and the United States in the seventeenth and the nineteenth centuries. In 1996, the Food and Drug Administration approved acupuncture needles as “safe and effective medical devices.” This approval was followed in 1997 by a consensus statement issued by the National Institute of Health, which recognized acupuncture for a variety conditions. Commenting on relative safety of acupuncture compared with other treatments, the NIH consensus panel stated that “adverse side effects of acupuncture are extremely low and often lower than conventional treatments.” They also stated that “incidence of adverse effects is substantially lower than that of many drugs or other accepted medical procedures used for the same condition” (NIH Consensus Panel, 1997, p. 9). Furthermore, the World Health Organization (WHO) recommends the use of acupuncture for 29 diseases. These diseases include seven genitourinary and reproductive disorders, including impotence, infertility, pre-menstrual syndrome, pelvic inflammatory disease, vaginitis, irregular period or cramps, and morning sickness.

According to ancient Chinese literature, many years ago the primitive stone needle (bian) was employed to treat diseases (Cao, 2010). Then bone and bamboo needles appeared. However, after the invention of metal-casting techniques and metal tools, medical needles made of bronze,
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iron, gold, and silver were utilized. At present, stainless steel needles are widely adopted for the
treatment.

On the basis of the several hundred acupuncture points already in use, many new points
have been discovered in practice, and new methods of acupuncture have been developed. More
commonly used methods include electro-needling; auricular, scalp and skin needling. For
centuries, acupuncture has been utilized to treat many diseases and medical conditions, including
disorders of the female reproductive system. The viewpoint of traditional Chinese medicine is
that the vital energy of human being “qi” is influenced and ruled by two opposing energy forces
called “yin and yang.” The balance and free flow of these energies are critical to the health of
body and mind. The deficiency, excess, or blockages of these energies are believed to cause
illness. When considering conception and fertility in PCOS patients, the Kidney essence and the
Liver energy are particularly important (Udoff & Zhang, 2010).

Generally speaking, acupuncture treatment for PCOS should be given in two forms: a
fixed protocol, which composes predetermined acupuncture points and frequency of treatment;
and an individualized treatment, where points change with each patient. In addition to the choice
of acupuncture points, manipulating the acupuncture needles, such as rotating the needles in a
certain direction, or in conjunction with electro-stimulation are components of treatment (Udoff
& Zhang, 2010).

Physiologic basis for using electro-acupuncture in PCOS.

The neurological and chemical processes that are involved with cutaneous stimulation are
explained hypothetically. Intramuscular needle insertion causes a particular pattern of afferent
activity in peripheral nerves (Fig 3.). Depending on the intensity of nerve stimulation,
acupuncture needles activate muscle afferents to the spinal cord and the central nervous system.
In electro-acupuncture, low frequency (1-15Hz) electrical stimulation excites ergoreceptors in the muscles, which are physiologically activated during muscle contractions. Needles placed and stimulated in the ovarian somatic innervation areas (located in the abdominal muscles and muscles below the knee), decrease sympathetic nerve activity that lead to decreased secretion and the release of the ovarian androgens.

In parallel, the activity of the CNS is modulated by the release of endogenous opioids. In particular β-endorphin (β-END) is released from the pituitary gland and the hypothalamus induces functional changes in different organ systems. It is known that in women with PCOS, the sympathetic nerve activity and β-END production is increased. Low-frequency electro-acupuncture decreases β-END, providing decreased sympathetic tone, decreased LH production, and the release of β-END into the bloodstream. Low-frequency electro-acupuncture may further decrease hypothalamic-pituitary-adrenal (HPA) axis activity by inhibiting the release of corticotrophin-releasing factor (CRF), which decreases the release of adrenocorticotrophic hormone (ACTH) from the pituitary gland and cortisol/dehydroepiandrosterone sulfate (DHEA(S)) from the adrenal cortex resulting in an inhibition of sympathetic adrenal (SA) axis activity. The adrenal medulla in response to these changes will decrease the secretion of norepinephrin and epinephrine, which in its turn affects the negative feedback system (Stener-Victorin et al., 2008).
Figure 3: A hypothetical model, illustrating the effects of low-frequency electro acupuncture in polycystic ovarian syndrome (Stener-Victorin & Wu, 2010).

Keys: VMC – Vasomotor Center

DHEA – Dehydroepiandrosterone
Literature Review

One of the earliest attempts to explain the influence of acupuncture on women’s reproductive health was done in 1976. In this study completed by Takeshi et al. six healthy women aged 24 to 36 years were studied over the period of one of their menstrual cycles. All of these women had no history of general medical or gynecological abnormality, had regular menstrual cycles that ranged between 28 and 33 days, and normal luteal phase rises of basal body temperature. Each woman who participated in the study was treated with electro-acupuncture (EA) and had a blood drawn prior and after the treatment for three days total in the particular phase of her menstrual cycle (follicular or luteal) that was specified by researchers. As a rule, EA stimulation was administered on the first test day, 100 μg of synthetic Luteinizing Hormone (LH) was given intravenously on the second day and the same injection of LH with electro-acupuncture stimulation was administered two to five days later. Four acupoints located in lower abdomen that have been known from experience to relate closely to female reproductive organs were used. Body responses to synthetic LH with and without electro-acupuncture stimulation were analyzed and recorded. In each case plasma hormone levels were measured by specific radioimmunoassay before electro-acupuncture and 15, 30, 60, and 120 minutes after electric stimulation. The analysis of plasma LH responses to LH injections under electro-acupuncture revealed re-elevation of plasma LH levels in luteal and preovulatory phases of menstrual cycles. Those results demonstrated that acupuncture could potentially influence the ovulation mechanism and/or ovarian luteal functions and that properly performed acupuncture might provide a new approach for fertility regulation (Takeshi et al., 1976). However, it is important to note that this study did not include women with diagnosed PCOS and the sample size was very small (six normally ovulating women).
In 1992, acupuncture’s use in the treatment of female infertility was reported by Gerhard and Postneek (Gerhard & Postneek, 1992). From 1984 to 1988 they utilized auricular acupuncture in the treatment of female infertility in 45 women who were suffering from oligomenorrhea (n=27) or luteal insufficiency (n=18). The results of this study were compared to a control group of 45 women who received Clomiphene and Gonadotropin. Using the matched-pairs method, each acupuncture subject was matched to a subject with hormone treatment who had attended the outpatient unit in the same year. Women were matched on the basis of age, duration of infertility, body mass index, type of infertility, type of menstrual cycle and tubal patency. In the acupuncture group auricular acupoints were used, including the gonadotropin point, the ovarian point, the uterus point, the gestagen point, and the kidney point, points of the hypothalamic-pituitary area, the spleen point, secondary psychosomatic points and omega points. Depending on the electrical potential of the selected point either gold or silver needles were inserted into the skin to a depth of 0.5 mm and left there for 30 min. All women in the acupuncture group had weekly acupuncture sessions that lasted anywhere from 30 min to one hour. Concentrations of LH, FSH, prolactin, estradiol, TSH, testosterone and dehydroepiandrosterone sulfate (DHEAS) were determined before the initiation of acupuncture therapy. Following three months of therapy these serum concentrations were again obtained. If women failed to conceive during those three months, all therapy was suspended for six months. Hormone substitution was offered only after this six-month interval to correct an underlying hormone abnormality. The women treated with acupuncture had 22 pregnancies total, of those eleven became pregnant during the treatment trial, four pregnancies occurred more than three months after termination of treatment and seven women had pregnancies after additional medication treatment with Clomiphene or Gonadotropin six months after the initial session of
acupuncture. In contrast, women treated with hormones had 20 pregnancies; five of those women had pregnancies while in therapy and 15 women became pregnant after the hormonal therapy was done. Four women in each group had spontaneous abortions. The hormone levels during the follicular and luteal phases were very similar in both data pools. It was observed that cervical mucus and the rise of basal body temperature at mid-cycle were more often normal in the acupuncture group. Side effects were observed only in those subjects receiving hormone treatment.

In order to assess if electro-acupuncture can reduce high uterine artery blood flow impedance, a prospective, non-randomized study was conducted in Sweden by Stener-Victorin et al. As is shown in reproductive literature, the Pulsatility Index (PI) values of uterine artery blood flow greater than 3.0 are predictive for implantation failure (Schmidt & Kurjak, 2004). PI value is measured by transvaginal color or pulsed Doppler sonography and is equal to a difference between the peak systolic and minimum diastolic velocities divided by the mean velocity during the cardiac cycle (PI = (Vmax-Vmin)/Vmax mean).

In this study ten infertile, but otherwise healthy women with a mean age of 32.3 years and PI greater than or equal 3.0 in the uterine arteries, were treated with eight electro-acupuncture (EA) sessions twice a week for four weeks. Before inclusion in the study and throughout the entire study period, these women were down-regulated with a gonadotropin-releasing hormone analogue in order to exclude any fluctuating endogenous hormone effects on the PI. The PI index was measured for both uterine arteries between 08:30 am and 14:30 pm to reduce the risk that the measurements would be affected by the circadian rhythm. The needles were inserted intramuscularly (IM) to a depth of 10-20 mm and then attached to an electric stimulator. Four needles were located bilaterally at the thoracolumbar and lumbosacral levels of
Acupuncture as a method of stimulating the body can be effective for various conditions. The intensity was low, giving non-painful paraesthesia. Four needles were located bilaterally in the calf muscles, and were stimulated with low frequency (2Hz) pulses of 0.5 ms duration. The intensity was sufficient to cause local muscle contractions. This study reports that the PI of the uterine arteries significantly decreased soon after the eighth EA treatment, and remained significantly decreased 10-14 days after the EA period. These findings suggested that a series of EA treatments reduced vascular resistance of uterine arteries resulting in increased blood flow.

The most likely proposed etiology was a decreased tonic activity in the sympathetic vasoconstrictor fibers to the uterus and an involvement of the central mechanisms with general inhibition of the sympathetic outflow (Stener-Victorin, Waldenstrom, Andersson, & Wikland, 1996).

In contrast, Paulus et al. (Paulus, Zhang, Strehler, El-Danasouri, & Sterzik, 2002), in a larger randomized study of 160 infertile patients with mean age of 32.5 years who underwent assisted reproduction therapy found no acupuncture-assisted changes in the uterine artery PI. All patients were undergoing treatment with in-vitro fertilization (n=101) or intracytoplasmic sperm injection (n=59). According to the randomization, 80 women were treated with a 25 minute session of acupuncture shortly before and after embryo transfer, and 80 patients underwent the usual therapy without acupuncture. Just prior to and following embryo transfer, all patients underwent ultrasound scans of the uterus using transvaginal probe. Pulsed Doppler curves of both uterine arteries were measured by an observer and the Pulsatility Index (PI) for each artery was calculated electronically. Five body acupuncture points along with four auricular points were utilized. Sterile, disposable stainless steel needles were inserted to the depth of 10 to 20 millimeters, depending on the region of the body and were kept in for 25 minutes. According to
the results of study, the blood flow impedance in the uterine arteries (PI) did not differ between the groups before and after embryo transfer. Different acupuncture protocol and selected patient population prevent direct comparison between this study and the Stener-Victorin et al. study that was described in details earlier.

In 2000, 24 women with PCOS and oligo-/amenorrhea between the ages of 24 and 40 were included in a non-randomized, longitudinal, prospective study to evaluate if electro-acupuncture would affect oligo-/anovulation and related endocrine and neuroendocrine parameters in women with PCOS (Stener-Victirin, Tagnfors, Lundeberg, Lindstedt, & Janson, 2000). The duration of the study was defined as the period extending from three months before the first electro-acupuncture treatment to three months after the last electro-acupuncture treatment, for a total of eight to nine months. Two variables, vaginal bleeding and basal body temperature, were used to monitor the menstrual and ovulation cycles. These data were recorded daily. Also, blood samples were obtained measuring the plasma concentrations of gonadotropins, prolactin, steroids and neuropeptides and collected a week prior the first EA treatment, a week following the last EA and three months after EA. A woman was defined as having experienced a good effect if the basal body temperature demonstrated repeated ovulations (or pregnancy) during the treatment period and in the following three months.

EA was given twice a week for two weeks and then once a week, for a total of 10-14 treatments. Four needles at the thoracolumbar and sacral level and four needles in the calf muscles were then attached to an electrical stimulator and stimulated with low frequency (2Hz) pulses of 0.5 ms duration for 30 minutes. The intensity was sufficient to cause non-painful local muscle contractions. In the reported results of this study nine women (38%) experienced a positive effect of increased rates of regular ovulation. These nine women at baseline had
significantly lower levels of body-mass index (BMI), serum testosterone concentration, serum testosterone/sex hormone binding globulin (SHBG) ratio, serum basal insulin concentration, and significantly higher levels of serum SHBG than those who did not respond to electro-acupuncture. There were no adverse effects reported in the study population (Stener-Vicririn et al., 2000).

The most recent study reported from Sweden from 2009 investigated the effect of low-frequency electro-acupuncture and physical exercise on muscle sympathetic nerve activity in women with PCOS. In a randomized, controlled trial, 20 women with PCOS were randomly allocated to one of three groups: low frequency electro-acupuncture (n=9), physical exercise (n=5), or untreated control (n=6) for 16 weeks. In the EA group the acupoints were selected in somatic segments according to the innervations of the ovaries (bilaterally in the abdominal muscles and in the muscles below the knee). Needles in abdominal muscles and in legs were attached to an electrical stimulator and stimulated with low-frequency EA of two Hz. The intensity of the electrical stimulation was adjusted to produce local muscle contractions, as strong as possible, without pain and discomfort. Each treatment lasted 30 minutes, was given two per week during two weeks, one per week during six weeks, and once every second week for eight weeks, in a total of 14 treatments during 16 weeks. In the physical exercise group all women received a pulse watch and were instructed to take up regular exercise, comprising brisk walking, cycling, or any other aerobic exercise at a selected pace described as “faster than normal walking but a pace that could be sustained for at least 30 minutes”. They were instructed to exercise for 16 weeks at least three days per week, for 30-45 minutes in duration, raising their heart rate up to 120 beats/min. Women in the control group were taught about the importance of physical activity and a healthy diet, as were women in the low-frequency EA group and the
physical exercise group. Direct recordings of multiunit efferent postganglionic muscle sympathic nerve activity were obtained from all 20 women with a microelectrode inserted into a muscle fascicle of the peroneal nerve, posterior to the fibular head, before and following sixteen weeks of treatment. This study is the first to report that low-frequency electro-acupuncture and physical exercise decreased high muscle sympathetic nerve activity in women with PCOS. These results indicate a possible alternative non-pharmacologic approach to reduce muscle sympathetic nerve activity perhaps reducing cardiovascular risk in patients with PCOS (Stener-Victorin, Jedel, Janson, & Sverrisdottir, 2009).

There are multiple limitations to the studies reviewed. Only two studies were randomized, blinded, and controlled studies specific to those with PCOS. Sample sizes in all these studies were small. Not all studies incorporated an appropriate control group. Variable types of acupuncture, different points and a variety of protocols were used. None of the studies listed above have revealed the mechanisms responsible for the beneficial effects of acupuncture. Thus, further research is needed to demonstrate precisely how acupuncture causes physiologic changes in the uterus and the reproductive system in patients with PCOS.

**Summary**

PCOS is a syndrome characterized by excess androgen secretion manifested by hirsutism, ovarian dysfunction with or without polycystic ovaries as a diagnosis by exclusion (Lim & Wong, June 2010). The current conventional medical treatment options for patients with ovulatory disorders, whether or not they want to become pregnant, are prescription medications, surgery, and lifestyle changes. However, there are many problems with current western therapies including high cost, risk of multiple pregnancies, undesirable side effects, and inconsistent effectiveness. On the other hand, acupuncture has a low rate of adverse events; is relatively
inexpensive, and has no increased risk of multiple pregnancies. It may be offered as an appropriate alternative for patients who are intolerant, ineligible, or have contraindications for conventional ovulation induction hormonal therapy. More research and evidence-based clinical studies are needed before acupuncture can be widely recommended to support, treat, and manage PCOS. Future research suggestions include prospective, randomized, placebo-controlled trials to evaluate the effect of acupuncture on women with PCOS.
References


Stener-Victorin, E., Jedel, E., Janson, P. O., & Sverrisdottir, Y. B. (2009). Low-frequency electroacupuncture and physical exercise decrease high muscle sympathetic nerve


