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THE EFFECTIVENESS OF ACUPUNCTURE ON WOMEN WITH POLYCYSTIC OVARY SYNDROME: SYSTEMATIC LITERATURE REVIEW

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ABSTRACT

Background: *Women with polycystic ovary syndrome (PCOS) experience metabolic disorders and hyperandrogenism. The acupuncture is an alternative medicinal treatment and complimentary for the women with PCOS. The aim of this research was to identify acupuncture effectiveness for metabolism problem and hyperandrogenism for the women with PCOS.*
Methods: *This was a systematic review using several published literature obtained from direct electronic data of science, PubMed, and other sites through the PRISMA method using the Boolean operator's system (AND). The inclusion criteria consisted of the studies with Randomized controlled trial (RCT) published in 2009 to 2019, women with PCOS aged 18 to 45 years old as the subjects, the intervention using all of the kind of acupuncture that was compared to placebo, physical training, sham, and medicines. Meanwhile, exclusion criteria were studies with systematic review and meta-analysis, focusing on intervention, medicines, and physical training by using experimental animals. The measurement value of HOMA-IR, LH, FSH, ratio LH/FSH, TT, FT, SHBG, and DHEA-S.*
Results: *The search resulted in 509 studies, of which a total of 6 studies were included in this systematic review. The acupuncture has effects on metabolism problem and hyperandrogenism for the women with PCOS, such as the decrease of HOMA-IR (3 studies) and LH tense (2 studies), LH/FSH ratio reduction (3 studies), as well as, the decline of TT tense (4 studies) and FT tense (4 studies), but the increase of SHBG tense (3 studies), and the decrease of DHEA-S (2 studies). However, the tense of LH had no significant change in all of the studies.*
Conclusions: *The acupuncture can be effective in solving the metabolism problem and hyperandrogenism of women with PCOS.*

Keywords*: Acupuncture, Polycystic Ovary Syndrome (PCOS), Hormone, Alternative medicinal treatment*

INTRODUCTION

Polycystic ovary syndrome (PCOS) is a disease that occurs because of the imbalance of hormone system or endocrine disorders in women of reproductive age [1] it is about 4% and 12% [2]. The most commonly used diagnosis of women with PCOS is utilized on the Rotterdam Consensus on the 2003 Diagnostic Criteria, the women with PCOS have at least two of the three criteria namely; 1) oligo or anovulation, 2) the presence of clinical or biochemical evidence of hyperandrogenemia, and 3) the presence of a polycystic ovary in the assessment of ultrasound (> 12 small antral follicles in the ovary) [3]. Hyperandrogenemia is the most dominant endocrine phenotype in women with PCOS in addition to ovulation dysfunction and polycystic ovarian morphology [4]. The main metabolic phenotype is hyperinsulinemia and insulin resistance [5, 6].

Acupuncture is one of complementary occurring methods and alternative that employing develope fast in this era. Consensus National Institute of Health in USA, recommended the acupuncture to be clinic procedure which is useful until the national center of complementary occurring and alternative can be made to compare therapy complementary to the practice of the first clinic [7]. Acupuncture is effective in dealing with endocrine disorders in the reproductive system of women with PCOS [8-10]. Pharmacological management and surgical for PCOS is indeed effective, but has adverse side effects such as cardiovascular complications and multiple pregnancies [11], Some women with PCOS who take pharmacological therapy and lifestyle modifications also report no change in metabolic disorders and hyperandrogenism, so they switched to alternative and complementary treatments such as acupuncture that do not cause side effects such as pharmacological therapy [12].

Metabolic disorders in 40-50% of PCOS women tend to be overweight characterized by an increase in body mass index (BMI) [13]. This increase can cause hyperinsulinemia and insulin resistance [14]. The prevalence of insulin resistance and hyperinsulinemia ranges from 65-80% in thin women and 90% in obese women with PCOS [15, 16]. Women with PCOS have a two to four times the chance of developing type 2 diabetes mellitus in the future and have risk factors for experiencing cardiovascular disease [13, 14, 17]. Acupuncture is able to overcome metabolic disorders that play a role in causing insulin resistance such as hyperglycemia, overweight, hyperphagia, hyperlipidemia, inflammation, changes in sympathetic nervous system activity, and impaired insulin signals. Electroacupuncture (EA) can increase glucose uptake activities through activation of afferent nerves and repetitive muscle contractions [18]. Acupuncture performed for 5 weeks manually started and EA can improve glucose homeostasis throughout the body in insulin resistant women with PCOS [19].

Hyperandrogenemia is characteristic of biochemistry using clinic manifestation of PCOS [20]. Hyperandrogenemia is able to get a diagnosis by a biochemistry exam. The practice is recommended doing biochemistry exam to hyperandrogenemia on PCOS by checking Thyroid Stimulation Hormone, prolactin, Follicle Stimulation Hormone (FSH), Luteinizing Hormone (LH), dehydroepiandrosterone (DHEA), DHEA sulfate (DHEA-S), testosterone total (TT) and free testosterone (FT) suggest ratio LH: FSH similar to 2: 1 by hormone standard of androgenic that correlated to PCOS [21]. American College of Obstetrics and Gynecology recommends hyperandrogenemia screening by carrying out biochemical tests on TT, Sex Hormone Binding Globulin (SHBG), and FT. Acupuncture applied to PCOS women significantly reduced androgen levels, which is a major cause of hyperandrogenism [22]. The low frequency of EA and manually stimulated acupuncture can be managed hypothalamic neuroendocrine [23, 24], then it can reduce the production of excessive androgen levels in women with PCOS.

Based on previous before, acupuncture can overcome hyperinsulinemia or insulin resistance and hyperandrogenemia in women with PCOS. Therefore, this makes researchers interested in conducting a systematic review of the effectiveness of acupuncture in women with PCOS.

METHODS

Search Strategy

The searching of research article was reviewed based on the Science Direct and PubMed of electronic databases from 2009 to January 2019 through the PRISMA method. All design articles of randomized controlled trials and presented in English that used all types of acupuncture methods compared to placebo, physical exercise, acupuncture, and drugs such as metformin. Article collection is conducted from January to March 2019.

Criteria for Inclusion and Exclusion

Inclusion Criteria

The article searching is focused on articles that used the design research of Randomized Controlled Trial that discussed the application of acupuncture to women with PCOS and presented in English. Participant criteria included women of reproductive age ranging from 18 to 45 years who were diagnosed with PCOS. The measurement results included insulin sensitivity by the Homeostatic Model Assessment for Insulin Resistance (HOMA-IR), and hyperandrogenism by observing the levels of LH, FSH, LH / FSH ratio, TT, FT, SHBG, and Dehydroepiandrosterone sulfate (DHEAS).

Exclusion criteria

The research articles that focus on intervention using drugs, physical exercise are issued, and use trial animals are issued. Articles with the type of review, systematic review and meta-analysis were also issued.

Search Result

The keywords used in the articles search were "Acupuncture for PCOS", "Acupuncture" and "PCOS", and "Randomized Controlled Trial". The keywords for an article search are combined using the *Boolean operators* (AND) system.. After conducting a literature search by using keywords and *Boolean operators* (AND), it was obtained 509 research articles. The researcher checked duplicate research articles and left 499 articles. Then, the researcher conducted a follow-up to determine the relevant articles taking into account the abstract so that 29 articles were obtained. Of the 29 articles, 17 articles were released because they did not use the RCT research design, and 6 articles were released because they did not display the results of insulin sensitivity namely HOMA IR androgen hormone levels such as LH, FSH, LH / FSH ratio, TT, FT, SHBG, and DHEA-S. At the end of the literature study, 6 research articles were produced that met the inclusion criteria of this study.

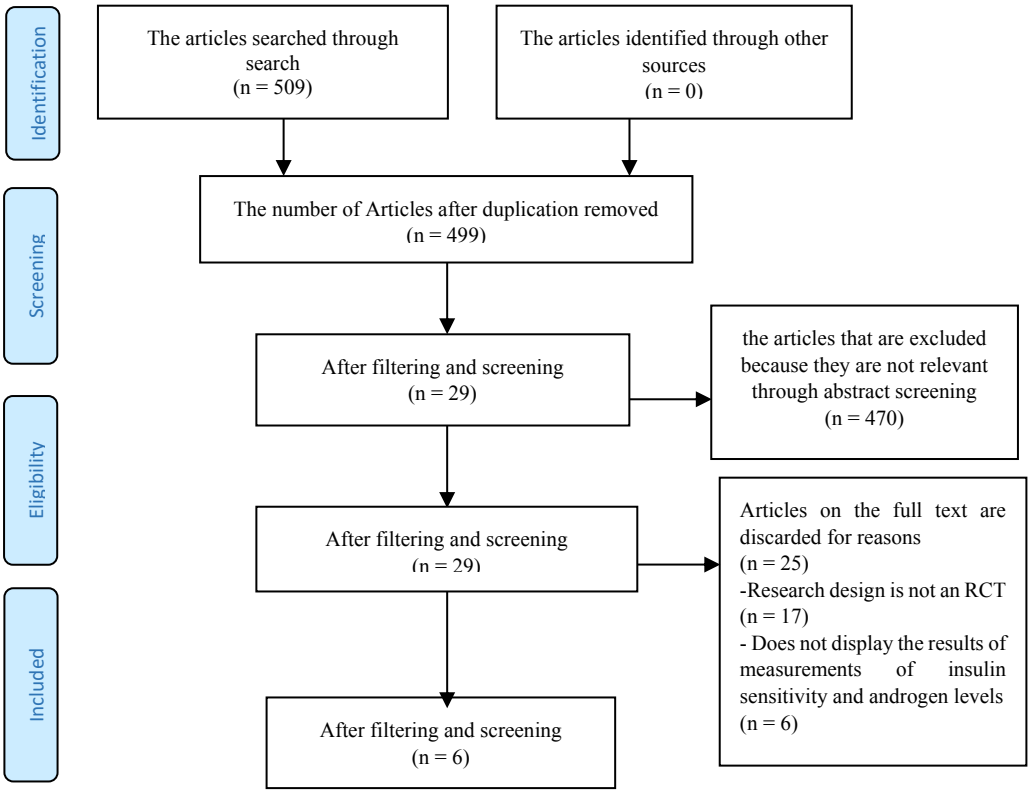

Figure 1. The PRISMA method item framework for systematic review

RESULTS

The quantity and characteristics of the population

The population in this study was 263 women with PCOS, with the largest number of participants was 86 participants and the lowest was 20 participants. The inclusion criteria for respondents, four studies namely women diagnosed with PCOS based on Rotterdam criteria, Pastore [25] diagnosed respondents with PCOS based on National Institute of Health (NIH) and Fayiz criteria [26] based on the diagnosis of PCOS by the Androgen Excess Society (AES). Pastore [25] added an agreement not to use hormonal contraception, metformin, or fertility drugs for 5 months of intervention. Exclusion criteria between studies have some similarities. Johansson [27], Stener [28] and Pastore [25] determined that women who were on pharmacological therapy 3 months earlier and were breastfeeding for less than 6 months were excluded from this study. women with endocrine disorders cause hyperandrogenemia exited in the six studies. Zheng [29], Johanson [27] and Jedel [30] added cardiovascular disease and diabetes mellitus. Whereas Pastore

Table 1. Articles Characteristics

References	Sample	Characteristics		Method	Comparison	Duration	session
		Age	BMI				
		mean±SD	mean±SD				
Stener 2009	20	29.9 ± 4.5 and 30.4 ± 5.5 and 31.0 ± 3.2	27.5 ± 8.6 and 26.8 ± 4.8 and 28.0 ± 6.2	Electroacupuncture	PE and untreated controls	4 months	14
Jedel E. 2010	74	29.7 ± 4.3 and 30.2 ± 4.7 and 30.1 ± 4.2	29.1± 8.83 and 27.7± 6.44 and 26.8 ±5.56	Electroacupuncture	PE and no intervention	4 months	14
Pastore 2011	84	28.0 ±6.3 and 26.5± 5.8	30.1±7.0 and 30.0±6.8	True acupuncture	Sham acupuncture	2 months	12
Johanson 2013	28	28.4±3.1 and 27.9±3.2	23.3±3.6 and 24.7±3.1	acupuncture	Attention control	10-13 weeks	20-26
Zheng 2013	86	26.5 ± 3.0 and 24.9 ± 4.9	29.4 ± 3.7 and 29.1 ± 3.9	Abdominal acupuncture	metformin	6 months	48
Fayiz 2018	21	20.2±0.3 and 19.8±0.8	27.15±2.1 and 26.9±1.7	Laser acupoints	Placebo laser acupoints	3 months	11

added diabetes mellitus without mentioning cardiovascular disease. Pastore [25] included women who performed acupuncture to treat ovulation disorders 30 days earlier, had immune deficiencies and a

history of bleeding disorders into the exclusion criteria. Fayiz [26] stated women who missed 3 intervention sessions would be excluded from the study.
The age characteristics of the study population can be observed in Table 1 which ranges from 19 to 31 years. The BMI in the four studies ranged from 23.3 to 30.1 kg / m2.

Intervention
Stener [28] and Jedel [30] conducted a study on the low-frequency Electroacupuncture group compared to physical exercise and groups without any intervention. Pastore made a comparison between the True Acupuncture and Sham Acupuncture groups. Zheng [29] conducted a comparison between the abdominal group of acupuncture and metformin. Johansson [27], compared groups of acupuncture stimulated manually and electrically (electroacupuncture) with groups that were given more attention. Fayiz [26] in comparison with laser acupoints and placebo laser acupoints. The duration of interventions varied namely for 6 months and the lowest is 2 months. The highest session in giving acupuncture interventions were 48 sessions and the lowest were 11 sessions.

Measurement results

Insulin sensitivity
HOMA-IR
Research conducted by Zheng [29] showed that HOMA-IR in the abdominal acupuncture group experienced a significant decrease ($p < 0.05$). The same results were shown by Fayiz [26] which revealed a significant decrease in HOMA-IR in the Laser Acupoints group ($p < 0.05$). Research conducted by Johansson [27] Showing the change of HOMA-IR from the beginning to the end of the intervention occurred between the acupuncture and attention control groups ($p = 0.041$), but no significant differences were seen in each group. However, Stener [28] stated there was no significant difference in HOMA-IR between the low-frequency electroacupuncture group, physical exercise, and groups without any intervention.

The androgen hormone levels
The hormone levels LH, FSH, LH / FSH
The research was conducted by Zheng [29] and Fayiz [26] showed that LH hormone levels and LH to FSH ratio decreased significantly ($p < 0.05$). However, different results are shown by Johanson [27], Stener [28], and Jedel [30] which states that there were no significant changes in LH hormone levels and LH / FSH ratio ($p > 0.05$). Pastore [25] showed there was a significant change in the LH ratio to FSH ($p < 0.04$) and continued to last up to 3 months followed up ($p = 0.001$), LH did not experience significant changes ($p = 0.095$), but after 3 months of follow-up there was a significant decrease in LH ($p = 0.004$). Six studies analyzed did not show significant changes in FSH hormone levels.

Levels of TT and FT hormones
The results of measuring TT hormone levels in four of the six studies showed a significant decrease ($p < 0.05$). FT hormone levels in four of the five studies showed a significant decrease ($p < 0.05$). Zheng [29] did not measure FT levels. Pastore [25] in their study showed no significant changes in TT and FT hormone levels between the True Acupuncture and Sham Acupuncture groups. However, the results of this study also showed that bivariate analysis of low FT levels with better levels of menstrual cycles and high levels of SHBG were suggestive factors as predictors of ovulation rates ($p < 0.10$)

Levels of SHBG hormone
The results of Johanson [27], Jedel [30] and Pastore [25] showed that there was a significant change in the hormone levels of SHBG ($p < 0.05$). However, different results are shown by Stener [28], the hormone levels of SHBG did not undergo significant changes ($p > 0.05$).

Levels of DHEA-S hormone

The measurements of DHEA-S hormone levels showed a significant change ($p < 0.05$) by Johansson [27] and Jedel [30]. However, the measurement of DHEA-S hormone levels did not show significant changes in the research by Stener [28] and Pastore .

Table 2 Outcomes of Measurements of Articles Analysis

References	Outcomes							
	HOMA-IR	LH	FSH	LH/FSH	Testosterone	Free T	SHBG	DHEA-S
	mean±SD	mean±SD	mean±SD	mean±SD	mean±SD	mean±SD	mean±SD	mean±SD
Stener 2009	1.9±2.3[b] and 1.3±0.6 and 1.6±0.7	6.1±3.7[bd] and 5.8±1.5 and 5.8±2.2	4.6 ± 1.5[bd] and 4.1 ± 1.3 and 3.9 ± 1.3	1.3 ± 0.6[b] and 1.5 ± 0.5 and 1.6 ± 0.9	1.9 ± 0.3[bf] and 2.0 ± 0.3 and 2.0 ± 0.7	4.0 ± 2.3[al] and 5.4 ± 2.8 and 4.4 ± 2.8	44,3 ± 25,8[bf] and 54,6 ± 53,9 and 57,7 ± 34,5	5,0 ± 1,0[bi] and 4,8 ± 2,2 and 4,5 ± 2,0
Jedel E. 2010	NR	-2.52±12.0[bcd] and -0.45±4.33 and -1.63±7.98	-0.13±1.57[bcd] and 0.26±1.57 and -0.31±1.65	-0,34±1.58[bc] and -0.18±0,83 and -0.20±1.36	-0.10± 0.14[acg] and -0.04± 0.14 and 0.01±0.09	-2.21 ± 2.99[acm] and -1.24 ± 2.66 and 0.03 ± 1.71	3.52 ± 11.8[acf] and 7.30 ± 22.0 and 3.33 ± 12.7	-0.29 ±0.56[acj] and -0.24 ± 0.55 and -0.17 ± 0.30
Pastore 2011	NR	7.0±5.0[be] and 7.8 ± 6.1	4.8 ± 1.6[be] and 5.8 ± 3.1	1.4 ± 1.4[a] and 1.4 ± 1.1	59.4± 6.0[bh] and 66.3±36.2	12,9 ± 7.2[bm] and 14.4 ± 9.9	41.8 ± 27.8[af] and 41.8 ± 28.8	192.6 ± 117.2[bk] and 178.1 ± 79.5
ohanson 2013	-0.01±0.41[ac] and -0.37±0.60	-0.35±3.04[bcd] and 1.11±2.32	0.61±1.28[bcd] and -0.19±1.42	-0.24±0.55 [bc] and 0.28±0.70	-0.09±0.02[acg] and 0.26±0.1	-2.22 ± 6.4[acm] and 1.05 ± 1.5	4.3 ± 16.4[acf] and -6.0 ± 17.4	-0.35 ± 0.7[acj] and 0.32 ± 0.6
Zheng 2013	2.5 ± 1.7[a] and 2.6 ± 1.8	8.4 ± 4.0[ae] and 9.3 ± 2.9	5.6 ± 1.4[be] and 5.3 ± 2.1	1.6 ± 0.8[a] and 1.7 ± 0.6	1.9 ± 0.8[af] and 2.4 ± 0.6	NR	NR	NR
Fayiz 2018	2.1±0.7[a] and 2.1±0.7	6.9±0.9[ae] and 9.9±0.2	4.8±0.6[be] and 4.8±0.4	1.3±0.0[a] and 2.0±0.6	63.0±1.9[ah] and 63.0±1.9	1.09 ± 0,1[ah] and 1,5 ± 0.05	NR	NR

NR : Non Reported, EA: electroacupuncture, PE: physical exercise a: significant, b: non significant, c: Δ end point vs baseline, d: IU/l, e: mIU/l, f: nmol/l, g: ng/ml, h: ng/dl, i: µmol/l, j: µg/ml, k: µg/dl, l: pmol/l, m: pg/ml

DISCUSSION

Significance of Benefits of Acupuncture

Polycystic ovary syndrome (PCOS) is now considered the most common endocrinopathy problem in women of reproductive age. PCOS occurs characterized by hyperandrogenemia, hyperinsulinemia, dysfunction of the hypothalamic-pituitary-ovarian axis, and the secretion of adipokines from adipose tissue [31]. These signs are interrelated with each other and interact in different tissues, such as fat, liver, muscle, and ovaries, which then produce various phenotypes of the syndrome [32]. The most common syndrome is in the form of insulin resistance and high glucose intolerance. Obese women with PCOS are at increased risk of long-term health problems ranging from insulin resistance, including gestational diabetes (GDM), impaired glucose tolerance and type 2 diabetes [33] .

BMI worsens insulin resistance in women who have PCOS. Measurement of insulin resistance can be done using the calculation HOMA-IR. WHO defines the highest quartile value in the HOMA-IR index in nondiabetic subjects as a reference in determining insulin resistance and has a limit value that varies from 1.7 to 3.87 [34].

Acupuncture is as a non-pharmacological treatment that can be used in the treatment of compounds and alternatives for treating PCOS. Several studies stated acupuncture has the potential to reduce obesity [35], BMI, hyperglycemia and increase insulin sensitivity [36-39]. EA with the mechanism of repetitive muscle contraction can activate physiological processes similar to those produced from physical exercise so that hypothetically EA can affect metabolic variables [40]. Acupuncture can overcome obesity by influencing the biochemical mechanisms of obesity markers such as insulin resistance, glucose and lipid metabolism, obesity-related peptides and inflammatory markers [41]. EA can also reduce obesity in women by reducing weight, BMI, and HbA1C [42]

Acupuncture applied at several points such as CV4, CV6, CV12, ST25, ST36, ST40, BL18, BL20, BL21, and BL23 was effective in increasing insulin sensitivity in women with PCOS [41, 43]. An experiment on mouse-induced animal experiments so that obesity showed that EA applied to bilateral ST36 and LI11 acupoints, could improve insulin sensitivity by reducing fasting glucose, insulin levels and HOMA-IR [44]. A study on diabetic rats induced with streptozotocin is given LA intervention at BL20 pointing to a decrease in glucose levels compared to the control group of untreated diabetic rats [45]. Increased insulin sensitivity by LA may involve reduced levels of inflammatory cytokines, including tumor necrosis factor α, interleukin 1β and interleukin 8, and modulates cation transport across cell lines by stimulating ATP synthesis and increasing proton gradients [46].

Mechanism of Acupuncture on Hyperandrogenism

The level of LH, FSH, and LH / FSH ratio

The results of this systematic review show that of the six existing studies, two of them showed a significant reduction in LH levels, LH showed significant changes after 3 months of follow-up by Pastore's study. Three of the six studies showed a change in the LH / FSH ratio, while the other three showed no significant changes in LH or LH / FSH ratio. FSH levels did not experience significant changes in the six studies. There are 745 PCOS patients were observed to have varying LH / FSH ratios [47]. Previous researchers explained that LH (GnRH) pulses in PCOS women have a regular and constant frequency of about one pulse per hour, and this is not included in the typical cycle changes observed in women during ovulation [48], this then causes synthesis and LH secretion is faster and consistent compared to FSH, therefore in women with PCOS there tends to be an increase in LH and LH / FSH ratio [49]. An increase in the LH / FSH ratio in PCOS reflects an increase in activity and secretion of GnRH neurons in the rostral forebrain and an increase in LH pulsatility contributing to the

ovarium pathology of women with PCOS, which indicated by theca cell hyperplasia and increased androgens [50].

Acupuncture applied to acupuncture points that are in accordance with ovarian innervation with manual stimulation or low-frequency EA can produce central and peripheral effects [51]. The central effect is mediated by the release of β-endorphins in the hypothalamus which inhibits the work of GnRH, resulting in a decrease in the LH / FSH ratio, the level of estradiol and androgens in the ovary. Peripheral effects occur through the production of segmental spinal effects that inhibit sympathetic nerve activity in the ovary.

Testosterone and SHBG levels

PCOS syndrome can be diagnosed with hyperandrogenemia associated with ovulation dysfunction. Hyperandrogenemia is characterized by excessive production and androgen secretion and is manifested by the appearance of excessive acne, hirsutism, and alopecia. Hyperandrogenism refers to an increase in androgen levels in the blood [52]. An evaluation of hyperandrogenism to diagnose PCOS shows that the hormone testosterone is the most important androgen hormone produced by theca cells in the ovary [53]. The total testosterone concentration that has been produced is strongly influenced by the concentration of SHBG because 1 to 2% of testosterone circulates freely in the circulation, 65% binds to SHBG, and the rest binds to albumin [53]. So women with PCOS who have low SHBG levels tend to have normal total testosterone levels, but there is an increase in free bioavailable and testosterone levels. Especially for women who are obese with insulin resistance tend to have low SHBG levels [54]. Therefore, diagnosis of hyperandrogenism in PCOS, not only measuring TT levels, because it made it possible to misdiagnose PCOS, so it must be followed by the measurement of SHBG levels and FT [55, 56]. This can be measured by the ratio between TT and SHBG.

The results of this study indicate that acupuncture can reduce TT and FT levels and increase female SHBG levels with PCOS. This shows that acupuncture can overcome the symptoms of hyperandrogenemia in women with PCOS. Even a study conducted by Pastore et al showed that when bivariate analysis, low FT levels, high SHBG levels, and better menstrual cycle levels were suggestive factors as predictors of ovulation rates ($p < 0.10$). Electroacupuncture can reduce testosterone hormone levels which cause a decrease in levels of inflammatory factors such as tumor necrosis factor alpha (TNF-α), interleukin 6 (IL-6), and monocyte chemotactic protein 1 (MCP-1), so that a decrease in the level of these inflammatory factors can then prevent the development of ovarian hyperstimulation syndrome (OHSS) in women with PCOS [57].

The grade of DHEA-S

Excessive androgen levels are characteristic of PCOS. The ovary is considered the main androgen source in PCOS women. Adrenal androgen increases, especially testosterone, androstenedione, DHEA and DHEA-S have become part of the diagnosis of patients with PCOS [58, 59] .Adrenal and ovarian glands have been recognized as sources of hyperandrogenism over the past two decades [60]

The ovary is a complex endocrine organ and is influenced by two pituitary peptide hormones namely LH and FSH. Oocytes that are vivarium are covered by granulosa cells, with the outermost layer being theca cells. Granulosa cells will express FSH which will then be followed by LH during the menstrual cycle. Whereas theca cells can only express LH receptors. Granulosa cells and theca cells together with LH and FSH are needed to produce androgens. Theca cells under the influence of LH secrete 3 enzymes namely CYP11A, 3β-HSD, and CYP17. These three enzymes function to convert steroid precursor cholesterol into androgens. CYP11A enzyme can convert cholesterol to pregnenolone. Furthermore, pregnenolone is then converted to 17β-hydroxypregnenolone, then CYP17 converts 17β-hydroxypregnenolone to DHEA [59, 61, 62]. However, DHEA levels for PCOS diagnostics are quite limited, so it tends to use DHEA-S to assess adrenal levels of androgen production in the ovary. 20-70% of women with PCOS experience elevated DHEA-S levels [63].

The results of this study indicate that two of the six studies analyzed showed a significant reduction in DHEA-S levels, two studies did not show significant changes, while the rest did not measure DHEA-S levels. Acupuncture performed by placing a needle followed by stimulation of the somatic area of the uterus associated with the ovary can reduce the sympathetic nerve activity in the ovary [28], which can then cause a decrease in androgen secretion and release by the ovary. EA is thought to have reduced levels of β-endorphins which caused a decrease in LH level secretion. Decreasing LH levels causes a decrease in androgen production in the ovary so that eventually it can also reduce DHEA-S levels [64].

CONCLUSION

Acupuncture can treat metabolic disorders and hyperandrogenemia due to excess androgens in women with PCOS by increasing insulin sensitivity that can be observed by HOMA-IR measurement and by reducing the ratio of LH / FSH levels, testosterone, DHEA-S, and increasing SHBG levels. Future researchers can examine acupuncture in women with PCOS because of the lack of RCT design articles that address this issue. So that it can make a better comparison of systematic reviews with accurate results that prove the effectiveness of acupuncture in women with PCOS.

CONFLICT OF INTEREST

The researcher does not have a conflict of interest with anyone.

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